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# Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II

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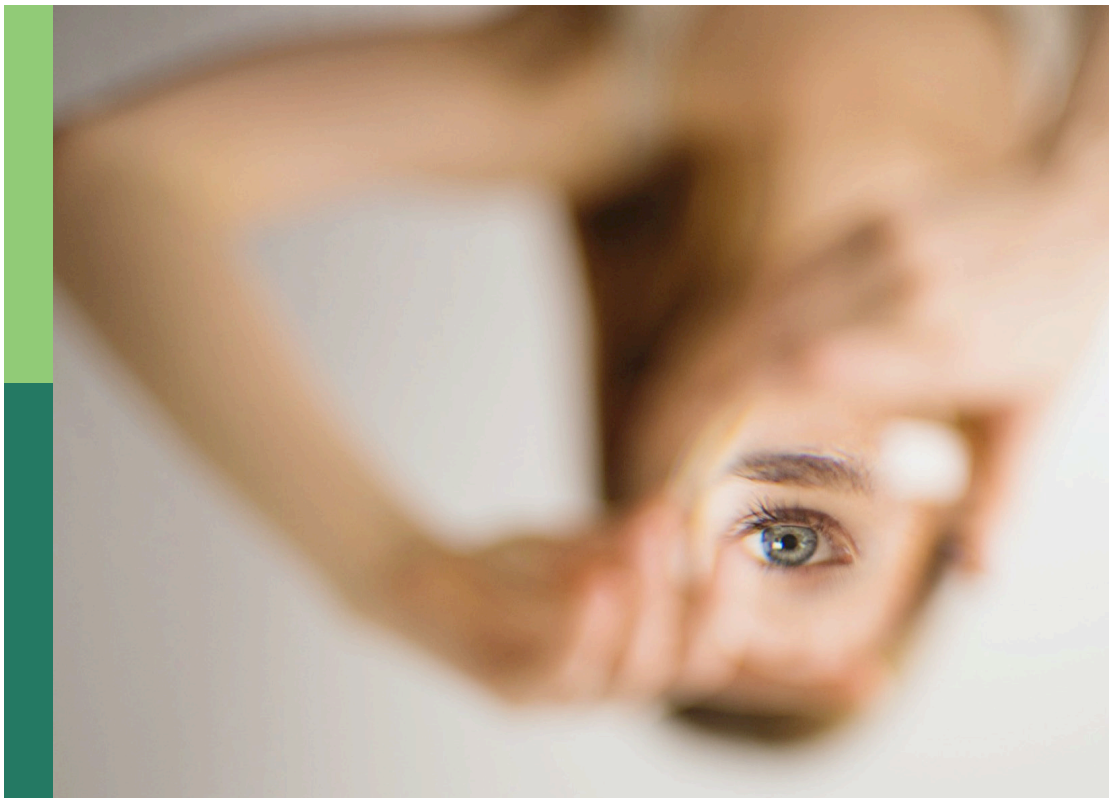
**Published in**
Frontiers in Psychology
Frontiers in Sports and Active Living



ISSN 1664-8714
ISBN 978-2-8325-6192-8
DOI 10.3389/978-2-8325-6192-8

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# Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II

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**Citation**

Predoiu, R., Predoiu, A., Piotrowski, A., Panisoara, G., eds. (2025). *Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II*. Lausanne: Frontiers Media SA.
doi: 10.3389/978-2-8325-6192-8

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frontiers | Frontiers in Psychology

TYPE Editorial
PUBLISHED 18 March 2025
DOI 10.3389/fpsyg.2025.1581203



OPEN ACCESS

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RECEIVED 21 February 2025
ACCEPTED 28 February 2025
PUBLISHED 18 March 2025

CITATION
Predoiu A, Pânişoară G, Piotrowski A and Predoiu R (2025) Editorial: Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II.
*Front. Psychol.* 16:1581203.
doi: 10.3389/fpsyg.2025.1581203



# Editorial: Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II

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KEYWORDS

**growth mindset, life skills in children, teenagers and adults, performance improvement, educational development, innovative methods**

Editorial on the Research Topic
Innovation in developmental psychology, education, sports, and arts: advances in research on individuals and groups, volume II

This Research Topic (now in its second volume) aims to produce valuable insights for psychologists, educators, and sports science professionals to promote growth and development in children, adolescents, and adults, thereby enhancing their performance levels.

Human development is a complex process influenced by psychological, educational, and physical factors that shape individuals' cognitive, emotional, and social identity and wellbeing. Psychological aspects such as resilience, emotional intelligence, and social support play a crucial role in mental health and behavior regulation, affecting academic performance and personal development. Studies on aggression, bullying, and family resilience highlight the importance of fostering supportive environments to promote emotional stability and prevent negative behavioral patterns. Understanding these factors is essential for creating interventions that enhance mental health and social integration, particularly among children and adolescents.

Education and personal development are equally significant in shaping individuals' cognitive abilities and life skills. Motivation, parenting styles, and early childhood environments influence language development, non-cognitive skills, and academic achievement. Additionally, innovative pedagogical methods and assessment tools contribute to optimizing learning processes, ensuring that students receive comprehensive support for intellectual and social growth.

Physical health and sports further complement psychological and educational development by enhancing motor skills and emotional resilience. Regular physical activity and sports programs have been shown to improve mental health, social relationships, and stress management.

The manuscripts in this Research Topic explore interdependent themes, which we will group and suggestively name below.

The first theme, *Emotional and Behavioral Development Factors,* focuses on psychological factors influencing individual behavior, including aggression, emotional resilience, mental health, and interpersonal relationships. The authors investigated aggressive behaviors in different contexts: school vs. sports. The study by Rus et al. underlines the significant link between conflicts in the school environment and aggressive behaviors, while Patenteu et al. draw attention to the role of foul (violent) play in athletes' risky behaviors. Moreover, articles have investigated how resilience, emotional intelligence, and family support contribute to preventing negative behaviors and enhancing mental wellbeing. Children's emotional states, parental coping strategies, and family resilience were examined by Vladislav et al. The authors discussed the importance of adaptive coping strategies within the family system during a period of crisis, with maladaptive strategies being linked to anxiety, depression, and stress. In the context of a possible period of crisis, Yang et al. stressed that the crucial role of physical activity in generating positive emotions, interpersonal forgiveness, and emotional intelligence is also positively influenced. In a sports setting (runners being investigated), it seems that not only athletes but also their partners need to be physically active in a crisis situation (such as the COVID-19 pandemic). For the quality of interpersonal relationships/marital satisfaction, the research by Vilaregut et al. increased awareness of the role of exercise on mental health. Specific concepts of positive psychology, such as happiness, resilience, hope, gratitude, character, mindfulness, and growth mindsets, were examined by Platt et al. Integrating these concepts into daily life improves symptoms of mental distress and levels of wellbeing.

The second theme we identified in our Research Topic is *Education and Personal Development*. This theme addresses motivation, learning, cognitive and motor development of children and students, and factors influencing academic performance. Regarding motivation and educational performance, Li et al. emphasized the essential role of students' mentorship homegate (or team) support, which encourages creative behaviors, with intrinsic motivation being a mediator. The authors highlighted the need for higher education institutions to cultivate a challenging research environment that positively impacts students' intrinsic motivation. In the context of educational performance, research by Peng and Zhang revealed that achievement motivation has a positive and significant impact on the educational practice skills of pre-service teachers. Researchers underlined that achievement motivation is an internal drive to pursue and accomplish objectives (Wu et al., 2017), influencing work responsibility and learning engagement. Considering the cognitive development in children, Qiu and Wang, and Wang and Zheng examined how the home environment and parenting styles influence non-cognitive development and language skills. In the first case, it was found that the home environment predicts the language development of toddlers, with executive function playing a mediating role, while children's temperamental characteristics should also be taken into account. In terms of parenting style, the authoritative and authoritarian parenting styles were investigated. Wang and Zheng emphasized the positive impact of the authoritative style and the negative impact of the authoritarian style on the non-cognitive abilities of students (e.g., interpersonal skills, resilience), with a greater impact being observed in girls. It is worth mentioning that the family's socioeconomic status influences the parenting style and represents an important indicator of the home environment (Chow et al., 2017), the most influential microsystem on childhood development. Not least, children's motor skill development, linked to pedagogical approaches and assessment tools, was investigated. The study by Ghorbanzadeh et al. recommends the combined method of sports education and teaching games for understanding to improve children's motor proficiency. However, the perceived motor competencies (PMCs) are also important, along with the actual motor competencies, in children's motor and psychological development. Bretz et al. proposed the SEMOK-1-2 instrument, which can be economically used for assessing children's perceived motor competencies and is suitable for monitoring PMCs during physical education.

Another subject can be identified as theme no. 3—*Health and Sports*. This theme examines the influence of psychological phenomena on emotional health and performance. Predoiu et al. highlighted the importance of investigating athletes' subconscious levels to increase the likelihood of sports performances. Based on the dual processing model (Gawronski and Bodenhausen, 2006), authors explored the implicit/indirect aggression of athletes using an implicit association test (IAT), being aware that the automated/unconscious way of processing information contributes to and defines human behavior (Richetin and Richardson, 2008). The research by Zhou et al. underlines the existence of causal relationships between physical activity, social support, and family relationships in college students. Precisely, family relations represent a causal variable for physical activity behaviors, while social support represents a causal variable for both family relationships and physical activity behaviors. We also found research, like that conducted by Hong and Minikin, which offers insights into practitioners' perceptions and experiences of the *Voices of Athletes*—a specialized athlete support program that plays a critical role in empowering athletes, preparing them for post-sport life, and helping them become leaders within their communities.

Research in this Research Topic provides valuable insights into how educational practices can be improved to foster lifelong learning and adaptability in an evolving world. Studies on aggression in sports, the impact of the COVID-19 pandemic on athletes, and the role of exercise in emotional regulation emphasize the interconnectedness of physical and psychological wellbeing. By integrating these perspectives, educators and researchers can develop holistic approaches that support healthy development across multiple life domains. The important insights that the Research Topic generates assist professionals, such as teachers, social workers, psychologists, and coaches, in supporting children, adolescents, or adults, encouraging them to consistently focus on their capacity to learn and evolve.

## Author contributions

APr: Writing – original draft. GP: Writing – original draft. APi: Writing – review & editing. RP: Writing – review & editing.

## Acknowledgments

We thank all the contributing authors, editors, and reviewers of this Research Topic for their time and effort to make this a successful project, and we thank the Frontiers Publication team for their special role and guidance throughout the entire process.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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frontiers | Frontiers in Sports and Active Living

TYPE Original Research
PUBLISHED 27 February 2024
DOI 10.3389/fspor.2024.1351451



OPEN ACCESS

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RECEIVED 06 December 2023
ACCEPTED 16 February 2024
PUBLISHED 27 February 2024

CITATION
Hong HJ and Minikin B (2024) Voices from the field: exploring practitioners' experiences and perceptions of the voices of athletes (VOA) in the pacific islands.
Front. Sports Act. Living 6:1351451.
doi: 10.3389/fspor.2024.1351451



# Voices from the field: exploring practitioners' experiences and perceptions of the voices of athletes (VOA) in the pacific islands

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This exploratory study aims to gain insights into practitioners' experiences and perceptions of the "Voices of Athletes" (VOA), a specialized athlete support program, developed and implemented in the Pacific Islands. Semi-structured interviews enabled participants to share detailed experiences, with 14 practitioners participating. Thematic analysis of the data identified five key themes: "Fostering Athlete Empowerment", "Impact of Sport on Education and Social Change", "Expanding VOA's Reach and Impact", "VOA's Role in Preparing Athletes for Post-Sport Life", and "Optimizing VOA Implementation and Experience". The findings demonstrated that the VOA plays a critical role in empowering athletes and assisting them in becoming leaders within their societies. Practitioners emphasized the power of sport as an effective channel for education and inspiration, and the potential for the VOA framework to be applied in various contexts and regions. The study also revealed that the VOA helps athletes prepare for life after sport, contributing to increased self-esteem, development of transferable skills, and awareness of their social roles. The findings also emphasized the need for VOA improvements, including enhanced interactivity, larger spaces, and financial support. Recognition from sport governing bodies and coaches could broaden the program's reach and impact. Incorporating internship schemes within the VOA or related programs could address life after sport more effectively. Developing written VOA guidelines would ensure consistent, sustainable delivery, supporting its potential for wider implementation and adaptation, contributing to holistic development for athletes and young people globally.

KEYWORDS

athlete empowerment, educational initiatives, holistic development, sport education, transferrable skills development

## 1 Introduction

High-performance sports systems worldwide commit substantial resources, including finances, personnel, and time, to support exceptionally promising athletes. A growing trend has emerged among nations to increase investment in their elite sports systems over recent decades (1). This shift can be partly attributed to the understanding that success on the international stage brings prestige, national pride, and economic benefits (2, 3). Achieving international success in sports depends on athletes engaging in intensive training and participating in a number of competitions over an extended

period, requiring significant individual investments (4, 5). Financial investments in training, equipment, and travel for competitions can place a considerable burden on athletes and their families (6).

Evidence suggests that providing targeted support programs for athletes, such as access to specialized coaching, sport science services, and financial assistance, can significantly enhance their performance and chances of success (7–9). Such athlete support programs not only reduce the financial burden on athletes and their families but also establish an environment conducive to optimizing their potential and achieving their athletic goals. By understanding and addressing the unique needs and challenges faced by individual athletes, these programs can contribute to the overall development and success of high-performance sports systems (10–12).

Athletes, along with their families and sports clubs, can only invest limited resources, which might hinder their chances of success. In this respect, athlete support programs are designed to offer supplementary resources to selected athletes, thus subsidizing their endeavors. These programs identify the most promising athletes and engage them in a sequence of interventions focused on improving their performance, eventually increasing their probability of success (13). Previous studies have emphasized the importance of holistic and multifaceted support for athletes. For instance, Ryba et al. (14) highlighted the value of considering the cultural context and mental well-being of athletes in support programs, suggesting that tailored interventions can enhance performance outcomes.

Talent development environments should be also structured to optimize athletes' long-term development, including their physical, psychological, and social competencies (15). Athlete support programs that encompass various forms of support, such as financial, educational, and mentoring, have been shown to be more effective in enhancing athletes' performance (16). Comprehensive support systems may also help athletes develop key life skills and transferrable competencies that contribute to their overall well-being and success beyond their athletic careers (17). In this regard, athlete support programs play a crucial role in providing additional resources to aspiring athletes, increasing their chances of success. Thus, comprehensive, multifaceted, and context-specific support programs are ciritical for optimizing athletes' performance and overall development.

Initiatives worldwide have been developed to assist athletes with career development and transitions beyond sport (8, 11, 18). Athletes face a number of challenges during and after their athletic careers (15, 19), prompting experts to call for sport governing bodies, organizations, and National Olympic Committees (NOCs) to support athletes in managing both athletic and non-athletic careers, ensuring their overall well-being. As a result, sport governing bodies have established athlete support programs to assist athletes in navigating their sports careers and preparing for life after sport (8, 20, 21). Research on organizational support in high-performance sport is underdeveloped compared to studies on social support for such athletes (22, 23).

Previous research has shed light on organizational support's different dimensions, with some studies examining the role of organizational support in athlete burnout (24), mental health (17), and well-being (25). In addition, research has explored how organizational support contributes to athletes' satisfaction (26), development (27), and overall career development and transition (8, 11, 15). However, despite the growing interest in organizational support in high-performance sports, the literature still has gaps. For example, researchers have called for more research on organizational support in different cultural contexts and among various sports (28). Researchers have also highlighted the need to better understand the specific mechanisms by which organizational support influences athletes' outcomes and experiences (29).

The majority of studies focusing on athletes' career development and transitions have been carried out in Australia, Europe, and North America (30). Park et al. (19) also highlighted that a significant portion of research on athlete support systems originated in Western countries, with 10 instances in Australia, 45 in Europe, and 60 in North America. To counteract this geographical unevenness, Hong and Coffee (8) explored athlete support programs in 19 countries spanning Africa, Asia, Europe, North America, South America, and Oceania. Despite their work presenting a comprehensive assessment of organizational support through athlete support programs across multiple continents, the nations examined were primarily developed, such as Australia and New Zealand within the Oceania region. This leads to an evident gap in research concerning athlete support programs in developing nations, particularly in the Pacific Islands, excluding Australia and New Zealand. The lack of representation in these areas constrains the generalizability of study outcomes and obstructs the formulation of efficient support approaches tailored to the distinct requirements and conditions of athletes from these regions. Expanding research to include Pacific Island developing countries would offer not only a broader understanding of the global scope of athlete support systems but also reveal potential cultural, social, and economic factors influencing the success of organizational support via structured programs.

To the authors' understanding, there are no structured athlete support programs in the Pacific Island regions equivalent to those established in other nations for assisting athletes with career growth and transitions. Nonetheless, by 2006, the Oceania National Olympic Committees (ONOC) had set up its regional sports education initiatives, collectively referred to as the Oceania Sport Education Program (OSEP). Initially centered on educating coaches and sports administrators, OSEP also facilitated the emergence of new initiatives like Voices of Athletes (VOA). VOA's inception was the result of collaboration between two athlete-focused education programs introduced to Oceania: a drug education program by the Oceania Regional Anti-Doping Organisation (ORADO) and the Stop HIV initiative, co-funded by the United Nations Programme on HIV/AIDS (UNAIDS), the South Pacific Commission (SPC), and ONOC. Launched in 2004 as a pilot program by the World Anti-Doping Association (WADA) and ONOC, these initiatives joined forces in 2007, creating a platform to deliver messages directly to athletes. The first effort to involve athletes began in 2007 during the Pacific

Games in Samoa, where an education booth was set up in the Games Village (31). This effort led to several athlete outreach activities at various national and regional sports events and within specific countries. These endeavors successfully increased awareness and allowed athletes to discuss different issues impacting their lives.

Although VOA represents progress in athlete support in the Pacific Islands, more research and program expansion are required to address the region's athletes' unique challenges and needs. While examining athletes' perspectives of athlete support programs is crucial, and indeed forms part of a larger project that encompasses the present study, there is an increasing awareness of the value in exploring practitioners' experiences and perceptions of these programs. Gaining insights from practitioners can contribute to enhancing the effectiveness and quality of such initiatives, as they possess unique knowledge and understanding of the program's workings and impact on athletes. Hong and Coffee (8) explored who is responsible for delivering athlete support programs and how sport organizations support practitioners in developing their competence to assist elite athletes. They suggested that future research should investigate practitioners' views on the content and delivery of such programs to enhance their impact. Considering this evidence, it is crucial to extend the focus beyond athletes' experiences and incorporate the perspectives of practitioners involved in the VOA to better understand its functioning and potential areas of improvement. By investigating practitioners' experiences and perceptions of VOA and similar initiatives, researchers can contribute to developing comprehensive and culturally sensitive support strategies that promote the holistic development and well-being of Pacific Island athletes and beyond.

The VOA emerged from the need for coordination and collaboration among multiple agencies in resource-limited settings (32). It serves as an educational platform supporting athletes' personal growth, empowering well-rounded individuals positively impacting communities and sport. Continually adapting and expanding its initiatives, the VOA demonstrates the potential for similar programs to address diverse athlete needs and foster holistic development. VOA's primary objective is to inspire athletes to become positive role models, captured by the motto "Be a Leader". The program comprises four distinct initiatives, each addressing different aspects of athlete development and responsibility (31, 32). **Play True** adapted from WADA's original anti-doping programs, promotes a culture of clean sport and integrity among athletes in the Pacific Region. **Stay Healthy**, which originated from Stop HIV initiatives, now covers broader health and lifestyle issues, encouraging healthier lifestyles. **Go Green**, adopted from IOC-established environmental initiatives, uses sport to spread conservation messages and urges athletes to be environmentally responsible. **Play Safe** addresses athletes' concerns about harassment and abuse, focusing on protection, especially for those vulnerable to authority figure abuse.

The various practitioners deliver these initiatives, motivating athletes to engage in each component and helping them absorb key messages from each segment. The present study, thus, aims to examine practitioners' experiences and perceptions of VOA, as they interact directly with athletes. In doing so, this study seeks to provide insights into an athlete support program in the Pacific Island region, an area less extensively explored compared to athlete support programs in other countries documented in previous research. Gaining insights from practitioners involved in athlete support programs in this region will not only inform the ongoing development and implementation of the program but also contribute to the broader understanding of athlete support systems in diverse contexts. This valuable information can help sport governing bodies develop well-established support systems and initiatives tailored to various settings.

## 1.1 Theoretical background

Communities of practice (CoP), a concept introduced by Wenger (33), are prevalent in various aspects of our lives, which includes social learning processes that occur within groups sharing common interests, goals, and practices, with participation levels ranging from core membership to more peripheral involvement. Members within a CoP are informally connected through their collaborative activities, mutual engagement, and shared learning experiences. Characterized by mutual engagement, a shared repertoire of resources, and a joint enterprise, CoPs enable members to learn from one another, develop shared understandings, and generate new knowledge through interactions and collaborations (33). Distinct from communities of interest or geographic communities, CoPs need a shared practice. As CoPs evolve, they progress through various stages of development, characterized by differing levels of interaction among members and distinct types of activities. These communities form around topics of importance to their members, with their practices reflecting the members' understanding of what matters most. Although external factors can influence this understanding, CoPs create practices that serve as their response to these external influences. As a result, even when a community's actions align with an external mandate, it is the community itself that shapes the practice. Thus, CoPs can be perceived as fundamentally self-organizing systems, capable of adapting and evolving based on the needs and interests of their members (33).

This social learning approach has significant implications for understanding the dynamics of various professional contexts. Willem et al. (34) examined the difficulties that sport organizations and policymakers across the world faced in implementing Sport-for-All. This field is both practical and rich in knowledge, involving a wide network of knowledge creation and sharing among various groups, including multiple agencies, professionals, and volunteers. Using the concept of CoP as their theoretical framework, Willem et al. (34) investigated the role of governing bodies of sport as facilitators of knowledge exchange within Sport-for-All communities. The findings demonstrated that governing bodies facilitate knowledge sharing, new ideas exploration, and knowledge creation in Sport-for-All communities. However, these bodies were not fully utilizing

online tools strategically. The authors recommended a more strategic approach to new media tools usage, allowing CoP standards to emerge naturally instead of determining them. In a broader context of sport, Culver and Trudel (35) sought to clarify the concept of CoP by exploring learning opportunities outside conventional classroom environments. These opportunities, known as workplace learning, non-formal learning, informal learning, or incidental learning, are marked by the crucial role peers play in the learning process (35). The authors investigated the potential of CoPs in sports by offering a concise overview and comparison of the concept, as well as reviewing recent research in the area. They highlighted the importance of adhering to Wenger's (33) framework when applying CoPs in sports. Culver and Trudel's study contributed to fostering a better understanding of CoPs in sports while promoting further discussions on the potential applications of this concept in the fields of coaching education and sports management.

In applying the CoP framework to the present study, which explores practitioners' experiences and perceptions of the VOA in the Pacific Island region, valuable insights can be gained regarding the mechanisms through which CoPs facilitate learning, collaboration, and the dissemination of best practices among VOA practitioners. This understanding can enhance the effectiveness and impact of the athlete support program such as the VOA, furthering the field's knowledge and practical applications. By examining the VOA from the CoP perspective, the study can explore the relationships and interactions among practitioners, how they engage in shared activities, and how they collectively deliver the existing resources to achieve the program's objectives. This can provide a richer understanding of the factors that influence practitioners' perceptions and experiences, as well as shed light on the challenges they face in delivering the VOA and the strategies they employ to overcome these challenges. In addition, the application of the CoP can help identify areas where VOA practitioners can further enhance their collaborative learning and knowledge sharing processes. Thus, the application of the CoP to the present study of the VOA in the Pacific Island region has the potential to provide a deeper understanding of practitioners' experiences and perceptions, as well as uncover opportunities for enhancing collaboration, learning, and the sharing of best practices within the program. This, in turn, can contribute to the ongoing development and effectiveness of the VOA and similar athlete support initiatives in different contexts.

TABLE 1 Participants.

| Participants | Gender | Nationality | Role |
|---|---|---|---|
| Practitioner 1 | Male | American Samoa | VOA champion (Former athlete) |
| Practitioner 2 | Male | Fiji | VOA champion (Active athlete) |
| Practitioner 3 | Female | Fiji | VOA champion (Former athlete) |
| Practitioner 4 | Female | Papua New Guinea | Senior management member in the ONOC athletes commission |
| Practitioner 5 | Female | Vanuatu | VOA champion (Active athlete) |
| Practitioner 6 | Female | Vanuatu | VOA champion (Active athlete) |
| Practitioner 7 | Male | Fiji | Co-ordinator |
| Practitioner 8 | Female | Samoa | One of the key figures involved in the development and creation of the VOA |
| Practitioner 9 | Male | PNG | VOA champion (Active athlete) |
| Practitioner 10 | Male | Fiji | VOA champion (Former athlete) |
| Practitioner 11 | Female | Fiji | VOA champion (Former athlete), events and travel officer for the ONOC |
| Practitioner 12 | Female | Fiji | VOA project officer |
| Practitioner 13 | Female | Samoa | VOA champion (Former athlete) |
| Practitioner 14 | Male | Samoa | VOA champion (Former athlete) |

# 2 Materials and methods

## 2.1 Design

This study employed an intrinsic case study design to explore in-depth insight into the experiences of VOA practitioners in implementing the VOA. An intrinsic case study is regarded as a research approach focused on understanding a specific phenomenon, which researchers need to clearly identify and define what makes such phenomenon unique and stands out from others (36). Our research design facilitated a detailed exploration of a specific case, focusing on the personal experiences of those involved. This was to gain a deep understanding of the participants' perspectives on their experiences, making an interpretive phenomenological approach suitable. This approach is based on an interpretivist paradigm, aligning with relativist ontology and subjectivist epistemology (37). This paradigm enabled us to explore the individual perspectives and interpretation of experiences (37, 38). Interpretive phenomenology aims to describe, comprehend, and interpret phenomena, thereby uncovering the essence of lived experiences (39, 40). To thoroughly capture the richness of the participants' experiences, we employed semi-structured interviews.

## 2.2 Participants

To explore the practitioners' perception and experience of delivering the VOA, a total of 14 practitioners participated in the study. The roles of the practitioners included VOA Champions ($n = 10$; both former and active athletes), chair of the Oceania National Olympic Committee (ONOC) Athletes Commission ($n = 1$), coordinator of the VOA ($n = 1$), creator and developer of the VOA ($n = 1$), and VOA project officer ($n = 1$). They are from five different countries including American Samoa, Fiji, Samoa, Papua New Guinea, and Vanuatu. Eight of them are female and the rest were male ($n = 6$; see Table 1).

## 2.3 Data collection

Semi-structured interviews were applied to gain in-depth insight into the VOA from the practitioners. An interview guide was developed based on the literature review [e.g., (8, 15, 19, 41)] and research questions and applied to each interview to ensure

consistency throughout the interviews (42). The interviews were conducted to address the following: (a) role and responsibility (i.e., can you describe your role and responsibilities within the VOA?); (b) overall experience of delivering the VOA (i.e., how would you describe your overall experience in delivering the VOA?); (c) highlights/key impact factors of the VOA (i.e., what do you consider to be the most significant highlights or key impact factors of the VOA?); (d) expected/experienced outcomes of the VOA (i.e., what were the expected or experienced outcomes of the VOA for the athletes involved?); and (e) areas for improvement (i.e., in your opinion, what areas of the VOA could be improved or enhanced to better support the athletes?). Six out of 14 participants were interviewed as a pair upon their request. Interviews lasted for between 34 and 96 min ($M = 62.00$, $SD = 20.63$). All interviews were audio-recorded with each participant's permission.

## 2.4 Data analysis and rigor

Thematic analysis was employed to examine the transcribed data, a method that enables researchers to identify patterns within qualitative data such interview data that the present study used (43). The author adhered to the six-phase process outlined by Braun and Clarke (44). To ensure a rigorous and systematic thematic analysis, the author utilized a checklist to guide the data processing (43). Multiple readings of each transcript were conducted to achieve familiarity with the participants' narratives. Initial codes were identified and subsequently categorized into initial themes. These themes were then reviewed and refined (44), with input from two experienced qualitative researchers serving as critical friends (45). To establish trustworthiness in the data analysis process, the following measure were employed: (a) prolonged engagement with data (e.g., the lead author conducting all interviews and reading the transcripts multiple times), (b) documented theoretical and reflective thoughts, (c) documented reflections on potential codes/themes, (d) storage of raw data in well-organized archives, (e) diagrammatic representation of theme connections (see Figure 1), (f) themes and subthemes reviewed by other researchers (e.g., critical friends), (g) documentation of theme naming (46).

# 3 Results

Five key themes were identified: (a) Fostering athlete empowerment, (b) Impact of sport on education and social change, (c) Expanding VOA's reach and impact, (d) VOA's role in preparing athletes for post-sport life, and (e) Optimizing VOA implementation and experience.

## 3.1 Fostering athlete empowerment

All practitioners highlighted the critical role of the VOA in empowering athletes and assisting them in becoming leaders within their communities. The VOA provides athletes with opportunities to develop knowledge about contemporary social issues, broadening their perspectives on their societies and the world, while increasing their awareness of their potential contributions as athletes and leaders. This aligns with the overarching aim of the VOA: *Be a leader*. Practitioner 8 emphasized the core purpose of the VOA in this context, stating, "the overarching intended outcome of Voices of the Athletes was to help create athlete leaders".

The transformative power of the VOA was further evidenced by the experiences of ten out of 14 practitioners who were VOA Champions. These practitioners, either former or active athletes themselves, had experienced the VOA as athletes before transitioning to the role of facilitator as VOA Champions. Their experiences serve as a testament to the positive impact the VOA has had on athletes, empowering them based on the knowledge and insights they gained through the program. For instance, Practitioner 10 explained, "you are not only a national hero on the court, remember off the court too you are a public figure. […] so, discipline needs to be maintained at all levels, on and off court". This statement highlights the holistic approach of the VOA, emphasizing the importance of both athletic performance and personal conduct in shaping athletes as role models in their communities.

Practitioner 6's experience further illustrates the VOA's impact on personal growth and leadership development. Having dropped out of education at a young age due to a lack of family support, she later became a national team athlete through determination. The VOA played a crucial role in motivating her to become involved in spreading the program's messages and embracing her role as a leader within the athletic community. Participants' insights highlight the importance of the VOA in cultivating leadership qualities among athletes, empowering them to become role models and agents of change within their communities. The program's success in providing athletes with the tools and knowledge necessary to navigate contemporary social issues and develop leadership skills is evident in the experiences shared by the practitioners. The transformative effect of the VOA on the lives of these individuals, as well as the potential for similar impacts on other athletes, highlights the value of the program and its potential for fostering positive change at both individual and community levels.

## 3.2 Impact of sport on education and social change

The practitioners notably emphasized the power of sport as an effective and influential medium for educating and inspiring individuals to become aware of public health and social issues, prompting them to take action. They also highlighted the role that sport, and athletes play in leading positive changes within the Pacific Islands. Practitioner 9 remarked, "the VOA really demonstrates the power of sports because you see these national athletes here, they're not just athletes coming, they are representatives of their country". Many of them further

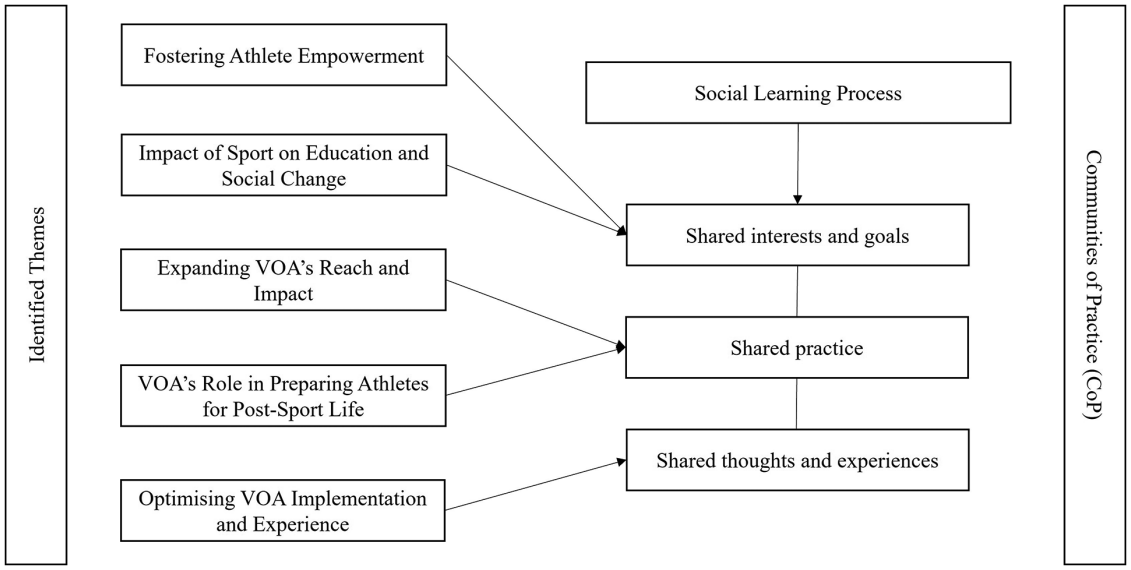


FIGURE 1
Final thema.ic map of the experiences and perceptions of the VOA practitioners.

elaborated on why sport is a valuable tool for educating not only athletes but also wider populations. Practitioner 10 explained, "Sport is the only tool or is the only thing that does not discriminate against anyone, regardless of your age, gender, religion, abilities, or disabilities […] So, sport is a very effective means of delivering sessions back home".

Drawing from their appreciation for the power of sport, practitioners acknowledged the significant role the VOA plays in showcasing how sport and athletes can influence people across different societies within the Pacific Islands. However, participants expressed concern that sport is not valued as highly as it should be in many countries and that investment in sport is not yet sufficiently encouraged, despite growing recognition of its importance. This lack of investment has impacted the delivery of the VOA in various regions, limiting its reach to a wider population at different events beyond the Mini Pacific Games due to budget constraints. The practitioners' insights underline the transformative potential of sport as a vehicle for education and social change. By harnessing this potential, the VOA and similar programs can continue to promote awareness of public health and social issues, ultimately empowering individuals and fostering leadership in communities across the Pacific Islands.

## 3.3 Expanding VOA's reach and impact

One of the primary strengths of the VOA is its adaptability. Participants identified the VOA as a multifaceted framework that can be applied in various contexts and regions. They also discussed examples of programs informed by the VOA that have been implemented in their countries, demonstrating its potential for delivery outside of the Pacific Islands. Among these programs, the Hero program in Papua New Guinea was most frequently mentioned. This program, delivered by national sport heroes in remote areas where young children have limited access to education, has gained recognition and support through funding from a private company and the National Olympic Committee.

Participants specifically mentioned the potential for VOA's implementation in South American and African countries. As the VOA has functioned as a framework for other programs, as exemplified by the Hero program, this could be a future pathway for the initiative. Practitioner 4 highlighted the potential for sharing best practices not only from developed countries (Global North) to developing countries (Global South) but also in the reverse direction. This emphasizes the potential for cross-cultural learning and the adaptability of the VOA as a framework that can be tailored to suit diverse contexts, ultimately expanding its reach and impact in promoting education and social change through sport.

## 3.4 VOA's role in preparing athletes for post-sport life

Participants discussed the importance of the VOA in helping athletes prepare for their lives after sport, as the program provides opportunities to increase self-esteem and confidence, develop transferable skills (e.g., public speaking, leadership, communications skills, organizational skills), and raise awareness of their social roles as athletes. Practitioner 9, who has actively influenced children at various schools in his country using the knowledge he gained from the VOA, stated, "I have a social responsibility to make use of sports as a tool to give back to the people". Participants expressed frustration at witnessing retired athletes returning to their everyday lives, engaging in activities

they were not passionate about due to a lack of information and support. This highlights the need for programs like VOA to extend their reach and create a long-lasting impact on athletes' lives, not only during their athletic careers but also after retirement.

A challenge identified by some participants, which impedes the VOA's capacity to support athletes in developing transferable skills and preparing for their post-athletic life, was the limited awareness and accessibility of the VOA or other associated programs across various regions, primarily due to budget restrictions. Increased funding and partnerships with local organizations could help expand the reach of VOA and similar programs, making them more accessible to athletes across various regions. Practitioner 8 highlighted the difficulty athletes face in maintaining a balance between education and sports as they prepare for life after sport: "Sports people who have given up school or left school to pursue a career in sports often struggle to advance to different levels in their sport. Only a handful of sportspeople manage to pursue both, a dual career". This observation highlights the importance of programs like the VOA in offering resources and support for athletes to navigate both their athletic and educational endeavors. It also signifies the need of promoting dual career awareness among athletes to emphasize its significance.

Recognizing the importance of preparing for life after sport, participants argued that this issue should be addressed by various stakeholders, including sports organizations, educational institutions, and community leaders. They suggested that promoting the VOA more extensively to athletes could foster greater awareness of available resources and support networks for athletes transitioning out of their sports careers. Participants also proposed the implementation of internship schemes for athletes to tackle the challenges of transitioning from sport to other careers, as such initiatives have not yet been included in the VOA or other related programs. These internships could help athletes gain valuable work experience, develop new skills, and establish professional networks, easing their transition into the workforce in the end.

### 3.5 Optimizing VOA implementation and experience

The practitioners offered valuable insights into areas for improvement in order to optimize the implementation and experience of the VOA. Common concerns included the need for more interactive activities to engage participants, larger spaces, sufficient time for athletes to complete all stations, and optimal booth locations. Regarding interactive activities, participants with extensive experience in delivering the VOA noted significant improvements over the years, as they recognized that athletes prefer learning key messages while having fun. As a result, the coordinator and facilitators addressed athletes' feedback, requesting more interactive and enjoyable activities. Despite their efforts, facilitators believe they still need to be more creative in enhancing each activity.

Many practitioners also discussed the need for support, particularly financial, to improve the program's delivery: "Money helps" (Participant 4). Financial assistance is crucial not only for the VOA's implementation but also for training more VOA Champions across the Pacific Islands, as most of them currently come from a few countries like Fiji, Papua New Guinea, Samoa, and Vanuatu. Practitioners acknowledged the power of word of mouth in promoting the VOA. While word of mouth is effective, practitioners argued that their efforts should be more widely recognized by sport governing bodies, enabling the VOA to be delivered more frequently in various regions. They also stressed the importance of gaining recognition from coaches who can encourage athletes to participate in the VOA at the Games. Finally, Practitioner 4, 7, 8, 11, and 12 particularly emphasized the need to develop written VOA guidelines. The program is currently delivered, and facilitators are trained based on their experience. However, practitioners believe that a written set of guidelines is crucial for sustainable and consistent delivery of the VOA in the future. These suggestions highlight the practitioners' commitment to continually refining the VOA to maximize its impact on athletes and communities. By addressing the challenges and embracing opportunities for improvement, the VOA can continue to evolve and strengthen its role in empowering athletes and fostering positive change in the Pacific Islands and beyond.

## 4 Discussion

Practitioners' perspectives on the VOA offer critical insights into current practices and have significant implications for the direction of its future implementation. The central message of "empowering athletes" was highlighted in relation to the program's overarching aim. The opportunity for learning, which raises awareness of contemporary social issues and emphasizes the actions athletes can undertake as role models, was highly valued, constituting a crucial aspect of the VOA (32, 47). The VOA's potential for wider impact lies in its ability to inspire and empower athletes, who can then positively influence their communities and create a ripple effect of change and growth. Sport has the unique ability to unite people and transcend cultural, social, and economic barriers (48). The VOA leverages this power to educate athletes on essential topics and promote social change. By providing education and support across various aspects of athlete development and responsibility, the VOA inspires athletes to become positive role models and leaders. These athletes, in turn, have the potential to drive change and make a significant impact on their communities, promoting values such as integrity, health, environmental responsibility, and safety. The findings in this study also demonstrate the great potential of VOA Champions serving as practitioners within the program. The majority of practitioners in this study had personally participated in the VOA as athletes, and they provided insights into how the VOA positively influenced their careers and lives, ultimately fostering their development as role models, leaders, and empowered individuals. This holistic approach to athlete support not only enhances their performance as both athletes

and practitioners but also contributes to their overall development and well-being (15, 16).

Practitioners appreciated the VOA's role in enabling athletes to develop transferrable skills for their career development and life after sport (49). By equipping athletes with essential life skills and transferrable competencies, the VOA supports their overall well-being and success beyond their sporting careers, ensuring a smoother transition into their post-sport lives. Given the significance of pre-retirement planning (19) and transferable skills (49) for athletes' life after sport, and the limited availability of athlete support programs in the Pacific Islands, it is critical to expand the VOA's implementation. In addition, incorporating more content to assist athletes with their transition out of sport could enhance the program's effectiveness and support (8, 11). Researchers have argued that support for athletes' career development and transitions should be provided to help them manage challenges and barriers they may face during and after their athletic careers (15, 19, 41). The importance of organizational support from sports organizations and national governing bodies has also been emphasized (8, 11, 50, 51). In this context, the findings of this study demonstrate that the ONOC has played a significant role in supporting athletes' career development and transitions.

Even though the VOA has shown positive outcomes, practitioners highlighted the need to further promote the program among athletes and communities in the Pacific Islands. This would enable more young individuals to benefit from these best practices. To achieve this goal, consideration should be given to increasing funding and budget allocations for the program, which may require attention from sport governing bodies such as the ONOC and IOC. Increased funding, partnerships, and accessibility can be critical to maximize the impact of the VOA and similar programs. Sufficient funding and resources can ensure the effective implementation and expansion of these programs, while partnerships with sports organizations, educational institutions, and community stakeholders can further enhance their reach and effectiveness (1). The practitioners also suggested that the VOA as a framework could be adapted to different cultural contexts, representing an excellent case of transferring best practices from the Global South to the Global North. This finding holds considerable importance, as existing literature on athlete support has predominantly concentrated on Western countries (19, 30). In order to adapt the VOA's practices for the Global North and other countries, the practitioners responsible for coordinating and leading the VOA highlighted the necessity of creating written guidelines that would facilitate the program's long-term implementation and success. In addition, to optimize the VOA delivery and experience, several suggestions were made by the practitioners including incorporating more interactive activities that engage athletes, utilizing larger spaces to accommodate more participants, promoting the VOA to reach a wider group of athletes. By implementing these improvements, the VOA can better cater to athletes' needs and enhance their overall experience and development.

In terms of increasing accessibility, it will enable a broader range of athletes to benefit from the VOA and contribute to their success. However, expanding the VOA's reach and impact in different regions presents both challenges and opportunities. Challenges include the need to adapt the program to diverse cultural contexts, limited resources, and varying levels of sport infrastructure as proved in this study. Despite such challenges and limitations, as the practitioners demonstrated, the VOA framework holds potential for cross-cultural learning and adaptability in diverse contexts. By understanding and accommodating cultural nuances (28), the VOA can effectively serve athletes from various backgrounds and address their unique needs. Cross-cultural learning, in turn, can contribute to the ongoing improvement and refinement of the VOA framework, ensuring its continued relevance and effectiveness in supporting athletes from around the world.

Communities of Practice (CoPs) are social learning processes within groups that share common interests, goals, and practices (33). The practitioners' approach in this study, during the delivery of the VOA, appeared to align with the CoP concept. Analyzing the VOA from the CoP perspective enabled the exploration of shared thoughts and experiences among practitioners, as well as the identification of positive outcomes and challenges in the program's delivery. This approach offers a deeper understanding of factors influencing practitioners' perceptions and experiences. Meanwhile, the CoP framework assists in identifying areas for improvement in VOA practitioners' delivery, ultimately contributing to athletes' personal and professional growth. By exploring the dynamics of CoPs within the VOA, this study offers valuable insights for sport governing bodies and other stakeholders involved in athlete support initiatives. These insights can inform the design and implementation of comparable programs in other regions and guide the development of strategies to enhance existing programs while promoting a culture of continuous learning and improvement among practitioners. It is hoped that the findings in this study can contribute to the ongoing development and effectiveness of the VOA and similar athlete support initiatives across diverse contexts.

## 5 Conclusions

The findings in this study make significant contributions to both academic literature and practical applications by providing insights from practitioners who deliver athlete support programs in the under-researched Pacific Islands region. These insights facilitate the identification of critical recommendations for developing effective strategies and initiatives to better support athletes in developing countries. First of all, we advocate for the continued emphasis on athlete empowerment within the program. To enhance this, it is critical to motivate athletes to engage with the VOA, helping them become knowledgeable about social issues and how sports, along with athletes as role models, can contribute to positive changes in society. Such engagement promotes athletes to leadership roles,

further strengthening their empowerment. Thus, increased attention and investment are necessary to expand the program and reach more athletes in the region. This expansion will allow more athletes to benefit from the VOA, enabling them to influence young people as role models and leaders in their communities. Given the VOA's positive impact on athletes' preparation for life after sports, this content should be more clearly incorporated into the program, possibly as a new theme, with development based on relevant research evidence and regional athletes' experiences. For instance, career assistance programs (CAPs) highlighted in sports literature [e.g., (11, 18)], can help develop themes and content specifically designed to support athletes in preparing for their lives after sports. Developing guidelines may be crucial and even urgent for the program's continued growth and sustainability. Regarding the sharing of best practices from the Global South to the Global North, further research is encouraged to apply the VOA in countries in the Global North, with a focus on adapting the program to different cultural contexts. In addition, the present study employs the Communities of Practice (CoP) theoretical framework, demonstrating its applicability within the context of athlete assistance programs and initiatives. By examining the interactions and shared learning among practitioners, the study demonstrates the value of the CoP framework in understanding and enhancing the delivery of the VOA. As a result, this research not only fills a gap in the existing literature but also offers practical guidance for stakeholders looking to improve athlete support initiatives in diverse settings.

This study, while offering valuable insights, is subject to some limitations. Although it provides an in-depth exploration of practitioners' perspectives on the VOA and its delivery, it is crucial to explore athletes' perspectives on the program as well. While the larger project that this study is a part of addresses athletes' perspectives to some extent, obtaining more detailed insights from athletes could help further enhance and better facilitate the program. If it is feasible, conducting focus groups with practitioners to discuss athlete support programs could potentially strengthen the analysis of their perceptions and experiences from the Communities of Practice (CoP) perspective. In addition, it would be valuable to compare athletes' and practitioners' points of view, as there might be discrepancies in their perceptions that could be addressed to improve the program. Future research could benefit from incorporating these additional perspectives and employing varied research methodologies to provide a more comprehensive understanding of athlete support programs, such as the VOA. By doing so, researchers can continue to identify ways to optimize program delivery and better support athletes in their personal and professional development.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by General University Ethics Panel (GUEP) at the University of Stirling (GUEP659). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

HH: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. BM: Conceptualization, Formal Analysis, Methodology, Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article.

The study was conducted with support from an internal funding source named SPARK, provided by the University of Stirling.

## Acknowledgments

We would like to thank our participants for taking their time to make this research project possible. We are also grateful to Robin Mitchel, President of Oceania National Olympic committees (ONOC), Ricardo Blas, Secretary General of the ONOC, Sainimili Roqica, Manager of the Oceania Sport Education Program from the ONOC, Natanya Potoi, Manager Regional Anti—Doping Program from the ONOC, Karo Lelai, Chair of the ONOC Athletes Commission, ndrew Minogue, CEO of Pacific Games Council, and the National Olympic Committee of Samoa for supporting our project. Lastly, we appreciate University of Stirling's APC support for the publication.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 25 March 2024
DOI 10.3389/fpsyg.2024.1257446



OPEN ACCESS

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RECEIVED 17 July 2023
ACCEPTED 26 February 2024
PUBLISHED 25 March 2024

CITATION
Platt IA, Hochard KD, Tytherleigh M, Kannangara C, Carson J, McFaul C and North C (2024) The Hummingbird Project year 2: decreasing distress and fostering flourishing in a pragmatic pre–post study. *Front. Psychol.* 15:1257446. doi: 10.3389/fpsyg.2024.1257446



# The Hummingbird Project year 2: decreasing distress and fostering flourishing in a pragmatic pre–post study

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Multi-component Positive Psychology Interventions (mPPIs) in secondary schools have been shown to improve mental health outcomes for young people. The Hummingbird Project mPPI is a six-week program of workshops designed to introduce a variety of positive psychology (PP) concepts to secondary school-aged children in schools to improve well-being, resilience, and hope. The effects on mental distress, however, were not explored. The current study, therefore, was designed to replicate the effects of the Hummingbird Project mPPI on positive mental health and to also explore the effects on symptoms of mental distress. Secondary school-aged children ($N$ = 614; mean age = 11.46 years) from a sample of secondary schools located across the North West of England ($N$ = 7) participated in the study; the majority of children were in Year 7 (94%). The PP concepts explored included happiness, hope, resilience, mindfulness, character strengths, growth mindset, and gratitude. The results showed significant improvements associated with the mPPI in well-being (as measured by the World Health Organization Well-Being Index; WHO-5), hope (as measured by the Children's Hope Scale; CHS), and symptoms of mental distress (as measured by the Young Person's Clinical Outcomes in Routine Evaluation; YP-CORE) from pre- to post-intervention. While acknowledging the limits due to pragmatic concerns regarding the implementation of a control group, the effectiveness of the Hummingbird Project mPPI on well-being was replicated alongside reducing the symptoms of mental distress. Future evaluation, however, will need to implement more robust designs and consider follow-up duration to assess the longer-term effects of the Hummingbird Project mPPI.

KEYWORDS

**school, well-being, positive psychology, child, adolescent, intervention**

## Introduction

Mental health is associated with improvements in educational attainment, greater productivity, reductions in mortality, increases in social interaction and engagement, reduced risk of both suicide and mental illness, reduced likelihood of risk-taking, and increased levels of resilience (Campion et al., 2012). Indeed, mental health is on a spectrum, distinguishing

those who flourish and live a good life and function well at the positive extreme, from those who languish, have low levels of satisfaction and may be living a life without purpose, meaning and fulfillment, etc., at the negative extreme (Keyes and Haidt, 2010). Mental illness is the second largest source of burden of disease in England. Mental illnesses are also more common, long-lasting, and impactful than other health conditions (Public Health England, 2019). Notably, 50% of lifetime mental illness starts by age 14 and 75% by the mid-20s (Kessler et al., 2007). In the United Kingdom (UK), 13.6% of children aged 11–16 years can have a mental health disorder at any one time (RCPCH, 2020).

The effects of mental illness in younger life can also be long-lasting. A longitudinal study involving 17,634 children in England, Scotland, and Wales showed an association between psychological problems in childhood and employability in later life (Goodman et al., 2011). The Children's Society (2020) also showed that, at 15 years of age, children in the UK ranked lowest out of 24 European countries for life satisfaction and having a positive sense of purpose in life. They also ranked second in terms of sadness (The Children's Society, 2020). Taken together, therefore, understanding why this is and finding ways to reduce mental illness in young people in the UK is a priority.

## The role of schools in young people's mental health

Globally, children in OECD countries spend an average of over 800 h a year in school (OECD, 2020). Since children spend such a large amount of their time in schools and over several critical periods in their early development, schools have a large role to play in their cognitive, emotional and social development, social skills, academic attainment, and, ultimately, well-being (Fazel et al., 2014). Even so, in the UK, the Department for Education saw a real-term budget cut of 7.4% between 2010 and 2016 (Crawford and Keynes, 2015), which has triggered some significant impacts and challenges in schools. These include staff cuts and poorer retention, scaled-back curriculums, and increased levels of teacher ill-being.

While initiatives for embedding well-being into the curriculum in UK schools are nothing new (e.g., the *Children and Social Work Act 2017* made PSHE [personal, social, health, and economic education] a statutory requirement at all schools in England from September 2020), many tend to run separate well-being initiatives alongside mainstream teaching (Spratt et al., 2006). Mental health outcomes can also be improved by delivering both mental health identification and prevention programs in schools (Levitt et al., 2007). However, the engagement of affected parties, including school staff, counselors, and support staff, is necessary for the successful implementation of evidence-based interventions in school settings, and it has been shown that such engagement is lacking (Fazel et al., 2014). Fazel et al. also identified a number of other challenges associated with the delivery of mental health interventions in schools. These operate on three levels: individual factors, such as stigma, individual risk factors, and parental issues; community-related factors, such as geographic location and social status; and system-related factors, including access to funding, waiting times, and availability of training.

## The role of positive psychology in schools

Positive psychology (PP) and its application in schools through Positive Education provides a more holistic approach to education that addresses both academic success and well-being without one having to overshadow the other. Building on the science of well-being (Seligman, 2002), and more often based on Seligman's (2011) PERMA Framework (positive emotions, engagement, positive relationships, meaning, and accomplishment) and its' adaptations, Positive Psychology Interventions (PPIs) are now being developed for schools (Slade et al., 2017; Rashid and Seligman, 2018), and it has been shown that embedding well-being lessons as part of the school curriculum improves student mental health (Boniwell et al., 2016). As a consequence, this includes benefits on academic performance, too. PPIs that run year-round as part of class timetables have also shown efficacy in not only improving well-being but also reducing stress and anxiety (Shoshani and Steinmetz, 2014). Such an approach, however, requires support on a number of levels, including embedding well-being into teacher training, school leadership training, educational culture, and shifting mindsets too (Waters, 2011). To be effective at embedding well-being for students, teachers need to have positive well-being, too.

An alternative approach is to offer brief PPIs that run outside of the school's usual curriculum. While the results of these have been mixed (Suldo et al., 2014), leading to the conclusion that the widespread adoption of brief school-based PPIs is not empirically supported (Dawood, 2013), more recent evidence is much more optimistic. For example, brief PPIs have been shown to enhance academic performance by increasing students' motivation to study (Muro et al., 2018). They have also demonstrated a diverse range of benefits to students in terms of both well-being and learning (Shankland and Rosset, 2017). A limitation of the majority of brief PPIs, however, is that they can focus on a single concept from PP, such as gratitude (Froh et al., 2010), character strengths (Quinlan et al., 2015), or mindfulness (Sapthiang et al., 2019).

Although peer-reviewed research in this area is limited, especially when compared to that which uses a single PPI approach, PPIs that broaden the focus to include multiple concepts from positive psychology [Multi-component Positive Psychology Interventions; mPPIs] in schools have been shown to be more effective. For example, in her review of 12 school-based PPIs designed to increase student well-being and academic performance, Waters (2011) concluded that, while acknowledging that some limitations in, e.g., design exist, the effectiveness of PPIs is encouraging. The PP concepts utilized in her review included positive emotions, resilience, and character strengths. In more recent exploratory research of a mPPI designed to improve happiness and classroom behavior in a sample of at-risk high school students, DeBiase et al. (2022) also found that, while the effects were not as expected, even the small changes in a positive direction were promising, and especially for those working with at-risk populations of adolescents. Although limited by the small number of systematic literature reviews that have been carried out on the effectiveness of PPIs, the reporting of smaller effect sizes appears common (White et al., 2019). Indeed, in their meta-analysis of the effectiveness of PPIs more generally (i.e., not just in schools), White et al. found the effect sizes reported were much smaller, although they also justified this by differences across studies and their design, including issues related to methodology and the use of smaller sample sizes.

## Multi-component positive psychology interventions

Given there is no 'one fits all' approach to PPIs, and with some PPIs found to be more effective and engaging for some students than others, additional benefits of adopting a mPPI over a single PPI approach include having a broader reach, greater inclusivity and, ultimately, a larger range of beneficial effects. One such mPPI carried out in secondary schools in the UK is the Hummingbird Project (Platt et al., 2020). Drawing on Seligman's (2011) PERMA Framework, the Hummingbird Project mPPI involves teaching students concepts from positive psychology in class, which they then practice at home, using at-home activities. The delivery of the mPPI is approximately 1 h per week over 5–6 weeks. Indeed, studies discussed above have demonstrated the efficacy of interventions that target each of the individual variables targeted in the Hummingbird Project.

The results of the Hummingbird Project mPPI following its' first year of academic delivery showed improvements in well-being, resilience, and hope in secondary school-aged children, thus evidencing an increase in flourishing as conceptualized by Keyes and Haidt (2010). A limitation of this study, however, and one which this current study was designed to address, is that the effects on symptoms of mental distress were not also explored. Acknowledging that repeat doses may be necessary (Stockings et al., 2016), previous research has shown that school-based mental health interventions can lead to reliable and clinically significant changes in anxiety and depression (Punukollu et al., 2020). Such information would be of particular interest to schools since mental ill-health has higher costs for schools than other public service sectors (Fazel et al., 2014). It would also be of interest to researchers, as evidence for the effects of school-based anxiety prevention is mixed (Waldron et al., 2018).

## The current study

The current study aimed to explore the effects of the mPPI Hummingbird Project on well-being in secondary school students following its' second full academic year of delivery. The project had previously been piloted with 90 students in two schools and then delivered to 1,058 students in 14 schools across the North West of England [see Platt et al. (2020)]. Furthermore, it aimed to expand on prior findings of the Hummingbird Project mPPI (Platt et al., 2020), which found a small beneficial effect on indicators of flourishing, by also assessing the impact of the mPPI on symptoms of mental distress.

Given the time, funding, and resource difficulties faced by schools, a full randomized controlled trial was impractical; hence, a pragmatic approach using within-subject comparisons was adopted. The delivery was carried out by a single researcher, assisted by Undergraduate and master's level psychology students recruited from two universities local to the schools. All participating schools were based in the North West of England and selected from those who chose to respond favorably to the offer of this free mPPI; some variability across schools did exist. As such, the current study explored whether any effect of the mPPI found would remain having accounted for individual, school, or local authority-related differences. These three levels have been chosen as proxies for the levels of individual, community, and system suggested by Fazel et al. (2014) discussed above, each of which is expected to bring unique challenges that may negatively effect the outcomes of the PPI. [note: there are 353 local authorities in England. These provide the local government for their metropolitan borough, county, or district (National Audit Office, 2017)].

Using standardized measures of well-being and mental distress and building on the effectiveness of previous research using the Hummingbird Project (Platt et al., 2020), it was hypothesized that:

i The mPPI would improve the students' levels of well-being and hope from pre- to post-intervention, having accounted for the potential random effects from local authorities, schools, or participants.
ii The mPPI would reduce students' symptoms of mental distress from pre- to post-intervention, having accounted for the potential random effects from local authorities, schools, or participants.

# Method

## Intervention

Year 2 of the Hummingbird Project involved six weekly 1-h sessions that took place during normal timetabled school hours, at different stages across the academic year depending on timetable availability in each school, delivered by a single researcher (Author 1), with support from Undergraduate and Masters Psychology students (trained by Author 1). An introduction to the mPPI for students and teachers took place in session 1, along with a discussion of what happiness means to each individual in the group. A range of concepts from positive psychology was then discussed in sessions 2 to 5, with activities relating to each concept. The concepts covered in these sessions were as follows: happiness, hope and resilience, mindfulness, character strengths, growth mindsets, and gratitude, respectively. During each session, students took part in a range of activities intended to help them understand and use these concepts in their daily lives and were given a homework task to help them understand how each concept can improve their own mental health. The final session involved a recap of the topics covered in previous sessions, along with advice for students on how to incorporate these concepts into their lives in future.

Delivery of the project took place across the academic year in eight secondary schools across North West England. However, delivery of the project had to be halted at one school before post-intervention testing could take place due to the imposition of lockdowns in relation to the coronavirus pandemic. All students were given a workbook to complete throughout the intervention, which then became theirs to keep at the end. The workbook was a place where students could record any work they completed in sessions and at home, as well as their thoughts and feelings regarding the experience. Students were also given questionnaires to complete as baseline and outcome measures.

## Participants

Participants were an opportunity sample of 727 students. However, due to COVID-19 restrictions, complete data could not

be obtained from 113 students in one school. As such, our final sample consisted of 614 students. Recruitment of participants involved emailing the Head Teachers and Special Educational Needs Coordinators of a number of schools in the region. Schools in the Cheshire West and Chester Local Authority were selected based on their location being in the top 40% for deprivation (MHCLG, 2019). The participant inclusion criteria for the intervention, which were provided by the research team to the school, were as follows: (a) studying at a secondary school and (b) willingness of the school, parents, and/or carers for students to take part in the study. Furthermore, school staff allowed students to participate based on the student's form group, PSHE group, timetabled lesson group, or perceived need for intervention; the researchers were not privy to the reason for perceived need. The schools were in control of this process, without interference from the research team.

Participants were aged between 11 and 15 ($M = 11.46$, $SD = 0.70$), and 46% were female, which was fairly representative of all schools in the study. A majority of participants (94%) were in Year 7, 2% were in Year 8, 2% were in Year 9, and 3% were in Year 10. White British students made up 82% of the sample, with the next most populous ethnic group being British Asian, at 8%, students of a mixed background making up 5%, and Black British being 4% of the sample. The remainder were of Polish, Romanian, Turkish, and Hungarian descent.

## Instruments

Questionnaires included three standardized quantitative measures. These were as follows:

i The World Health Organization-Five Well-Being Index (WHO-5; Staehr, 1998) is a five-item well-being scale, with items measured on a 6-point Likert scale (0 = at no time; 5 = all of the time). Staehr (1998) has shown that Cronbach's $\alpha = 0.75$, and an example item is "I have felt cheerful and in good spirits." The WHO-5 has been validated as a measure of well-being for adolescents (De Wit et al., 2007), showing a one-factor structure using confirmatory factor analysis. Cronbach's $\alpha$ was 0.82, and the WHO-5 showed a moderate to strong correlation with the CES-D ($r = 0.67$), with the mental health ($r = 0.60$) and self-esteem ($r = 0.43$) subscales of the CHQ-CF87, and with the DFCS ($r = 0.34$), which was taken to confirm concurrent validity. The same study used ROC curve analysis to show the WHO-5 cutoff point of 50 for the identification of mild-to-severe depressive affect, with sensitivity at 89% and specificity at 86%. For our sample, the WHO-5 demonstrated good reliability in both pre-intervention ($\alpha = 0.73$) and post-intervention ($\alpha = 0.84$).

ii The Young Person's Clinical Outcomes in Routine Evaluation (YP-CORE; Twigg et al., 2016) is a monitoring tool with items covering anxiety, depression, trauma, physical problems, functioning, and risk to self. Items are rated on a 5-point Likert scale (0 = not at all; 4 = most or all of the time). An example item is "I have not felt like talking to anyone." Twigg et al. (2016) showed a one-week test–retest mean Time 1 score of 8.3 (95% CI: 7.2–9.5; range: 0–27; SD = 5.6) and mean Time 2 score of 7.7 (95% CI: 6.5–9.3; range: 0–30; SD = 6.6). Mean change was shown not to be statistically significant ($t = 1.2$, df = 89, $p = 0.23$; Wilcoxon $U = 1787$, $p = 0.15$) with a negligible effect size (Hedges' $g = 0.09$, 95% CI:-0.21 to +0.39). They found that Pearson's correlation coefficient for Time 1 and Time 2 scores was as follows: 0.76 (95% CI: 0.65–0.86) and Spearman's rho was 0.74 (95% CI: 0.58–0.83). They also demonstrated reliability for the YP-CORE when used in a non-clinical sample of children, with Cronbach's $\alpha = 0.83$. Similarly, our sample demonstrated good reliability pre-intervention ($\alpha = 0.81$) and post-intervention for ($\alpha = 0.84$) the YP-CORE.

iii The Children's Hope Scale (CHS; Snyder et al., 1997) is a measure of hope that uses six items on a 6-point Likert scale (1 = none of the time; 6 = all of the time). An example item is "I can think of many ways to get the things in life that are most important to me." Snyder et al. (1997) demonstrated that the CHS has high internal consistency (Cronbach's Alpha = 0.72–0.86) and high temporal stability [$r$ (359) = 0.17, $p < 0.01$]. The internal reliability of the CHS was high for our sample, both pre-intervention ($\alpha = 0.87$) and post-intervention ($\alpha = 0.92$).

## Data collection procedures

Pre-intervention outcome measures were administered to participants at the start of session 1 of the mPPI, with post-intervention measures being administered at the end of session 6. Participants were assured of their anonymity in the outcome testing, encouraged to be as honest as possible, and informed that they had the right to withdraw from the study if they so wished. They were also informed that their school grades would not be affected by their participation in the study or by any of the answers they gave to the questions. Procedures were conducted in line with relevant guidelines and approved by the university ethics board. Once participants had completed both pre- and post-intervention questionnaires, responses were coded, and scores were calculated in line with each instrument's published scoring guidance.

## Data analysis procedure

The repeated measures outcomes followed a nested structure: within participants ($n = 614$), within schools ($n = 6$), and within local authorities ($n = 2$).

All analyses were performed using the open software Jamovi (version 2.0.0, The Jamovi Project, 2021). To test our hypotheses, mixed-effect model analyses were conducted as these provide more robust estimates than repeated measures ANOVA with respect to missing data and type 1 error rate (Mallinckrodt et al., 2001). Further mixed-effect models account for fixed and random effects, which provide a more comprehensive overview of the effect in the data by accounting for both the overall trends and the individual variations. These analyses were performed in the General Analyses for Linear Models in Jamovi (GAMLj) package version 2.4.8 (Gallucci, 2019). The GAMLj package is able to account for the nested data structure without explicit specification. Three models (one per outcome) were computed, which included the repeated measure (pre and post) as our fixed-factor predictor (time) and included correlated participant level,

school-level, and county-level random intercepts, using a restricted maximum-likelihood function with the bobyqa optimizer.

## Results

Descriptive statistics for our full sample for each of the repeated measures outcome variables are presented in Table 1.

The mixed-effect models reported displayed approximately normally distributed, homoscedastic residuals. Significant main effects of time were consistently observed across all of the outcome variables (see Table 2), indicating the intervention to have salutary effects. However, the marginal $R^2$ were low for all models, suggesting a small effect of the fixed factor. ICC for the models showed that the clustering for participants was substantial for all models. However, the similarity of observations by school and county was much less important for the WHO-5 than for our YP-CORE and CHS outcomes. It should be noted that results were found to be unchanged by removing all non-year seven students.

## Discussion

The findings of this study indicate significant positive improvements in all three of the outcome measures, with increases of 0.79 in well-being (WHO-5) and 0.67 in hope (CHS) and very small reductions of −0.08 in symptoms of mental distress (YP-CORE) from pre- to post-intervention, while also accounting for random effects from the local authority, school, and participants. As such, these findings replicate the effects on well-being observed by Platt et al. (2020) following the first year of delivery of the Hummingbird Project mPPI. Like Shoshani and Steinmetz (2014), following a year-round delivery of PPIs, they also show that, even over a much shorter time period of delivery (i.e., five to six weeks), the Hummingbird Project mPPI also reduces mental distress alongside improving well-being. This is further supported by the small marginal $R^2$ in the models (0.005–0.01). The inter-class correlations (ICCs) for the models also support the inclusion of random intercepts for participants by accounting for a significant amount of variance in scores. This was particularly noticeable in the model of well-being, indicating individual differences among participants to account for some of the effects observed. Conversely, school and local authorities had a small ICC, suggesting that these did not account for much variation in scores. As such, both hypotheses are supported. That is to say, the mPPI improved participants' levels of well-being and hope from pre- to post-intervention, accounting for the random effects from local authorities, schools, and participants. Also, the mPPI reduced participants' symptoms of mental distress from pre- to post-intervention, accounting for the random effects from local authorities, schools, and participants.

TABLE 1 Descriptive statistics for outcome variables.

| | Pre | | Post | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Wellbeing (WHO-5) | 13.40 | 5.10 | 14.19 | 6.02 |
| Mental distress (YP-CORE) | 1.31 | 0.78 | 1.25 | 0.82 |
| Hope (CHS) | 22.58 | 7.25 | 23.25 | 8.22 |

WHO-5, World Health Organization-Five well-being index, YP-CORE, young person's clinical outcomes in routine evaluation, CHS, children's hope scale.

These results add more evidence to the idea that PPIs need not take place over long durations, as in the example of Shoshani and Steinmetz (2014), using time and resources that might otherwise be used for more academic learning, which, as discussed earlier, can often be prioritized above student mental health (Waters, 2011).

Interventions can impact on three levels—individual factors, community-related factors, and system-related factors (Fazel et al., 2014). The results here show that individual factors play a large part in the outcomes of the Hummingbird Project. Though a large contribution of community factors, namely county (local authority) and school-related factors, were not shown, a large proportion of error variance remains in the models. This is not, however, uncommon when delivering interventions in uncontrolled settings, or by way of measurement error for the key variables. Research designs which afford greater experimental control would likely yield reduced error variability (Cohen, 1988), though the implementation of these designs is limited in education settings due to limited resources and constraints on participant burden imposed by gatekeepers. Indeed, the very imposition of these limits not only points to educators' lack of priority of student mental health, discussed above, but also that school-related factors do have a significant effect on the efficacy of PPIs, even though this has not been demonstrated in this case. It is, therefore, important that researchers attempting to implement PPIs in the school setting attempt to account for such factors. It would also be advisable to conduct further studies accounting for and attempting to measure these effects.

Although not compared statistically, compared to results from cohort 1 (Platt et al., 2020), this second year of delivery of the Hummingbird student cohort also displayed a larger improvement in well-being, but with a smaller improvement in hope. Given the delivery of the mPPI was during the early part of the pandemic, and particularly early on, when the levels of uncertainty may have been more heightened, this result remains optimistic. Children can be particularly vulnerable to the mental ill-health-related effects of uncertainty, particularly if others around them are experiencing the effects of uncertainty, too. Irrespective, an increase in well-being following the Hummingbird Project was still found. Also, while there was a smaller improvement in hope than those who participated in the first year of delivery (which may also be explained by the heightened levels of uncertainty), a significant increase in hope was still found, too. It is important to note, however, that the children who participated in the second year of delivery were different from those who participated in the first year and, as such, some effects of individual differences may be at play here.

With the dosage of the intervention being relatively small, associated small effects are promising. Larger doses may yield larger effects, although this would require further testing. It would also likely be difficult to implement due to the logistical constraints of testing in schools. It is also likely that, as the intervention facilitator did not benefit from having a pre-existing relationship with the students (Paulus et al., 2016), greater effects could be observed should Hummingbird be delivered by a class teacher. Stockings et al. (2016)

10.3389/fpsyg.2024.1257446

TABLE 2 Mixed-effect models for well-being (WHO-5), mental distress (YP-CORE), and hope (CHS) outcomes.

| | Well-being (WHO-5) | | | | | | Mental distress (YP-CORE) | | | | | | Hope (CHS) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 95% CI | | | | | | 95% CI | | | | | | 95% CI | | | |
| Fixed effects | Estimates | LL | UL | *t* | *p* | | Estimates | LL | UL | *t* | *p* | | Estimates | LL | UL | *t* | *p* | |
| Intercept | 13.07 | 11.80 | 14.34 | 20.13 | 0.04 | | 1.46 | 1.07 | 1.84 | 7.39 | 0.090 | | 21.49 | 18.39 | 24.60 | 13.58 | 0.052 | |
| Time | 0.79 | 0.36 | 1.21 | 3.64 | < 0.001 | | −0.08 | −0.14 | −0.03 | −3.14 | 0.002 | | 0.79 | 0.30 | 1.28 | 3.16 | 0.002 | |

| Random effects (intercept) | $\sigma^2$ | ICC | Model fit | | | $\sigma^2$ | ICC | Model fit | | | $\sigma^2$ | ICC | Model fit | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AIC | $R^2$ marginal | $R^2$ conditional | | | AIC | $R^2$ marginal | $R^2$ conditional | | | AIC | $R^2$ marginal | $R^2$ conditional |
| County | 0.48 | 0.04 | 6655.50 | 0.01 | 0.62 | 0.06 | 0.26 | 2127.45 | <0.01 | 0.75 | 3.53 | 0.19 | 7109.22 | <0.01 | 0.75 |
| School | 0.68 | 0.05 | | | | 0.04 | 0.20 | | | | 3.54 | 0.19 | | | |
| Participant | 18.03 | 0.60 | | | | 0.41 | 0.71 | | | | 40.29 | 0.72 | | | |
| Residual | 11.92 | | | | | 0.17 | | | | | 15.49 | | | | |

LL and UL, lower limit and upper limit for 95% confidence intervals; $\sigma^2$, variance; ICC, intraclass correlation coefficient; AIC, Akaike information criterion; $R^2$ marginal, variance explained by the fixed effects over the total (expected) variance of the dependent variable; $R^2$ conditional, variance explained by the fixed and random effects over the total (expected) variance of the dependent variable.

have shown teacher delivery to be more effective than clinician delivery for internalizing disorders. Although a recommendation for teacher training, as teachers seldom receive mental health training (Byrne et al., 2015) and report feeling uncomfortable intervening in student well-being issues for fear of making things worse (Hatton et al., 2017), the use of a facilitator may, therefore, be a necessity for brief mPPIs. It is also worth noting that facilitated interventions give students the time and opportunity to express feelings and emotions. They might also present teachers with the opportunity to see and hear what might be helpful for individual students. Hence, offering training to teachers so they can carry out the intervention within the classroom could be of interest to institutions as a way to incorporate the benefits of the interventions into the whole school setting. If teachers are finding benefit from the interventions, they are also more likely to be able to communicate this with enthusiasm to their students.

It stands to reason that improvements in levels of hope (CHS) would be found in participants in the project, not least because this is one of the concepts covered in the intervention itself. However, improvements in mental distress resulting from an intervention that does not address this construct may at first seem counterintuitive. Promoting positive mental health can 'buffer' the negative effects of mental illness (Trompetter et al., 2017) and produce health and social benefits (Lyubomirsky et al., 2005; Keyes, 2007). Therefore, an intervention that improves mental health can be expected to lead to improvements in educational attainment, productivity, longevity, and reduced risk of both suicide and mental illness (Campion et al., 2012). Indeed, an intervention that leads to flourishing can be expected to reduce languishing (i.e., low levels of satisfaction, purpose, meaning and fulfillment; Keyes and Haidt, 2010), as has been shown in the case of the Hummingbird Project.

## Limitations

On the one hand, a limitation that could be raised is that the effect sizes were overall small. However, in response to this, the observed effect sizes for the present cohort of participants are within the range to be expected for universal prevention programs of this type delivered to school-aged children of 0.07–0.16 (Tanner-Smith et al., 2018), with the estimates (marginal $R^2$) when converted to Cohen's *d* (Cohen, 1988) ranging from 0.14 to 0.20. While likely not perceptible at the individual level, they can also be meaningful at the population level (Cohen, 1988; Kraemer and Kupfer, 2006) in the context of prevention. The reporting of small effects following PPIs is also quite common (White et al., 2019), with even small changes in a positive direction promising, particularly for students at risk (DeBiase et al., 2022).

The two time points of the intervention do not allow for the inclusion of varying slopes in the models. That is to say, one data point more than cells per individual (i.e., three data points for random intercept and random slopes) is required. As such, it is impossible to estimate the varying rate of improvement, and the estimates are for the sample as a whole. It is also likely that rates of improvement are not fixed and differ at an individual level. Future studies, therefore, may want to increase the number of time points to allow for this more refined estimation and to measure any potential stability of change found between pre- and post-intervention.

Additionally, the lack of control groups in this study makes it impossible to state with certainty that the observed effect was due to

the intervention, or possibly a placebo effect. Furthermore, the lack of a control group makes it possible that the effects are in part due to regression to the mean, or possibly by unaccounted-for tertiary variables. Thus, describing the intervention as a causal factor for the salutary effects observed would be beyond the scope of the data. Studies that included a control group would be more able to speak to the causes of these observed improvements.

That said, when designing such a study, one must consider the difficulties of recruitment in a school context. Resources and time are limited (Crawford and Keynes, 2015), which calls for pragmatic decisions. This was the case for the Hummingbird Project. Schools recruited into the study could not allocate more time to the study than was given, as participant burden for three-time points was judged too high and control groups were not deemed acceptable by gatekeepers. This remains a limitation, and replication with robust designs is necessary to strengthen the evidence base for this mPPI.

Data for the well-being outcome (WHO-5) replicate previously published findings (Platt et al., 2020) with effect sizes being comparable (i.e., small effects). However, while the effect of the Children's Hope Scale did replicate, it was not of the same magnitude in the current study, being smaller. As described previously, it is possible that the national context impacted the outcomes of the study, but the lack of consistency may simply indicate that the variation in effect sizes is due to a cohort effect. Alternatively, the intervention delivery (facilitated by the lead author, IP) may have improved in line with the growing experience of the facilitator (Coetzee et al., 2021). The YP-CORE, measuring psychological distress, was an additional inclusion for the second year of the Hummingbird project; thus, it is a novel finding which will require replication.

Although the impact of the lockdowns on the outcomes of the study cannot be clearly established, they did prematurely end the delivery of the intervention. Schools where delivery was impacted by the lockdown were omitted from the analyses, as these participants were unable to complete post-intervention measures. The potential for future school closures due to local or national contexts does suggest that in order for PPIs to reach those in need when they need it most, delivery must be flexible. Therefore, we recommend that the feasibility of an online version of the Hummingbird Project should be assessed. Comparing self-guided (completed at participant's own pace following pre-prepared materials) against facilitated (completed with a facilitator at a mutually convenient time) online interventions would allow the comparison of the effectiveness of varying modes of delivery. An online facilitated intervention also has the potential to be more effective than a self-guided online intervention (Fischer et al., 2020), and it may even outperform the school-based version, given the typically small effect sizes shown in such a setting. However, this is an empirical question, and data obtained from such a comparison would inform decisions where resources are limited, by indicating if the relative gains in effectiveness are worth the resource cost.

The YP-CORE was used to measure symptoms of mental distress in this study and, compared to the effects of the Hummingbird Project on hope and well-being, its' effects on symptoms of mental distress showed the smallest effect. Interestingly, however, the YP-CORE also had the smallest standard deviations. This suggests that participants displayed low distress symptomology and, as such, this might be an indication of restriction of range in scores. That is, the effects of the mPPI were subdued due to participants being clustered around low distress symptomology scores; higher scores, by and large, were not present. This is a limitation and yet also a possible strength. Even though standard deviations were small, a small effect of the mPPI was found. If participants had higher levels of distress, a larger effect size might have been found. The standard deviations for hope and well-being did have larger standard deviations and, as such, less restriction of range. Although also an issue in younger children, 50% of lifetime mental illness starts by age 14 and increases to 75% by the mid-20s (Kessler et al., 2007). The majority of participants in this study were in Year 7 (age 11–12 years). As such, future research needs to expand to older age groups to see if the benefits of the Hummingbird Project on mental distress increase with increasing age. By implementing a longer-term evaluation of the mPPI, the potential of the Hummingbird Project to 'buffer' against the development of mental distress most often associated with older-aged secondary school students could also be explored. As no follow-up data are currently available, there is no option to explore this yet.

## Conclusion

The findings of the current study concur with, and expand upon, previous research (Platt et al., 2020) by demonstrating small improvements in well-being and hope, together with a small but significant reduction in distress from pre- to post-intervention. Since mental ill-health has higher costs for schools (Fazel et al., 2014), an mPPI which benefits both mental health and mental distress will be of more interest. The effectiveness of this mPPI has now also been demonstrated with regard to well-being and hope in two consecutive cohorts, which provides incremental support for the effectiveness of the Hummingbird Project mPPI. However, caution must be observed in interpreting these results, as causal inferences are not possible due to the pragmatic restraints which limited the study design. As such, and particularly given the replication crisis more generally, continued replication efforts are warranted to further the evidence base for this promising prevention program with more robust evaluation design.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors on request, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Departmental Research Ethics Committee, Psychology Department, University of Bolton. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

## Author contributions

IP: Methodology, Project administration, Resources, Writing – original draft. KH: Formal analysis, Funding acquisition, Software, Writing – original draft. MT: Conceptualization, Funding acquisition, Supervision, Writing – review & editing. CK: Supervision, Writing – review & editing. JC: Conceptualization, Supervision, Writing

– review & editing. CM: Writing – review & editing. CN: Conceptualization, Funding acquisition, Project administration, Resources, Supervision, Writing – review & editing.

## Funding

The authors declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

The authors are grateful to the charities that supported the project and all the schools and children that took part.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 27 March 2024
DOI 10.3389/fpsyg.2024.1358170



OPEN ACCESS

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RECEIVED 17 January 2024
ACCEPTED 18 March 2024
PUBLISHED 27 March 2024

CITATION
Bretz K, Strotmeyer A, Seelig H and Herrmann C (2024) Development and validation of a test instrument for the assessment of perceived basic motor competencies in first and second graders: the SEMOK-1-2 instrument.
*Front. Psychol.* 15:1358170.
doi: 10.3389/fpsyg.2024.1358170



# Development and validation of a test instrument for the assessment of perceived basic motor competencies in first and second graders: the SEMOK-1-2 instrument

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Both actual motor competencies (AMC) and perceived motor competencies (PMC) play an important role in motor development research and children's physical and psychological development. PMC refer to children's perceptions of their motor competencies. To assess the PMC of first and second grade children (aged 6–9 years), the SEMOK-1-2 instrument was developed. The instrument is aligned to the validated MOBAK-1-2 instrument which assesses AMC in the competence areas "object movement" and "self-movement" Accounting for possible reading difficulties in younger children, the motor tasks and answer options were illustrated and explained verbally. The purpose of this study was to test and validate the SEMOK-1-2 instrument and investigate the associations between the constructs AMC, PMC and physical activity (PA), whereby PA was measured by the participation in team and individual sports. Data from $N = 404$ pupils in the German-speaking part of Switzerland from first and second grades ($M = 7.8$ years, SD = 0.69, 49% boys) were analyzed. Confirmatory factor analyses were conducted to test the factorial validity of the SEMOK-1-2 instrument. Structural equation models were used to investigate the association between the constructs. The analyses confirmed a two-factor structure with the factors PMC "object movement" and PMC "self-movement", corresponding to the factors existing in the MOBAK-1-2 instrument. Latent correlations between AMC factors and the corresponding PMC factors were $r = 0.79$ for "object movement" and $r = 0.76$ for "self-movement". Associations with external criteria and covariates, such as sex, were associated with both AMC and PMC. Analyses also revealed that children who participated more often in individual and team sports showed higher levels in both AMC and PMC. The confirmation of the two-factorial structure of the SEMOK-1-2 instrument and the associations between AMC and PMC as well as external criteria indicate construct and criterion validity. The SEMOK-1-2 instrument can be economically utilized for assessing PMC and is also suitable for the monitoring of PMC in the context of Physical Education.

KEYWORDS

**sport, motor development, Physical Education, sport participation, childhood, test development**

# 1 Introduction

Based on reflexive and rudimentary movements and determined by socio-cultural and geographical influences, children develop and extend their repertoire of motor competencies (e.g., kicking, running; Herrmann, 2018; Hulteen et al., 2018). In childhood, motor competencies are the prerequisites to participate in the culture of sport and movement. Since actual motor competencies (AMC) and perceived motor competencies (PMC) are seen to be driving influencing factors of physical activity (Lopes et al., 2021), the investigation of AMC and PMC as well as their interplay has been the focus of several studies (Barnett et al., 2022; Estevan et al., 2023).

Deficits in AMC have been revealed worldwide. For instance, Bolger et al. (2021) showed, that children in preschool age (3–5 years) show average AMC, while children aged 6–10 years show below-average levels compared to the normative data of the used test instrument. Deficits regarding physical activity could also be observed. The World Health Organization (WHO) recommends at least 60 min of moderate to vigorous physical activity per day for children and adolescents. However, the WHO Global Status Report on physical activity shows that the physical activity recommendations are not achieved by 81% of adolescents (WHO, 2022). Therefore, the assessment and investigation of AMC and PMC as determinants of PA is important, as high levels of both AMC and PMC are positively related to good health attributes (Barnett et al., 2022; Estevan et al., 2023).

The development of AMC is seen as a main goal of Physical Education in school and AMC are considered as important components for sport-specific skills and an active lifestyle over the lifespan (Bildungsdirektion des Kantons Zürich, 2017). Moreover, they are necessary to overcome the proficiency barrier and to develop sport-specific skills (Hulteen et al., 2018). This sport-specific skills can used for participation in different sports and can result in a lifetime of physical activity (Hulteen et al., 2018). All developmental steps are depending on and influenced by biological (e.g., sex) and environmental factors (e.g., participation in learning situations) and associated with physical (e.g., weight status) and psychological (e.g., perceived competence) attributes (Hulteen et al., 2018; Lopes et al., 2021).

AMC refer to the ability to perform various motor tasks, including coordinating gross and fine movements for everyday activities (Robinson et al., 2015; Almeida et al., 2023). As the term "motor competence" is based on several definitions, AMC will be used as an umbrella term to include different definitions and constructs.

Different approaches lead to the use of different test instruments to measure AMC, e.g., Test of Gross Motor Development (TGMD, Webster and Ulrich, 2017), the "Körperkoordinationstest für Kinder" (KTK, Kiphard and Schilling, 2017), or the MOBAK instruments (in German: Motorische Basiskompetenzen, Herrmann, 2018). The Test of Gross Motor Development (TGMD, Webster and Ulrich, 2017) is a process-oriented assessment and examines qualitative aspects of movement (e.g., movement patterns). The test relates to the construct of fundamental movement skills (FMS) which can be measured in the subscales "locomotor skills" and "object control skills." The KTK (Kiphard and Schilling, 2017) is a product-oriented test which measures quantitative outcomes of motor performance (e.g., number of correct jumps). The KTK instrument includes four items which assess gross body control, coordination, and dynamic balance. The MOBAK instruments assess basic motor competencies and refer to the newly developed approach which theoretically substantiates basic motor competencies as an educational goal in Physical Education (Herrmann et al., 2016). The MOBAK instruments were developed for preschool and primary school (first to sixth grade). Accordingly, the difficulties of the test items refer to the educational goals of the curriculum (Herrmann and Seelig, 2017a; Herrmann, 2018; Herrmann et al., 2020). With the MOBAK instruments, the basic motor competencies can be assessed in the competence areas "object-movement" and "self-movement."

Children's self-perceptions are based on concrete, observable characteristics. PMC are an important construct in the context of motor development and are also defined as an educational goal in Physical Education (Stodden et al., 2008; Högger, 2015). PMC refer to the perception of the motor competencies a child thinks to have. As children with low PMC will probably engage less in sports and PA than children with higher levels of PMC, it is seen as an important factor in motor development research (Stodden et al., 2008; Almeida et al., 2023). Estevan and Barnett (2018) have integrated perceived motor competence (PMC) into the hierarchical and multidimensional model of self-concept by Shavelson et al. (1976). Further constructs are differentiated within PMC, analogous to AMC, e.g., PMC in "locomotor skills" and PMC in "object control skills," analog to the construct of "fundamental movement skills" and the dimensions of the TGMD.

Both AMC and PA are associated with improved physical and mental health parameters (Lubans et al., 2010; Robinson et al., 2015; Pate et al., 2019). As mentioned before, national and international studies show, that the recommendations given by the WHO are not achieved by children and adolescents (Hänggi et al., 2022; WHO, 2022). PA is relevant from a health-related perspective throughout the whole lifespan. In early childhood, PA, e.g., running or balancing, is elementary for the development of AMC. Later in childhood, an inverse relationship could be observed, as AMC are relevant for further PA (Stodden et al., 2008). PA can be assessed in different ways. Wearables, such as accelerometers, can be used to measure PA quantitatively. On the other hand, questionnaires can be used to investigate the content of physical activity, such as the participation, type, and frequency in sports clubs. Especially regarding the approach of an idea of participation in the culture of sport and movement, the content, in which children move is relevant (Neuber and Golenia, 2018).

Stodden et al. (2008) postulated a conceptual model and within it a reciprocal and developmentally dynamic relationship between AMC and PA. Children with low levels of AMC cannot overcome the proficiency barrier to develop sport specific motor skills and do not reach the adequate levels of PA and health related fitness. This can result in a higher risk of obesity and a negative spiral of engagement, whereas children with a higher level of AMC can result in a positive spiral of engagement. This relationship can also be mediated by PMC and health related fitness—depending on the phase of childhood. In early childhood, both AMC and PA

are influenced by PMC, whereas reciprocal relationships between PMC and AMC as well as PMC and PA were postulated. PMC is seen as an important factor in motor development as children with low PMC will probably engage less in sports and physical activity than children with high PMC (Stodden et al., 2008; Almeida et al., 2023). In addition, Barnett et al. (2022) conducted a systematic review related to the model and found that the evidence on the relationship between AMC and PMC is insufficient due to cross-sectional studies with different aligned instruments. In a longitudinal study by Utesch et al. (2018), the interplay between AMC and its perception was found to be an important aspect for PA in childhood. Children with high levels of AMC did not necessarily have high levels of PMC and vice versa. The authors concluded that an accurate self-perception of AMC is a significant predictor of PA. Estevan and Barnett (2018) suggested to use task-specific and aligned instruments to measure both AMC and PMC to ensure that the constructs of interest are represented in both assessments.

## 2 Assessment of PMC in children

Various instruments have been developed to measure PMC, some of which are directly based on and aligned to measure instruments for AMC. McGrane et al. (2016) developed the physical self-confidence scale to assess adolescents perceived confidence at performing specific skills, of which some questions are based on the skills assessed in the TGMD. Herrmann and Seelig (2017b) developed an instrument to assess the PMC of fifth- and sixth-graders (SEMOK-5-6), whereby the questions were aligned to the MOBAK instrument for the assessment of AMC in fifth and sixth grade students (Herrmann and Seelig, 2017a). Due to the low level of reading literacy at the beginning of primary school, instruments are needed specifically for this target group. In the following section, instruments for the assessment of PMC are presented, whereby a newly developed instrument for the assessment of PMC (SEMOK-1-2; in German: Selbstwahrnehmung motorischer Basiskompetenzen) will be introduced.

### 2.1 Pictorial scales in assessments for children

The assessment of different constructs in young children who cannot read requires specific test instruments, as written questionnaire cannot be used. Attempts to solve this problem led to the development of pictorial instruments or scales. Sauer et al. (2020) conducted a review of pictorial scales in research and practice and developed recommendations for the development of pictorial scales. The review shows, that there is a lack of stringent methodological approaches in the development and validations of these instruments.

There are pictorial instruments which were developed for preschool and primary school children, e.g., to assess children's fears. Muris et al. (2003) used an illustration of a Koala for pictorial response options, representing three different levels of fear. The Koala Fear Questionnaire uses different pictures representing possible fear situations, and the child could choose one of the three Koala faces showing emotional expressions ("no fear," "some fear," "a lot of fear").

In the field of motor competencies, pictorial response options are used in the Pictorial Movement Skill Competence (PMSC) instrument, which alignes to the TGMD (Barnett et al., 2015; Webster and Ulrich, 2017). Due to the young age of the children, the instrument is administered one-on-one to each child and takes about 15–18 min per child. In addition, gender-specific versions for girls and boys are used (Barnett et al., 2015; Estevan et al., 2019). By using this instrument, a child first has to choose between two pictures, whereby one represents the success and the other one the failure of the task. Following this, he/she has to specify whether he/she is "really good" or "pretty good" for the success picture and "sort of good" or "not that good" for the failure picture.

### 2.2 Development of the SEMOK-1-2 instrument (in German: Selbstwahrnehmung motorischer Basiskompetenzen)

To assess PMC, instruments which are aligned to the AMC instruments are used. As there is no aligned PMC instrument to the MOBAK instrument for the first and second grade yet, the SEMOK-1-2 instrument has been developed to measure PMC of the children. Based on the review by Sauer et al. (2020), the given recommendations will be addressed below. Moreover, the following points were considered in the development of the instrument: (1) Economic assessment of PMC: in contrast to other instruments that assess the PMC of the children in a one-to-one situation, the developed instrument should be applicable in a class setting. (2) Enforceability despite poor reading skills: to be feasible in a classroom setting, the instrument should not require written instructions. Therefore, the motor tasks were illustrated. (3) Neutral gender and ethnic representation of the illustrated animal: to avoid gender and ethnic representation, the tasks were performed by an illustrated fox instead of illustrated children.

Based on the MOBAK-1-2 instrument, which assesses the AMC of the children with each four items in the competence areas "self-movement" and "object movement," the eight PMC items in the SEMOK instrument refer to children's perception of whether they can perform the basic motor requirements (e.g., throwing, catching, balancing, rolling) formulated on the basis of curricular standards in the MOBAK instrument (e.g., "the child can throw a ball against a target"; Herrmann, 2018). A fox named "Foxy" was illustrated performing the tasks. As the motor tasks of the MOBAK instrument can be represented by a picture (Sauer et al., 2020), each task was illustrated, whereby Foxy was performing the task (Bretz et al., 2023, p. 6f). Comparable to Muris et al. (2003), three pictorial response options were illustrated, representing "negative," "neutral" or "positive" valances (Figure 1).

For the PMC assessment, every child receives a questionnaire with the illustrated test items and the pictorial response options next to each item (Figure 2; Bretz et al., 2023, p. 14f). The questionnaire is presented in paper format, with a front and back page, whereby four tasks displayed one below the other on each

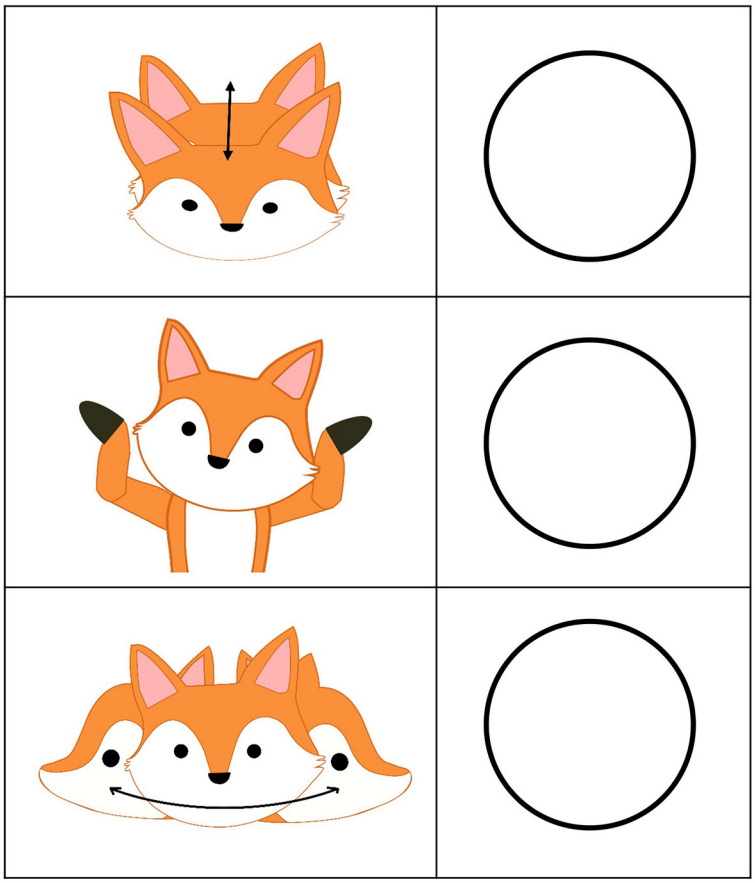

FIGURE 1
Scale of the SEMOK-1-2 instrument. Pictorial response options: nodding, shrugging shoulders, shaking head (Bretz et al., 2023, p. 5).

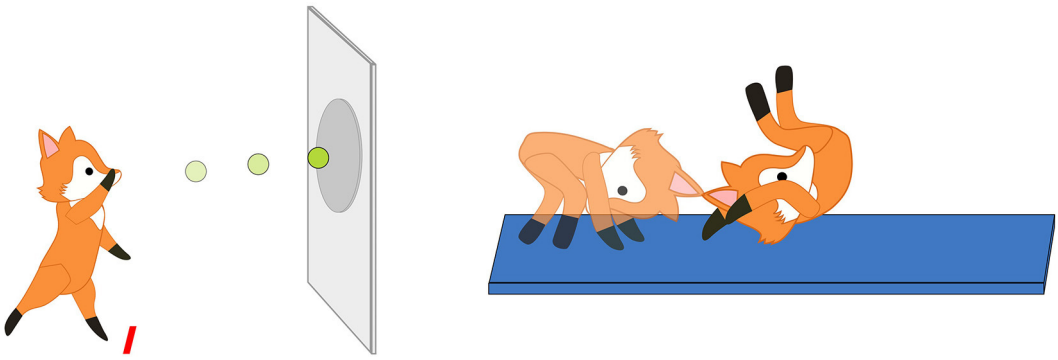

FIGURE 2
Examples of the illustrated motor tasks "throwing" and "rolling" (Bretz et al., 2023, p. 6, 11).

page (Bretz et al., 2023, p. 14–15). In the beginning, the pictorial response options (Figure 1) are explained.

The standardized explanation of the pictorial response option is as follows (translated from German, Bretz et al., 2023): "First of all, we will look at the answer options together. In the first picture, Foxy is nodding, which means that Foxy can do the task. In the second picture, Foxy is shrugging its shoulders, which means that Foxy can partially do the task. In the third picture, Foxy is shaking its head, which means that Foxy cannot do the task. Each time there is a circle next to Foxy's head. On your sheet, you will find this box next to each task Foxy is performing. After the task has been explained, you have time to think about how you can do the task and tick one of the circles. Today there is no right or wrong and it is only about yourself. After explaining the pictorial response options, each task

TABLE 1 Explanation of the SEMOK-1-2 items (translated from German, Bretz et al., 2023).

| Item | Explanation |
|---|---|
| 1. PMC throwing | Foxy throws a small ball, about the size of a tennis ball, at a target and hits the target. |
| 2. PMC catching | Foxy catches a small ball, about the size of a tennis ball, with both hands. The ball may only be caught with the hands and must not touch the body. |
| 3. PMC bouncing | Foxy bounces a ball on the floor while walking through a narrow passage. The ball can be bounced with one hand or both hands and must not be lost. |
| 4. PMC dribbling | Foxy dribbles a ball with the feet through a narrow passage. The ball must not be lost in the process. |
| 5. PMC balancing | Here we have built a small seesaw. Foxy balances forward over an inverted long bench that tips over halfway. Then Foxy balances backwards and the bench tips back again. Foxy keeps the balance and does not fall off the bench. |
| 6. PMC rolling | Foxy does a somersault. The chin is close to the chest and the back is round. Then Foxy stands up again. |
| 7. PMC jumping | Foxy hops through a parkour of carpet tiles. Foxy hops between the tiles on one leg, straddling the tiles with both legs. |
| 8. PMC running | Foxy runs sideways from one cone to the other and then back again. |

is explained separately followed by the sentence "Now think about yourself and tick one of the circles." After ticking, the children are asked to wait with their arms crossed until all children finish and the next task will be explained. The whole questionnaire takes 10–15 min to complete. The instructions for the items are listed in Table 1. To ensure survey standardization, the test administrators undergo training and are provided with a manual containing the verbal instructions. The motor tasks are not shown but explained verbally only.

## 2.3 Aim of the study

The MOBAK instruments for the assessment of AMC (Herrmann and Seelig, 2017a; Herrmann, 2018), have been used in numerous studies and are a widely accepted instrument for assessing AMC (Strotmeyer et al., 2020; Herrmann et al., 2021; Wälti et al., 2022; Carcamo-Oyarzun et al., 2023). To assess PMC, aligned instruments for the fifth and sixth grade were developed (Herrmann and Seelig, 2017b) and adapted for the third and fourth grade (Strotmeyer et al., 2022). With the development of the SEMOK-1-2 instrument, the assessment of PMC in younger children can also be assessed.

Against this background, the study aims first to test the construct of the developed SEMOK-1-2 instrument to examine the assumed two-factorial structure, analogous to the MOBAK instrument with the factors "object movement" and "self-movement." Second, to investigate the criterion validity by relating the AMC and PMC constructs. Third, to examine associations between the AMC and PMC constructs and covariates (age, sex and BMI) as well as sports club participation.

# 3 Materials and methods

The present validation study was a cross-sectional study based on the second measurement point of the longitudinal study "Development of basic motor competencies in children (EMOKK)" (2021–2025), funded by the Swiss National Science Foundation (SNSF; Grant number 200840).

## 3.1 Actual motor competencies

To measure AMC, the MOBAK instrument for the first and second grade of primary school was used (MOBAK-1-2, Herrmann, 2018). With the MOBAK instrument, AMC can be measured in the competency area "object movement" and "self-movement," operationalized with four items per competency area (object movement: throwing, catching, bouncing, dribbling; self-movement: balancing, rolling, jumping, running) (Herrmann, 2018). Each test item describes a standardized task with corresponding assessment criteria. During the test, each child had two attempts to try to achieve the motor task (no trial run). The two single attempts were rated on a dichotomous scale (0 = failed, 1 = successful), and the individual results were summed up to form the final item score (0 points = no successful attempts, 1 point = one successful attempt, 2 points = two successful attempts). The scores for the test items throwing and catching were calculated differently. In these cases, the children had six attempts each, and the number of successful attempts was recorded. Subsequently, 0–2 successful attempts were scored as 0 points, 3–4 successful attempts as 1 point, and 5–6 successful attempts as 2 points. For each competency domain, a maximum of eight points could be achieved (for details, see Herrmann, 2018). Data was collected in class during a regular 45-min Physical Education lesson. The class was divided into small groups of three to four children each and led through the eight test stations by trained testers. The testers provided a standardized explanation and one demonstration of each test item. The factorial validity of the MOBAK instrument for primary school (MOBAK-1-2) has already been investigated and confirmed in various studies (Herrmann et al., 2016, 2019a). The weight and height of the children was measured as part of the MOBAK test to calculate the Body-Mass-Index (BMI).

## 3.2 Parent questionnaire

The parents of the children completed a questionnaire. In addition to general information about the child, the questionnaire contained questions about the sports activity of the child, e.g., how often the child plays outside or participates in organized sports activities (in detail, see Herrmann et al., 2023). Parents were asked whether their children participate in a sports club and, if so, to what extent (frequency per week) and in which sports (up to three answers possible, either by ticking predefined sports or as open answers). The type and frequency data were assigned to the categories team sports (e.g., football, handball) or individual sports (e.g., swimming, gymnastics) and summed up. This resulted in sum

values for the variables frequency of team sports and frequency of individual sports.

## 3.3 Perceived motor competencies

PMC were assessed before measuring the AMC. Therefore, the children filled out the questionnaire during the last 15 min of the regular lesson in their classroom before the Physical Education lesson or on another day before the AMC assessment. The procedure and instructions were briefly described in the previous section.

For subsequent analyses, the answers given to the pictorial response options were coded: "positive"/nodding = 2 points, "neutral"/shrugging shoulders = 1 point, "negative"/Shaking head = 0 points. Following, the points per competency domain were summed up (0–2 points per item, eight points per competency domain). This means that the tasks in the PMC instruments refer to the tasks in the AMC instrument but also that the scores of the AMC and PMC instruments are aligned.

## 3.4 Sample

AMC and PMC data were collected in the Swiss cantons Basel-Landschaft and Zurich in spring/summer 2023. In total, we contacted parents or legal guardians of 558 children from the first and second grade. Of these children, 404 parents (72.4%), gave their written consent for their children to participate in the study. We included $N = 404$ children ($M = 7.8$ years, SD = 0.69, 49% boys) from 29 classes in the study, with an average class size of $n = 14$. The data was obtained from three different sources (AMC, MOBAK instrument; PMC, SEMOK instrument; PA, parent questionnaire) and was merged. The assessment of AMC, which took place during a Physical Education lesson, involved $n = 378$ children, and data on PMC was collected prior to the assessment in the regular classroom from $n = 391$ children. The parents of $n = 376$ children completed the parent questionnaire at home. The study was conducted in the accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Zurich (Nr. 21.2.5, 19.12.2022). Informed consent was obtained from all parents of the participants in this study and the participation was voluntary and could be canceled at any time.

## 3.5 Data analysis

The data processing, descriptive and correlational analyses were conducted with SPSS 28 (IBM Corp., 2021). Multivariate analyses were performed by using Mplus 8.8 (Muthén and Muthén, 2017).

At a manifest level, descriptive statistics were calculated. Therefore, sum values regarding the AMC and PMC single items were calculated for AMC "object movement," AMC "self-movement," PMC "object movement" and PMC "self-movement." The mean values were calculated for the total sample and separately for girls and boys. We calculated 95% confidence intervals and Cohen's *d*. As effect sizes Cohen's d were interpreted as small ($d = 0.10$), medium ($d = 0.50$) and large ($d = 0.80$) (Cohen, 1988). Regarding PA, the mean values of frequency in team and individual sports were also calculated for the total sample and girls and boys separately. Moreover, we calculated Spearman correlations for non-parametric data to investigate the associations between the constructs on a manifest level.

Modeling latent structures was carried out in three steps. First, the factorial validity of the SEMOK instrument, which measures PMC, was examined by calculating confirmatory factor analyses (CFA). Second, the criterion validity was investigated, whereby the AMC and the PMC factors were related. Third, correlations with covariates (age, sex, BMI) and the frequency of sports club participation were examined. Influences of the multilevel structure (students from different classes) were tested with the help of interclass correlations (ICC).

### 3.5.1 Missing data handling

There were missing values due to the different data sources (AMC assessment, PMC assessment, parent questionnaire) and partly different survey days. Some children participated in the AMC assessment, but not in the PMC assessment and vice versa. Moreover, not all parents filled out the parent questionnaire. From children who participated in the assessment of AMC, frequencies of missing values ranged from 0.5% (AMC jumping) to 4.2% (AMC balancing). In the PMC assessment, missing values were only identified for PMC bouncing and PMC dribbling (both 0.5%). Regarding the parent questionnaire, 5.1% of the parents who filled out the questionnaire did not answer the question about sports club participation. Missing values were estimated via the full information maximum likelihood (FIML) algorithm. The FIML procedure is a conservative and well-established procedure in educational research. The FIML procedure prevents bias in the sample composition by preventing a reduction in the sample size (Urban and Mayerl, 2014).

### 3.5.2 Modeling latent structures

Construct validity of the SEMOK-1-2 instrument was investigated by calculating CFAs.

*Model 1a:* Due to the two-factorial structure of the MOBAK instrument (Herrmann et al., 2015) as well as the previous SEMOK-5-6 instruments (Herrmann and Seelig, 2017b; Strotmeyer et al., 2022), it was assumed that the developed SEMOK-1-2 instrument would also have a two-factorial structure. Therefore, the factor structure of the SEMOK instrument was tested by calculating a two-factorial CFA with the factors "PMC object movement" (PMC throwing, PMC catching, PMC bouncing, PMC dribbling) and "PMC self-movement" (PMC balancing, PMC rolling, PMC jumping, PMC running).

*Model 1b:* Based on model 1a, the covariates sex, age and BMI were included as covariates in the model. Modification indices (MI) can be used to check which relaxation of restrictions leads to a statistically significant improvement of the model (Geiser, 2011). In this model, we requested the modification indices (MI = all) for the direct effect of the covariates.

Criterion validity of the SEMOK-1-2 instrument was investigated by calculating associations between AMC and PMC of the children.

*Model 2:* In model 2, the relationship between the AMC and PMC factors was investigated to test concurrent validity. Therefore, we calculated a confirmatory factor analysis with the four factors AMC "object movement," AMC "self-movement," PMC "object-movement" and PMC "self-movement." Sex, age and BMI were integrated in the model as covariates.

Finally, the associations between AMC, PMC and PA were calculated.

*Model 3*: In Model 3 we investigated associations between AMC, PMC, and PA. Next to the latent AMC and PMC factors, the manifest factors of frequency of team sports and frequency of individual sports were included. Age, sex, and BMI were included as covariates in the model.

In all models, we treated the AMC and PMC as ordinal-scaled data. Accordingly, we used the mean- and variance-adjusted weighted least squares (WLSMV) estimator. We accounted for dependencies within the multilevel structure ($0.01 \leq ICC \leq 0.19$; Table 2) in all models by correcting the standard error with the "type = complex" function for nested datasets implemented in Mplus. The goodness of fit of the models was assessed using fit indices proposed in the literature (Schreiber et al., 2006). Effect sizes were interpreted as small ($r > 0.10$, $\beta > 0.05$), medium ($r > 0.30$, $\beta > 0.25$), or large ($r > 0.50$, $\beta > 0.45$) (Cohen, 1988; Peterson and Brown, 2005).

# 4 Results

Table 2 shows the descriptive values of AMC and PMC as well as the frequency of sport participation in team and/or individual sports. Boys showed better AMC in "object movement" ($d = 0.57$) than girls while girls had better AMC in "self-movement" ($d = -0.27$). Regarding PMC, boys rated themselves higher than girls in PMC "object movement" ($d = 0.97$). Most of the children whose parents filled out the questionnaire, were a member of a sports club (83.8%). Of the children, who participated in a sports club, 59.1% were active only in individual sports, 16.8% were participating only in team sports and 24.1% of the children were participating in both individual and team sports. Regarding the participation in organized sports, girls engaged more in individual sports ($d = -0.34$) than boys whereas boys engaged more in team sports ($d = 0.64$).

## 4.1 Factorial validity of the SEMOK-1-2 instrument

Model 1a: The CFA with the two factors PMC "object movement" and PMC "self-movement" showed a good model fit ($\chi^2 = 26.447$; df = 19; $p = 0.118$; CFI = 0.940; RMSEA = 0.032; $N = 391$). The factor loadings ranged from $\beta = 0.35$ to $\beta = 0.69$ (Figure 3). The correlation between the factors PMC "object movement" and PMC "self-movement" was $r = 0.66$ ($p < 0.001$).

Model 1b: Based on model 1a, the covariates sex, age and BMI were integrated to model 1b. The model showed a good model fit, whereby the model fit increased slightly in comparison to the model without the covariates. ($\chi^2 = 45.14$; df = 37; $p = 0.017$; CFI = 0.969; RMSEA = 0.023; $N = 377$). No modifications concerning the minimal value (MI > all) were suggested. Sex was found to have a significant effect on the factor PMC "object movement" ($r = -0.63$, $p < 0.001$), but not on the factor PMC "self-movement" ($r = 0.06$, $p = 0.457$). Age and BMI did not show significant effects on PMC factors. The correlation between PMC "object movement" and PMC "self-movement" was $r = 0.93$ ($p < 0.001$).

Both models and the resulting model fits showed that the assumed two-factor structure with the factors PMC "object movement" and PMC "self-movement" could be confirmed.

## 4.2 Criterion validity of the SEMOK-1-2 instrument

To investigate the criterion validity, the associations between the AMC and PMC factors were calculated. The four-factor confirmatory analysis with the factors AMC "object movement," AMC "self-movement," PMC "object movement" and PMC "self-movement" with the covariates resulted in a good model fit ($\chi^2 = 173.651$; df = 134; $p = 0.012$; CFI = 0.909; RMSEA = 0.027; $N = 404$). The correlation between the factors AMC "object movement" and PMC "object movement" was $r = 0.88$ ($p < 0.001$) and between the factors AMC "self-movement" and PMC "self-movement" $r = 0.85$ ($p < 0.001$). There was no correlation between PMC "object movement" and AMC "self-movement" ($r = 0.01$, $p = 0.953$) but a significant correlation between PMC "self-movement" and AMC "object movement" ($r = 0.50$, $p = 0.011$; Figure 4). The correlation between AMC "object movement" and AMC "self-movement" was $r = 0.74$ ($p < 0.001$) and between PMC "object movement" and "self-movement" $r = 0.95$ ($p < 0.001$).

## 4.3 Associations between AMC, PMC and PA

Model 3: Based on model 2, frequency of team sports and frequency of individual sports, were included as manifest variables in model 3 to investigate the associations between AMC, PMC and PA. Moreover, sex, age and BMI were included as covariates.

The model showed a good model fit ($\chi^2 = 200.149$; df = 158; $p = 0.013$; CFI = 0.914; RMSEA = 0.026; $N = 404$). The correlations are shown in Table 3 (below the diagonal).

Older children performed better in AMC "object movement" ($r = 0.56$, $p < 0.001$) and AMC "self-movement" ($r = 0.52$, $p < 0.001$) than younger children. Strong correlations were also found between sex and AMC and PMC as well as sport participation. Boys performed better in AMC "object movement" ($r = -0.36$, $p < 0.001$) than girls, whereas girls were better in AMC "self-movement" ($r = 20$, $p = 0.003$). Regarding PMC, boys rated themselves higher in "object movement" ($r = -0.65$, $p < 0.001$). Correlations between PA and sex were also found. Boys participated more often in team sports ($r = -0.30$, $p < 0.001$), whereas girls were more active in individual sports ($r = 0.17$, $p < 0.001$). The frequency of team and individual sports was also associated with PMC. Moreover, there were significant correlations between the frequency of team sport and AMC "object movement" ($r = 0.20$, $p < 0.001$), PMC "object movement" ($r = 0.53$, $p < 0.001$) and PMC

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TABLE 2 Descriptive values and interclass-correlations (ICC) of the actual (AMC) and perceived (PMC) motor competency domains and the frequencies of team and individual sports.

| | Overall | | | Boys | | Girls | | *d* |
|---|---|---|---|---|---|---|---|---|
| | *N* | *M* CI 95% | ICC | *n* | *M* CI 95% | *n* | *M* CI 95% | |
| AMC object movement[a] | 369 | 5.76 (5.60; 5.93) | 0.11 | 179 | 6.23 (6.01; 6.45) | 190 | 5.33 (5.09; 5.57) | 0.57 |
| AMCsSelf-movement[a] | 352 | 5.70 (5.52; 5.89) | 0.19 | 174 | 5.46 (5.18; 5.74) | 178 | 5.94 (5.69; 6.19) | −0.27 |
| PMC object movement[a] | 383 | 6.33 (6.18; 6.48) | 0.03 | 190 | 6.97 (6.80; 7.14) | 193 | 5.70 (5.50; 5.90) | 0.97 |
| PMC self-movement[a] | 383 | 7.23 (7.14; 7.33) | 0.01 | 190 | 7.17 (7.02; 7.33) | 193 | 7.30 (7.17; 7.42) | −0.12 |
| Frequency team sports[b] | 369 | 0.54 (0.45; 0.64) | 0.04 | 182 | 0.84 (0.67; 1.00) | 187 | 0.26 (0.17; 0.35) | 0.64 |
| Frequency individual sports[b] | 369 | 1.08 (0.96; 1.19) | 0.05 | 182 | 0.89 (0.75; 1.03) | 187 | 1.25 (1.08; 1.42) | −0.34 |

[a]Range: 0–8.
[b]Days per week.

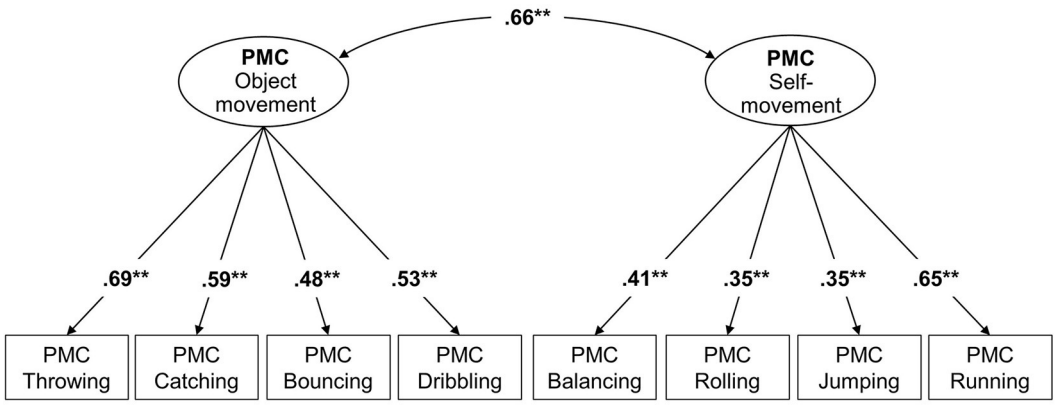


FIGURE 3
Two-factorial confirmatory factor analysis for the SEMOK instrument with the factors PMC "object movement" and PMC "self-movement" (Model 1a). $^{**}p < 0.01$.

"self-movement" ($r = 0.21$, $p = 0.037$). Associations with frequency of individual sports were found with PMC "self-movement" ($r = 0.39$, $p < 0.001$).

The partial Spearman correlations (Table 3, above the diagonal) also showed correlations between AMC and PMC in "object movement" ($r = 0.28$, $p < 0.001$) and "self-movement" ($r = 0.18$, $p < 0.001$). Moreover, correlations between PMC "object movement" and the frequency in team sport ($r = 0.22$, $p < 0.001$) as well as PMC "self-movement" and the frequency in individual sport ($r = 0.11$, $p = 0.048$) were found. The same correlations were found at the latent and manifest levels, although they were lower at the manifest level, as expected.

## 5 Discussion

PMC is seen as an important factor in the context of motor development. An instrument was developed to measure PMC in children in first and second grade, as there was no instrument to measure PMC aligned to the MOBAK-1-2 instrument. Because of the young age of the children and the poor reading skills, illustrated tasks were developed, supported by verbal instructions. The aim of this study was to test construct and criterion validity of the newly developed SEMOK-1-2 instrument and to investigate the associations between AMC, PMC and PA. In the following, the investigated construct and criterion validity are discussed.

Regarding the factorial validity the two-factorial structure with the two factors PMC "object movement" and PMC "self-movement" was confirmed, equivalent to the two-factor structure of the MOBAK instruments. Due to the high correlation between the PMC factors "object movement" and "self-movement" ($r = 0.95$, $p < 0.001$), a one-factor model was also tested, but this resulted in a poorer model fit than the two-factor solution. It is therefore assumed that the two-factor model is the better solution. Thus, it can be seen, that both the MOBAK and SEMOK instruments consistently show this two-factor structure with the factors "object movement" and "self-movement" (Herrmann et al., 2015; Herrmann and Seelig, 2017a,b,c; Strotmeyer et al., 2022).

Integrating sex, age and BMI as a covariate resulted in better model fits. Regarding the modification indices, no relaxation of the restrictions would lead to an improvement of the model and can be taken as an indication that there was no difference in the model regarding sex, age and BMI.

In terms of criterion validity, strong positive correlations between children's AMC and PMC were found, especially at the latent level (Model 2). These correlations indicate that the children's

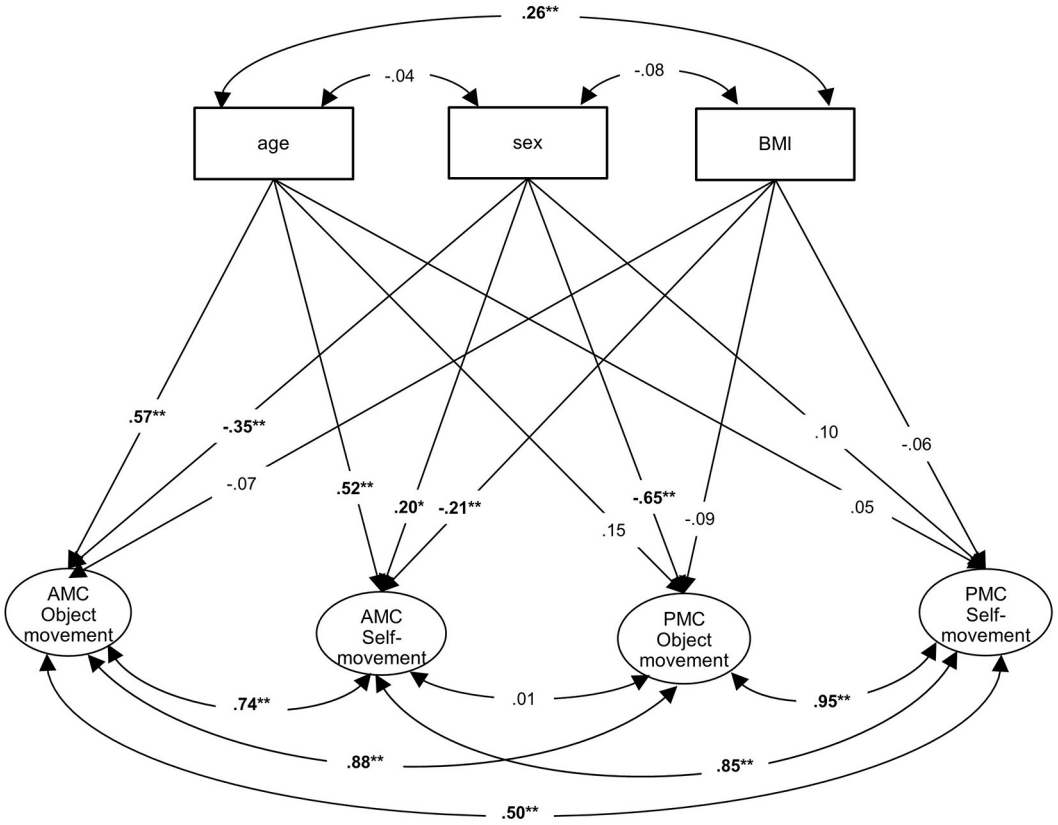


FIGURE 4
Structural equation model (SEM) with the factors AMC "object movement," AMC "self-movement," PMC "object movement" and PMC "self-movement" with the covariates age, sex and BMI (Model 2). *$p < 0.05$, **$p < 0.01$.

assessed PMC are related to the relevant criterion of children's AMC. The correlation between AMC and PMC was higher than in the study by Strotmeyer et al. (2022) ("object movement": $r = 0.45$, $p < 0.01$; "self-movement": $r = 37$, $p < 0.01$) and similar to the study by Herrmann and Seelig (2017b) ("object movement: $r = 0.70$, $p < 0.001$; "self-movement": $r = 0.76$, $p < 0.001$). The high correlation between the constructs could possibly be due to the high alignment between the AMC and PMC instruments. Other studies show low to moderate correlations between AMC and PMC in children (De Meester et al., 2020). However, it is possible that not only the alignment between the instruments but also the alignment between the scales is decisive for the strength of the correlation.

Differences between girls and boys appeared in model 1c, with boys rating themselves better than girls. That PMC in "object movement" was higher in boys than in girls, is also in line with the literature (De Meester et al., 2016; Herrmann and Seelig, 2017b; Niemistö et al., 2019; Martínez-González et al., 2022). In addition to PMC, differences in AMC were also found between boys and girls. Boys performed better in "object movement," whereas girls performed better in "self-movement." The result that boys are better in object movement and girls are better in self-movement has also been found in other studies with children from different age groups (Herrmann et al., 2019b; Wälti et al., 2022). Differences between boys and girls were also found regarding their sport participation. Boys participated more often in team sports (e.g., soccer), whereas girls participated in individual sports (e.g., gymnastics). The finding that boys prefer ball games while girls prefer sports such as dancing or gymnastics was also observed in other Swiss and international studies (Gramespacher et al., 2020; Peral-Suárez et al., 2020; Lamprecht et al., 2021).

The high correlation between sex and PMC "object movement" may be due to a link via the participation in sports club. Children, who participated in team sports showed a higher level in both PMC "object movement" ($r = 0.52$, $p < 0.001$) and PMC "self-movement" ($r = 0.21$, $p = 0.04$). Children who took part in individual sports showed higher levels only in PMC "self-movement" ($r = 0.39$, $p < 0.001$). A positive association between the organized sport activities and perceptions of "object movement" was also found by Niemistö et al. (2019). As boys participate more often in team sports and ball sports, they enhance their AMC in "object movement." Gramespacher et al. (2020) found that the differences between boys and girls in their AMC were mediated by club sport participation. Indirect effects of sex on "self-movement" were found through the frequency of individual sports and the frequency of team sports. An indirect effect on "object movement" was found via the frequency of team sports (Gramespacher et al., 2020). This would also be conceivable for PMC. It is also possible, that children who have a higher level of AMC and PMC, tend to participate more often in club sports than children with lower levels of AMC and PMC. As PMC in "object movement" is associated with

TABLE 3 Correlations between the AMC and PMC factors, frequency of team and individual sports and sex, age and BMI as covariates (Model 3).

| | First-order correlations | | | | | | Zero-order correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| (1) AMC object movement | | **0.27** | **0.28** | 0.05 | **0.12** | 0.02 | **−0.29** | **0.40** | 0.08 |
| (2) AMC self-movement | **0.75** | | 0.10 | **0.18** | 0.09 | 0.04 | **0.16** | **0.32** | −0.02 |
| (3) PMC object movement | **0.89** | <0.01 | | **0.22** | **0.22** | −0.02 | **−0.45** | **0.13** | 0.03 |
| (4) PMC self-movement | **0.50** | **0.85** | **0.94** | | 0.04 | **0.11** | −0.01 | 0.09 | −0.02 |
| (5) Frequency team sport | **0.20** | 0.12 | **0.53** | **0.21** | | **−0.19** | **−0.35** | 0.05 | 0.08 |
| (6) Frequency individual sport | 0.05 | 0.11 | −0.05 | **0.39** | **−0.21** | | **0.18** | 0.07 | 0.06 |
| (7) Sex | **−0.36** | **0.20** | **−0.65** | 0.10 | **−0.30** | **0.17** | | −0.05 | −0.10 |
| (8) Age | **0.56** | **0.52** | 0.14 | 0.05 | 0.04 | 0.05 | −0.04 | | **0.22** |
| (9) BMI | −0.08 | **−0.21** | −0.09 | −0.06 | 0.06 | 0.02 | −0.08 | **0.26** | |

Correlations in bold are significant ($p < 0.05$). Latent correlations below the diagonal, manifest correlations above the diagonal; sex: 0 = boys, 1 = girls.

physical activity over time (Barnett et al., 2008), PMC in "object movement" should be promoted, especially in girls.

There are also some limitations in this study. As the children were interviewed in class, the possibility of mutual influence on the answers to the questions cannot be excluded. Although the test leader pointed out that the questions should be answered independently, a few children communicated their answers to the class. Another limitation is that the illustration shows the motor task in a simplified way. The operationalization into an illustration and a short instruction did not explain all the criteria for passing or failing the motor task. Regarding the item difficulty, ceiling effects could be observed, as the mean values in PMC were high, especially in PMC "self-movement." This could be due to the three-point-scale, as Estevan et al. (2019) mentioned this limitation also regarding the four-point-scale in the PMSC instrument. The high correlation between PMC "Object movement" und PMC "self-movement" ($r = 0.95$, $p < 0.001$) could also be due to these ceiling effects. It should be also considered that young children tend to overestimate their own abilities (Harter, 1999).

What should be considered in future studies is, that due to the study design, no retest for reliability analysis could be conducted. Because of the cross-sectional design of the study, no causal interpretations can be made. However, there is little evidence regarding the direction for preschool and primary school age children due to a lack of longitudinal studies (Dreiskämper et al., 2020). This might be due to the resources and time-consuming assessment of PMC in young children. With the SEMOK-1-2 instrument, the PMC of children can be assessed in a more efficient and economical way what might be an advantage for assessments in large samples.

Overall, it was found that the instrument is suitable for assessing PMC in first and second graders. The strength of the instrument is the economic assessment of PMC in a classroom setting facilitated by the illustrated motor tasks and the neutral gender and ethnic representation of the illustrations. Due to the illustration and the organization of questioning the children in their normal class setting the instrument can be used economically in a larger sample. Physical Education teachers could also use the instrument in class to identify children with low PMC and consequently encourage and support them to reflect on their PMC. These results are important for the diagnosis and identification of PMC to promote AMC and thus an active lifestyle.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by Ethics Committee of the University of Zurich. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

## Author contributions

KB: Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Conceptualization. AS: Writing – review & editing. HS: Data curation, Writing – review & editing. CH: Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Writing – review & editing.

## Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This study was supported by the Swiss National Science Foundation (Grant No. 200840).

## Acknowledgments

The authors thank all teachers, children, and parents for their participation in the study and the research assistants for their

contributions to data assessment. We would also like to thank Christian Bretz for the illustrations.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 05 April 2024
DOI 10.3389/fpsyg.2024.1295605



OPEN ACCESS

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RECEIVED 16 September 2023
ACCEPTED 12 March 2024
PUBLISHED 05 April 2024

CITATION
Vilaregut A, Abadia S, Pineda-Hernández S, Torras S and Pujadas X (2024) The impact of the COVID-19 pandemic on the mood and family relationships of runners.
*Front. Psychol.* 15:1295605.
doi: 10.3389/fpsyg.2024.1295605



# The impact of the COVID-19 pandemic on the mood and family relationships of runners

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**Introduction:** The aim of this study was to analyze the impact of the COVID-19 lockdown on the mood of amateur runners and on their relationships with their partners and families.

**Methods:** Adult runners 18 years or older (*N*=260) completed an online survey that included demographic information, standardized psychological assessments of Exercise Dependence (EDS-R) and mood (POMS), and, to measure relationship functioning, either the Dyadic Adjustment Scale (DAS) if they did not have children, or the Basic Family Evaluation Questionnaire (CERFB), measuring conjugal and parental relationships. Participants also answered questions about their exercise habits and the coping strategies they adopted during lockdown.

**Results:** The results suggest that runners who saw the largest reductions in time spent exercising during lockdown tended to feel significantly less energetic ($p < 0.05$) and friendly ($p < 0.01$). In addition, they recorded significantly lower scores in marital satisfaction with their peers ($p < 0.05$). The runners with a higher degree of dependence on physical exercise registered significantly higher levels of depression, tension and anger than non-dependent runners ($p < 0.001$). Runners whose partners were physically active and did not have children had significantly higher scores marital satisfaction than runners whose partners were not physically active and had children ($p < 0.05$).

**Discussion:** These findings seem to indicate that the psychological approach to athletes in the context of crises such as the pandemic should consider not only individual aspects, but also include the family perspective.

KEYWORDS

**affect, runner, exercise dependence, family relations, COVID-19 lockdown**

## Introduction

With more than 772 million confirmed cases worldwide (as of December 19, 2023, World Health Organization, 2023), COVID-19 is a global pandemic. When Spain reached 5,000 confirmed cases on March 14, 2020, the country's government declared a State of Alarm (Real Decreto, 2020) and ordered the population to remain at home, except for those performing strictly essential duties.

Unlike most other countries around Europe, during this period Spain also prohibited outdoor exercise by individuals, and physical activity was limited to what could be done in the home (Rodríguez-Larrad et al., 2021). The State of Alarm continued through June 21, 2020, but the ban on outdoor physical activity was lifted on May 2, the start of a gradual easing of restrictions (Real Decreto-ley, 2020). During the lockdown, 41% of the country's population did physical activity at least once a week, a drop of 13.8% from

the figure for 2020 as a whole (Ministerio de Cultura y de Deporte, 2021).

Notwithstanding the epidemiological and medical benefits of the lockdown, a number of observers have pointed out the adverse effects these measures have had on the psychological well-being and behavior of the population. The months spent confined at home led to increases in confusion and stress (Alderwick et al., 2020), social isolation, loneliness, and the risk of self-harming behavior (Holmes et al., 2020), boredom, a lack of social contact, sleeping problems, anxiety disorders, depression, suicide, eating disorders, addictive behavior, domestic violence and child abuse (Bauer et al., 2020; Mengin et al., 2020). Balanzá-Martínez et al. (2021) studied lifestyle changes during lockdown and observed changes in environmental exposure (pattern of time spent indoors and outdoors), physical activity, stress management, social support, sleep patterns, diet and nutrition and substance abuse. These changes in habits and lifestyle prompted us to wonder how the lockdown affected people who view physical activity as an important part of their lives. More specifically, we were interested in whether the ban on outdoor physical activity that accompanied the State of Alarm declared on March 14, 2020, had affected the family and partner relationships of runners.

These changes in habits and lifestyle led us to ask how the lockdown affected people who view physical activity as an important part of their lives. And, if the ban on outdoor physical activity that accompanied the state of alarm declared on March 14, 2020 had affected the runners' mood and family relations. These athletes were among the groups most directly affected by the restrictions imposed by the Spanish government, as during the lockdown they were unable to continue their usual exercise routines. The large impact on this group, and the fact that running is the second most frequent physical activity in the country (Subdirección General de Estadística y Estudios, 2020) were the main factors that drove us to focus the study on these athletes.

As Rodríguez et al. (2020) and Fennell et al. (2022) observed, exercise contributes to overall physical and psychological well-being, both of which are essential in overcoming the effects of COVID-19. Despite the potential benefits of exercise in the context of the pandemic, a systematic review by Stockwell et al. (2021) showed that most studies have recorded a decrease in physical activity during the lockdown period. Along the same lines, in an international study De la Vega et al. (2022) found that during the COVID19 pandemic habitual exercisers decreased their usual exercise volume to about half of the usual amount.

A number of researchers have explored the effects of the COVID-19 lockdown on the well-being of athletes. For example, Meyer et al. (2020) found that adults who stopped doing physical activity during the period of restrictions saw their mental health worsen. Lockdown was often particularly difficult for athletes because they were deprived of their usual opportunities for physical exercise. Therefore, they tended to miss the health benefits and the rest and recuperation that they habitually got out of their exercise routines. The blow was especially felt by dual career athletes, for whom the combination of physical activity and other tasks is important. This deprivation also affected athletes' mental health (in the form of greater anxiety, depression, social dysfunction and loss of self-confidence), which in turn made it even more difficult for them to maintain their training regimens (Brand et al., 2020; Pillay et al., 2020). The lockdown also isolated athletes from teammates and colleagues, which also denied them access to the protective effect exerted by social interactions with teammates (i.e., social support and connectedness, Graupensperger et al., 2020). A lack of exercise has also often been linked to feelings of guilt and other negative emotions (Ackard et al., 2002; Malcolm and Velija, 2020; Cerea et al., 2023) and to less healthy eating habits (Taheri et al., 2023a). In light of the above, it is likely that athletes' wellbeing was greatly affected by the pandemic.

Maltagliati et al. (2021) also observed a decrease in the frequency of physical activity in the context of COVID-19, especially among people who had strong exercise habits prior to the lockdown. Continuing to exercise in some form helped counteract some of the effects of the interruption of physical activity habits. Along similar lines, Petersen et al. (2021) recorded a decrease in physical activity among Australian adults during lockdown. The study also found a positive association between certain psychological constructs (social support, self-efficacy and autonomous motivation) and the tendency to physical activity during lockdown.

Another study by Washif et al. (2022) found that during the lockdown most athletes at different levels of competition and in a range of different sports had reduced the frequency, duration and intensity of their activities. These athletes tended to report feeling less motivated in this period because of the need to do remote training (to exercise alone, 53%) and the lack of competition (58%).

Elsewhere, however, Martin et al. (2021) observed an increase in the number of days of exercise done each week by people in the UK, and they found that the use of apps and online platforms for physical activity had become more widespread. Meanwhile, Rodríguez-Larrad et al. (2021) recorded a decrease in moderate to intense physical activity among students in Spain during lockdown but found that this decline was accompanied by a greater presence of "mind–body" exercises such as Pilates, Tai-Chi and Yoga. Nonetheless, the study found an overall increase in sedentary behavior and in the use of social media.

Iancheva et al. (2020) and Brand et al. (2020) explored how the interruption of people's usual physical activity during lockdown affected their moods. Another study along similar lines by Ronkainen et al. (2021) looked at differences in mood among participants in different types of sport. This study found that when restrictions were lifted and outdoor activity became possible again, people who usually exercise in the gym or do extreme conditioning program training or Pilates were less likely to see an improvement in their moods than others whose usual activities were badminton, volleyball, hockey, running, orienteering and hiking. This might be because the former group were unable to return to their usual indoor activities in the early phases of the lifting of lockdown restrictions. Elsewhere, Taheri et al. (2023c) analyzed the impact of COVID-19 2 years after the start of the pandemic on the mental health and eating habits of elite and sub-elite athletes and found that elite athletes displayed better mental health profiles than their sub-elite counterparts, the former showing lower levels of depression, anxiety and stress.

Another study by Roberts and Lane (2021) looked at the lockdown's effects on boxers, finding that it had taken a toll on athletes' moods, as the participants reported increased feelings of anger, confusion, depression, fatigue and tension, as well as a reduction in vigor, mostly due to changes in their training regimens. Meanwhile, a study by Jaenes Sánchez et al. (2021) found that athletes who accepted the need for lockdowns and social isolation tended to experience more positive emotional states such as feelings of friendship. Meanwhile, athletes who lacked motivation during this period reported higher levels of stressful thoughts, more behavioral problems, and greater

emotional upheaval (anger, fatigue, tension, and depression). The results of another study in a similar vein showed that sufficient levels of physical activity accompanied by a positive attitude with regard to the issues athletes had to face in the context of the COVID-19 lockdown acted as protective factors against sleeping problems (Taheri et al., 2023b). A number of studies have documented that athletes in individual sports differ from those in team sports in their self-regulation abilities (Jonker et al., 2010) and their adaptation strategies (Nicholls et al., 2007), as well as in certain individual traits (Correia and Rosado, 2019) and personality characteristics (Eagleton et al., 2007). The research by Taheri et al. (2023b) did not find any differences between amateur and elite athletes in terms of how likely they were to view the pandemic as stressful, challenging or threatening.

Aghababa et al. (2021) reported a significant positive correlation between exercise dependence during lockdown and positive moods, as well as a corresponding significant negative correlation between this dependence and worsened mood states. Meanwhile, the study found that compliance with lockdown measures and exercise dependence were the best predictors of the frequency and intensity of exercise during this period.

Recent years have witnessed an increase in research into exercise dependency among runners, an interest driven by the growing popularity of running. One of the instruments most frequently used to measure this phenomenon is the Exercise Dependence Scale (Hausenblas and Downs, 2002), the Spanish version of which was validated by Sicilia and González-Cutre (2011). Smith et al. (2010) used this tool to conclude that competitive runners were more likely than amateurs to show symptoms of exercise dependency. Researchers such as Lukács et al. (2019) and Zandonai et al. (2020) also employed this instrument and observed that increases and decreases in the frequency of physical exercise among amateur runners depend on the context of exercise and other variables such as loneliness and anxiety. Elsewhere, researchers such as Ruiz-Juan and Zarauz Sancho (2012) and Nogueira et al. (2021) using the Spanish version of the Running Addiction Scale (RAS-8) have found that runners who score higher for addiction tend to be those who register the longest distances run and most time spent on training.

Whitcomb-Khan et al. (2021) defined the moment of impasse due to COVID-19 as a "critical pause" in the lives of athletes, a time marked by feelings of loss (of physical conditioning, of routine, of motivation and of identity). However, the researchers observed that most of the athletes in the study, after an initial period of adaptation and acceptance, used the situation as an opportunity for growth. Indeed, researchers such as Martin et al. (2021) and Szczypińska et al. (2021) found that acceptance is the most common coping strategy adopted by athletes during the lockdown. Other strategies included having a sense of humor, active coping and self-distraction (Martin et al., 2021), as well as reliance on social support (Levine et al., 2022). Elsewhere, Kaur et al. (2020) observed that as athletes were gradually able to overcome the effects of the pandemic through adopting more constructive attitudes, they were also able to find alternatives to their usual physical exercise. Activities such as home workouts, yoga and meditation helped them to stay physically active and fit, and to improve their mental health. López-Bueno et al. (2020) found that the most common way for Spanish adults to exercise during the lockdown was in the home, observing that the use of social networks and apps on mobiles and other devices was also frequent. For example, some sought out alternatives such as virtual races or remote running clubs, which helped them to maintain their competitive motivation and offered opportunities for social support (DeJong et al., 2021).

In light of these findings, we wondered whether the act of discussing and sharing the effects of the deprivation of physical activity with athletes' most immediate circle, such as family, might also have contributed to protecting their wellbeing in the context of lockdown.

With regard to this issue of COVID and family relationships (couple and parental relationships), Günther-Bel et al. (2020) studied the individual and family wellbeing of 409 people who were locked down with their partners and/or children during the first 3 weeks of restrictions imposed by the Spanish government. Nearly half of the individuals (49.2%) in the study had experienced a high degree of state anxiety, but a lesser presence of depression (4.6%) was recorded. In terms of family relations, the researchers found that greater anxiety and depression during lockdown were tied to decreased dyadic adjustment in couples and worsened parental functioning. In other words, the implications of lockdown went beyond the individual, as the situation also affected couple and family relationships.

Williamson (2020) carried out another study of couples during the early stages of the pandemic in March and April of 2020. The findings showed that the pandemic had exerted moderate effects on the participants' ability to deal with conflict. Among couples with more positive functioning, satisfaction increased and maladaptive attributions decreased, while the opposite occurred among couples with lower functioning. Working along similar lines, Quezada et al. (2020) assessed the relationship between the marital satisfaction of 101 Mexicans who were living with their partners and their experience of the lockdown. The study showed that those who were more satisfied with their relationships were more likely to have felt calm and happy during the lockdown and less likely to have suffered blows to their happiness, health, physical condition or emotional well-being.

Gadermann et al. (2021) explored the impact of the early stages of lockdown on the mental health of families in Canada. The results showed that parents living with children under 18 were more likely to have experienced a deterioration of their mental health in this situation (44.3%) than the participants without children (35.6%).

Shum et al. (2023), conducted a qualitative study to examine the experiences of parents during the COVID-19 pandemic. The findings revealed the concerns and uncertainties that parents had to deal with, as well as feelings of mental exhaustion. Despite the challenges, some parents reported positive results experiences, such as strengthening family ties during the pandemic. In this line, Calvalho and Matias (2023) in their study on the impact of the COVID-19 pandemic and confinement on families, they also detected experiences of parental exhaustion of couples during confinement that contributed to decrease relationship satisfaction and increase conflicts.

At this point, we wondered about the impact on the mood of amateur runners with differing degrees of exercise dependence who were locked down for a month and a half due to the Spanish State of Alarm Decree of March 14, 2020, and if this deprivation had an impact on their couple and family relations. In order to answer the questions we have posed, we undertook this study with the following objectives: (a) to describe the effects of lockdown and the accompanying ban on outdoor exercise on the moods of amateur runners with differing degrees of dependency on physical exercise, (b) to explore how runners' family relations were affected, (c) to examine the relationship between dependency on physical exercise, mood and

family relations of amateur runners during the lockdown and (d) to discover what aspects of their usual physical activity they most missed and what coping strategies they adopted to make up for the loss of opportunities for physical activity during the lockdown.

# Method

## Participants

A total of 260 amateur runners from six different athletic clubs and associations in Spain were recruited to take part in this cross-sectional exploratory study with the help of members of the groups. The selection of participants took the form of intentional non-probability convenience sampling. In order to be included, potential participants had to: (a) be legal adults, (b) reside in Spain and (c) be habitual runners. The descriptive data of the participants are summarized in Table 1.

## Instruments

*Exercise Dependence Scale* [EDS-R, Downs et al., 2004; Spanish validation by Sicilia and González-Cutre (2011)]. Made up of 21 Likert-type items, where responses range from 1 (never) to 6 (always) and yields an overall dependency score ($\alpha = 0.92$), a higher score indicates a greater risk of dependency. Give individual scores for each of the seven factors that make up the scale. The subscales tolerance (3-items, $\alpha = 0.73$) is defined as either a need for increased amounts of exercise to achieve the desired effect (e.g., *I continually increase my exercise intensity to achieve the desired effect/benefits*), withdrawal (3-items, $\alpha = 0.85$) the same amount of exercise is performed to relieve or avoid withdrawal symptoms (e.g., *I exercise to avoid feeling irritable*), intention effect (3-items, $\alpha = 0.83$) represent when exercise is taken in larger amounts or over a longer period than was intended (e.g., *I exercise longer than intent*), lack of control (3-items, $\alpha = 0.78$) is defined as a desire or unsuccessful effort to cut down exercise (e.g., *I am unable to reduce how long I exercise*), reductions in other activities (3-items, $\alpha = 0.68$) assesses social, occupational, or recreational activities are given up or reduced because of exercise (e.g., *I would rather exercise than spend time with family/friends*), time (3-items, $\alpha = 0.84$) represents a great deal of time is spent in activities necessary to obtain exercise (e.g., *I spend a lot of time exercising*) and continuance (3-items, $\alpha = 0.81$) presents exercise that is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the exercise (e.g., *I exercise despite recurring physical problems*). It allows dividing athletes into three groups: risk of dependency, non-dependent-symptomatic, and asymptomatic non-dependent.

*Profile of Mood States* for adults (POMS, by McNair et al., 1971, 1992, Spanish validation by Andrade et al., 2013). This instrument assessment of an individual's mood consists of 30 Likert-type items with responses ranging from 0 (Not at all) to 4 (extremely). Six different dimensions of mood are assessed over a given period of time. Four of these dimensions are negative: anger (5-items, $\alpha = 0.87$, e.g., *angry*), fatigue (5-items, $\alpha = 0.87$, e.g., *worn out*), tension (5-items, $\alpha = 0.88$, e.g., *tense*) and depression (5-items, $\alpha = 0.86$, e.g., *sad*). Two of them are positive: vigor (5-items, $\alpha = 0.86$, e.g., *active*) and friendliness (5-items, $\alpha = 0.78$, e.g., *friendly*).

*Basic Family Relations Evaluation Questionnaire* (*Cuestionario de Evaluación de las Relaciones Familiares Básicas,* CERFB; Ibáñez et al., 2012). This questionnaire consists of 25 items answered on a 5-point Likert scale with responses ranging from 1 (never) to 5 (always). It includes a 14-item conjugal functioning scale ($\alpha = 0.92$), measuring the quality of parent–child relations (e.g., *I feel that my children return my affection*) and an 11-item parental functioning scale ($\alpha = 0.91$), reflecting the quality of how parents relate to each other as a couple (e.g., *My partner knows how to treat me*). Scores for parental functioning can range from 1 to 55, while those for conjugal functioning can go from 1 to 70.

*Dyadic Adjustment Scale* (DAS; Spanier, 1976, Spanish adaptation by Martín-Lanas et al., 2017). This questionnaire consists of 32 items that measure people's overall satisfaction with their relationships with their partners with whom they cohabitate, whether or not they are married. It consists of 4 subscales: consensus (13 items, $\alpha = 0.90$) degree of agreement with the partner (e.g., *about career decisions*), cohesion (5 items, $\alpha = 0.86$) degree of participation with the partner in activities together (e.g., *lough together*), satisfaction (10 items, $\alpha = 0.94$) degree of satisfaction with the partner (e.g., *Do you confide in your mate?*) and affective expression (4 items, $\alpha = 0.96$) *degree of agreement with the partner regarding emotional affections* (e.g., *demonstration of affection*). The overall score for dyadic adjustment can range from 0 to 151. Higher scores indicate greater levels of dyadic adjustment between the members of a couple.

TABLE 1 Descriptive statistics.

| Variables | *n* (%) |
|---|---|
| Male | 178 (68.5) |
| Female | 82 (31.5) |
| Age | |
| 18–24 years | 1 (0.4) |
| 25–34 years | 18 (6.9) |
| 35–44 years | 82 (31.5) |
| 45–54 years | 105 (40.4) |
| >55 years | 54 (20.8) |
| Marital status | |
| Partners with children living together | 133 (51.2) |
| Cohabitant partners without children | 50 (19.2) |
| Divorced with children and have a new partner | 14 (5.4) |
| Divorced with children and did not have a new partner | 15 (5.8) |
| Lived alone | 27 (10.4) |
| Lived with their parents | 21 (8.1) |
| Partner physically active (living together or not) | |
| Active partner | 152 (58.5) |
| Inactive Partner | 82 (31.5) |
| Degree of dependence | |
| Non-dependent symptomatic | 152 (58.5) |
| Non-dependent asymptomatic | 92 (35.4) |
| Risk dependence | 16 (6.1) |

### *Ad hoc* questionnaire

This instrument was created for the purposes of this study and gathered demographic data, information on participants' job status and living situation, and data about athletic activity before and during lockdown. Data was also collected about whether or not the partner did physical exercise. Finally, included open-ended questions in which participants were asked what they most missed about their pre-lockdown exercise routines and what strategies they were using to compensate for the lack of opportunities to maintain their usual routines during the lockdown.

## Procedure

This project received the approval of the Research Ethics Committee of the School of Psychology, Education and Sports Sciences, Blanquerna, Ramon Llull University (certificate # 1920006P). Before completing the questionnaires, which were conducted online during the first period of lockdown, each participant received detailed information about the study's purpose and procedure, including a guarantee of confidentiality, and each provided her or his informed consent.

The questionnaires were administered online using Google Forms. They were distributed with the help of contacts (mainly coaches) from the six participating athletic clubs and associations. The forms were completed totally anonymously. The overall questionnaire had a three-part structure. The first section consisted of demographic questions and items about participants' job status, living situations, and athletic practices both before and during the lockdown. This first part concluded with the two open-ended questions from the *ad hoc* questionnaire. The second part of the form consisted of the EDS-R and the POMS ($N = 260$). The form concluded here for participants who lived alone, with their parents ($n = 48$) or divorced with children and did not have a new partner ($n = 15$).

The third and last section was answered only by the participants who indicated living as a partner, either without ($n = 50$), with children ($n = 133$) or divorced with children and have a new partner ($n = 14$). The three groups completed the DAS ($n = 197$), and those who had children together also completed the CERFB (partners with children, $n = 133$).

## Data analysis

Parametric tests were used to analyze the data from the sample, following the principle of the Central Limit Theorem (TCL). The Pearson correlation coefficient was calculated in order to analyze the relationships among the variables of the decrease in hours of exercise during lockdown, dependence on physical exercise, mood and family relations (conjugal and parental relationships). *T*-Student was used to compare the means recorded by runners with different exercise dependence profiles for hours of exercise, mood and family relations. Groups were compared with Bonferroni's *p* values to identify if there were statistically significant differences between each of the groups. *T*-student was used to compare the conjugal and parental relationships of runners whose partners were physically active with those whose partners were not.

Structural equation modeling (SEM) was conducted through the maximum likelihood estimation method (ML). The following goodness-of-fit indices were obtained: goodness-of-fit index (GFI), and the normed fit index (NFI), and the root-mean square error of approximation (RMSEA). The cut of points for these indices were: equal to or higher than 0.90 for GFI and NFI and equal or lower than 0.08 for RMSEA (Steiger, 2007; Hu and Bentler, 2009). Version 26 of the statistics program SPSS for Mac and version JASP 0.15 were used to analyze the quantitative data.

The qualitative analysis conducted here focused on the responses to the two open-ended questions in the first section of the questionnaire, in which participants were asked what they most missed about their pre-lockdown exercise routines and what strategies they were using to compensate for the lack of opportunities to maintain their usual routines during the lockdown. Thematic analysis was used to identify repeated patterns of meaning within the textual data. The method used here consisted of the six-phase analytic procedure described by Braun and Clarke (2006): (1) familiarizing oneself with data, (2) generating initial codes, (3) searching for themes, (4) reviewing these themes, (5) naming and defining (6) reporting the results. An interrater reliability of $K = 0.84$ was calculated between the assessments of the researchers. Discrepancies were resolved through discussion to obtain full agreement. Separately, the frequency of the answers in each category was analyzed, reaching a consensus on the results of this process.

The choice to use mixed analysis also responded to the desire to achieve a broader understanding of the area of study through the use of both qualitative and quantitative results (Creswell and Clark, 2011). We used dichotomous variables that represented the presence (1) or absence (2) of certain qualitative categories in the participants' answers in order to explore potential associations with the variables measured through the POMS, EDS-R, DAS and CERFB.

## Results

With regard to the study's first objective, we observed that the participants scored higher than the population as a whole for tension, depression, anger and lower than the broader population for vigor and friendship (see Table 2).

Meanwhile, the runners displayed a statistically significant decrease ($d = 0.77$, $p < 0.001$) in the amount of time they spent exercising during the lockdown ($M = 2.32$, SD = 1.06) compared to before the pandemic ($M = 3.18$, SD = 0.84). Those who saw the greatest drop-off in the time spent running reported significantly lower levels of vigor and lesser levels of friendship (see Table 3). Those with the biggest declines in time spent on exercise also tended to have higher levels of tension, depression, anger and fatigue, although the results were not statistically significant in this regard.

Continuing with the first objective, the *t*-Student showed statistically significant differences ($p < 0.001$) in tension, depression and anger between non-dependent symptomatic runners and non-dependent asymptomatic, with an effect size of $d = 0.55$ for tension ($M = 7.66$, SD = 4.96 and $M = 5.14$, SD = 3.82), $d = 0.51$ for depression ($M = 6.69$, SD = 4.27 and $M = 4.63$, $SD = 3.61$) and $d = 0.52$ for anger ($M = 6.58$, SD = 4.77 and $M = 4.33$, SD = 3.56), respectively.

The study's second objective as can be seen in Table 4 makes clear, runners with partners but without children recorded significantly higher scores for marital satisfaction than those with both partners and children. Additionally, runners with partners but without children

TABLE 2 Descriptive data on mood (POMS).

| | *n* | *M* sample | SD sample | *M* population* | SD population* |
|---|---|---|---|---|---|
| POMS tension | 260 | 6.85 | 4.84 | 5.01 | 4.54 |
| POMS depression | 260 | 6.05 | 4.23 | 3.25 | 3.91 |
| POMS anger | 260 | 5.87 | 4.55 | 2.93 | 3.84 |
| POMS vigor | 260 | 8.89 | 4.33 | 10.48 | 4.31 |
| POMS fatigue | 260 | 5.09 | 3.94 | 5.45 | 4.48 |
| POMS friendship | 260 | 12.03 | 3.85 | 13.46 | 3.36 |

*Andrade et al. (2013).

TABLE 3 Pearson's Correlation between decrease in hours of physical exercise during lockdown and mood (POMS).

| | Decrease in hours of exercise during lockdown |
|---|---|
| POMS tension | 0.107 |
| POMS depression | 0.066 |
| POMS anger | 0.099 |
| POMS vigor | −0.254** |
| POMS fatigue | 0.063 |
| POMS friendship | −0.130* |

**Results deemed statistically significant at $p < 0.01$; *$p < 0.05$.

registered significantly higher scores for dyadic adjustment than those that have been recorded for the Spanish population as a whole.

The runners who experienced the greatest decreases in the time spent running during the lockdown recorded significantly lower scores for marital satisfaction (DAS) and conjugal relationship (CERFB). Also, while the differences did not reach the threshold for statistical significance, runners with the largest drop-off in hours tended to score lower for consensus, cohesion and affection in their relationships with their partners (DAS) and to have more difficulties in their parental relationship (see Table 5).

It is worth noting that relationships were found for some of the individual dimensions of exercise dependence. Athletes who prior to the lockdown had done exercise to avoid bad moods, anxiety and tension (withdrawal), continued exercising despite having physical problems or injuries (continuance), experienced difficulties in reducing the length, frequency and intensity of exercise session (lack of control), and spent most of their free time exercising (time) recorded lower scores for affection toward their partners. Additionally, runners who prior to the pandemic had preferred exercising to spending time with their families or friends or to working (reduction in other activities) tended to register lower scores for conjugal harmony, consensus with their partners, expressions of affection and dyadic adjustment (see Table 6).

The results also show a negative correlation between scores for dyadic adjustment (DAS TOTAL) and those for tension, depression, anger and fatigue during the lockdown. Scores for conjugal relationships negatively correlated with those for depression and anger. Meanwhile, dyadic adjustment and conjugal relationship showed positive correlations with the scores for vigor and friendship (see Table 6).

It is also worth highlighting that runners with children whose partners also did exercise tended to have more conjugal relationships with their partners than their peers whose partners did not exercise. Meanwhile, runners without children whose partners exercised displayed greater marital satisfaction, cohesion and dyadic adjustment than their counterparts whose partners were not physically active (see Table 7).

Regarding the third objective of this study, to examine the causal relationship between dependency on physical exercise with mood and family relations during the lockdown, a structural model was developed that included these constructs as latent variables. The proposed model included several indicators for each latent variable, and measurement errors and residuals were omitted from the path diagram. Goodness-of-fit indices revealed an adequate data fit: $\chi^2 = 271.47$, df = 117, GFI =0.99, CFI = 0.91, NFI = 0.85 and RMSEA = 0.07. Standardized regression weights were adequate in all cases, ranging from 0.35 to 0.94. According to this model, during the confinement, the runners' dependence on physical exercise led them to have a state of mood with a high level of anger, depression and tension and less vigor and friendliness, which, in turn, affected their family relationships especially in the conjugal functioning, satisfaction marital and cohesion (see Figure 1).

Finally, regarding the last objective of this study, Table 8 shows some of the aspects that runners reported missing the most during the lockdown, grouped into categories with representative examples of each. The categories emerged through the qualitative analysis of the participants' responses to an open-ended question about what they had most missed during the lockdown. The three overarching categories were nature/the outdoors, social relations and emotional benefits. This last category was divided into the three subcategories of relaxation, a feeling of freedom and self-esteem. The aspects runners most frequently reported missing during lockdown were the outdoors/nature and social relations.

Participants who identified social relations as the aspect they missed the most ($N = 65$) recorded significantly higher scores ($d = 0.28$, $p = 0.049$) for feelings of friendship ($M = 12.77$, SD = 3.22) during lockdown than those who did not report missing these relationships ($N = 195$; $M = 11.77$, SD = 4.04).

The comparison of the groups with different degrees of exercise dependence showed no statistically significant differences ($p > 0.05$) in the aspects of their pre-pandemic exercise routines that athletes most missed. The strategies that the participants reported using to compensate for the lack of opportunities for physical exercise during the lockdown are collected in Table 9.

It is worth noting that participants who ran indoors tended to score higher for tension ($d = 0.51$, $p = 0.017$; $M = 8.86$, SD = 6.53) and depression ($d = 0.35$, $p = 0.016$; $M = 7.83$, SD = 3.24) than those who did not ($N = 246$; M tension = 6.60, SD = 4.73; $M$ depression = 5.82, SD = 3.51).

TABLE 4 Descriptive data on dyadic adjustment (DAS) and conjugal and parental relationships (CERFB).

| | *M* sample without children | SD sample without children | *M* sample with children | SD sample with children | *p* | *d* | *M* population | SD population |
|---|---|---|---|---|---|---|---|---|
| DAS consensus | 54.52 | 8.58 | 51.25 | 10.91 | 0.058 | 0.64 | | |
| DAS satisfaction | 42.71 | 3.78 | 40.65 | 5.98 | 0.028 | 0.71 | | |
| DAS cohesion | 18.34 | 4.27 | 18.14 | 4.15 | 0.076 | 0.37 | | |
| DAS affection | 9.12 | 2.36 | 8.50 | 2.54 | 0.138 | 0.57 | | |
| DAS total | 124.94 | 15.08 | 119.50 | 18.59 | 0.050 | 0.64 | 114.90* | 17.50* |
| CERFB conjugal relationship | | | 53.29 | 9.89 | | | 57.35** | 8.98** |
| CERFB parental relationship | | | 42.19 | 4.82 | | | 43.93** | 5.90** |

*Martín-Lanas et al. (2017) and **Ibáñez et al. (2012).

TABLE 5 Pearson's correlation decrease in hours spent running during lockdown and dyadic adjustment (DAS) and conjugal and parental relationship (CERFB).

| | Decrease in hours of exercise during lockdown |
|---|---|
| DAS consensus | −0.073 |
| DAS satisfaction | −0.213** |
| DAS cohesion | −0.011 |
| DAS affection | −0.126 |
| DAS total | −0.137 |
| CERFB conjugal relationship | −0.185* |
| CERFB parental relationship | −0.039 |

**Results deemed statistically significant at $p < 0.01$; *$p < 0.05$.

Meanwhile, participants who did alternative exercise during the lockdown scored significantly higher on the subscales measuring withdrawal (exercising to avoid bad moods, anxiety and tension) ($d = 0.33$, $p = 0.011$; $M = 9.83$, SD = 3.63) and time (spending most of their free time on exercise) ($d = 0.35$, $p = 0.013$; $M = 9.16$, SD = 3.68) than their counterparts who did not do any alternative exercise ($M$ withdrawal = 8.57, SD = 4; $M$ time = 7.92, SD = 3.44).

Runners who turned to wellness activities during the lockdown scored higher for conjugal relationship ($d = 0.69$, $p = 0.030$; $M = 59.46$, SD = 7.27), parental relationship ($d = 0.62$, $p = 0.049$; $M = 44.91$, SD = 5.99) and consensus with their partners ($d = 0.57$, $p = 0.049$; $M = 56.82$, SD = 6.34) than those who did not do these activities ($N = 236$; $M$ conjugal relationship = 52.74, SD = 9.93; $M$ parental relationship = 41.94, SD = 4.67; $M$ consensus with partner = 51.94, SD = 10.34).

## Discussion

The lifestyle change brought about by the COVID-19 lockdown had a number of implications for psychological and physical health (Balanzá-Martínez et al., 2021). By way of further evidence of this, our study found that the interruption of runners' habitual athletic activity affected their moods and their relations with their partners and families.

The low degree of prevalence of dependence on physical exercise among the participants in the study echoed the findings of Lukács et al. (2019), Zandonai et al. (2020), and Aghababa et al. (2021). Meanwhile, the runners in the study scored higher than the general population as a whole for tension, depression, anger, while they scored lower for vigor and friendship.

The findings with regard to tension coincide with those of studies by Jaenes Sánchez et al. (2021) and Roberts and Lane (2021). The level of tension also showed a correlation with the practice of running indoors as a strategy to compensate for the lack of physical activity during the lockdown. The runners in the study scored higher for depression than the population on average, another finding that confirms those of prior studies (Mengin et al., 2020; Pillay et al., 2020; Jaenes Sánchez et al., 2021; Petersen et al., 2021; Roberts and Lane, 2021). The presence of depression was statistically tied to the practice of running in enclosed spaces.

The decrease in the figures for friendship recalled the results of studies by Mengin et al. (2020), which found a reduction in social contact, Pillay et al. (2020), which observed a spike in social dysfunction, and Graupensperger et al. (2020), which detected a decrease in social relations among teammates. The importance of this decrease in contact with friends was reinforced by the fact that the runners in the study cited social relations as one of the pre-pandemic aspects of their athletic activities that they most missed. Indeed, Washif et al. (2022) made observations along the same lines, finding that solo training tended to reduce athletes' motivation. Runners who did not adopt any athletic strategies in order to exercise during the lockdown were more likely to take up other activities that allowed them a greater feeling of friendly connection.

The comparison between groups of runners showed that the nondependent-symptomatic participants and the runners at risk of exercise dependence were more likely than nondependent-asymptomatic runners to suffer from tension and anger as in studies by Jaenes Sánchez et al. (2021) and Roberts and Lane (2021) and depression, echoing findings by Mengin et al. (2020), Pillay et al. (2020), and Petersen et al. (2021). These results stand in contrast with the general better mental health profile of elite athletes, who tend to have lower levels of depression, anxiety and stress than sub-elite athletes (Taheri et al., 2023c), often due to factors such as coping ability, income inequalities, and support.

These effects on mood coincide with the statistically significant decrease in the number of hours the participants spent on exercise in comparison with their pre-pandemic habits. These data align neatly with findings in studies by Aghababa et al. (2021), Maltagliati et al. (2021), Petersen et al. (2021), Rodríguez-Larrad et al. (2021), Stockwell

TABLE 6 Correlations between exercise dependence (EDS), mood (POMS), dyadic adjustment (DAS), and conjugal and parental relationships (CERFB).

| | Conjugal relationship | Parental relationship | DAS consensus | DAS satisfaction | DAS cohesion | DAS affection | DAS total |
|---|---|---|---|---|---|---|---|
| EDS tolerance | 0.022 | 0.041 | 0.049 | 0.123 | 0.059 | −0.080 | 0.085 |
| EDS withdrawal | −0.056 | 0.069 | −0.048 | 0.058 | −0.013 | −0.157* | −0.039 |
| EDS continuance | −0.083 | −0.094 | −0.090 | 0.015 | −0.060 | −0.182* | −0.107 |
| EDS lack of control | −0.064 | −0.016 | −0.117 | 0.034 | −0.079 | −0.206** | −0.092 |
| EDS reduction in other activities | −0.276** | −0.056 | −0.204** | −0.073 | −0.114 | −0.202** | −0.194** |
| EDS time | −0.027 | 0.052 | −0.098 | 0.104 | −0.036 | −0.159* | −0.061 |
| EDS intention effect | −0.010 | 0.122 | −0.186** | 0.105 | −0.033 | −0.073 | −0.093 |
| POMS tension | −0.144 | −0.084 | −0.201** | −0.183* | −0.142* | −0.245** | −0.246** |
| POMS depression | −0.279** | −0.173* | −0.303** | −0.293** | −0.205** | −0.341** | −0.378** |
| POMS anger | −0.200* | −0.116 | −0.217** | −0.227** | −0.150* | −0.259** | −0.294** |
| POMS vigor | 0.340** | 0.181* | 0.142* | 0.390** | 0.262** | 0.185** | 0.315** |
| POMS fatigue | −0.147 | −0.051 | −0.143* | −0.161* | −0.106 | −0.141* | −0.237** |
| POMS friendship | 0.307** | 0.339** | 0.145* | 0.371** | 0.241** | 0.153* | 0.285** |

**Results deemed statistically significant at $p < 0.01$; *$p < 0.05$.

TABLE 7 Comparison between family relationships of runners whose partners are physically active and those whose partners are not.

| | *M* (SD) Active partner | *M* (SD) Inactive partner | *t* | *p* | *d* |
|---|---|---|---|---|---|
| DAS consensus | 53.00 (10.22) | 50.59 (10.00) | 1.49 | 0.139 | 0.26 |
| DAS satisfaction | 42.03 (4,75) | 39.65 (6,33) | 2.73 | 0.007** | 0.46 |
| DAS cohesion | 18.90(3,80) | 16.87 (4,88) | 3.19 | 0.002** | 0.58 |
| DAS affection | 8.80 (2,61) | 8.45 (2,29) | 0.90 | 0.369 | 0.18 |
| DAS total | 123.44 (16,31) | 116.42 (19,28) | 2.47 | 0.014* | 0.45 |
| Conjugal relationship | 55.00 (9,12) | 50.83 (10,52) | 2.42 | 0.017* | 0.46 |
| Parental relationship | 42.51 (4,82) | 41.77 (4,82) | 0.87 | 0.387 | 0.18 |

** Results deemed statistically significant at $p < 0.01$; *$p < 0.05$.

et al. (2021), and Washif et al. (2022). The findings here stand in contrast, however, to those of a study by Martin et al. (2021). This drop in the number of hours spent on exercise corresponds with a decrease observed among the Spanish population in the wake of the ban on outdoor exercise by individuals (Ministerio de Cultura y de Deporte, 2021; Rodríguez-Larrad et al., 2021).

According to Iancheva et al. (2020), Jaenes Sánchez et al. (2021), and Ronkainen et al. (2021) this significant decrease in the number of hours the participants spent on exercise is connected to a decrease in motivation, as these groups of athletes were unable to keep up their usual exercise habits despite feeling the need to do so. This finding was reinforced by the fact that the most frequently cited factors that athletes said they missed during the lockdown were the outdoors/nature and social relations, as it seems reasonable to conclude that the lack of these aspects led to decreased motivation and, in turn, to a drop-off in hours spent on athletic activity.

However, the results also showed that the runners who spent the greatest amount of time on exercise both prior to the pandemic and during the lockdown were more likely to register higher degrees of exercise dependence, as was also observed by Aghababa et al. (2021) and in studies of runners conducted prior to the pandemic (Ruiz-Juan and Zarauz Sancho, 2012; Lukács et al., 2019; Zandonai et al., 2020; Nogueira et al., 2021). It is worth noting, however, that, much like Smith et al. (2010) found in their research, competitive runners showed greater symptoms of exercise dependence than non-competitive ones.

Meanwhile, athletes who had spent more of their time on running prior to the pandemic were likely to experience greater tension during the lockdown. As Iancheva et al. (2020) and Ronkainen et al. (2021) have written, this is due to the impossibility of continuing their usual exercise routine.

The findings described above connect neatly with the fact that the participants most often reported missing the outdoors/nature and social relations. These results also underline the importance of finding alternative ways of exercising to make up for the inability to continue usual regimens, beyond the acceptance of restrictive measures (Martin et al., 2021; Szczypińska et al., 2021; Taheri et al., 2023a,b). Runners who used this sort of coping strategy also tended to record better scores for withdrawal, tolerance and time (dimensions of dependence). It is also worth noting that a lack of exercise can contribute to an increase in negative mood states (Aghababa et al., 2021).

In Spain, unlike elsewhere in Europe, there was a complete ban on exercise outside the home. This undoubtedly led to a greater change in exercise habits, and it may have prompted athletes to adopt coping strategies. Some of the alternative activities that athletes did during

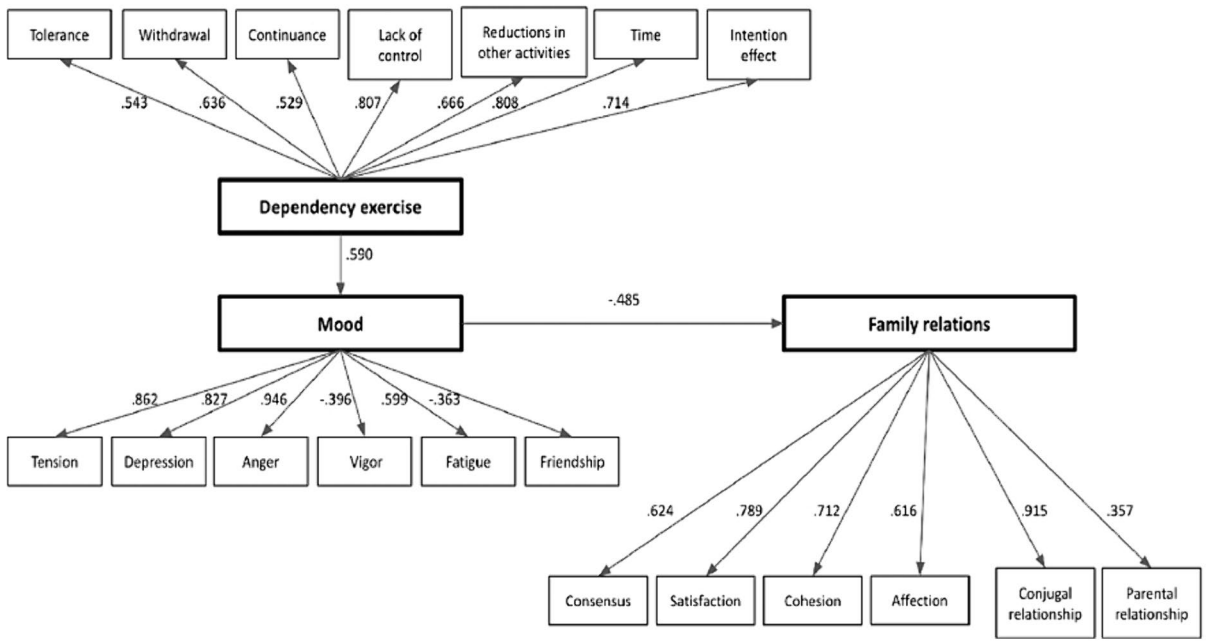


FIGURE 1
The structural equation model linking dependency on physical exercise with mood and family relations during the lockdown.

this period included the use of the personal resources they had at hand by climbing up and down stairs or walking in the hallway. Others involved the use of digital resources such as devices and online platforms, a trend that has also been observed by others scholars (López-Bueno et al., 2020; DeJong et al., 2021; Martin et al., 2021) and is reflected in the data gathered by the *Encuesta de hábitos deportivos en España 202*0 [Survey of sporting habits in Spain 2020] (Ministerio de Cultura y de Deporte, 2021).

Meanwhile, athletes who spent the greatest amount of time exercising during the lockdown were more likely to feel energetic, cheerful, active and vigorous (vigor), and they displayed greater friendliness and understanding (friendship). It should be noted that athletes who participate in individual sports like running tend to have different kinds of self-regulation abilities (Jonker et al., 2010), coping strategies (Nicholls et al., 2007), individual characteristics (Correia and Rosado, 2019) and personality characteristics (Eagleton et al., 2007) than team sport athletes. The athletes in this study mostly turned to alternative physical activity (using personal and/or virtual resources).

Structural equation modeling confirmed the relationship between dependency on physical exercise, mood and family relations of amateur runners during the lockdown. According to this model, during the confinement, the runners' dependence on physical exercise led them to have a state of mood with a high level of anger, depression and tension and less vigor and friendliness, which, in turn, affected their family relationships especially in the conjugal functioning, satisfaction marital and cohesion. The findings here, then, reaffirm the results of studies by Malcolm and Velija (2020) and Ackard et al. (2002), both of which tied decreases in physical activity to the presence of negative emotions.

As Günther-Bel et al. (2020) and Shum et al. (2023) observed, the effects of the lockdown were not only felt by individuals, but also affected couple and family relations. This was true among the runners in this study. The participants who felt angrier and more depressed registered lower scores for dyadic adjustment and conjugal functioning, while the athletes who reported more feelings of vigor and friendship had more harmonious relations in this regard.

Following Williamson (2020), we suggest that the lockdown's impact on people's satisfaction with their partners was lesser when their individual emotional state was better. In this study, we observed that runners who engaged in wellness activities tended to achieve more positive emotional states, as well as to display better consensus with their partners and more harmonious conjugal relations, and to maintain their parental functioning. It might also be the case, as the same author argues, that the pandemic saw improved satisfaction among couples with better functioning and decreased satisfaction among those functioning was less positive.

Our study also dovetails with findings by Aghababa et al. (2021) in that we found that athletes who spent more time on exercise during the lockdown were more likely to experience more positive mood states, a factor which, in turn, is linked to improved satisfaction with relationships. Our findings as to the differences between runners with and without children align with those of a study by Gadermann et al. (2021). Specifically, couples without children experienced greater satisfaction with their relationships and better dyadic adjustment during the lockdown than those with children. As Westrupp et al. (2021) point out, during the lockdown parents not only had to deal with work and other concerns, but also to take care of their children, and this often led to greater irritability and fewer positive expressions in family relations.

Finally, this study has made clear that runners whose partners also did physical exercise during the lockdown had better relations with these partners than runners whose partners were not physically active. As Linares and Campo (2002) have observed, sharing interests contributes to harmony among couples.

TABLE 8 Aspects of previous physical activity that runners most missed during lockdown.

| Category | Subcategory | Quote | Freq. |
|---|---|---|---|
| Outdoors/Nature | | *Running in the mountains*<br>*Being able to go out to run* | 210 |
| Social relations | | *Being outdoors with the friends*<br>*Socializing* | 65 |
| Emotional effects | Relaxation | *Exercising is stress relief*<br>*Being able to relax mentally* | *8* |
| | Feeling of freedom | *Feeling free to go where I want*<br>*Being able to feel free, which in turn makes me happy, something I cannot experience right now, unfortunately* | 22 |
| | Self-esteem | *Running helps me to think*<br>*Winding up tired but proud of myself*<br>*The psychological benefits that I get from the time I spend running* | 22 |

TABLE 9 Strategies to compensate for the lack of physical activity during lockdown.

| Category | Subcategory | Quote | Freq. |
|---|---|---|---|
| Running indoors | | *Running in the corridor at home*<br>*Running on the rooftop* | *14* |
| Alternative exercise | Personal resources | Going up and down the stairs<br>I walk to work | 149 |
| | Virtual resources | Online training with my personal trainer and YouTube, videos from different platforms and virtual gyms | 46 |
| Wellness activities | | Yoga, Chikung<br>Pilates | 24 |
| Diet | | A nutritious diet<br>Regulating my diet | 12 |
| Strategies unrelated to exercise | | Social networks and reading<br>I devote most of my day to my daughter | 15 |

In short, our study has yielded exploratory results on the lockdown's effects on the moods of a group of amateur runners, as well as on their relationships with their partners and families. In addition, it has been able to develop a structural model that examines the causal relationship between dependency on physical exercise with mood and family relations during the lockdown. It is important, of course, to be aware of the study's limitations: (a) The responses to the online questionnaires were gathered from among amateur runners who all belonged to one of six athletic clubs and associations and, as such, were especially interested in the topic. This could limit the representativeness of the sample. (b) It should also be noted that a lot more men than women participated in the study, a trend that could have affected the results, (c) Although family relationships were examined, only one family member was interviewed which could result in a biased perspective, (d) Finally, it is worth highlighting that no in-depth interviews were conducted. Such interviews could have provided valuable information on some of the more subjective aspects of the study.

Despite these limitations, this study reveals the importance of analyzing the relationships of athletes and their families. Such an approach has the potential to contribute to knowledge about the effects of the pandemic and the accompanying lockdown on the world of sports. This study shows the way forward for future research in this area, which could explore how the impossibility of maintaining usual routines affected other groups of athletes in both individual and team sports. The study also points to the potential for other kinds of studies even outside the context of the pandemic, as there is relatively little research into the relations between participation in sports and athletes' relationship and family dynamics. And finally, carry out longitudinal studies because moods can fluctuate over time and influence family relationships.

In conclusion, our study shows that the COVID-19 lockdown restrictions in Spain not only influenced amateur runners as individuals, but also influenced their relationships with their partners and families. The study shows that in situations of crisis like the pandemic, psychological interventions for athletes should bear in mind not only individual aspects, but also concerns about their most immediate relationships, such as those with their partners and families.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by Research Ethics Committee of the School of Psychology, Education and Sports Sciences, Blanquerna, Ramon Llull University (certificate # 1920006P). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

AV: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. SA: Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. SP: Writing – original draft, Supervision, Software, Methodology, Investigation, Conceptualization. ST: Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. XP: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was supported by the Ramon Llull University under Grant 2023-URL-Proj-005. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Acknowledgments

We would like to thank William Bromberg for providing language assistance and reading the article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 22 May 2024
DOI 10.3389/fpsyg.2024.1408022



OPEN ACCESS

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RECEIVED 27 March 2024
ACCEPTED 03 May 2024
PUBLISHED 22 May 2024

CITATION
Yang S, Jing L, He Q and Wang H (2024) Fostering emotional well-being in adolescents: the role of physical activity, emotional intelligence, and interpersonal forgiveness.
*Front. Psychol.* 15:1408022.
doi: 10.3389/fpsyg.2024.1408022



# Fostering emotional well-being in adolescents: the role of physical activity, emotional intelligence, and interpersonal forgiveness

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**Introduction:** Adolescence is considered a stress-sensitive developmental period, and the escalating and sustained pressure during this phase poses a significant threat to the mental and physical well-being of adolescents. Therefore, enhancing positive emotions in adolescents is crucial. This study aims to investigate the impact of physical activity on the emotional intelligence, interpersonal forgiveness, and positive emotions of adolescents.

**Methods:** Using a cluster sampling method, data were collected from 500 adolescents in four schools across the Xiangxi Tujia and Miao Autonomous Prefecture of Hunan Province, China. A total of 428 valid questionnaires were collected and analyzed. The study employed AMOS v.23 to construct a structural equation model to validate the hypotheses.

**Results:** The results indicate that physical activity significantly influences the emotional intelligence, interpersonal forgiveness, and positive emotions of adolescents. Furthermore, emotional intelligence and interpersonal forgiveness mediate the relationship between physical activity and positive emotions.

**Discussion:** Based on these findings, collaborative efforts from government agencies, schools, and families are essential to provide robust support for adolescents' participation in physical activity, encouraging more adolescents to actively engage in sports.

KEYWORDS

**physical activity, emotional intelligence, interpersonal forgiveness, positive emotions, adolescents**

## 1 Introduction

Over the years, adolescents have been subjected to sustained pressure from internal and external sources in schools, such as academic stress (Ye et al., 2019; Högberg et al., 2020), interpersonal stress (Fiorilli et al., 2019), daily life hassles (Chiang et al., 2019), and educational competition pressure (Högberg, 2021). These pressures often result in negative emotions like anxiety, depression, anger, sorrow, and fear (Reddy et al., 2018; Pascoe et al., 2020). Moreover, a meta-analysis of 41 studies across 27 countries revealed a global mental disorder prevalence of 13.4%, with anxiety at 65% and depression at 26% (Högberg, 2021). With time, the psychological stress burden continues to escalate. Urgent intervention is required, as failure to

address this issue not only impacts adolescent health but also perpetuates a vicious cycle hindering their future social development.

However, numerous studies confirm that fostering positive emotions not only helps alleviate the negativity adolescents experience under stress but also broadens their attention and cognitive abilities (Fredrickson, 2004). It enhances adolescents' psychological health resilience (Zhang et al., 2022). Scholars argue that adolescents should cultivate positive emotions in their lives to alleviate the oppression brought by daily challenges. Effective solutions for negative emotions and hindrances to mental and physical health not only promote individual and collective well-being but also contribute to overall environmental improvement, elevating individuals to higher mental states (Fredrickson, 1998; Tugade et al., 2004). Furthermore, positive emotions motivate individuals to broaden and build their cognitive, attentional, and behavioral repertoires. Unique positive emotional concepts are particularly likely to provide individuals with more informational value than overall emotions (Tan et al., 2022).

Numerous studies indicate that engaging in physical activity offers various benefits for adolescents (Singh et al., 2023). Firstly, it effectively reduces the probability of adolescent depression and alleviates negative emotions (Zhang et al., 2022). Secondly, it enhances adolescents' self-efficacy and positive well-being (Norris et al., 1992; Steptoe and Butler, 1996; Zhang et al., 2022). Additionally, engaging in 2–2.5 h of high-intensity exercise per week can improve self-esteem and happiness, contributing to anxiety relief in adolescents (Anderson and Shivakumar, 2013). Importantly, regular physical activity enables adolescents to enjoy a higher quality of life and better positive emotions, enhancing their learning efficiency and academic performance in school (Singh et al., 2012).

However, the intensity of physical activity for many adolescents falls far short of the levels required to promote these benefits (Sallis, 2000). Physical education classes are a crucial component of school education, emphasizing their core role and profound impact on the health of almost all adolescents (Pate et al., 2006; Salmon et al., 2007; Van Sluijs et al., 2007). Due to the increasing pressure of academic studies, adolescents spend a significant amount of time on academic subjects, while the time allocated for physical activity continues to decrease. As a result, their physical activity intensity and time fail to meet ideal standards (Singh et al., 2012). Surveys show that the level of moderate-to-vigorous physical activity in physical education classes for adolescents remains low, falling short of the 50% standard recommended by the Centers for Disease Control and Prevention in the United States and the British Sports Association (Van Sluijs et al., 2021). Therefore, it is imperative to prioritize physical activity for adolescents, urging collaboration among governments, schools, and families to encourage and support increased time spent on physical activity in schools. This not only alleviates academic stress but also fosters the healthy development of positive emotions in adolescents.

While both positive and negative emotions are equally important for studying adolescent health, current research on adolescent positive emotions remains limited (Shen et al., 2018; Li et al., 2022). Most studies on adolescent emotions focus on treating depression, anxiety, and fear, with greater attention given to negative emotions in adolescents (Rodriguez-Ayllon et al., 2019). There is a lack of in-depth research and effective improvement suggestions in academia for enhancing adolescent positive emotions. This study posits that adolescents possessing more positive emotions are driven toward success, leading to success in various life domains. In contrast to previous research, this study primarily focuses on how to better enhance adolescent positive emotions through intervention in physical education classes, enabling adolescents to experience positive interpersonal interactions and improve emotional control. Given the gaps and issues identified in previous studies, this research proposes the following objectives: (1) investigate the factors influencing positive emotions in adolescents; (2) explore the relationship between physical activity, emotional intelligence, interpersonal forgiveness, and positive emotions in adolescents; (3) provide feasible suggestions for enhancing adolescent positive emotions through increased physical activity to the government, schools, and families.

# 2 Literature review and hypothesis development

## 2.1 The concept of variables

### 2.1.1 Physical activity

The definition of physical activity in the literature can be summarized from two perspectives. From a macro perspective, physical activity refer to various sports competitions, daily exercise, and related sports activities (Jia et al., 2019). From a micro perspective, physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (Singh et al., 2023). Given that the sample for this study consists of adolescents, the definition of physical activities in this research mainly focuses on the micro level, referring to engagement in physical exercises that promote physical and mental health.

### 2.1.2 Emotional intelligence

The concept of emotional intelligence was introduced in 1990 by Salovey and Mayer (1990), referring to an individual's ability to monitor, differentiate, and guide their own and others' feelings and emotions to facilitate thinking and actions (Kotsou et al., 2019). Emotional intelligence is considered an emotional skill, personality trait, and capability for interacting with others, determining how individuals respond to external needs and stress (Bar-On, 2000). Some scholars, such as Law et al. (2004), view emotional intelligence as the ability to evaluate one's own and others' emotions and apply emotional regulation skills. In this study, emotional intelligence is defined based on the perspectives of scholars like Law et al. (2004).

### 2.1.3 Interpersonal forgiveness

Interpersonal forgiveness has been widely studied in psychology, with McCullough et al. (2007) defining it as an individual's change in pro-social motives following an offense, including a reduction in motives for revenge and avoidance and an enhancement of benevolent motives. It is an effective approach to resolving interpersonal conflicts, going beyond eliminating negative emotions toward the offender to positively altering attitudes and behaviors toward them (Mccullough et al., 2003). Forgiveness, distinct from reconciliation, involves forgiving an individual and reestablishing a positive relationship with them. It signifies a pro-social change toward the offender, with individuals inclined to forgive often being more agreeable and emotionally stable (Riek and Mania, 2012). This study considers forgiveness as a positive psychological response to interpersonal harm, indicating a reluctance to retaliate against the perpetrator and a positive expectation for future relationships with others.

### 2.1.4 Positive emotion

In psychological studies, positive emotion is defined as a collection of discrete pleasant emotional states, including happiness, satisfaction, excitement, enthusiasm, and active positive emotional states (Carl et al., 2013). This definition is also considered a functional phenomenon that motivates individuals by mobilizing psychological and physiological resources to achieve anticipated goals, aiding in expanding social resources for enhanced happiness (Fredrickson, 1998; Fredrickson, 2001). In this study, positive emotion refers to an emotional state in adolescents, with positive emotional states promoting creativity, subjective well-being, emotional control, and healthy interpersonal development (Fredrickson, 2004). Positive emotion facilitates harmonious and positive relationships, creating a positive and healthy environment for adolescent physical and mental development.

## 2.2 Hypotheses

### 2.2.1 Physical activity, emotional intelligence, interpersonal forgiveness, and positive emotion

Existing research indicates that regular participation in physical activity can enhance emotional intelligence, strengthen relationships, improve academic performance, and reduce the risk of mental health problems, consequently promoting positive emotions in adolescents (Chan et al., 2019; Cho, 2020; Skurvydas et al., 2021; Li et al., 2022). Furthermore, participating in physical activity has positive effects on the physical and mental health of adolescents, fostering positive interpersonal relationships and improving emotional intelligence, enabling better control of negative emotions (Acebes-Sánchez et al., 2019). Some studies suggest that emotional intelligence is beneficial for character influences on mental health, promoting positive emotions in adolescents and contributing to healthier interpersonal relationships (Ruvalcaba-Romero et al., 2017). However, McCullough et al. (2000) argue that adolescents with higher emotional intelligence can better forgive others, facilitating constructive handling of negative emotional reactions to others' wrongdoing. Emotional intelligence plays a crucial role in interpersonal forgiveness, with adolescents who can better identify, absorb, understand, and regulate emotions being more adept at managing emotions, cooperating effectively, possessing superior social skills, and solving interpersonal problems more successfully (Karaoglan Yilmaz et al., 2023). This suggests a stronger ability for perspective-taking and a tendency to forgive others for harmful or transgressive behaviors (Hodgson and Wertheim, 2007). Rey and Extremera (2014) also assert that individuals with higher emotional intelligence are better at reducing retaliatory motives, maintaining positive relationships with offenders, and establishing positive interpersonal relationships. Higher levels of emotional intelligence correlate with higher levels of agreeableness, cooperativeness, and forgiveness tendencies. Individuals with high emotional intelligence can view problems from others' perspectives, thus promoting tolerance (Rizkalla et al., 2008).

Furthermore, research indicates a significant correlation between emotional intelligence and positive emotion. Emotional intelligence enables reflective regulation of emotions, playing a crucial role in promoting positive emotions (Sánchez-Álvarez et al., 2016). Study by Extremera and Rey (2016) suggest a significant correlation between emotional intelligence and positive emotion. Individuals with high emotional intelligence frequently experience pleasant or positive emotions and rarely experience unpleasant or negative emotions. By regulating emotions, emotional intelligence can foster the occurrence of positive emotions and reduce the frequency of negative emotions. Additionally, research by Ruvalcaba-Romero et al. (2017) indicates that emotional intelligence plays a vital role in social environments. Individuals with high emotional intelligence can effectively control their emotions, possess strong social skills, express positive emotions to themselves and others, and increase positive emotions in life. According to the results of Trigueros et al. (2019), adolescents' emotional intelligence is positively correlated with positive emotion. Emotional intelligence plays a crucial role in regulating and repairing emotions and increasing emotional efficiency, resulting in greater emotional satisfaction, stronger emotional happiness, and a healthier mindset.

Numerous studies suggest a significant correlation between interpersonal forgiveness and positive emotion (Mccullough et al., 2003; Barcaccia et al., 2020). Forgiveness is seen as not only eliminating negative emotions toward the offender but also enhancing the positive attitude and behavior toward them. It involves re-establishing a positive relationship with the offender, representing a pro-social change (Riek and Mania, 2012). Riek and Mania (2012) suggests a relationship between forgiveness and positive emotional outcomes. Higher levels of forgiveness can help individuals move away from negative emotions associated with unforgiveness, enhancing positive emotions and promoting physical and mental well-being. Forgiveness is related to a decrease in physiological arousal and an increase in positive emotion and psychological well-being (Lawler et al., 2005). Most Chinese studies suggest a significant positive correlation between forgiveness and positive emotion (Chen et al., 2017; Gao et al., 2022). Individuals with forgiveness have higher subjective well-being, greater life satisfaction, more positive emotions, and fewer negative emotions, making forgiveness an effective tool for resolving conflicts in interpersonal relationships. Based on the aforementioned relationships between the variables, this study proposes the following hypotheses:

> *Hypothesis 1 (H1)*: Physical activity is positively correlated with emotional intelligence.
>
> *Hypothesis 2 (H2)*: Physical activity is positively correlated with interpersonal forgiveness.
>
> *Hypothesis 3 (H3)*: Emotional intelligence is positively correlated with interpersonal forgiveness.
>
> *Hypothesis 4 (H4)*: Emotional intelligence is positively correlated with positive emotion.
>
> *Hypothesis 5 (H5)*: Interpersonal forgiveness is positively correlated with positive emotion.

### 2.2.2 The mediating effects

Adolescents with higher levels of positive emotion can foster creativity, subjective well-being, emotional control, and healthy interpersonal development (Fredrickson, 2004), thereby enhancing their learning efficiency and academic performance in school (Singh et al., 2012). Numerous studies indicate that regular participation in physical activity can elevate positive emotions in adolescents, concurrently enhancing their emotional intelligence, strengthening interpersonal relationships, improving academic performance, and

reducing the risk of mental health problems (Skurvydas et al., 2021; Li et al., 2022). Engaging in physical activity has a positive impact on the physical and mental well-being of adolescents, not only contributing to the establishment of positive interpersonal relationships but also elevating their emotional intelligence, enabling better control of negative emotions (Acebes-Sánchez et al., 2019). Moreover, adolescents with higher emotional intelligence are better able to forgive others, facilitating constructive handling of negative emotional reactions to others' wrongdoing (Acebes-Sánchez et al., 2019). Emotional intelligence, beneficial for character influences on mental health, promotes positive emotions in adolescents, thereby contributing to healthier interpersonal relationships (Ruvalcaba-Romero et al., 2017; Guerra-Bustamante et al., 2019).

Rey and Extremera (2014) propose that individuals with higher emotional intelligence can better reduce retaliatory motives, maintain positive relationships with offenders, and establish positive interpersonal relationships. Adolescents with stronger forgiveness abilities are more likely to experience positive emotions. Therefore, this study posits the following mediating hypothesis.

> *Hypothesis 6 (H6)*: Emotional intelligence and interpersonal forgiveness mediate the relationship between physical activity and positive emotion.

A summary of all hypotheses is presented in Figure 1.

# 3 Methodology

## 3.1 Participants and procedure

The research targeted adolescents aged 12 to 18. From late August to mid-September 2023, the researcher distributed paper questionnaires in four schools in the Xiangxi Tujia and Miao Autonomous Prefecture of Hunan Province, China. All students participated voluntarily, and parental informed consent was obtained before their involvement. As a token of appreciation, each participating student received a notebook upon completing the questionnaire. A total of 500 adolescents from 10 schools were selected for the survey, and 428 valid questionnaires were collected, resulting in an effective response rate of 85.6%.

Table 1 presents demographic information for the 428 participating adolescents, including age range, gender, types of physical activities, and weekly exercise frequency. The demographic statistics in Table 1 reveal that nearly 64.6% of the sample falls within the age range of 16 to 18. Additionally, the survey achieved a balanced representation of both genders. The adolescents' exercise preferences were predominantly in basketball, soccer, and badminton. Lastly, 48.8% of the adolescents reported not engaging in physical activities on a weekly basis.

## 3.2 Instruments

The questionnaire comprises five sections. The first section gathers information on respondents' age, gender, types of sports activities, and weekly exercise frequency. The second section utilizes the Physical Activity Scale developed by Sallis et al. (1985), encompassing three items. Sample items include "During the past week, I actively participated in various forms of moderate physical activity, including tasks like sweeping and mopping, as well as engaging in sports such as volleyball, Ping-Pong, and similar activities." The third section collects respondents' emotional intelligence data using a scale developed by Davies et al. (2010), consisting of five items. Sample items include "I easily recognize my emotions as I experience them." The fourth section gathers respondents' interpersonal forgiveness data using a scale developed by McCullough et al. (1998), comprising four items. Sample items include "I wish that something bad would happen to them; I want to see them hurt and miserable." Lastly, the fifth section collects data on respondents' positive emotion, employing a scale developed by Diener et al. (2010), with five items. Sample items include "I lead a purposeful and meaningful life." All four scales are measured using a five-point Likert scale, with response options ranging from 1 (i.e., strongly disagree, disagree) to 5 (i.e., strongly agree, agree).

To adapt to the Chinese cultural background and context, the researcher made some modifications to certain items in the scales. We removed some items from the scale due to their redundancy and similarity; we only retained items that differed significantly in content. For example, in the scale measuring positive emotions, there were two very similar statements: "I lead a purposeful and meaningful life" and "I am a good person and live a good life." We ultimately retained "I

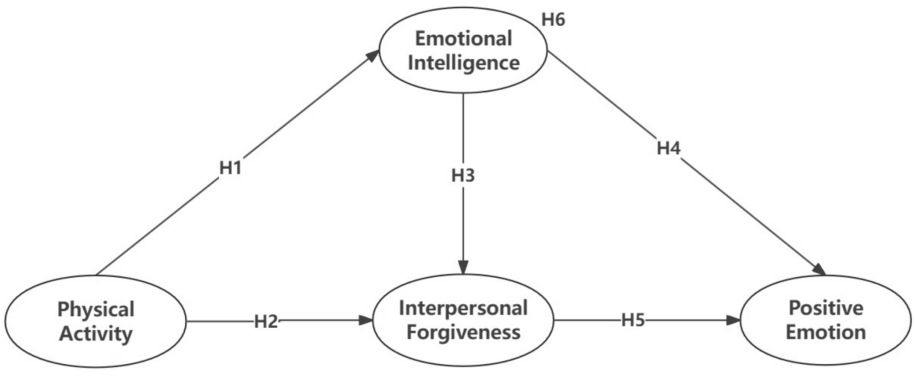


FIGURE 1
The hypothesized model.

TABLE 1 Participant profile ($N = 428$).

| Profiles | Survey (%) |
|---|---|
| Age | |
| 12–15 | 35.4 |
| 16–18 | 64.6 |
| Gender | |
| Male | 51.8 |
| Female | 48.2 |
| Sporting event | |
| Basketball | 28.5 |
| Soccer ball | 20.2 |
| Volleyball | 14.1 |
| Run | 12.3 |
| Badminton | 17.1 |
| Others | 7.8 |
| The frequency of exercise each week | |
| 0 | 48.8 |
| 1–2 | 27.5 |
| 3–4 | 14.9 |
| 5–7 | 8.8 |

lead a purposeful and meaningful life" because this item alone effectively captures whether respondents are enjoying and are satisfied with their lives. Reducing repetitive questions was crucial to avoid respondent fatigue and resistance, which can occur when participants perceive questions as overly similar.

To ensure the changes did not compromise the reliability and validity of the questionnaire, a pilot test was conducted prior to the main data collection. This pilot test involved a total of 82 participants, and the results were promising. The Cronbach's alpha coefficients for the revised scales exceeded 0.8, indicating high internal consistency and confirming the appropriateness of the modifications. This pilot testing was essential not only for verifying the effectiveness of the item reductions but also for ensuring that the revised items were suitably adapted to the cultural context without altering their original intent.

## 3.3 Data analysis

This study employed AMOS v23 to construct a Structural Equation Model (SEM) to examine how adolescents enhance positive emotions through physical activity. Maximum Likelihood (ML) estimation was used to estimate the model parameters. Prior to conducting the ML estimation, the normality of data was assessed to validate the assumption of normal distribution, which is essential for the accuracy of ML estimation. Skewness and kurtosis values were examined for all variables involved in the study. According to commonly accepted guidelines, the absolute value of skewness should be less than 3, and the absolute value of kurtosis should be less than 7 to consider the distribution as normal (Kline, 2005). In this study, the absolute values of skewness ranged from 0.082 to 1.168, and the absolute values of kurtosis ranged from 0.047 to 1.202, all of which are well within the recommended thresholds. Therefore, it can be concluded that the data conforms to a normal distribution, ensuring that these values were within acceptable ranges for assuming normality in the subsequent analyses.

The two-step modeling approach was adopted to assess both the measurement and structural models (Anderson and Gerbing, 1988). The first step involved a comprehensive evaluation of the model's reliability and validity. Subsequently, fit coefficients and path coefficients of the hypothesized model were measured, and the existence of the mediating effects was examined.

The researcher checked for Common Method Variation (CMV) by comparing the chi-square values and degrees of freedom differences between Model 1 and Model 2, following the suggestion of Mossholder et al. (1998). The results showed that the chi-square value for Model 1 was 2871.1, with 119 degrees of freedom, and a $p$-value less than 0.001. For Model 2, the chi-square value was 187.5, with 113 degrees of freedom, and a p-value less than 0.001. The ratio of the chi-square difference to the degrees of freedom difference between the two models was 447.3, indicating that the fit of Model 1 was proportional to Model 2. Therefore, it can be concluded that there is no evidence of univariate structure, suggesting that CMV does not exist in this study.

# 4 Results

## 4.1 Assessment of the measurement model reliability and validity

This study examined reliability and discriminant validity by calculating the Composite Alpha (Cα) and Composite Reliability (CR) coefficients for latent variables (Fornell and Larcker, 1981). As presented in Table 2, the Cα coefficients for each variable range between 0.861 and 0.964, with CR values exceeding 0.8 on average, and the Average Variance Extracted (AVE) for each variable falls between 0.624 and 0.844. Therefore, all variables demonstrate high reliability and convergent validity. Additionally, as indicated in Table 3, the correlation coefficients for all variables are lower than the square root of AVE, suggesting robust discriminant validity among the variables.

## 4.2 Hypothesis testing results

Firstly, the structural equation model's error and residual terms did not exhibit negative values, indicating that the model did not violate estimation principles. Secondly, both the data and the structural equation model demonstrated high goodness of fit ($\chi^2$/df = 2.233, GFI = 0.938, AGFI = 0.917, NFI = 0.969, RMSEA = 0.051), significantly surpassing recommended thresholds. Thirdly, according to the Pearson correlation results in Table 3, there were significant correlations among the independent, mediating, and dependent variables, supporting the validation of the hypotheses. Fourthly, the structural path model in Figure 2 illustrated that the relationships between physical activity and emotional intelligence ($\beta = 0.574$, $p < 0.001$, supporting H1), physical activity and interpersonal forgiveness ($\beta = 0.352$, $p < 0.001$, supporting H2), emotional intelligence and interpersonal forgiveness ($\beta = 0.493$, $p < 0.001$,

TABLE 2 Reliability and validity test.

| Items | Loadings | Cα | AVE | CR |
|---|---|---|---|---|
| Physical activity (PA) | | 0.861 | 0.684 | 0.866 |
| PA1 | 0.844 | | | |
| PA2 | 0.846 | | | |
| PA3 | 0.745 | | | |
| Emotional intelligence (EI) | | 0.963 | 0.825 | 0.949 |
| EI1 | 0.954 | | | |
| EI2 | 0.877 | | | |
| EI3 | 0.920 | | | |
| EI4 | 0.878 | | | |
| EI5 | 0.947 | | | |
| Interpersonal forgiveness (IF) | | 0.866 | 0.624 | 0.868 |
| IF1 | 0.883 | | | |
| IF2 | 0.779 | | | |
| IF3 | 0.748 | | | |
| IF4 | 0.734 | | | |
| Positive emotion (PE) | | 0.964 | 0.844 | 0.964 |
| PE1 | 0.936 | | | |
| PE2 | 0.923 | | | |
| PE3 | 0.897 | | | |
| PE4 | 0.931 | | | |
| PE5 | 0.905 | | | |

Cα, Cronbach's alpha; AVE, average variance extracted; CR, composite reliability.

TABLE 3 Pearson correlations and square roots of AVE for discriminant validity test.

| Construct | Physical activity (1) | Emotional intelligence (2) | Interpersonal forgiveness (3) | Positive emotion (4) |
|---|---|---|---|---|
| 1 | **(0.827)** | | | |
| 2 | 0.523** | **(0.908)** | | |
| 3 | 0.544** | 0.637** | **(0.790)** | |
| 4 | 0.625** | 0.641** | 0.574** | **(0.919)** |

The square root of the average variance extracted (AVE) is in the diagonals (bold); off diagonals is a Pearson's correlation of contracts. **$p < 0.01$.

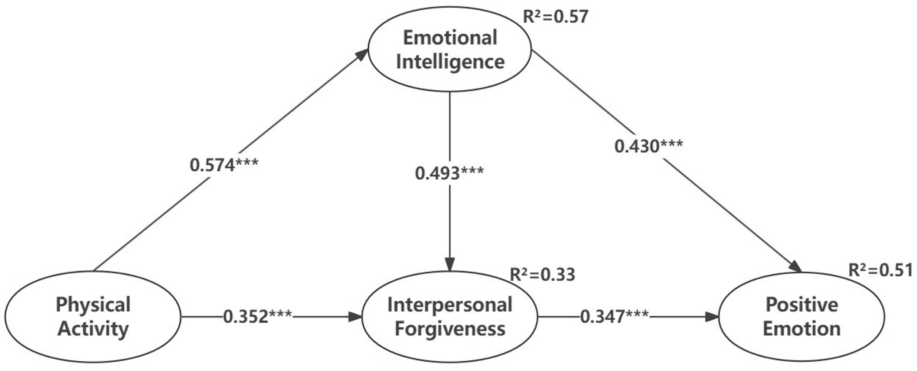


FIGURE 2
Structural path model. ***$p < 0.001$. Standardized coefficients are reported.

TABLE 4 Indirect effects.

| | Point estimate | Product of coefficients | | Bootstrapping | | |
|---|---|---|---|---|---|---|
| | | | | Bias-corrected 95% CI | | Two-tailed significance |
| | | *SE* | *Z* | Lower | Upper | |
| PA → EI → IF→PE | 0.467 | 0.045 | 10.378 | 0.378 | 0.554 | <0.001 |
| PA → EI → PE | 0.171 | 0.041 | 4.171 | 0.205 | 0.387 | <0.001 |
| PA → IF→PE | 0.283 | 0.046 | 6.152 | 0.100 | 0.262 | <0.001 |

Standardized estimations of 5,000 bootstrap samples.

supporting H3), emotional intelligence and positive emotion ($\beta = 0.430$, $p < 0.001$, supporting H4), and interpersonal forgiveness and positive emotion ($\beta = 0.347$, $p < 0.001$, supporting H5) were all statistically significant.

Researchers hypothesized that physical activity affects positive emotion through both emotional intelligence and interpersonal forgiveness, and the study utilized bootstrapping to test the mediating effects (Bollen and Stine, 1990). The standardized results of the 5,000-bootstrap samples with a 95% confidence interval are presented in Table 4: the absolute values of the *Z*-statistics for the PA → PE mediating effect exceeded 1.96, indicating no zero values within the 95% confidence interval. Additionally, emotional intelligence and interpersonal forgiveness significantly influenced the relationship between physical activity and positive emotion (standardized indirect effect = 0.467, $p < 0.001$), supporting H6. The findings suggest that students with higher levels of physical activity, emotional intelligence, and interpersonal forgiveness also exhibit higher levels of positive emotion.

# 5 Discussion

## 5.1 Theoretical contribution

This study makes several contributions to the theory of adolescent mental health. Firstly, existing research predominantly focuses on the impact of physical activity on adolescents' anxiety (Reddy et al., 2018), depression (Young et al., 2019; Tran et al., 2023), sleep quality (Shen et al., 2018; Albrecht et al., 2022) and physical health (Godoy-Cumillaf et al., 2023). The direct exploration of positive emotions in adolescents is relatively scarce. By investigating the influence of physical activity on adolescents' emotional intelligence, interpersonal forgiveness, and positive emotions, this study addresses a critical research gap. It provides a solid theoretical foundation for the relationship between physical activity and interpersonal forgiveness, offering a more targeted perspective and enriching the theoretical research in positive psychology. The study posits that positive emotions in adolescents can promote physical activity, and in turn, positive physical activity motivations can enhance their positive emotions—a mutually reinforcing process conducive to the holistic development of adolescents' mental and physical well-being.

Moreover, this research takes a step further by primarily intervening in physical health courses in school sports to enhance adolescents' positive emotions. It offers a theoretical basis for the practical implementation of physical activity interventions among adolescents. Adolescents, facing academic pressure, parental expectations, competition, and complex interpersonal relationships during puberty, often have limited time for physical activity. The reduction in physical activity makes it challenging for them to achieve the full benefits for health promotion (Sallis, 2000). Therefore, they require more theoretical guidance for practice. The study reveals that participation in physical activity has a profound impact on adolescents' positive emotions. Engaging in sports not only improves their emotional management skills but also enhances their interpersonal forgiveness abilities, contributing to the establishment of positive interpersonal relationships.

Secondly, the results of this study establish a solid theoretical foundation for the positive effects of physical activity on adolescents' emotional intelligence, interpersonal forgiveness, and positive emotions. It is noteworthy that physical activity has the greatest impact on emotional intelligence, followed by interpersonal forgiveness. This observation can be attributed to the mediating roles that emotional intelligence and interpersonal forgiveness play in the relationship between physical activity and positive emotions. While physical activity directly influences adolescents' positive emotions, it also indirectly affects their positive emotions by influencing levels of emotional intelligence and interpersonal forgiveness. Figure 2 visually illustrates the relationships between these variables, supporting the findings of Chan et al. (2019) and Ubago-Jiménez et al. (2019), revealing that emotional intelligence and interpersonal forgiveness jointly explain 51% of the variance in positive emotions. This study provides a promising pathway for researching the relationship between physical activity and positive emotions.

## 5.2 Practical implications

Given the significant impact of physical activity on adolescents' emotional and interpersonal well-being as identified in our study, it is critical that concerted efforts are made across various societal domains to promote physical activities among this demographic. These efforts should be multifaceted, addressing not only the availability of opportunities for physical activity but also the quality and inclusivity of these opportunities.

Firstly, government authorities should recognize the pivotal role of physical activity in enhancing the overall health of adolescents. Elevating the status of physical education in school curricula, increasing the weightage of sports in exams, and incorporating physical education into high school education are essential steps. Encouraging policymakers to integrate positive practices into school curricula as effective and easily implementable tools for enhancing adolescent mental health is imperative. Government departments should actively enact policies, urging and incentivizing adolescents to actively engage

in physical activities, enhancing their physical fitness. Additionally, enhancing regulation of physical education in schools ensures effective implementation of policies rather than merely fulfilling formalities. Financial and logistical support from the government to schools is vital to ensure adequate resources for the development of sports programs. Furthermore, public awareness campaigns should be initiated to promote the benefits of sports activities and elevate public awareness of sports culture.

Secondly, schools should actively implement government regulations and policies, translating the emphasized issues into tangible actions. Schools need to shift from a purely academic evaluation system to prioritize holistic education. Many schools in China tend to prioritize students' academic performance, neglecting their physical health development, leading to the phenomenon of physical education classes being frequently replaced by other subjects. This significantly reduces adolescents' physical activity time, impacting their overall development. Focusing on the development of school sports, increasing the proportion of physical education courses, and providing sufficient time for physical activity during school hours are essential. Schools should also enhance the training of physical education teachers and improve the quality of physical education courses. Diversifying the content of physical education courses, adapting teaching methods to individual students, and encouraging students to collaborate, communicate, and actively participate in sports activities are crucial. To address the issue of inadequate facilities and equipment, schools should increase investment in sports culture construction, ensure the allocation and management of basic facilities such as sports venues and equipment, creating a conducive environment for students' physical education and extracurricular activities.

Thirdly, family awareness of the concept of sports plays a crucial role in adolescents' participation in physical activities. The family is a key factor in interventions aimed at enhancing adolescents' self-awareness capabilities. Parents' self-awareness is closely related to the extent of children's participation in sports activities. Therefore, parents should establish correct educational values, actively collaborate with schools in implementing physical education programs, and encourage adolescents to participate in diverse extracurricular sports activities. Moreover, parents should strive to create a positive sports atmosphere at home, actively supporting and encouraging adolescents to engage in physical activities, participating in sports together, fostering healthy sports habits, and instilling awareness of lifelong physical fitness.

### 5.3 Limitations

However, despite the positive contributions of this study, it is not without limitations. Firstly, it is a cross-sectional study, preventing us from drawing conclusions about causation. Therefore, longitudinal studies should delve deeper into examining these relationships. Additionally, we recommend that future research employs longitudinal designs to validate the findings of our cross-sectional study. Secondly, the sample used and its size also limit the generalizability of the results. Furthermore, this study primarily focused on a sample of Chinese adolescent students, highlighting the need for an understanding of cultural differences when exploring similar topics. Thirdly, this study did not ask respondents to record the number of days they engage in physical activities, which may affect the accuracy of our assessment of the relationship between exercise frequency, intensity, and positive emotions. Future research should consider collecting more detailed data on physical activity, including duration, frequency, and intensity, to more accurately analyze the impact of physical activity on psychological health. Fourthly, to simplify the questionnaire and reduce respondent fatigue, several items with similar expressions were removed from the scale. Although this decision was based on the redundancy among these items, future research should determine whether to delete or retain items. This could include more comprehensive pilot testing or statistical analysis to ensure that such modifications do not compromise the reliability or validity of the scale. We also recommend that subsequent studies explore the impact of these changes across different cultural contexts to validate the universality and applicability of the scale. Additionally, incorporating these detailed dimensions could further reveal the specific effects of physical activity on emotional intelligence and interpersonal forgiveness, providing a theoretical basis for developing more effective intervention measures.

## 6 Conclusion

Addressing the research objectives, the results of this study underscore the significant impact of physical activity on the emotional intelligence, interpersonal forgiveness, and positive emotions of adolescents. Therefore, it is crucial for governmental bodies, schools, and families to collaboratively foster the comprehensive development of the physical and mental well-being of adolescents.

In conclusion, the results of this study confirm the positive impact of physical activity on the emotional intelligence of adolescents, as well as its positive influence on interpersonal forgiveness, laying the theoretical foundation for future research on the relationship between physical activity and interpersonal forgiveness. Moreover, physical activity has been proven to have a positive effect on the positive emotions of adolescents. Through collaborative efforts from the government, schools, and families, a conducive environment and conditions can be created to promote the physical and mental health growth of adolescents.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by Ethics Committee of the School of Physical Education of Hunan University of Science and Technology (No. ECBPEHNUST 2023/0011). The studies were conducted in accordance with the local legislation and institutional

requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

## Author contributions

SY: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. LJ: Investigation, Resources, Writing – original draft, Writing – review & editing. QH: Resources, Supervision, Writing – original draft, Writing – review & editing. HW: Conceptualization, Funding acquisition, Project administration, Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study was supported by the Hunan Provincial Social Science Committee (No. XSP21YBZ163).

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 28 May 2024
DOI 10.3389/fpsyg.2024.1385289



OPEN ACCESS

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RECEIVED 28 February 2024
ACCEPTED 03 May 2024
PUBLISHED 28 May 2024

CITATION
Ghorbanzadeh B, Kirazci S and Badicu G (2024) Comparison of the effect of teaching games for understanding, sport education, combined and linear pedagogy on motor proficiency of children with developmental coordination disorder. *Front. Psychol.* 15:1385289. doi: 10.3389/fpsyg.2024.1385289



# Comparison of the effect of teaching games for understanding, sport education, combined and linear pedagogy on motor proficiency of children with developmental coordination disorder

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**Introduction:** The prevalence of developmental coordination disorder (DCD) is increasing and it has been shown that the main problem of children with DCD is their low motor proficiency. Therefore, it is important to find a way to improve motor skills in these children. Thus, this study aimed to compare the effect of teaching games for understanding (TGFU), sport education (SE), combined (TGFU and SE), and linear pedagogy (LP) on motor proficiency of children with DCD.

**Methods:** In this regard, among 7-year-old children in Turkey, 80 children were selected voluntarily and by evaluating the MABCD-2 test. These children were randomly placed in four-LP (control), SE, TGFU, and combined (SE-TGFU) groups and practiced futsal exercises for 16 sessions under the supervision of coaches specific to each method. BOT-2 short-form test was used to evaluate motor proficiency.

**Results:** The results of the analysis of the covariance test showed that the group effect is significant, and the results of the *post hoc* LSD test showed a significant difference between the LP with SE, LP with TGFU, LP with combination, SE with TGFU, SE with combination and TGFU with combination groups ($p = <0.001$).

**Discussion:** Based on the results of this study, the combined method is the best compared to other methods. Generally, combining games as an important activity in childhood with SE that emphasizes improving the child's self-esteem is a method that can solve the movement competence that is the main problem of DCD children and lead them to continue physical activity.

KEYWORDS

**developmental coordination disorder, linear method, sports education method, teaching games for understand method, combined method, motor skills**

# 1 Introduction

Some children perform poorly in motor skills and daily activities compared to their peers; based on the Diagnostic Statistical Manual (DSM) of American Psychiatric Association (2013), this problem is called developmental coordination disorder (DCD) (Vahia, 2013). According to DSM criteria, these children's motor competence is lower than children without the disorder, and it is difficult for them to enjoy physical activity because they do not believe in their abilities (Hendrix et al., 2014). Children with DCD are not independent in their work and avoid physical activity (Lloyd et al., 2006). Although DCD receives less attention than other developmental disorders, its impact can be severe and long-lasting (Hill and Barnett, 2019). This issue is important because DCD is recognized as a neurodevelopmental disorder based on the latest report of the DSM-5 (DSM-5) (Hill and Barnett, 2019).

International estimates show that the prevalence of this disorder is about 6% of school children with an emphasis on boys (American Psychiatric Association, 2013). Studies in England, Germany, the Netherlands, and Canada indicate a prevalence of 2.5–7.7% of DCD in children (Lingam et al., 2010; Blank et al., 2011; Baghernia and Mohammadizadeh, 2012; American Psychiatric Association, 2013). The prevalence of this disorder in Turkey boys is high, which is twice the ratio compared to girls (Tunçtürk et al., 2019). Children with this disorder have characteristics such as delay in the development of motor skills, inability to perform school activities and daily life, and finally, inability to perform sports and motor proficiency (Kirby and Sugden, 2007).

For the age group of 7–10 years, movement is a practical way to achieve complex motor skills, professional sports skills, and daily life. This period is one of the most important periods of life in consolidating movement, fundamental, and manipulation skills (Ozmun and Gallahue, 2016). However, for children with DCD, performing normal daily activities and school, especially motor proficiency, is a major challenge (American Psychiatric Association, 2013; Bieber et al., 2016). DCD children's biggest problem is the low score of motor proficiency (American Psychiatric Association, 2013). Low motor proficiency is related to self-esteem and physical activity eventually leads to obesity and overweight, which endangers the child's health in the future (Stodden et al., 2008; Ozmun and Gallahue, 2016). Therefore, it is important to try to improve the motor proficiency of DCD children. It has been shown that motor interventions have been a successful way to improve the motor proficiency of children with DCD (Crova et al., 2014; Farhat et al., 2015). However, the main issue in children with movement disorders is how to teach movement interventions (Ebrahimi Tavakolian et al., 2020). In this regard, games can be used because children enjoy it (Butler and McCahan, 2005).

One of the games is teaching games for understanding (TGfU), which is a representation of a real game with simpler rules (Butler and Griffin, 2010). TGfU is a new model introduced by Bunker and Thorpe as an alternative to the traditional skill-based approach to teaching sports skills; besides, TGFU has attracted the attention of many teachers, educators, and researchers (Werner et al., 1996). Game-based approaches such as TGFU introduce simple game tactics first, and skill practice comes next upon demand. In the TGFU approach, what should be done comes first, and the necessary training is provided before the way to do it (Tan, 2018). In this method, communication between tactics and techniques that aim to promote intelligent and skillful performance is suggested (Ríos et al., 2019). This type of game can be very effective for creating excitement in children and motivating them to continue the activity by raising self-esteem and motor competence (Ríos et al., 2019).

There is another model in physical education teaching, known as sports education (SE). The SE model aims to create competent and enthusiastic students (Siedentop et al., 2011). According to Kirk (2013), it is an evidence-based instructional model in which teachers focus on student learning facilitated through constructivist instruction through six features: (1) goals are organized, (2) children become members of teams to have a commitment to the team, (3) in the form of a game, competition between teams is created, (4) each person in the team has a role, (5) training and games are recorded, and (6) there is a celebration in times of victory (Carlson and Hastie, 1997). As a result, the SE learning environment can help teachers promote students' motivation because students have social opportunities, make decisions, and enjoy competition, these are very valuable conditions in terms of effort levels and improve children's motor competence by increasing children's physical activity (Carlson and Hastie, 1997).

In recent years, studies have introduced TGFU and SE games as useful exercise programs (Healey and Mendelsohn, 2019). However, studies show that both TGFU and SE methods have advantages and disadvantages. For example, TGfU and SE share several aims, concepts, and educational processes. In addition, learning in these models is based on constructivist theories of learning (Dyson et al., 2004).

However, there are also differences between the two models. For example, while SE focuses on a formal and developing sports experience in which students play roles other than players, TGFU focuses on developing the communicative aspects of techniques and tactics and designing assignments accordingly (Casey, 2012). For this reason, each model has limitations when used separately (Hastie and Curtner-Smith, 2006). Nevertheless, a combined TGfU/SE model may yield higher-quality academic and behavioral outcomes (Hastie and Curtner-Smith, 2006). In support of this issue, recently, studies have shown that the combination of TGFU and SE has a greater effect on variables such as creativity (Davoodi et al., 2021) than when each method of SE or TGFU is presented alone. However, despite the claims of these studies (Ríos et al., 2019), it has not been determined experimentally what effect their combination has on the motor skills of DCD children, which are the basis of success in team sports. Therefore, in this study, we included boys with DCD disorder in four traditional groups (control group), SE, TGFU, and combined for 8 weeks and two sessions per week in futsal team sports interventions to find the best type of training to improve the motor competence/proficiency of DCD children. This study aimed to compare the effect of games for understanding, game training, combined, and linear on motor skills of children with developmental coordination disorder. Therefore, it is assumed that the combined intervention has better effectiveness compared to other interventions for children with developmental coordination disorder.

# 2 Materials and methods

The current research applied an experiment, a pre-test-post-test research design with a control group. The statistical population of this study was all 7-year-old children in Türkiye, Ankara. *A priori* power

TABLE 1 Demographic characteristics of the participants.

| Variable | Total $N = 80$ $M \pm SD$ | Linear $N = 20$ $M \pm SD$ | SE $N = 20$ $M \pm SD$ | TGFU $N = 20$ $M \pm SD$ | Combined $N = 20$ $M \pm SD$ |
|---|---|---|---|---|---|
| Age | 7.37 ± 1.12 | 7.1 ± 1.25 | 7.44 ± 1.21 | 7.17 ± 1.02 | 7.8 ± 1.03 |
| Weight | 21.25 ± 2.16 | 21.23 ± 2.09 | 20.04 ± 3.47 | 22.01 ± 1.54 | 21.72 ± 1.56 |
| Height | 119.77 ± 2.51 | 118.42 ± 2.67 | 121.09 ± 1.22 | 119.44 ± 3.44 | 120.15 ± 2.74 |

analysis ($\alpha = 0.05$, $1\text{-}\beta = 0.80$, $f = 0.40$) (Mohammadi Orangi et al., 2021) indicated that at least 76 subjects are required. Therefore, 80 participants were selected for this study.

## 2.1 Participants

All participants of this study were boys and were selected from Ankara schools. The average age of the subjects was 7.37 and their standard deviation was 1.12 (see Table 1). The criteria for entering the study are (1) 7-year-old children with developmental coordination disorder, (2) having physical and mental health based on children's health records other than DCD, and (3) providing written consent of parents. After the approval of the proposal, the code of ethics[1] was obtained for this work, and written consent was received from all parents; 1 year, all of them received sports insurance from the authors.

## 2.2 Measuring tool

Movement Assessment Battery for Children-2 (MABC-2) test was used to diagnose motor coordination disorder. This is an effective tool for diagnosing developmental coordination disorder, which has also been used in previous studies (Caçola et al., 2016; Smits-Engelsman et al., 2020). This test is designed to evaluate the motor perception ability of people aged 3–16 and is a suitable test for diagnosing developmental coordination disorder. In this test, hand dexterity, ball skills, and balance are evaluated. In this test, the cut-off point of less than 5% is considered as disordered people, namely, individuals whose scores are less than or equal to 56 in this test. The MABC-2 test has a reliability and validity above 80% in the original version (Chow and Henderson, 2003; Brown, 2021), and Turkey version (Kerkez, 2013).

BOT-2 Bruininks-Oseretsky Test of Motor Proficiency Ed. 2 (short form) was used to measure motor proficiency. The overall set of this test includes 8 sub-tests (4 sub-tests in the group of gross movements, 3 sub-tests in the group of fine movements, and 1 sub-test of upper body coordination) 46 items including a wide profile of high-quality movement skills from separate measures of gross and fine movement skills. The test set provides a comprehensive index of motor proficiency as well as individual scales of fine and gross motor skills for 4–21-year-olds. The duration of the long form is 45–60 min and the short form is 15–20 min. The short form, which contains 14 items from the full collection, can be used as a quick screening tool. This test has the necessary validity and reliability so that the reliability coefficient of its scores in the examination of motor skills was equal to 90%. The retest reliability coefficient of this test is reported as 0.78 in the long form and 0.86 in the short form. The short form measures an individual's motor skills in general, and the total score indicates the overall skill including gross and fine skills (Bruininks and Bruininks, 2005). This test has also been used in previous studies to measure motor skills (Köse et al., 2021). For this study, standard scores were considered and the total score was the criterion (Mohammadi Orangi et al., 2018).

## 2.3 Procedure

This study was conducted in 2023 and its process started in June. In the first stage, the proposal of this work was approved by the university and permission to carry out the research was obtained. Then a letter was sent from the university to the Ministry of Education to cooperate with this project. Then schools were selected as available to do this. The MABC-2 test was conducted to select children with developmental coordination disorder by a motor behavior specialist who had experience with this test. Then 96 individuals from 15 schools were identified as children with DCD. Of these, 16 individuals were excluded due to reasons such as lack of parental consent for the intervention, having other disorders such as hyperactivity, etc., and finally, 80 male students were randomly divided by one of the researchers into four linear groups of 20 individuals (control), SE, TGFU and combined.

Then each group received futsal training from their coach who had experience in each of the methods. The groups were trained outside the school environment and in a predetermined hall for the children of this study. In this regard, briefing sessions were also held for the trainers before and during the training, and the authors went to the training sessions on a regular basis to ensure that the training was going according to the purpose of the study. These interventions were held as 16 sessions in 8 weeks (see Table 2) and the pre-test and post-test were taken by different people. These people were motor development experts who were completely familiar with how to evaluate motor skills with the BOT-2 test.

## 2.4 Intervention

In the traditional training method, each skill was taught separately and feedback was used to improve performance. Children were trained with the teacher's opinion, and the tasks after learning were taught separately and combined. In this method, finally, after the subjects learned all the materials, the teacher practiced all the tasks together in a game (Crespo et al., 2004; Supriadi, 2019). For example, to practice passing in futsal, the coach would show the skills to the students in the first stage. In the next step, the learners were asked to repeat the pattern. At this stage, the trainer tried to

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TABLE 2 General forms of education (adapted from Davoodi et al. (2021), CC BY-NC 4.0).

| Weeks | 1- LP | 2- TGFU | 3- SE | 4- Combined |
|---|---|---|---|---|
| 1 | Introduction of skills | Choosing the easiest skill | Determining the role of subjects | Getting to know and choosing a simple skill and giving a role to the subjects |
| 2 | Presentation of the patern | Designing a group game to learn the selected skill | Selection of skills based on the role of subjects | Game design based on the role of subjects |
| 3 | Pattern repetition by subjects | Adjusting the game based on the strengths and weaknesses of the subjects | Setting short-term and long-term goals | Adjusting the game to achieve the set goals |
| 4 | Providing feedback to individual subjects | Adding a more complex skill | Offering a reward to children who do the skill correctly | Combining skills and encouraging successful children |
| 5 | Changing learned skills based on group average progress | Game design for two combined skills | Changing roles and introducing new skills | Changing roles to suit the combined skills |
| 6 | Providing feedback for weaker people to practice more | Introducing a new skill and game design for it | Creating competition between groups | Game in the form of a race to reach the set goal |
| 7 | Making the skill harder based on group average progress | Introducing a new skill and game design for it | Changing roles based on changing skills and training for it | Introducing a new skill and giving a role to teach that skill to friends |
| 8 | Reducing feedback in proportion to group progress and encourage to complete skills | The combination of the four introduced skills with the designed game | Creating quizzes for all skills learned | Encouraging and rewarding all children and designing a game in which everyone wins, for example, dividing the players into two teams without a goal and the criterion of getting the ball from each other |

bring the students' skills closer to the desired pattern with verbal feedback.

In the TGFU teaching method, children learn all the tasks and skills from the beginning in the form of games. In this method, first, simple tasks were practiced in the form of a game, and then skills were integrated in the form of a game so that all the time of the child was spent in the game. In the SE method, competitive games, celebration for victory, giving a role to each of the children, and organizing the goal for the whole exercise, which the children were also aware of, were done. The combined method was the combination of these two methods (Gil-Arias et al., 2017). For example, in the first stage, the trainer classified the skills from simple to complex. For example, if we consider passing, the coach first considered simple passing and designed a game for this skill. So that he prepared balls for the number of players and told the students to face each other pass the ball to each other and change their places quickly. These types of games were varied according to the creativity of the coach and were combined with the progress of the individual. In this method, no model was given and no feedback was used, and whenever the instructor determined that all learners learned the skill (performing the skill with high proficiency), the combination game and complex skills were considered (see Table 2), in which, based on age, each row was trained in two sessions (Gil-Arias et al., 2017).

These exercises were presented for 2 months during 16 sessions and each session lasted one and a half hours. The linear group and SE trained on Saturdays and Mondays from 1:30 to 3 p.m. and from 3 to 5:30 p.m., respectively, and the combined group and TGFU trained at the same time on Sundays and Tuesdays. Finally, the post-test was taken 1 day after the last training session of each group and the results were analyzed.

## 2.5 Statistical method

The demographic information of the subjects was checked and compared by a one-way statistical test. ANOVA test was used for inferential statistics. To check the normality of the data, the Kolmogorov–Smirnov test was used, and before analyzing the data, the hypotheses of the ANOVA statistical test were checked. All statistical works were analyzed in SPSS-24 software at the level of 0.05. Effect sizes smaller than 0.06 were considered small, between 0.06 and 0.14 as moderate, and larger than 0.14 as large (Mohammadi Orangi et al., 2021).

# 3 Results

Kolmogorov–Smirnov test showed that the data are normal at the level of >0.05. The results of the one-way ANOVA test showed no significant difference between the groups in terms of height ($p = 0.38$, $F = 0.11$), weight ($p = 0.44$, $F = 0.08$), and age ($p = 0.32$, $F = 0.05$). Table 3 shows the results of the MABC-2 test. Accordingly, all participants had DCD. Table 4 shows the descriptive information on movement skills in different groups.

The analysis of the covariance method was used to analyze the data and to control the pre-test effect, and the LSD *post hoc* test was used to check the difference between groups. The results are shown in Tables 5, 6. As shown, the effect of the pre-test is not significant, but the effect of the group is significant. In this regard, the results of the follow-up test showed a significant difference between the linear group with SE, linear with TGFU, linear with combination, SE with TGFU, SE with combination, and TGFU with the combination ($p < 0.001$), and according to the descriptive information in Table 4, the experimental group that combined TGFU and SE teaching methods

have the greatest effect on motor skills, and then TGFU, SE, and LP groups are listed, respectively.

## 4 Discussion

This study aimed to compare the effect of games for understanding, game training, combined, and linear on motor skills of children with developmental coordination disorder. The results of this study showed that the combined method of SE and TGFU was better than other groups in the post-test. This is even though at the initial test, no significant differences were observed between the 4 investigated groups (3 experimental and 1 control) in terms of motor proficiency. Finally, although there was an improvement in all groups from pre-test to post-test. However, this improvement has been more in the combined group. However, by the standard table of the BOT-2 test (Bruininks and Bruininks, 2005), the post-test scores of all four groups are lower than the fifth percentile rank, which shows that they still have developmental coordination disorder. Nevertheless, the combined group has a better and above average condition considering people with developmental coordination disorder. Based on the authors' information, no study has been conducted on the effect of TGFU, combined, SE, and linear methods on the motor skills of DCD children; nonetheless, the study of Davoodi et al. (2021) considers TGFU studies a suitable method in education.

For example, Norouzi Seyed Hoseini and Seyed Hossieni (2017) considered TGFU better than the linear method for learning the volleyball serve and Santos et al. (2017) introduced playing games as an effective method for improving creativity. Davoodi et al. (2021) and Davoodi et al. (2023) also considered the combined method (SE, TGFU) and TGFU as a suitable method for creativity and motor skills. However, in the field of motor skills of DCD children, the present study is the first study to be conducted.

To explain the results of this study, it can be said that in the SE method, some advantages such as giving a role to the child and celebrating the victory can be decisive in the child's independence and self-confidence (Raiola, 2017). However, this method may be harmful at times when the child does not have much role in the game (Gil-Arias et al., 2017). The researchers emphasize that victories and roles in this method should be periodic so that all children can participate in it (Gil-Arias et al., 2017). Nevertheless, the main issue is for meetings where the child does not play a role, and because the world of childhood has its own rules and children are living, these moments of transition can be effective for their learning and growth (Raiola, 2017). Therefore, combining the SE method with a method that emphasizes games can be helpful (Gil-Arias et al., 2017). Combining the TGFU method with the SE method is helpful for children. Because children need to enjoy training. Therefore, behavioral science scientists emphasize that the training environment should be happy and satisfying for children to enjoy it (Dyson et al., 2004). In addition, the type of practice should be such that the child is not judged by other learners and only enjoys the practice. One of the effective ways to implement this is the use of games. In the games, in addition to the fact that the child is involved in the game and does not feel the passage of time, he does not care about the performance of others and is only playing (Dyson et al., 2004). In this case, the child is immersed in the activity, and based on Stodden et al. (2008) model, this activity improves motor skills in the person. When a person's motor skill improves, he finds himself competent and this increases his motivation to continue the activity. This is an issue that Harter (2000) has also mentioned. Thus, the increase in motor competence increases the self-esteem in the individual and this itself causes the child to continue the activity (Harter, 2000). Therefore, the game helps the child to improve his self-esteem by improving motor skills. This issue is also evident in this study and it was shown that the combined method is the best compared to other methods. Combining games as an important activity in childhood with SE education methods that emphasize improving the child's self-esteem is a method that can solve the movement competence that is the main problem of DCD children and lead them to continue physical activity. In general, the results of this study showed that childhood is formed by games and games shape children's world, however, combining games with methods such as SE has better results.

The strength of this study was the comparison of TGFU, combined, SE, and linear methods in DCD children; previous studies either compared only one of these methods with the linear method or focused on normal children. The main limitation of this study is the short duration of the interventions. In addition, the interventions of this study were not standardized and the educators had freedom of action for the interventions. Also, different people have carried out

TABLE 3 Descriptive statistics related to MABC-2 test.

| Group | *N* | *M* | SD |
|---|---|---|---|
| LP | 20 | 36.47 | 4.25 |
| SE | 20 | 34.52 | 2.62 |
| TGFU | 20 | 35.35 | 3.5 |
| Combine | 20 | 37.4 | 4.43 |

TABLE 4 Descriptive information of the motor proficiency in the pre-test and post-test of BOT-2 test based on standardized scores.

| Variable | Group | *N* | Pre test $M \pm SD$ | Post test $M \pm SD$ |
|---|---|---|---|---|
| Motor proficiency | Linear | 20 | 23.1 ± 2.26 | 26.75 ± 2.29 |
| | SE | 20 | 22.6 ± 1.72 | 30.09 ± 2.84 |
| | TGFU | 20 | 23.35 ± 1.71 | 33.65 ± 2.27 |
| | Combine | 20 | 23.40 ± 2.13 | 39.7 ± 4.45 |

TABLE 5 The results of covariance analysis for the motor proficiency post-test.

| Variable | Test | Mean square | DF | *F* | *p*-value | Eta | Statistical power |
|---|---|---|---|---|---|---|---|
| Motor proficiency | Pre test | 0.144 | 1 | 0.015 | 0.904 | 0.001 | 0.89 |
| | Group | 584.75 | 1 | 58.93 | 0.002 | 0.702 | 0.104 |
| | Error | 9.922 | 0.75 | | | | |

TABLE 6 Result of LSD.

| Group (I) | Group (J) | Mean difference (I-J) | SD | *p*-value |
|---|---|---|---|---|
| LP | SE | −4.16 | 1 | <0.001 |
| | TGFU | −6.89 | 1 | <0.001 |
| | Combine | −12.94 | 1 | <0.001 |
| SE | TGFU | −2.73 | 1 | <0.001 |
| | Combine | −8.78 | 1 | <0.001 |
| TGFU | Combine | −6.04 | 1 | <0.001 |

initial and final evaluations using BOT-2. However, these people were specialists who were completely familiar with how to evaluate motor skills with the BOT-2 test. Finally, daily variations in children's mental and physical state may have (also) contributed to the potentially positive changes in motor skills. Therefore, it is suggested to carry out similar research in the future considering the limitations of the study and the retention test.

## 5 Conclusion

In general, any method that is associated with the game can be suitable for improving motor proficiency. Children must play an active role in training and playing. Therefore, the combination of TGFU and SE method has the characteristics of good exercise and helps the child to improve his motor proficiency. Based on the results of this study, the combination of the TGFU and SE teaching method is the best method for improving the motor proficiency of DCD children compared to TGFU, SE, and linear methods.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by the Middle East Technical University Human Research Ethics committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

## Author contributions

BG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. SK: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. GB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 26 June 2024
DOI 10.3389/fpsyg.2024.1433835



OPEN ACCESS

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RECEIVED 16 May 2024
ACCEPTED 06 June 2024
PUBLISHED 26 June 2024

CITATION
Patenteu I, Gawrych R, Bratu M, Vasile L, Makarowski R, Bitang A and Nica SA (2024) The role of psychological resilience and aggression in injury prevention among martial arts athletes.
*Front. Psychol.* 15:1433835.
doi: 10.3389/fpsyg.2024.1433835



# The role of psychological resilience and aggression in injury prevention among martial arts athletes

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**Introduction:** For martial artists, the ability to manage reactions in the face of adversity and bounce back after a stressful event can have major impact on performance. The scope of the research is to investigate martial artists' level of resilience and aggression (Go-ahead, Foul play, and Assertiveness factors), what is specific to athletes and who have suffered from moderate and/or severe injuries (in terms of resilience and three factors of aggression examined), and test the possibility that a psychological variable under investigation can predict athletes' injury severity.

**Materials and methods:** A total sample of 154 athletes from striking combat sports—SC (karate, taekwondo, kickboxing, and boxing), grappling combat sports—GC (judo and BJJ), and mixed martial artists (MMA) participated in the research. For assessing resilience, the Romanian adaptation of the Brief Resilience Scale (BRS) was used, and for aggression, the Romanian adaptation of Makarowski's Sports Aggression Questionnaire was used. An injury report form was also created and applied to athletes.

**Results:** The post-hoc tests (after running a single-factor multivariate analysis of variance) revealed significant differences for resilience and Foul (violent) play between the sports disciplines analyzed. A significant positive correlation was found between athletes' injury severity and assertiveness in SC and between injury severity and resilience in GC. Through the *t*-test for independent samples, it was highlighted that the average value for Foul (violent) play is significantly higher in athletes who have suffered mild, moderate, and/or severe injuries compared with martial arts athletes who have suffered from only mild/minor injuries. A binomial logistic regression was also performed to verify to what extent Foul play predicts athletes' injury severity.

**Conclusion:** A low level of Foul (violent) play is linked with a decreased likelihood of moderate and/or severe injuries in martial arts athletes. The study findings suggest that resilience, foul play, and assertiveness have an important role in injury prevention among martial artists.

KEYWORDS
resilience, sports injury, martial arts, aggression, assertiveness

## 1 Introduction

As heuristic sport disciplines and direct contact with the opponent, martial arts require fast decisions under stressful situations, mental toughness, and creativity under un-certainty (Predoiu et al., 2018). Researchers underlined the importance of practicing martial arts to promote ethics, moral values, and social development of practitioners (Fukuda et al., 2011; Kostorz and Sas-Nowosielski, 2021a). However, there may be times when the win-at-all-costs philosophy (way of thinking that can manifest regardless of age and level of training) can facilitate the manifestation of hostile aggression and violence (Urzeală and Teodorescu, 2018), making sports injuries more likely.

Martial arts can be divided into Striking Combat sports—SC (e.g., karate, boxing, Muay Thai, kenpō, kick-boxing, and taekwondo), Grappling Combat sports—GC (e.g., judo, freestyle wrestling, and BJJ), as in previous study (Predoiu et al., 2022a), while Mixed Martial Arts (MMA) involve techniques from both striking and grappling fighting styles (Miarka et al., 2019). In addition, Kalina (2000) argued that "every combat sport is martial arts but not vice versa" (p. 18).

A question that has aroused the interest of specialists relates to the association between martial arts athletes' injury severity and their level of sports performances. For example, during low-level competitions, a higher frequency of injuries was reported (Frey et al., 2004). However, in a recent study, authors found no significant link between the two variables (martial arts athletes were investigated separately, from SC, GC, and MMA) (Patenteu et al., 2023). Interestingly, in 2012, Kazemi argued that in elite taekwondo athletes, injuries before competition were related to a 30% increase in medal prevalence (although not statistically significant) (Kazemi, 2012).

Considering the definition of sports injuries, we will present the following: "damage or a wound caused to a person's body" (Dictionary of Sport and Exercise Science, 2006); "any sports-related musculoskeletal complaint that resulted in an athlete to stop, limit, or modify participation for one or more days" (Li et al., 2015). After exploring the existing data in the literature (Caine and Maffulli, 2005; Piedade et al., 2021), we may conclude that in the case of minimum 2–3 weeks missed/time loss from training or competition, we can discuss about (at least) a moderate injury. Injuries are very important stressors encountered by athletes, being classified in the category (of stressors) linked to competitive performance (Sarkar and Fletcher, 2014). Therefore, on the road to great sports results, athletes' resilience/ability to positively cope with difficult events (and overcome them) is essential.

Coming from mammalian adaptation literature, resilience (as a basic definition) refers to an organism's ability to adapt to one's life-preserving capability when confronted to stressful conditions (Kent et al., 2013). In the case of humans, psychological resilience represents the mental ability that helps people withstand emotional, cognitive, or physical difficulties (Everly et al., 2015), being a psychological phenomenon that operates at multiple levels (Masten et al., 2021). In their systematic review of resilience across sports and work, after conducting a frequency word analysis, researchers found that most definitions included concepts such as bouncing back (cf. rebound), positive adaptation, and maintenance of well-being (in face of adversity) (Bryan et al., 2019). Resilience is not only the ability to bounce back from failure or challenges but also the ability to be stronger (mentally or physically) and obtain superior results in the task performed (Fletcher and Sarkar, 2013). Therefore, resilience facilitates learning, development, recovering and growth (Shi et al., 2019), authors discussing about, growth following adversity in competitive sport" (Howells et al., 2017).

According to the sporting resilience meta-model (Gupta and McCarthy, 2022), the biopsychosocial protective filter makes its mark on adversity, determining a lower or a higher disruption in athletes. More resilient athletes will return faster to their sports performance (after a disruption), while less resilient athletes (having fewer biopsychosocial resources to bounce back after failure) are likely to experience negative sports results followed by further negative performances in competitions (Bejan-Mureșan and Cinpeanu, 2019). Moreover, considering the grounded resilience theory (Fletcher and Sarkar, 2012), protective factors such as perceived social support, confidence, motivation, focus, and positive personality (resources that are influenced by challenge appraisals and metacognitions) contribute to resilience in successful athletes. In sports field, psychological variables associated with maintaining or building resilience were identified, the most important being (Bryan et al., 2019) as follows: self-efficacy, coping skills, support, perspective, motivation, optimism, self-regulation, hardiness, and positive mindset.

Social support and coping skills must interact to increase resilience and reduce distress associated with sports injuries (Smith et al., 1990). Investigating athletes with spinal cord injury, researchers highlighted multiple types of social support, behavioral and cognitive coping strategies, and motivation to adapt as important resources to increase athletes' resilience (Machida et al., 2013). Galli and Gonzalez (2015) mentioned that only recently specialists and practitioners have begun to investigate the construct of resilience within the sport environment. Psychological resilience was examined between current and former high-level athletes (Galli and Vealey, 2008) and various competitive athletes, for example, swimmers (Morgan et al., 2013), handball and soccer players, or futsal teams (Mummery, 2008). In a recent article, resilience level of athletes (including martial artists from striking combat sports—boxing, karate, fencing, kickboxing, taekwondo, and grappling combat sports—judo) was investigated in relation to the Big Five personality factors (Rawat et al., 2023).

With respect to martial artists, resilience is positively influenced by athletes' schooling level and practice time and affected by psychoticism, in this last situation athletes being less likely to experience high degrees of resilience (da Gama et al., 2018). Psychological resilience has the potential to mitigate the negative effect of distress and exhaustion in martial arts athletes (judokas were examined) (Jo, 2016), while in the case of taekwondo, adolescent practitioners contribute to performance, more exactly, "psychological skills work positively between resilience and performance" (Yang

et al., 2019). When talking about preadolescents, martial arts-based interventions significantly increased resilience level (Moore et al., 2021).

It was found that psychological resilience is an essential factor linked with recovery time (and not only) following sports-related concussions: low resilience values predict protracted recovery (Ernst et al., 2022) and were related to higher scores for depressive symptoms and anxiety during recovery (Bunt et al., 2021). Resilience was also linked with adjustment and adaptation for persons faced with acquired brain injury (Neils-Strunjas et al., 2017), while positive reframing, optimism, athletes' informational social support, and injury centrality represent predictors for sport injury-related growth (Pollak et al., 2022). There is a gap in the literature considering the resilience level of martial arts athletes (also, investigated separately from SC, GC, and MMA) and its link with athletes' injury severity in competitions.

The second psychological variable examined in the present study in relation to martial arts athletes' injury severity is explicit aggression (measured primarily through questionnaires), different from implicit aggression, which is observed as a "result of automated processes that can be assessed with indirect measurement tools (e.g., Implicit Association Test)" (Predoiu et al., 2022b). Researchers present aggression as a person's behavior aimed at causing pain (the stimulus could be physical, a gesture, or verbal) (Klimczak et al., 2014). Therefore, by definition, aggression supposes the intent to produce harm/damage to another person. In these conditions, it is probable that the incidence of injury in a specific sports discipline to be linked to the amount of aggression involved in that sports. For example, rugby, hockey, soccer, MMA, and other contact sports "are likely, by their very nature, to produce injuries, whereas sports that are less aggressive such as golf and tennis are less likely to do so" (Pedersen, 2007). These results were confirmed by Pedersen (2007) that the probability of a severe injury is the highest in football, followed by boxing, hockey, rugby, gymnastics, and wrestling (16 sports branches were investigated).

However, in sports, aggression has a positive connotation (Cashmore, 2008), most of the time being instrumental (see, for example, Silva for instrumental and hostile aggression—Silva, 1983), athletes manifesting it to achieve the objective set (e.g., to win/dominate in a competition or to score in a certain situation) (Predoiu et al., 2022a). The level of training or training duration cannot significantly influence the degree of aggression in martial artists (Kostorz and Sas-Nowosielski, 2021b). Anger, verbal reactions, dominance behavior during competition, and physical violence are all forms in which aggression can manifest. To win inevitably, martial arts athletes must act aggressively, but this type of aggression is accepted socially (in the context of respecting the rules of the game) (Vít et al., 2019).

Following a systematic review which addressed psychological factors that influence the severity of sports-related concussions (Trinh et al., 2020), a gap considering the aggression level of martial artists in relation to injury severity persists. For example, a higher level of aggression and negative emotionality were related to an increased incidence of sports-related concussions (football players were examined in this case) (Klotz et al., 2017). However, other authors underlined that footballers' aggression has less influence on their head impacting exposure as compared with other factors (Marks et al., 2022). In addition, aggressive tennis players, exposing more in competitions, are more likely to get injured (Aggression scale of the Factor Personality Inventory—FPI was used) (Keller et al., 2013). In the case of anger (a factor of aggression, see Buss and Perry, 1992), it was linked with higher incidences of athletic injuries (Galambos et al., 2005), but no combat sports athletes were included in the sample. This is particularly important that in martial arts, a higher level of anger facilitates sports performance (Terry and Slade, 1995; Wargo et al., 2007), an aspect that cannot be asserted when talking about other sports disciplines (Maxwell et al., 2009).

In the current study, we investigated the following three factors of aggression: Go-Ahead, Assertiveness, and Foul Play, with respect to Ryszard Makarowski's model (Makarowski et al., 2021). Foul (violent) play is the closest to the definition of aggression presented in the current study (see Klimczak et al., 2014), referring to the manifestation of violent game strategies to harm and block the opponent, even in an unethical manner (including "dirty" play). Go-Ahead factor refers to the perseverance in achieving objectives despite numerous obstacles. Athletes reach their goals, sometimes regardless of the costs (they tend to observe obstacles as challenges). Regarding assertiveness in sports, it is the ability to behave decisively within appropriate boundaries, to voice criticism (critical feedback), and to express emotions and thoughts directly and firm. An assertive athlete respects the rules in competition which can lead to success (Bredemeier, 1994).

Therefore, the purpose of the current research was to investigate the level of resilience and aggression (Go-Ahead, Foul play, and Assertiveness) in competitive martial arts athletes, according to the practiced sports discipline. In the present study, we refer to grappling combat sports, striking combat sports, and striking and grappling combat sports (Mixed Martial Arts, which combines techniques from both fighting styles), as in previous studies (Predoiu et al., 2022b; Patenteu et al., 2023). At the same time, we wanted to capture the differences between martial arts athletes who have suffered at least medium severity injuries (minimum 2–3 weeks missed/time loss from training or competition) and athletes who have not suffered such sports injuries up to the time of testing (in terms of resilience and aggression). Not least, we verified whether the resilience level and the aggressive behavior can predict injury severity in martial artists.

The present research is part of a broader study, being a continuation of research aimed at identifying psychological variables that predict injury severity in martial arts (see Patenteu et al., 2023, where trait anxiety and risk-taking behavior were investigated in relation to martial arts athletes' injury severity).

## Objectives

- Establishing the level of resilience and aggression in martial artists;
- Knowing the links between athletes' level of aggression, resilience, and martial arts athletes' injury severity;
- Identifying the differences between athletes, in terms of resilience and aggression, taking into consideration martial artists' injury severity;
- Knowing predictors of injury severity in the case of martial arts athletes.

In the current study, it was hypothesized that:

a. There are significant differences between martial arts athletes according to the specifics of the sports disciplines (striking combat sports, grappling combat sports, respectively, striking and grappling—MMA), in terms of resilience and aggression;
b. There are significant correlations between athletes' injury severity and martial arts' level of resilience and aggression.
c. Investigation of martial arts athletes who have suffered mild, moderate, and/or severe injuries and athletes who have suffered only minor/mild injuries reveals significant differences between the two groups in terms of resilience level and aggressive behavior.
d. The results for aggression represent a predictor of injury severity among martial arts athletes.

# 2 Materials and methods

## 2.1 Participants and procedure

One hundred and fifty-four Romanian competitive martial arts athletes, affiliated at different sports clubs in Romania, male ($n = 132$) and female ($n = 22$), aged between 20 and 32 years, were participated in the study. The participants are the same martial arts athletes involved in the previous study (Patenteu et al., 2023). The questionnaires for assessing resilience and aggression were applied via Google forms (Google LLC, Mountain View, CA, United States) between March 2022 and September 2022. To clearly understand, the characteristics of the participants (and reduce the repetitive nature of data related to sample characteristics) and the descriptive statistics of surveyed martial arts and combat sports athletes can be accessed through the following hyperlink— Descriptive statistics of surveyed martial arts athletes (Patenteu et al., 2023).

The following sample characteristics are the same as in the previous study: competitive experience (M = 8.39, SD = 3.10—in the entire sample); inclusion criteria—(a) athletes having minimum 20 years old, (b) minimum 4 years of experience in competitions, (c) minimum 12 official fights/year, and (d) without severe injuries prior to the examined period (January 2018–December 2021). We mention that 19 athletes were removed from the research following the last inclusion criteria (from the 188 athletes who completed the questionnaires in the initial phase of the research), the reasoning behind this decision being related to the possible fear of reinjury (Cassidy, 2006), or anxiety associated with return to play (Bennett and Lindsay, 2016). These challenges (for martial artists), when returning from serious injuries, can affect future behaviors during competitions. Therefore, "a relatively similar level in terms of the severity of injuries suffered by athletes at time $t_0$" (Patenteu et al., 2023) was assured.

On the other hand, 15 martial arts athletes were removed from the study due to the (c) inclusion criteria. We mentioned that during the pandemic, "martial arts competitions were organized in Romania (and televised) but without spectators. Only athletes and coaches had access in the competition hall, and they were previously tested against COVID-19" (Predoiu et al., 2022a) (each martial arts athlete who participated in the study had a minimum of 12 official fights/year during the first year of the COVID-19 pandemic). The mean, at group level, was 16.8 matched per year (SD = 1.79).

In the study by Li et al. (2015), in the situation of a recurrent injury, it was counted once (this is the case of 16 athletes, who had the same moderate injury twice). In addition, in the case of 47 martial artists who suffered from a severe injury (30.5% of participants), the minimum 12 fights/year (inclusion criteria c) were counted from the first official match after recovery (because these athletes, following the severe injury, were out from competitions for months). Injuries were counted in the last 4 years (during January 2018–December 2021), being a retrospective study. The snowball sampling technique was used, as in the previous research (Patenteu et al., 2023).

## 2.2 Measures

Aggression was measured with the Romanian adaptation of the Makarowski's Sports Aggression Questionnaire (Makarowski et al., 2021) (the norms are the same for male and female martial arts athletes). It consists of 15 items arranged into three subscales (five items for each subscale): Foul play (e.g., I think that "anything goes" rule is appropriate to achieve the victory), Assertiveness (e.g., I'm not afraid to speak up to my supervisor or coach, if I know that he/she is wrong), and Go-Ahead (e.g., There is no argument that would turn me away from reaching my goal). The martial artists indicated their responses using a five-point Likert-type scale, where "a" = Definitely not (1 point), "e" = Definitely yes (5 points), "c" = Hard to say (3 points), "b" = Probably not (2 points), and "d" = Rather yes (4 points). In the current research, reliability for the three factors/subscales, measured with McDonald's omega coefficient ($\omega$), was 0.71 (Go-Ahead), 0.74 (Foul Play), 0.75 (Assertiveness), respectively.

To assess resilience, the Romanian adaptation of the Brief Resilience Scale (BRS) was used (Alexe et al., 2022). BRS consists of six items to which martial arts athletes answered by choosing a response option from 5 to 1, where 5 = Total Agreement and 1 = Total Disagreement. The questionnaire has three reverse scoring items. The higher the values obtained, the higher the degree of athletes' resilience. Item example:" I tend to bounce back quickly after hard times" (Smith et al., 2008). In the Romanian adaptation, BRS" revealed that adequate fit-indexes" and" suitable values were also obtained for reliability and convergent validity" (Alexe et al., 2022). In the current research, McDonald's $\omega$ reliability coefficient was 0.78. BRS was used in previous research on martial artists (Kuçuk Kiliç, 2020).

The injury report form (consisting of 10 close- and open-ended questions) realized starting from investigation by Willick et al. (2013), and the results obtained are the same as in the previous research (Patenteu et al., 2023) because the same martial artists were examined as explained at *Participants and Procedure* subsection. Therefore, data regarding age, gender, sports discipline practiced, competitive experience, and the highest sports performance obtained were gathered, as well as data regarding the number of official fights/year (January 2018–December 2021) and athletes' injury severity (examples of types of injuries were given to be selected, and also, blank spaces where athletes could fill in the type of injury suffered). Not least, martial arts athletes were asked about a severe injury suffered before January 2018 (response options Yes/No—question related to the inclusion criterion d). Athletes in this research suffered moderate or severe injuries only in competitions/official matches (however, mild/

minor injuries were suffered also inevitably during training and competition).

The Desirability Scale of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) was also used. Following the application of this scale [ZKPQ is calibrated on the Romanian population (Miclea et al., 2009)], no athlete was removed from the study (no martial arts athlete exceeds the threshold set by the Desirability Scale), meaning that the responses were not distorted and the likelihood of inappropriate answers was very low.

## 2.3 Research design

The investigation is based on *ex post facto* design—the analysis started (the online surveys were applied) after the fact has occurred, martial art athletes already suffered certain injuries (between January 2018–December 2021) and obtained various sports results in competitions, without interference from the researchers (is a retrospective research).

## 2.4 Statistical analysis

First, using stem-and-leaf and boxplots, data were screened for outliers (Tabachnick et al., 2013). Then, descriptive statistics were used through means and standard deviation. After that, MANOVA was used to see whether the results for resilience and the three factors of aggression differ significantly according to the practiced sports discipline. Because Box M is insignificant, we therefore refer to Wilk's Lambda test value, while according to Levene's test results, Scheffe post-hoc test (when equality of variance was assured—$p > 0.05$) and Tamhane post-hoc test (when $p < 0.05$), respectively, were interpreted (Popa, 2010). Then, Pearson correlation was used to verify the associations between variables, with the effect size index (coefficient of determination—$r^2$) interpretation: 0.25 (a large effect), 0.09 (a moderate effect), and 0.01 (small effect) (Cronk and Cronk, 2020). In case of the Independent Samples *t*-test, the normality of the distributions was checked using the skewness coefficient, this value being less than 1 (Morgan et al., 2004). Data analysis also involved the use of binomial logistic regression, Nagelkerke $R^2$ effect size having the following interpretation: 0.2 small, 0.15 medium effect size, and 0.35 large (Cohen, 1992). IBM SPSS Statistics 27.0 (Armonk, NY, IBM Corp) and Jamovi (for calculating McDonald's omega reliability coefficients) were used.

# 3 Results

Table 1 shows the descriptive statistics (in the case of resilience and the three factor of aggression) by sports discipline: striking combat sports ($n = 64$), grappling ($n = 39$), and MMA ($n = 51$).

The analyses in Table 1 show (in the case of the investigated martial artists and at group level) a moderate level of resilience, a slightly below average level for Go-ahead factor, a low level of Foul (violent) play, and an average level of Assertiveness (according to the norms).

Through one-way MANOVA, we verified the significant differences between martial artists from SC, GC, and MMA, in terms of resilience and aggressive behavior. The linearity condition was ensured (for the multivariate analysis of variance procedure); the correlations were observed between the investigated variables being weak and very weak. Box M test value is 0.064 (insignificant); therefore, Wilk's Lambda test value was reported: $F(8, 296) = 2.701$, $p = 0.007$, Wilk's Lambda = 0.869. With respect to the Test of Between-Subjects Effects, the sports discipline significantly influences the results for resilience ($F = 4.683$, $p = 0.011$, Partial Eta Squared = 0.058) and Foul play ($F = 4.122$, $p = 0.018$, Partial Eta Squared = 0.052) (see Table 2).

TABLE 1 Descriptive statistics by sports discipline ($n = 154$).

| Variables | Sport disciplines | Results | |
|---|---|---|---|
| Resilience | SC | Mean | 3.7159 |
| | | SD | 0.53181 |
| | GC | Mean | 3.4333 |
| | | SD | 0.53214 |
| | SC and GC (MMA) | Mean | 3.7710 |
| | | SD | 0.58425 |
| Go-ahead | SC | Mean | 17.83 |
| | | SD | 3.757 |
| | GC | Mean | 16.90 |
| | | SD | 3.538 |
| | SC and GC (MMA) | Mean | 17.65 |
| | | SD | 3.230 |
| Foul Play | SC | Mean | 8.03 |
| | | SD | 3.285 |
| | GC | Mean | 6.72 |
| | | SD | 2.051 |
| | SC and GC (MMA) | Mean | 8.61 |
| | | SD | 3.595 |
| Assertiveness | SC | Mean | 17.53 |
| | | SD | 4.309 |
| | GC | Mean | 18.10 |
| | | SD | 3.648 |
| | SC and GC (MMA) | Mean | 18.96 |
| | | SD | 3.939 |

SC, Striking combat sports; GC, grappling combat sports; MMA, mixed martial arts.

In the case of Foul play, considering homogeneity of variances, $p < 0.05$ (Levene's test), the Tamhane post-hoc test was interpreted, while Scheffe test results were presented for the other dependent variables (DVs).

The next step was to check the existing associations between injury severity and athletes' level of resilience and aggression.

With respect to martial artists' injury severity: 4 = athletes suffered 1 or 2 moderate injuries +1 severe injury, 3 = martial artists suffered only 1 severe injury, 2 = athletes had (during the investigated period) 1 or 2 moderate injuries, and 1 = only mild/minor injuries. Table 3 contains only the significant correlations highlighted.

Table 3 underlines a significant link between injury severity and assertiveness (in striking combat sports), respectively, and

TABLE 2 Results for the post-hoc tests single-factor multivariate analysis of variance.

| DVs | | (I) Discipline | (J) Discipline | MD (I-J) | *p*-value |
|---|---|---|---|---|---|
| Resilience | Scheffe | SC | GC | 0.2826 | 0.043* |
| | | | SC and GC (MMA) | −0.0550 | 0.868 |
| | | GC | SC | −0.2826 | 0.043* |
| | | | SC and GC (MMA) | −0.3376 | 0.017* |
| | | SC and GC (MMA) | SC | 0.0550 | 0.868 |
| | | | GC | 0.3376 | 0.017* |
| Go-ahead | Scheffe | SC | GC | 0.93 | 0.434 |
| | | | SC and GC (MMA) | 0.18 | 0.963 |
| | | GC | SC | −0.93 | 0.434 |
| | | | SC and GC (MMA) | −0.75 | 0.609 |
| | | SC and GC (MMA) | SC | −0.18 | 0.963 |
| | | | GC | 0.75 | 0.609 |
| Foul Play | Tamhane | SC | GC | 1.31 | 0.042* |
| | | | SC and GC (MMA) | −0.58 | 0.758 |
| | | GC | SC | −1.31 | 0.042* |
| | | | SC and GC (MMA) | −1.89 | 0.007* |
| | | SC and GC (MMA) | SC | 0.58 | 0.758 |
| | | | GC | 1.89 | 0.007* |
| Assertiveness | Scheffe | SC | GC | −0.57 | 0.784 |
| | | | SC and GC (MMA) | −1.43 | 0.171 |
| | | GC | SC | 0.57 | 0.784 |
| | | | SC and GC (MMA) | −0.86 | 0.607 |
| | | SC and GC (MMA) | SC | 1.43 | 0.171 |
| | | | GC | 0.86 | 0.607 |

SC, striking combat sports; GC, grappling combat sports; MMA, mixed martial arts; MD, mean difference, *$p < 0.05$.

TABLE 3 Pearson correlation between resilience, aggression, and athletes' injury severity.

| Injury severity | | | Resilience | Go-ahead | Foul play | Assertiveness |
|---|---|---|---|---|---|---|
| Striking combat sports | | | | | | |
| Assertiveness | *r* | 0.411* | | | | |
| | *p* | 0.019 | | | | |
| Go-ahead | *r* | | | | 0.519** | |
| | *p* | | | | 0.002 | |
| Grappling combat sports | | | | | | |
| Resilience | *r* | 0.451* | | | | |
| | *p* | 0.031 | | | | |
| Go-ahead | *r* | | 0.465* | | 0.552** | |
| | *p* | | 0.025 | | 0.006 | |
| Striking and Grappling (MMA) | | | | | | |
| Go-ahead | *r* | | 0.660*** | | 0.540** | |
| | *p* | | <0.001 | | 0.001 | |

*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

between injury severity and resilience (in grappling combat sports). A higher assertiveness score is associated with a higher injury severity in SC (the effect size $r^2 = 0.17$), and a higher resilience score (athletes recover more quickly after a difficulty) is associated with a higher injury severity in GC ($r^2 = 0.20$). Regarding the confidence interval (95%), lower limit = 0.184 and upper limit = 0.596 (SC), while lower limit = 0.158 and upper limit = 0.671 (GC).

In addition, the results (Table 3) highlight a positive correlation between Foul (violent) play and Go-ahead, in the case of each sport category: SC, GC, and MMA. As the athlete scores are higher on Go-ahead factor, this is linked with a higher probability of violent behaviors in competition (athlete may break the rules and, therefore, could lose points or could even be disqualified). In addition, a positive correlation was found between resilience and Go-ahead scores in both grappling combat sports and MMA.

To verify the third hypothesis, Independent Samples *t*-test was used (DVs were normally distributed, the skewness coefficient, in absolute value, being less than 1).

Data in Table 4 emphasize that the average value for Foul (violent) play is significantly higher [$t = 4.20$, $p < 0.01$] in athletes who have suffered mild, moderate, and/or severe injuries (M = 8.28, SD = 2.15), compared with martial arts athletes who have suffered only mild/minor injuries (M = 6.93, SD = 1.73). The effect size index (Hedge's *g*) is 0.66, meaning a moderate to strong difference between the results.

Knowing that Foul play factor is specific to martial arts athletes who have suffered at least one moderate injury, and in order to verity our fourth hypothesis, a binomial logistic regression was performed to examine to what extent the mentioned psychological variable predicts athletes' injury severity. Table 5 contains the main data of the logistic regression analysis.

The binomial logistic regression analysis highlights that the model is significant: Omnibus test—Model, $p < 0.01$, chi-square value—$\chi^2(1) = 17.219$. Considering the Hosmer and Lemeshow goodness of fit test, the *p*-value is 0.995 (chi-square = 0.394), meaning that the model is not a poor fit. In the case of martial artists, the results for Foul (violent) play can predict injury severity during competitions. The model correctly classified 63.6% of cases (overall percentage). The effect size index (Nagelkerke $R^2 = 0.142$) shows a moderate relation between Foul play and athletes' injury severity. As an example, according to PRE_1 column (automatically generated in SPSS when running the logistic regression), an athlete having 12 points for Foul play has 85.7% probability of suffering a moderate and/or a severe injury during competitions, a martial arts athlete obtaining 6 points has a 42.8% probability, while with 5 points this probability decreases at 37%.

It was underlined that a low level of Foul (violent) play is linked with a decreased likelihood of moderate and/or severe injuries in martial artists.

## 4 Discussion

In the current research, martial artists registered a moderate level of resilience, a low level of Foul play, a slightly below average level for Go-ahead factor, and an average level of Assertiveness (at group level). In addition, specialized literature mentioned that martial arts athletes' resilience (karate practitioners) was at mid-level (Kuçuk Kiliç, 2020) (BRS was used). Considering assertiveness, it was found that male athletes in individual sports (including taekwondo, judo, and wrestling) registered high values; however, only 32% of athletes, in the entire sample, were martial artists (Yetis, 2016).

In addition, the present study found that martial arts practitioners from SC and MMA, respectively, are significantly more resilient and score significantly higher on Foul (violent) play compared with athletes from GC. In other words, athletes in SC and MMA recover more easily after a failure or a difficult situation in life/sports career, while being more willing to win at any cost (even in an unethical way) compared with martial artists in GC. In this context, we find interesting results of Pedersen (2007) when the perceived likelihood to produce a career-ending injury was investigated; boxing (a SC) was more rated than wrestling (a GC). We point out that in the case of SC and MMA athletes, the score for the Foul play dimension is at a low level (at group level). In contrast, for the group of athletes from GC, the score is at a low to very low level.

In the next phase, the existing associations between injury severity, resilience, and athletes' aggression level were investigated. A significant link between injury severity and assertiveness (in striking combat sports), respectively, between injury severity and resilience (in grappling combat sports) was observed. A higher assertiveness score is associated with a higher injury severity in SC, and a higher resilience value (athletes recover more quickly after a difficulty) is associated with a higher injury severity in GC. Assertiveness is particularly useful in interpersonal relationships, with coaches, sports psychologists, physical trainers, peers, or referees, for the quality of relationships with interdisciplinary team members (and not only), but athletes also express firmly, honestly what they feel or think, without hurting others. In competition, however, in the SC, we observe that a higher level of assertiveness predisposes athletes to injuries. In sports, "harm may be a consequence of assertive behaviors, but it is not the intent" (Pedersen, 2007). Regarding assertion, there is "(1) no intent to harm, (2) use of legitimate force, (3) no anger-unusual effort and energy expenditure" (Cox, 1990). Looking in context, we recommend that in striking combat sports, during competition/fighting, athletes should manifest a higher level of anger which appears to facilitate athletes' performance (Terry and Slade, 1995; Wargo et al., 2007) and focus less on assertive behavior.

Resilience is essential in achieving sports performance, sports field being a stress-generating environment (Mellalieu et al., 2009), athletes having to face mental pressure specific to competitions, but also the "opponent inside" (e.g., fear of injury, of failure, different types of anxiety) (Predoiu et al., 2016). Resilience helps athletes thrive when

TABLE 4 Athletes who have suffered mild, moderate, and/or severe injuries ($n = 87$) and athletes who have suffered only mild/minor injuries ($n = 67$).

| DV's | Levene's test F *p* | | *t* | df | *p*-value | Confidence interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| Resilience | 0.002 | 0.962 | −0.310 | 152 | 0.757 | −0.210 | 0.153 |
| Go-ahead | 0.001 | 0.969 | −0.382 | 152 | 0.703 | −1.357 | 0.917 |
| Foul play | 2.65 | 0.105 | 4.20 | 152 | <0.01 | 0.716 | 1.985 |
| Assertiveness | 0.079 | 0.779 | 0.406 | 152 | 0.689 | −1.066 | 1.542 |

TABLE 5 Binomial logistic regressions analysis—Foul (violent) play as a predictor.

| | Foul (violent) play |
|---|---|
| Omnibus test—Model | <0.01 |
| Hosmer and Lemeshow test (*p*-value) | 0.995 |
| Nagelkerke $R^2$ | 0.142 |
| Overall percentage (Predicted—Percentage correct) | 63.6 |
| Wald test | 13.428 |
| B | 0.359 |
| SE | 0.094 |
| Odds ratio values | 1.432 |
| Confidence interval for Exp(B) | 1.191–1.722 |

dealing with adversities (Gonzalez-Mendez et al., 2023) and plays an important role in the injury rehabilitation process (Codonhato et al., 2018), being characterized by optimism, self-esteem, self-efficacy, and sense of control (Bonnano, 2004; Windle, 2011). It was found that resilience predicts higher participation (Wardlaw et al., 2018), persons with high resiliency better tolerating risky situations (McCleskey and Gruda, 2021). At a first view, the fact that a higher resilience score (in fact, a moderate/ slightly above average score, according to the norms) which is linked with a higher injury severity in grappling combat sports (judo and BJJ) is surprising, especially in the context of research by Klotz et al. (2017) who found that athletes without a concussion were characterized (among others) by resilience (however, footballers were investigated). We can discuss, at least in GC, about a level of resilience that can reduce the risk of injury, this level (in the present research) being slightly below average. As we specified earlier in the study, resilience is operating at multiple levels, being characterized (among others) by qualities such as optimism and self-esteem (and a higher self-esteem, together with a higher level of optimism, experienced too early in competition, can reduce athletes' fighting capacity, increasing the risk of injury). In addition, considering the positive significant relationship between resilience and engagement in combat sports athletes (wrestlers were studied, a GC) (Pedro, 2016), and that engagement is interconnected with motivation, we can better explain our findings—the positive link between GC athletes' resilience level and injury severity. It is known that motivation supposes direction, energy (effort, enthusiasm, and intensity), and duration toward actions, while "engagement is the visual manifest" of these components (Skinner and Pitzer, 2012). One can only think to the Yerkes–Dodson law which asserts that, in a complex task (and sport is characterized by complex tasks), a higher (or lower) level of arousal impairs performance (Chaby et al., 2015) (however, sports performance is idiosyncratic, each athlete having his/her own facilitative level of arousal and stress). Future research should shed more light on the level of resilience that relates to less severe injuries in a given sport and, at the same time, facilitates sports performance.

The results highlight also positive correlations between Foul (violent) play and Go-ahead, in the case of each sport category (SC, GC, and MMA) and between resilience and Go-ahead scores (in GC and MMA groups). As the athletes scores are higher on Go-ahead factor, this is linked with a higher resilience and, in the same time, with a higher probability of violent behaviors in competition (athlete may break the rules and, therefore, could lose points or could even be disqualified). Thus, athletes who are more resilient tend to attack, to go forward no matter what (specific aspects of the Go-ahead factor), and- also, these athletes who have set their sights on not giving up regardless of the obstacles encountered are more prone to unethical actions in sport (it should be noted that the athletes, in the case of Go-ahead factor, obtained, generally, slightly above average, moderate, or slightly below average scores). These results can also be explained through the Yerkes–Dodson law, a higher level of arousal (in this case) affecting martial arts athletes' behavior (athlete's actions could be outside the boundaries of the game).

On the other hand, data analysis revealed that martial arts athletes who have suffered from mild, moderate, and/or severe injuries (in the entire sample) registered higher scores for Foul (violent) play as compared with martial arts athletes who have suffered only mild/minor injuries. In the first case, the values are average/slightly below average or low, while in the case of athletes with only mild injuries, the results for Foul play are, mostly, low (according to the norms, see Makarowski et al., 2021). These data may be surprising. One might expect, at first glance, that after a moderate or even severe injury, the athlete would avoid breaking the rules of the game in order to win. However, the classical frustration–aggression hypothesis (see, for example, Berkowitz, 1989) could explain these findings, an aggressive behavior being the result of frustration. In the case of martial artists who suffered moderate and/or severe injuries, it may be the accumulated frustration due to lack of preparation and lack of participation in competitions during recovery periods (sometimes for several months), a period of declining income and perhaps even confidence in one's own ability to perform. We also bring up the fact that athletes with a history of concussion were more physically aggressive (Gallant et al., 2018) and more impulsive (Goswami et al., 2016).

Not least, the present research investigated to what extent, Foul (violent) play predict injury severity in martial artists (this factor of aggression being specific to athletes who suffered from moderate and/ or severe injuries in the 4 year period examined). In 2017, researchers underline the need for future studies (in sports and work) to measure adversity (for example, by magnitude), enhancing the possibility to make causal inferences with respect to specific process phenomena (Bryan et al., 2019). What we found is that a low level of Foul play is associated with a decreased likelihood of moderate and/or severe injuries in martial arts athletes (the link between variables was moderate). As the athletes' Foul play score decreases (for example, from 12 to 5 points), the probability of suffering a serious injury decreases (according to the example provided, from 85.7 to 37%). Sometimes, athletes are instructed to be more aggressive during the matches/fights, even to be unscrupulous to win, which may increase the risk of injury (Makarowski et al., 2021). Athletes, coaches, sports psychologists, and parents should pay attention to the win-at-all-costs mentality. Therefore, aggression management strategies are necessary for injury prevention and martial artists' personal development. Psychology-based counseling programs can be used such as positive self-talk, relaxation techniques, self-monitoring of emotional reactions (Gould et al., 2002; Perna et al., 2003), and breathing and meditation, especially for martial artists (Hernandez and Anderson, 2015).

Sport psychology consultants can work with injured athletes to transform injury into an opportunity for positive change, "rather than focusing on returning to preinjury level of functioning" (Wadey et al., 2019). Longitudinal studies are proposed to identify the changes that occur following a traumatic event (Gonzalez-Mendez et al., 2023). In addition, longitudinal research studies are needed to scale athletes'

variability of resilience and assertiveness over time, and these psychological variables are linked with athletes' injury severity, more exactly: a slightly below average level of resilience (in GC—judo and BJJ) and a lower level of assertiveness (in SC—boxing, kick-boxing, taekwondo, and karate) were associated with less serious injuries during competitions. A multidisciplinary and personalized perspective to better understand athletes' resilience and how they bounce back following adversity is proposed using apps, sensors, and algorithms "to detect warning signals in the psychological and physiological data" (Den Hartigh et al., 2022).

### 4.1 Limitations and future directions

Even if the results of the present research addressed gaps in the literature (considering the link between resilience, assertiveness, foul play, and martial artists' injury severity, according to the sports discipline practiced), the study has some limitations.

The current research was carried out only in Romania, being unclear whether the findings would be replicated in other contexts. Considering the research design (*ex post facto* design/a retrospective study) and taking into account Pocecco's observations (Pocecco et al., 2013) on the frequency of reported sports injuries in different context, one can argue the need for: (1) prospective studies (longitudinal investigations of athletes' level of resilience and aggression to emphasize how these psychological variables influence athletes' injury severity) and (2) retrospective studies (RS) based on institutional documentation (not RS utilizing surveys, the declarative data being subjected to more subjectivity and error—see Predoiu et al., 2022b for limits of explicit measures). However, self-report measures were used in many studies related to sports injury (e.g., Williams et al., 2020; Roșu, 2022), while Rădoi et al. (2019) highlighted that questionnaires "are critical tools for identifying patients with persistent post-concussion symptoms and their follow-up."

Additionally, other factors of aggression such as anger, physical and verbal aggression, and hostility (Buss and Perry, 1992) should be examined in relation to martial arts athletes' injury severity, as well as variables such as recovery, sleep quality, nutrition, and martial artists' exercise capacity. Not least, implicit aggression, investigated through indirect measures (see Predoiu et al., 2022a for an Aggression IAT used in sports), can also be assessed in relation to athletes' injury severity and maybe in the context of an even number of fights (for every martial artist).

## 5 Conclusion

The current study underlined that a low level in the case of Foul play factor is associated with a decreased likelihood of moderate and/or severe injuries in martial artists (in the entire sample). Therefore, a reduced frequency of violent game strategies to harm and block the opponent in an unethical manner (this type of aggression supposes unfair actions/play) helps to prevent more serious injuries in athletes. Additionally, it was found that a low or a slightly below average level of assertiveness is linked with a decreased probability of severe injuries in athletes from striking combat sports (karate, kick-boxing, boxing, and taekwondo), while in the case of grappling combat sports (judo and BJJ), a slightly below average level of resilience correlates with a decreased likelihood of more serious sports injuries. Thus, resilience and assertiveness represent psychological variables which play an important role in injury prevention, with respect to specific sports disciplines. It is recommended that specialists should work with athletes on aggression management, modeling factors such as foul (violent) play and assertiveness being a priority to enhance participation and for martial artists' injury prevention.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the research was conducted in accordance with the recommendations of Helsinki Declaration and approved by the Ethics Committee—National University of Physical Education and Sports, Bucharest, Romania (ID: 748/SG). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

IP: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft. RG: Resources, Supervision, Validation, Writing – review & editing. MB: Formal analysis, Investigation, Methodology, Resources, Writing – original draft. LV: Investigation, Methodology, Validation, Visualization, Writing – original draft. RM: Methodology, Resources, Visualization, Writing – review & editing. AB: Conceptualization, Resources, Writing – review & editing. SN: Conceptualization, Supervision, Validation, Visualization, Writing – original draft.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 01 July 2024
DOI 10.3389/fpsyg.2024.1421745



OPEN ACCESS

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RECEIVED 02 May 2024
ACCEPTED 18 June 2024
PUBLISHED 01 July 2024

CITATION
Vladislav EO, Marc G, Paica C-I and Pop O (2024) Family resilience in a social-ecological context – emotional difficulties and coping strategies. *Front. Psychol.* 15:1421745. doi: 10.3389/fpsyg.2024.1421745



# Family resilience in a social-ecological context – emotional difficulties and coping strategies

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**Introduction:** This research explored how crises such as the pandemic influence the family dynamic and the way that the parents and the children face new difficulties and challenges. The present study investigates children's and young people's emotional states, the dimensions of family resilience, and the types of coping strategies and parents' emotional states during the coronavirus pandemic. The final sample for the research was represented by 1,010 parents from Romania.

**Methods:** The present scientific research is a transversal study with the scope to understand the emotional difficulties that parents and children/ young people face and the coping strategies that they adopt in a crisis, such as the time of the coronavirus pandemic.

**Results:** Parents with maladaptive coping strategies are more affected by the pandemic. Also, the results indicate that there is a significant correlation between parental coping strategies and the children's emotional states, and the adaptability level. Therefore, the high scores on the subscales which measure maladaptive coping indicate high scores of the levels of depression, anxiety, and stress of the parents. Family resilience, through the dimension of 'communication and problem-solving in the family' has a moderation role in the relationship between parental depression and the maladaptive coping strategy of rumination. Family resilience through 'maintaining a positive attitude' has a moderation role in the relationship between catastrophizing and the teenagers' level of adaptability.

**Discussion:** The results of the study pointed out the role and place of family resilience within the family system and how a period of crisis can affect this system.

KEYWORDS

**family resilience, well-being, parents, coping, emotional difficulties, adaptability**

## 1 Introduction

In developmental psychology and mental health theory, research, and practice, the idea of resilience has gained prominence, challenging the predominant focus on dysfunction and disorder. The ability to endure and overcome significant adversity in life is known as resilience (Piotrowski et al., 2021). According to Luthar (2006), resilience is the result of dynamic processes that promote adaptive growth in the face of severe adversity. These resources and strengths facilitate healing and development in addition to coping and adjustment. Prime et al. (2020) note that the precise impact of the pandemic on family well-being remains uncertain

in their paper on risks and family resilience during the pandemic. However, over a third of families reported experiencing severe anxiety from the stress of isolation during the pandemic (Statistics Canada, 2020).

Over time, the family occupied a special place in research and several explanatory models appeared. Don Jackson (Ray, 2009) defined the family as a system with its own homeostasis that allows it to resist changes, while Bowen and Jahangiri (2019) considered the family from a psychodynamic perspective. He affirms that the family is a system of emotional relationships. Often, in his approach, he focused on one family member and how he or she relates to the rest of the family. Minuchin (1998), representative of structural family therapy, considered that the family is more than a sum of individuals and that within it a series of interactions take place according to some rules, explicit or not, and the totality of these rules constitutes a structure. Family is relevance to individual and social functioning. The family ensures human development, stability, the fulfillment of objectives and socio-emotional support, strengthens mental health and generates resources for the formation of individual and family resilience.

The way a family adapts to new challenges and copes with adversities, such as stress, crisis, and threats during uncertain times, such as the COVID-19 pandemic, is referred to as resilience. Family resilience is also defined as the ability to withstand and recover from adversity, which necessitates constructive adaptation, with resistance to losses and the ability to face unexpected difficulties that arise and are sometimes beyond the individual's control (Walsh, 2020).

Walsh (2015) elucidates the intricate interplay between biopsychosocial factors, risk, and resilience, highlighting key transactional processes that help struggling families become more resilient and stronger. These key processes in family resilience are belief systems (making meaning of adversity, positive outlook, transcendence, and spirituality), organizational processes (flexibility, connectedness, mobilize social and economic resources), communication and problem-solving processes (clarity, open emotional sharing, collaborative problem solving) (Walsh, 2016a,b).

There are various benefits to using a family resilience framework (Walsh, 2016a,b). It first, by definition, concentrates on strengths developed in times of stress, in response to crisis, and during prolonged adversity. Second, it is considered that no family or set of circumstances can fit neatly into a single model of healthy functioning. Functioning is evaluated in the context of each family's values, structural, situational, and relational resources, and constraints, as well as the challenges it faces. Third, when problems develop and families grow over their life cycle and across generations, procedures for optimal functioning and member well-being change with time.

If until now the studies focused either on adults (Marzilli et al., 2021), or on young people (Guessoum et al., 2020) and children (López-Bueno et al., 2021), this study follows the family, through the way parents use coping strategies and their impact on the emotional health of children. As concern the child's self-regulation this is determined by the more remote factors' influence, for example, social disturbances due to the pandemic and proximal processes, the relationships with those close to them, such as family members, teachers, and peers (Haine-Schlagel and Walsh, 2015; Browne et al., 2016). Therefore, understanding how one family member's functioning impacts another family member's functioning is essential for understanding the effect of a crisis on the family's well-being.

Li and Li (2021) described family resilience as the collective capability of family members to navigate and overcome challenging situations, stressors, and adversities. This involves a family's ability to rebound from life transitions and crises through warmth, support, and cohesion. Such positive behaviors and strategies exhibited by family members enable them to quickly recover from crises, ensuring the ongoing functioning and development of the family unit (Zhao et al., 2023). Family resilience is a multifaceted process that includes interactions between families and other systems within complex environments, which enhances the family's ability to cope with adversity over time (Ungar, 2015).

During the COVID-19 pandemic, both individual and family resilience have been crucial in supporting positive coping mechanisms in the face of adversity (Chan et al., 2021). By understanding and fostering family resilience, families can adapt, thrive, and maintain competent functioning following significant adversities or crises (Patterson, 2002).

Ying et al. (2020) indicated that the COVID-19 pandemic has led to mental and health problems, including stress, anxiety, and depression. Higher family resilience was associated with lower levels of anxiety, stress, and depression. The outbreak has particularly impacted the mental health of family members of healthcare workers, causing stress and anxiety (Ying et al., 2020).

The COVID-19 pandemic has brought both positive and negative effects on families. While it has led (in some cases) to increased quality time spent together, it has also caused disruptions in family relationships (Luttik et al., 2020). Parents play a crucial role in fostering family resilience, especially during large-scale public health crises. The resilience of children and adolescents is significantly influenced by their parents' resilience, including the level of care parents provide for themselves and for their families (Luthar et al., 2021). To prevent significant distress among young individuals facing high levels of stress, interventions should not only focus on the mental health of children, but also, on supporting key caregiving adults at home and in educational settings. Positive adaptation by parents during the pandemic can positively impact children's adaptation.

Another authors (Black and Lobo, 2008) consider that a repertoire of possible coping factors is exchanged in resilient families. There are times when family demands exceed the family's capabilities. When these imbalances exist, some capabilities may supersede others toward regaining equilibrium.

Like the previous studies, we also consider in this study the fact that an important factor in strengthening the family's resilience during a significant health crisis is the parents. The resilience of children and adolescents is impacted by the way parents care for their families and themselves. Children may develop positive adaptation skills because of their parents' positive pandemic adaption. Access to parental support is critical for mitigating the negative impact of COVID-19 on family resilience (Salin et al., 2020; Gayatri and Irawaty, 2022).

Familial coping is a cognitive strategy used by families to deal with stressful situations. Recent research (Killgore et al., 2020; Salin et al., 2020) found that families have developed more ways to cope during the COVID-19 pandemic and quarantine: increased support perceived by the family, increased social support perrelationship, the from the friends, less severe insomnia episodes, increased care and support from a close relationship, the faith, the hope and optimism, flexibility, financial management, communication, leisure time spent in the family. According to the findings of Mashudi and Yusuf (2021) the

adaptation strategy utilized by the family during the COVID-19 pandemic accounts for 15% of the family's health. It is anticipated that the family will assist in emotional problem-solving by providing useful coping mechanisms. In this study we follow what kind of strategies parents use in crisis situations and how these strategies emotionally influence parents and their children.

The primary goal of this study is to investigate how crises such as the pandemic affect the family dynamic and how parents and children deal with new difficulties and challenges.

At the same time, the present research has more specific objectives, such as:

1 The identification of the emotional states of parents and the types of coping mechanisms they employed throughout the coronavirus pandemic.
2 Knowing the emotional status of children and teenagers during the coronavirus pandemic as assessed by their parents, including anxiety, depression, somatization, and adaptation.
3 Identifying the relationship between the maladaptive coping strategies used by the parents and how they affect children's emotional health and level of adaptability.
4 Establishing the moderating role of family resilience in the relationship between parents' emotional state and coping strategies, and the level of adaptation of adolescents.

According to these objectives, the following hypotheses were put forward:

1 Maladaptive coping strategies generate high levels of depression, anxiety, and stress of the parents.
2 The emotional and adaptation difficulties of the children are associated with the maladaptive coping strategies of the parents.
3 Family resilience has a moderating role in the relationship between parents' depression and rumination, as a maladaptive coping strategy.
4 Family resilience has a moderating role in the relationship between the adaptation level of adolescents and catastrophizing, as a maladaptive coping strategy.

# 2 Materials and methods

## 2.1 Sample

The final sample for the research was represented by 1,010 adults (82% female and 18% male) with an average age of 40 and standard deviation of 6.02. All participants are parents, and their children are in the age categories: 2–6 years (26%), 6–12 years (43%), and 12–18 years (31%). The sample is predominantly composed of individuals hailing from urban areas, constituting 88.7% of the total. Within this group, 60% are actively employed and 40% have their own business. In terms of marital status, a significant 79.1% are married, 10.4% have experienced divorce and 10.5% of them have a children and a partner. The children were grouped into three categories according to the application standards of the evaluation tool Behavior Assessment System for Children Second Edition (Reynolds and Kamphaus, 2004). This study names children those aged between 2 and 6 years, pre-teenagers those aged between 6 and 12 years and teenagers those aged between 12 and 18 years. In the analyzes carried out, we looked for associations between parents' coping strategies and children's, pre-teenagers, and teenagers' emotional difficulties.

The selection method was sampling by convenience, which implies that the sample includes subjects that are accessible and available. The usefulness of this method cannot be denied when the special and temporal context of the selection is not directly linked with the dependent variable. If the subject's availability is not affected by any aspect which could significantly influence the scope of the research, then the sample is accepted.

## 2.2 Measures

The present scientific research is a transversal study with the scope to understand the emotional difficulties that the parents and the children/ young people face and the adaptive strategies that they adopt in a crisis, such as the time of the coronavirus pandemic. The participants completed self-evaluation questionnaires and an evaluation questionnaire of their children.

### 2.2.1 Emotional difficulties

Depression Anxiety Stress Scales (Lovibond and Lovibond, 1995)-DASS is an instrument used clinically and in research (Osman et al., 2012) for the assessment and structuring of three areas of suffering: symptoms of depression, symptoms of anxiety, and general stress. We used in our study the 21-item form (DASS-21R) which was adapted and standardized for the Romanian population by Perțe (2011). The DASS contains items such as: "It seemed to me that I was not able to mobilize myself at all," "I was not able to get excited about anything."

The response method is on a Likert scale with values from 0 to 3, with the following response options: 0 - It did not suit me, 1 - It suited me to some extent or from time to time, 2 - It suited me quite a lot or quite often, 3 - It suited me a lot or almost all the time.

For the present study the coefficients for the internal consistency for each subscale were: $\alpha = 0.80$ for depression, $\alpha = 0.68$ for anxiety and $\alpha = 0.82$ for stress.

### 2.2.2 Coping strategies

Cognitive Emotional Response Questionnaire (Garnefski and Kraaij, 2007) – CERQ consists of 36 items for assessing nine strategies for cognitive emotion regulation. CERQ is made up of two factors. The first factor, called cognitive emotion regulation orientated toward the positive, is in theory more adaptive, consisting of subscales: positive reassessment, putting in perspective, positive refocusing, planification, and acceptance. The second factor refers also to cognitive emotion regulation but is focused on the negative, and consists of these sub-scales: self-blame, other blame, rumination, and catastrophizing. Cognitive Emotional Response Questionnaire was adapted and standardized for the Romanian population by Perțe and Miclea (2010). The CERQ contains items such as: "I think that I have to accept what happened," "I think about pleasant things that have nothing to do with the situation," "I think that what happened to me is the worst thing that can happen to anyone."

The answer method is on a Likert scale with values from 1 to 5, with the following answer options: 1- (almost) never, 2- sometimes, 3- usually, 4- often, 5- (almost) every time.

Regarding the values for the coefficient Cronbach Alpha for our study, these are self-blame $\alpha = 0.81$, acceptance $\alpha = 0.92$, rumination $\alpha = 0.76$, positive refocusing $\alpha = 0.70$, putting in perspective $\alpha = 0.91$, positive reassessment $\alpha = 1$, planification $\alpha = 1$, catastrophizing $\alpha = 1$, other-blame $\alpha = 0.89$.

### 2.2.3 Children behavior

Behavior Assessment System for Children Second Edition (Reynolds and Kamphaus, 2004) – BASC-2 is a well-known system, used by psychologists, specialists from the educational system, doctors, and other clinicians, to find out more information about the child's behavior and feelings. Being developed by remarkable experts in child behavior, BASC-2 contains more components that gather information from the parents, teachers, and the child. This information focuses on the areas of strengths and weaknesses in the child's behavior and feelings, in a way that the child's strengths do not go unnoticed, while the potentially problematic domains are investigated.

During the research, we used the assessment method BASC-2 because this is the latest standardized version used on the Romanian population. Behavior Assessment System for Children Second Edition was adapted and standardized for the Romanian population by Mitrofan et al. (2011). The BASC-2 was applied to parents, it contains scales answered by parents of preschoolers aged 2–5 (PRS-P), parents of children aged 6–11 (PRS-C) and parents of adolescents aged 12–18 years (PRS-A). For the present study we investigated only the perception of the parents about the observable behavior of children. BASC contains items for ages 2–5 years, such as: "Sometimes sick," "Worries about what parents think"; for ages 6–11 years: "Cries easily," "He/she is afraid," "He/she adapts well to changes in his/her routine activities"; for ages 12–18: "He/she adapts well to changes in plan," "He/she is negative," "He/she changes his emotional state quickly." The answer options are: never (1), sometimes (2), often (3), always (4).

The Cronbach Alpha values for the subscales from our current study are Adaptability PRS-P $\alpha = 0.739$, Anxiety PRS-P $\alpha = 0.844$, Depression PRS-P $\alpha = 0.813$, Somatization PRS-P $\alpha = 0.816$, Adaptability PRS-C $\alpha = 0.590$, Anxiety PRS-C $\alpha = 0.879$, Depression PRS-C $\alpha = 0.825$, Somatization PRS-C $\alpha = 0.822$, Adaptability PRS-A $\alpha = 0.733$, Anxiety PRS-A $\alpha = 0.879$, Depression PRS-A $\alpha = 0.849$, Somatization PRS-A $\alpha = 0.874$.

### 2.2.4 Family resilience

Family Resilience Assessment Scale (Tucker Sixbey, 2006) – FRAS is a psychological assessment instrument that measures the level of family resilience based on the theory of Walsh (1996, 2003, 2007). The original scale's total score ranges from 54 to 270.

The six factors in the shortened version of the FRAS correspond to the six subscales: Communication and problem-solving in the family, Social, and economic resources, Maintaining a positive attitude, Familial closeness, Family spirituality, and Ability to find meaning in difficulties. The six factors are distributed as follows: the first factor has 27 items, the second factor has 8 items, the third factor has 6 items, the fourth factor has 6 items, 4 of which are items with inverted scores, the fifth factor has 4 items, and the sixth factor has 3 items. Family Resilience Assessment Scale was adapted and standardized for the Romanian population by Bostan (2014). The FRAS contains items scored on a Likert scale from 1 to 5, where 1 – never true, 2 – somewhat true, 3 – sometimes true, 4 – mostly true, 5 – always true. Examples of items are: "We accept stressful times as part of our life," "We are open to new ways of doing things in our family."

Cronbach Alpha coefficients for the current study have been: 0.82 for Communication and problem-solving in the family, 0.65 for Utilizing social and economic resources, 0.57 for Maintaining a positive attitude, 0.54 for Familial closeness, 0.63 for Family spirituality and 0.61 for Ability to find meaning in difficulties.

For data analysis in moderation we used these scales in the research: Communication and problem-solving in the family and Maintaining a positive attitude. The total score for those scales vary between 33 and 132.

## 2.3 Study variables

The research variables are represented by the psychological concepts measured through the test's subscales. As variables, there are:

- Depression, anxiety, and stress are measured with the DASS instrument,
- Self-blame, acceptance, rumination, positive refocusing, planification, positive reappraisal, putting in perspective, catastrophizing, other blame measured by CERQ instrument (however, in the current study, our focus was on the parents' maladaptive coping strategies),
- Communication and problem-solving in the family and Maintaining a positive attitude are measured with the evaluation scale for family resilience, FRAS and
- The adaptability, anxiety, depression, and somatization subscales from the BASC-2 instrument.

## 2.4 Procedure

Participants have been recruited and measurements have been completed between April 2020 and February 2021.

Among the conditions for the study, there has been voluntary participation in all parts of the research, accessing all the tests through the Google Forms platform. There have not been exclusions based on psychological and medical status.

Before starting the research, the aim of the study has been explained to all participants, the fact that their involvement is entirely voluntary, storage, confidentiality, and keeping of data. To participate in the study, all subjects provided informed consent.

## 2.5 Analytical approach

This study corresponds to the generic model of non-experimental research, following the methods of a quantitative and cross-sectional analysis, using questionnaires, and generating quantitative data. Correlation analyzes and moderation analyzes will be pursued.

The data is collected through the Google Forms platform, and the order of presentation of the tools is Behavior Assessment System for Children Second Edition, Cognitive Emotional Response Questionnaire, Depression Anxiety Stress Scales, Family Resilience

Assessment Scale. There were no special situations in the data collection procedure.

The data analysis will be carried out using the SPSS program. There were no special situations (e.g., outliers) in data collection.

# 3 Results

The results include the fulfillment of the objectives and refer to Parental emotional difficulties, Children's emotions and parental coping strategies and Family resilience.

## 3.1 Parental emotional difficulties

Table 1 presents the mean, the range and the standard deviation of the psychological dimensions measured through testing the parents, specifically the parents' emotional states and the types of coping strategies when faced with a crisis. Table 2 presents the Pearson correlation for depression, stress, anxiety, and coping strategies.

Parents with maladaptive coping strategies are more affected by the pandemic, therefore the high scores on the subscales which measure maladaptive coping indicate high scores of the levels of depression, anxiety, and stress. High scores on the depression scales are positively linked to all the maladaptive coping strategies (self-blame $r = 0.283$, $p = 0.000$; blaming other $r = 0.292$, $p = 0.000$; rumination $r = 0.137$, $p = 0.000$; catastrophizing $r = 0.409$, $p = 0.000$). The coefficient of determination $r^2$ values range between 0.018 and 0.167.

High scores for anxiety are linked to maladaptive coping strategies (self-blame $r = 0.252$, $p = 0.000$; blaming other $r = 0.282$, $p = 0.000$; rumination $r = 0.161$, $p = 0.000$; catastrophizing $r = 0.402$, $p = 0.000$). The coefficient of determination $r^2$ values range from 0.025 and 0.161.

High level of stress is linked to high scores on all the subscales for maladaptive coping strategies (self-blame $r = 0.322$ $p = 0.000$; blaming others $r = 0.328$, $p = 0.000$; rumination $r = 0.203$, $p = 0.000$; catastrophizing $r = 0.395$, $p = 0.000$). $r^2$ values vary between 0.041 and 0.156.

TABLE 1 Descriptive statistics.

| | N | M | SD |
|---|---|---|---|
| Depression | | 4.61 | 4.33 |
| Anxiety | | 4.43 | 4.86 |
| Stress | | 7.81 | 5.48 |
| Self-blame | | 11.29 | 3.58 |
| Acceptance | | 14.08 | 3.30 |
| Rumination | | 14.55 | 3.71 |
| Positive refocusing | | 13.69 | 3.84 |
| Planification | | 16.83 | 2.85 |
| Positive reassessment | | 16.72 | 3.10 |
| Perspective | | 15.63 | 3.49 |
| Catastrophizing | | 9.13 | 3.49 |
| Blaming others | | 8.30 | 3.19 |
| Total | 1,010 | | |

In conclusion, individuals with maladaptive coping mechanisms had higher levels of stress, anxiety, and depression (Table 2).

## 3.2 Children's emotions and parental coping strategies

The research's findings show positive significant correlations, between the children's emotional states and the maladaptive coping mechanisms used by their parents, and a negative link between teenagers' degree of adaptability and the maladaptive coping strategies. The significant correlations observed, in the case of each of the three age groups investigated: 2–6 years (children), 6–12 years (pre-teenagers), and 12–18 years (teenagers) are presented in Tables 3–6.

Maladaptive coping strategies, namely self-blame, significantly raises the children's depression level ($r = 0.128$, $p = 0.000$), that of the pre-teenagers ($r = 0.120$, $p = 0.000$), and that of the teenagers ($r = 0.068$, $p = 0.030$).

Rumination as maladaptive coping strategy was linked with children's depression level, for ages between 2 and 6 years old ($r = 0.121$, $p = 0.000$), while blaming other links with the level of depression in small children ($r = 0.075$, $p = 0.017$). Catastrophizing links with children's depression, ($r = 0.063$, $p = 0.044$), to that of pre-teenagers ($r = 0.087$, $p = 0.006$) and teenagers ($r = 0.069$, $p = 0.028$). The effect size index ($r^2$) values range between 0.003 and 0.014.

Also, children's anxiety links to all the maladaptive coping strategies: self-blame ($r = 0.187$, $p = 0.000$), blaming others ($r = 0.079$, $p = 0.000$), rumination ($r = 0.164$, $p = 0.000$), catastrophizing ($r = 0.121$, $p = 0.002$). Pre-teenagers' anxiety links with self-blame ($r = 0.160$, $p = 0.000$) and catastrophizing ($r = 0.162$, $p = 0.000$), while teenagers' anxiety is related to catastrophizing ($r = 0.089$, $p = 0.019$). $r^2$ values are between 0.006 and 0.034.

Small children's somatization links to the following maladaptive coping strategies: self-blame ($r = 0.118$, $p = 0.000$), rumination ($r = 0.081$, $p = 0.010$), and catastrophizing ($r = 0.097$, $p = 0.002$), pre-teen's somatization links to self-blame ($r = 0.127$, $p = 0.000$), blaming others ($r = 0.063$, $p = 0.047$) and catastrophizing ($r = 0.103$, $p = 001$), while teenagers' somatization links to catastrophizing ($r = 0.075$, $p = 0.17$). The coefficient of determination $r^2$ values are between 0.003 and 0.016.

The more the level of catastrophizing increases, the more the teenagers' adaptability level decreases ($r = -0.065$, $p = 0.039$, $r^2 = 0.004$).

## 3.3 Family resilience

Family resilience, through the dimension of 'communication and problem-solving in the family' has a moderation role in the relationship between parental depression and the maladaptive coping strategy of rumination. One can notice that $p$-value for interaction is lower than 0.001 (Table 7), and $F = 60.298$ (Table 8). We chose the communication and problem-solving in the family dimension as a moderator because it is part of Walsh's model (2015) of family resilience, which we followed in the study.

Family resilience through 'maintaining a positive attitude' has a moderation role in the relationship between catastrophizing and the

10.3389/fpsyg.2024.1421745

TABLE 2 Parental emotional difficulties and maladaptive coping strategies.

| | | Depression | Anxiety | Stress | Self-blame |
|---|---|---|---|---|---|
| Depression | Pearson Correlation | 1 | 0.761** | 0.753** | 0.283** |
| | Sig. (two-tailed) | | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Anxiety | Pearson Correlation | 0.761** | 1 | 0.754** | 0.252** |
| | Sig. (two-tailed) | 0.000 | | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Stress | Pearson Correlation | 0.753** | 0.754** | 1 | 0.322** |
| | Sig. (two-tailed) | 0.000 | 0.000 | | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Blaming other | Pearson Correlation | 0.292** | 0.282** | 0.328** | 0.179** |
| | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Rumination | Pearson Correlation | 0.137** | 0.161** | 0.203** | 0.435** |
| | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Catastrophizing | Pearson correlation | 0.409** | 0.402** | 0.395** | 0.342** |
| | Sig. (two-tailed) | 0.000 | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |

**$p < 0.01$.

TABLE 3 Children, pre-teenagers and teenagers' depression and maladaptive coping strategies used by parents.

| | | depression_ children | depression_ preteenagers | depression_ teenagers | self-blame |
|---|---|---|---|---|---|
| depression_children | Pearson Correlation | 1 | −0.320** | −0.233** | 0.128** |
| | Sig. (two-tailed) | | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| depression_preteenagers | Pearson Correlation | −0.320** | 1 | −0.314** | 0.120** |
| | Sig. (two-tailed) | 0.000 | | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| depression_teenagers | Pearson Correlation | −0.233** | −0.314** | 1 | 0.068* |
| | Sig. (two-tailed) | 0.000 | 0.000 | | 0.030 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Blaming other | Pearson Correlation | 0.075* | 0.059 | 0.025 | 0.179** |
| | Sig. (two-tailed) | 0.017 | 0.061 | 0.420 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Rumination | Pearson Correlation | 0.121** | 0.003 | −0.007 | 0.435** |
| | Sig. (two-tailed) | 0.000 | 0.930 | 0.830 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Catastrophizing | Pearson Correlation | 0.063* | 0.087** | 0.069* | 0.342** |
| | Sig. (two-tailed) | 0.044 | 0.006 | 0.028 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |

**$p < 0.01$, *$p < 0.05$.

TABLE 4 Children, pre-teenagers and teenagers' anxiety and maladaptive coping strategies used by parents.

| | | anxiety_children | anxiety_preteenagers | anxiety_ teenagers | Self-blame |
|---|---|---|---|---|---|
| anxiety_children | Pearson correlation | 1 | −0.334** | −0.253** | 0.187** |
| | Sig. (two-tailed) | | 0.000 | 0.000 | 0.000 |
| | *N* | 674 | 560 | 560 | 674 |
| anxiety_preteenagers | Pearson correlation | −0.334** | 1 | −0.391** | 0.160** |
| | Sig. (two-tailed) | 0.000 | | 0.000 | 0.000 |
| | *N* | 560 | 736 | 560 | 736 |
| anxiety_teenagers | Pearson correlation | −0.253** | −0.391** | 1 | 0.061 |
| | Sig. (two-tailed) | 0.000 | 0.000 | | 0.110 |
| | *N* | 560 | 560 | 697 | 697 |
| Rumination | Pearson correlation | 0.164** | 0.052 | −0.001 | 0.435** |
| | Sig. (two-tailed) | 0.000 | 0.158 | 0.987 | 0.000 |
| | *N* | 674 | 736 | 697 | 1,010 |
| blaming other | Pearson correlation | 0.079* | 0.062 | 0.010 | 0.179** |
| | Sig. (two-tailed) | 0.039 | 0.095 | 0.800 | 0.000 |
| | *N* | 674 | 736 | 697 | 1,010 |
| Catastrophizing | Pearson correlation | 0.121** | 0.162** | 0.089* | 0.342** |
| | Sig. (two-tailed) | 0.002 | 0.000 | 0.019 | 0.000 |
| | *N* | 674 | 736 | 697 | 1,010 |

**$p < 0.01$, *$p < 0.05$.

teenagers' level of adaptability. The p-value for interaction is $p < 0.001$ (Table 9), and $F = 2179.173$ (Table 10).

## 4 Discussion

An empirical foundation for evaluating successful relationships and family functioning has been established in recent decades by systems-oriented family process research (Lebow and Stroud, 2012). However, family scales and typologies are often static and a contextual, providing a snapshot of interaction patterns but rarely relating them to a family's stressors, resources, and challenges over time and in their social environment. Families most frequently seek assistance at times of crisis, when discomfort and deviations from the norm are all too easily interpreted as indicators of a dysfunctional family.

The study's findings demonstrate the function and importance of family resilience within the family system and how a moment of crisis might influence this system. The study is congruent with the results of other research in which we are presented with the fact that it is critical to track coping techniques and classify the best coping mechanisms (Marchetti et al., 2020; Adams et al., 2021; Calvano et al., 2021). A classification even of the maladaptive coping mechanisms is necessary to be able to do family screening and find techniques to optimize the quality of life in times of crisis.

This study indicates that parents with maladaptive coping strategies are more affected by the pandemic, therefore the high scores on the subscales which measure maladaptive coping indicate high scores of the levels of depression, anxiety, and stress. The tendency to associate higher levels of parental stress with higher levels of anxiety and depression is consistent with the research that suggests a connection between parental stress and symptoms of anxiety and depression, independent of the pandemic (Pripp et al., 2010; Crugnola et al., 2016; Vismara et al., 2016; Rollè et al., 2017; Brown et al., 2020; Russell et al., 2020; Spinelli et al., 2020).

Therefore, the maladaptive coping strategies most often used and associated with emotional symptoms in children and adolescents are self-blame, catastrophizing, rumination and blaming others. The results indicate that the use of these strategies by parents is related to the emotional difficulties of children and adolescents such as depression, anxiety, and somatization.

Regarding adaptive coping strategies, they are associated with the level of adaptability of adolescents, a fact also supported by Rodriguez et al. (2014) in their study on coping, the family environment, and the emotional health of adolescents, in which findings involve the role of coping in the relationship between family environment and adolescent mental health.

The result according to which family resilience is a moderator in the relationship between depression and rumination is very valuable and shows us that family support plays an essential role in the way psychological stress is perceived and manifested during a crisis. This result is also supported by previous studies that show that family environment is an important moderator in the relationship between depression treatment and adolescent's emotional difficulties (Dardas, 2019).

Spending time with parents can effectively reduce the symptoms of adolescents with depression (Manczak et al., 2019). Vladislav et al. (2022) emphasize the role of functional coping strategies, such as support strategies, in which social relationships and emotional adjustment predominate, in increasing adolescents' self-confidence

TABLE 5 Children, pre-teenagers and teenagers' somatization and maladaptive coping strategies used by parents.

| | | somatization_ children | somatizationpreteenagers | Somatization teenagers | Self-blame |
|---|---|---|---|---|---|
| somatization_children | Pearson correlation | 1 | −0.218** | −0.173** | 0.118** |
| | Sig. (two-tailed) | | 0.000 | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| somatization_ preteenagers | Pearson correlation | −0.218** | 1 | −0.217** | 0.127** |
| | Sig. (two-tailed) | 0.000 | | 0.000 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| somatization_teenagers | Pearson correlation | −0.173** | −0.217** | 1 | 0.056 |
| | Sig. (two-tailed) | 0.000 | 0.000 | | 0.076 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Rumination | Pearson correlation | 0.081** | 0.028 | 0.014 | 0.435** |
| | Sig. (two-tailed) | 0.010 | 0.366 | 0.662 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Catastrophizing | Pearson correlation | 0.097** | 0.103** | 0.075* | 0.342** |
| | Sig. (two-tailed) | 0.002 | 0.001 | 0.017 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| blaming other | Pearson correlation | 0.062 | 0.063* | 0.059 | 0.179** |
| | Sig. (two-tailed) | 0.050 | 0.047 | 0.061 | 0.000 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |

**$p < 0.01$, *$p < 0.05$.

TABLE 6 Children adaptability and maladaptive coping strategies used by parents.

| | | adaptability_ children | adaptability_ preteenagers | adaptability teenagers | catastrophizing |
|---|---|---|---|---|---|
| adaptability_ children | Pearson correlation | 1 | −0.413** | −0.320** | 0.019 |
| | Sig. (two-tailed) | | 0.000 | 0.000 | 0.544 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| adaptability_ preteenagers | Pearson correlation | −0.413** | 1 | −0.474** | 0.002 |
| | Sig. (two-tailed) | 0.000 | | 0.000 | 0.954 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| adaptability_ teenagers | Pearson correlation | −0.320** | −0.474** | 1 | −0.065* |
| | Sig. (two-tailed) | 0.000 | 0.000 | | 0.039 |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |
| Catastrophizing | Pearson correlation | 0.019 | 0.002 | −0.065* | 1 |
| | Sig. (two-tailed) | 0.544 | 0.954 | 0.039 | |
| | *N* | 1,010 | 1,010 | 1,010 | 1,010 |

**$p < 0.01$, *$p < 0.05$.

in the context of the COVID-19 pandemic. In fact, the results support the relationship with parents and social support in times of crisis.

Furthermore, family resilience has been identified as an effective family-centered intervention to promote family communication to improve the suffering of parents and children, and these improvements are sustained even after the intervention is discontinued (Saltzman, 2016).

The two subscales of family resilience used by us have not been followed in other studies, and the role of positive attitude and

TABLE 7 The moderator effect of family resilience (Communication and problem-solving dimension) in the relationship between depression and rumination (interaction effect).

| Model | | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. error | Beta | | |
| | (Constant) | 4.356 | 0.211 | | 20.624 | 0.000 |
| | Rumination | −0.230 | 0.009 | −0.197 | −25.311 | 0.000 |
| | Communication and problem-solving in the family | −0.006 | 0.002 | −0.025 | −3.292 | 0.001 |
| | Interaction | 0.061 | 0.000 | 1.015 | 128.448 | 0.000 |

TABLE 8 The moderator effect of family resilience (Communication and problem-solving dimension) in the relationship between depression and rumination.

| Model | | Sum of squares | df | Mean square | *F* | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 2026.263 | 2 | 1013.132 | 60.298 | 0.000 |
| | Residual | 16919.594 | 1007 | 16.802 | | |
| | Total | 18945.857 | 1009 | | | |

communication and problem solving within the family during periods of crisis is still not fully understood.

We consider that these two dimensions of family resilience bring some implications in the way to face difficult situations both for the individual and for the family. They can be the basis of family therapy in times of crisis, starting from the promotion of these two dimensions, as well as at the end of the therapeutic approach, being the therapeutic objectives for organizing the family in times of crisis.

The results of our study are congruent with those of Perry et al. (2023) who consider the fact that from a family resilience perspective, the COVID-19 pandemic required responses from the family system as roles, expectations, and relationships changed for all family members. Specifically, some families may be more vulnerable than others due to pre-pandemic factors, such as parent and child mental and physical health needs, and a history of trauma.

Therefore, the research will have an impact on the scientific, social, economic, and cultural environment. At the scientific level, the impact consists in the dissemination of important results for developmental psychology, family psychology and psychotherapy, with implications for the emotional health of parents and children. At the social level, the impact consists in raising awareness at the level of communities and society regarding parents' role in children's emotional difficulties.

Regarding the economic environment, the impact consists of the fact that by disseminating the results of the study and raising awareness of the role of parents' coping strategies in children's emotional state, prevention, and early intervention programs for children and families can be carried out. This fact reduces the costs of more expensive treatments.

The impact on the cultural environment reflects promoting a culture centered on the family needs and experiences of children and their families and supporting a culturally and ethnically diverse approach to family care services.

## 4.1 Limitations and future research directions

There were several limitations to this investigation. First, because this study employed cross-sectional data to conduct a variety of intermediate effect analyses, we were unable to identify whether the factors were causally related. Consequently, to confirm the findings of this research, a comparable effect analysis should be performed using longitudinal data in the future.

Another limitation of this study was the absence of standardized, homogeneous patient groups for screening purposes. The emphasis on creating homogeneous groups of patients for screening suggests a recognition of the need for standardized approaches and methods in coping and family resilience screening. This aligns with the state-of-the-art, as it emphasizes the importance of consistency and comparability in research and clinical evaluations. Also, there is no data on the financial level of the families/ parents investigated, which may influence the level of resilience and coping strategies in a crisis (such as the COVID-19 pandemic). Further studies are needed to investigate family-level resilience and children's emotional difficulties in a crisis, only in the context of higher and lower income families.

# 5 Conclusion

To the best of our knowledge, this is the first study that addresses the issue of children's emotions during the pandemic and the coping methods used by their parents to deal with family difficulties that arise during a crisis. There is another study published by Pereira et al. (2023) that addresses child mental health during a crisis. A novelty factor is the inclusion of the family resilience variable in our research. We wanted to study the importance of family resilience in the adaptation of parents and children/adolescents in situations of adversity. The current research adds to the limited body of literature concerning parental coping strategies and their relationship to children's emotional difficulties and adaptability.

The present study is oriented toward practical implications in the sphere of family therapy and the well-being of the family in times of crisis. The results indicate that maladaptive coping strategies of parents (catastrophizing, rumination, blaming) are associated with emotional difficulties in the case of children, pre-adolescents, and adolescents.

It is very important that parents are helped through psychological counseling programs to reduce these maladaptive coping strategies and to develop adaptive coping and stress management skills. Another

TABLE 9 The moderation role of family resilience (dimension Maintaining a positive attitude) in the relationship between maladaptive coping (catastrophizing) and the level of adaptability for teenagers (interaction effect).

| Model | | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. |
|---|---|---|---|---|---|---|
| | | *B* | Std. error | Beta | | |
| | (Constant) | 2.472 | 0.517 | | 4.784 | 0.000 |
| | Catastrophizing | −0.373 | 0.021 | −0.209 | −17.819 | 0.000 |
| | Maintaining a positive attitude | 0.055 | 0.018 | 0.036 | 3.090 | 0.002 |
| | Interaction | 0.100 | 0.001 | 0.937 | 80.190 | 0.000 |

TABLE 10 The moderation role of family resilience (dimension Maintaining a positive attitude) in the relationship between maladaptive coping (catastrophizing) and the level of adaptability for teenagers.

| Model | | Sum of Squares | df | Mean Square | *F* | Sig. |
|---|---|---|---|---|---|---|
| | Regression | 34119.214 | 3 | 11373.071 | 2179.173 | 0.000 |
| | Residual | 5250.300 | 1006 | 5.219 | | |
| | Total | 39369.514 | 1009 | | | |

practical implication is the development of work programs with families to improve family resilience and educate families to develop communication, receptivity and emotional availability of family members to each other, solving problems and increasing the positive attitude in the family.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The University of Bucharest's Ethics Commission regulations were followed in conducting this study; registration number: 21/21.04.2020. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

EV: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. GM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing. C-IP: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. OP: Data curation, Methodology, Software, Writing – original draft.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

The authors would like to thank the participants who were involved in the present research.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 18 July 2024
DOI 10.3389/fpsyg.2024.1393445



OPEN ACCESS

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RECEIVED 29 February 2024
ACCEPTED 02 July 2024
PUBLISHED 18 July 2024

CITATION
Wang S and Zheng L (2024) Parenting style and the non-cognitive development of high school student: evidence from rural China. *Front. Psychol.* 15:1393445. doi: 10.3389/fpsyg.2024.1393445



# Parenting style and the non-cognitive development of high school student: evidence from rural China

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**Introduction:** Understanding the relationship between parenting style and the non-cognitive development of high school students is crucial, particularly in rural China. Non-cognitive abilities, including traits such as emotional regulation, resilience, and interpersonal skills, play a significant role in students' overall development and future success. This study aims to investigate how different parenting styles impact non-cognitive abilities among high school students in rural China.

**Methods:** This study surveyed 6,549 high school students and their primary caregivers in rural China. The students had an average age of 17.61 years, with 48% being male, and 62% of Han ethnicity. Primary caregivers self-reported their parenting styles, while the students' non-cognitive abilities were assessed using the Big Five Inventory-Short (BFI-S). The relationship between parenting style and non-cognitive development was analyzed using two distinct methods: two dimensions (authoritative and authoritarian) and four categories of parenting styles.

**Results:** The study revealed that an authoritative parenting style had a positive impact on the non-cognitive abilities of students. Conversely, a negative association was observed between the authoritarian parenting style and the students' non-cognitive development. This association was more pronounced in the non-cognitive developmental scores of girls compared to boys. Additionally, parents from wealthier families or those with higher levels of education were more likely to adopt an authoritative parenting style rather than an authoritarian one.

**Discussion:** The results of this study highlight the significant influence of parenting styles on the non-cognitive development of high school students in rural China. Authoritative parenting, characterized by warmth and structure, appears to foster better non-cognitive outcomes, while authoritarian parenting, marked by strictness and less warmth, is associated with poorer non-cognitive development. The gender differences observed suggest that girls may be more sensitive to variations in parenting style. Furthermore, the socioeconomic and educational background of parents plays a crucial role in determining the parenting style adopted. These findings underscore the importance of developing and implementing parenting training interventions in rural China, aimed at promoting authoritative parenting practices to enhance the non-cognitive development of students.

KEYWORDS

**non-cognitive abilities, authoritative parenting, authoritarian parenting, high school student, rural China**

# 1 Introduction

The human capital literature emphasizes the crucial role of non-cognitive skills in shaping long-term economic outcomes. The development of non-cognitive abilities, encompassing traits like motivation, perseverance, interpersonal skills, self-esteem, and emotional regulation during childhood, establishes the groundwork for various life outcomes such as educational attainment, adult health conditions, labor market performance, and earnings (Heckman and Rubinstein, 2001; Cunha et al., 2010; Almlund et al., 2011; Kautz et al., 2014). Moreover, non-cognitive abilities have been recognized as more malleable than cognitive abilities. Specifically, cognitive skills undergo the greatest amount of change in early childhood and stabilize by adolescence. In contrast, non-cognitive skills continue to develop throughout childhood and into young adulthood, indicating a greater potential for improvement during later developmental stages (Brunello and Schlotter, 2011; Gutman and Schoon, 2013; Hoeschler et al., 2018). Given the importance and malleability of non-cognitive abilities, researchers have been motivated to investigate the determinants of school-aged children's non-cognitive development, with a particular focus on the role of the family, which is acknowledged as a significant contributor to children's skill formation (Becker and Tomes, 1986).

The impact of familial factors on the non-cognitive development of school-aged children exhibits a high level of complexity, with both school and family factors playing pivotal roles in shaping student non-cognitive abilities (Cunha and Heckman, 2007; Veiga et al., 2023). While numerous studies focus on investigating the influence of specific aspects of family characteristics, such as household income or socioeconomic status (Blau, 1999; Loken et al., 2012), parental education level (Leight and Liu, 2020), parental time and material investment (James-Burdumy, 2005; Bernal and Keane, 2011), and the child's birth order (Hotz and Pantano, 2015), the impact of parenting style on children's non-cognitive development has received comparatively less attention.

The concept of parenting style, as developed by Baumrind (1967, 1971), indicates how parents respond to their children's needs or behaviors. Parenting styles are defined by two main dimensions: responsiveness and demandingness, which are theoretically orthogonal or unrelated (Lamborn et al., 1991; Fuentes et al., 2022). Responsiveness involves parental warmth, involvement, and support for the child's individuality (Baumrind, 2013; Alcaide et al., 2023). Demandingness refers to the degree of strictness and the expectations parents have for their child to conform to society and family standards (Martinez-Escudero et al., 2020). Baumrind (1967) initially identified three primary parenting styles: authoritative, authoritarian, and permissive. Authoritative parenting combines high demands with high responsiveness and is associated with greater parental involvement, trust, and support (Durbin et al., 1993). Authoritarian parenting is characterized by high demands and strict control, but low responsiveness and communication (McClun and Merrell, 1998). Permissive parenting involves high parental warmth and a child-centered approach but lacks discipline (Smetana, 1995; Villarejo et al., 2024). Studies have shown that Baumrind's classification can be insufficient and has limitations in both Western and Eastern contexts (Darling and Steinberg, 2017; Chen et al., 2024). McCoby (1983) extended the framework by categorizing the permissive parenting style into negligent and indulgent. Neglectful parenting is defined by a lack of expectations and attentiveness, when parents demonstrate minimal concern for their children's viewpoints, pursuits, and feelings (Climent-Galarza et al., 2022; Palacios et al., 2022). Indulgent parenting is defined by a significant degree of attentiveness to the needs and wants of children, but a lack of emphasis on requiring and expecting adult behavior (García and Gracia, 2013).

The link between parenting style and students' cognitive and academic achievements has been well-established (Spera, 2005; Brown and Iyengar, 2008; Dornbusch et al., 2016; Xia, 2020)[1]. While evidence supporting the relationship between parenting style and non-cognitive child development has emerged more recently, earlier studies primarily focused on aspects such as the child's locus of control, risky behavior, patience, risk aversion, altruism, and social skills (Aunola and Nurmi, 2005; Alegre, 2011). For instance, Cobb-Clark et al. (2019) affirmed that respectful parenting correlated with an increased internal locus of control and a decreased inclination toward risky behavior. Fiorini and Keane (2014) demonstrated the significant impact of parenting style on non-cognitive abilities, encompassing behavioral problems, social skills, and emotional issues. In a recent study, Falk et al. (2021) explored the relationship between parenting style and a child's patience, risk aversion, conduct, and altruism. Their findings highlighted that a parenting style characterized by warmth and child-centeredness positively influenced all these aspects. Several studies consistently indicate that a parenting style combining effective disciplinary practices with parental warmth leads to the highest child adjustment (Martinez-Escudero et al., 2023).

This study aims to expand and enhance existing research on the relationship between parenting style and the non-cognitive development of high school students. Previous studies have shown that non-cognitive skills may be broadly defined as personality traits or "patterns of thought, feelings, and behavior" (Borghans et al., 2008), encompassing a broad range of characteristics, such as personality traits, motivation, confidence, perseverance, and social and communication skills (Hoeschler et al., 2018). We utilize a comprehensive scale that assesses a broader spectrum of personality traits related to non-cognitive abilities. Heckman and Kautz (2012) contend that, despite the diverse nature of non-cognitive abilities, the Big Five[2]—widely investigated in psychology—can effectively serve as an assessment tool for these abilities. The Big Five personality traits encompass openness, conscientiousness, extraversion, agreeableness, and emotional stability. Therefore, our objective is to explore the potential correlation between parenting style and the non-cognitive development of high school students. We categorize parenting styles using both a two-dimensional and a four-dimensional framework. To achieve this, we classify students into four groups based on high and low levels of authoritative and authoritarian parenting styles. Our investigation centers

1 Authoritative parenting style has been primarily associated with higher academic achievement and better cognitive development and lower school drop-out rates (Spera, 2005; Dornbusch et al., 2016; Wang et al., 2022). The rest three parenting styles have been associated with decreased estimates of completing higher education, lower cognitive ability, and lower academic achievement in high school (Majumder, 2016; Kimmes and Heckman, 2017).

2 The Big Five personality traits, also referred to as the five-factor model (FFM), is widely acknowledged by psychologists as a reliable taxonomy of personality that can be applied to a variety of theoretical frameworks, methodologies, and cultural contexts (McCrae and Costa, 1987; Mount and Barrick, 1998).

on understanding how these four distinct parenting styles impact students' non-cognitive development.

While the global evidence base connecting parenting style to non-cognitive development continues to grow, there remains a scarcity of evidence regarding parenting style and children's non-cognitive abilities. Presently, only two studies have delved into this area. Kugler et al.'s (2022) research, to the best of our knowledge, is the first to explore the relationship between parenting style and children's non-cognitive ability in developed countries, specifically Germany. Another study, conducted in Western Europe (Loudová and Lašek, 2015), also addresses this topic. Both studies had limited sample sizes[3], and were not conducted in Asian countries, where parents often exhibit a higher degree of disciplinary behavior (Deng and Tong, 2020). Additionally, neither study used samples from rural areas. Moreover, research has also revealed that cultural context may influence the prevalence and outcomes of different parenting styles (Pinquart and Kauser, 2018; Chen et al., 2024). Western cultures value individuality and self-expression, resulting in different effects of authoritarian and permissive parenting styles (Reyes et al., 2023). For example, studies conducted mainly in European and South American countries identified benefits related to greater responsiveness but without demandingness (Garcia et al., 2019). Chinese culture, shaped by Confucianism, emphasizes respect for authority and academic achievement (Chao, 1994). Studies within Chinese American families have shown that authoritarian parenting is related to benefits, especially in academic achievement (Chao, 2000). Therefore, the primary contribution of our study is to augment the existing literature by gathering data on caregivers' parenting styles and their potential impact on children's non-cognitive abilities in rural China.

A second noteworthy contribution of this study is the expansion of the age range within the sample population. Previous studies have established correlations between parenting style and the non-cognitive development of young children. Specifically, authoritarian parenting has been associated with increased extraversion and openness, while authoritarian-inconsistent parenting has been linked to heightened extraversion, conscientiousness, agreeableness, and increased emotional stability (Kugler et al., 2022). Ashraf et al. (2018) also reported a causal relationship between parenting style and personality traits in primary school children. However, it is important to highlight that none of the existing research has explored the impact of parenting style on the Big Five personality traits of high school students. Although adolescents seek greater independence, parental style continues to play a crucial role in shaping their non-cognitive skills (Zhang and Wang, 2022). Moreover, parenting style evolves with the child's age (Burnett et al., 2021) and may have different impacts on the non-cognitive abilities of children at different ages (Rosen et al., 2008). Parenting typically diminishes as the child reaches adulthood, at which point parents can no longer employ responsiveness and demandingness (Máñez et al., 2024).

The objective of this study is to investigate the relationship between parenting style and non-cognitive development outcomes among high school students, utilizing a substantial dataset and incorporating Big Five measures to assess non-cognitive development.

A third significant contribution is our examination of the differential impact of caregivers' parenting styles on children's non-cognitive development based on gender. Studies have indicated variations in the relationships between parenting style and child non-cognitive outcomes when considering gender differences (Crouter et al., 1995; Braza et al., 2015). Existing literature suggests a moderate role for a child's gender in the dynamic interaction between parenting style and students' non-cognitive development (Deater-Deckard et al., 2003; Barnett and Scaramella, 2013). One theory of child socialization posits that parents respond differently to boys and girls, adopting distinct parenting approaches for each gender. Additionally, the differential susceptibility theory suggests that different genders may react differently to the same parenting style (Keshavarz et al., 2012; Mandara et al., 2012). For example, Mandara et al. (2012) found that mothers exhibited greater warmth and support towards their daughters than their sons, with these parenting disparities contributing to more problematic behaviors in boys. Keshavarz et al. (2012), in a study involving 382 children and their parents in Malaysia, discovered that boys, especially those raised with authoritative fathers, exhibited better developmental outcomes compared to girls. This study also aims to investigate the heterogeneous effect of parenting styles on high school students' non-cognitive development, considering gender differences.

The remainder of the paper is structured as follows. The sample selection, data collection, ethical review, and econometric framework are described in Section 2. The results are presented in Section 3, and Section 4 concludes.

# 2 Methods

## 2.1 Sample selection

The data for this study were gathered through a survey conducted among high school students and households in two counties within Haidong City, located in Qinghai Province in 2023. Qinghai, predominantly situated on the Tibetan Plateau in northwestern China, is renowned for its high altitude and diverse mountainous terrain. Although geographically expansive, Qinghai is one of China's most sparsely populated provinces, with only 5.9 million residents, ranking second-fewest in population. Within this population, 49.47% belong to ethnic minority groups, and 58.8% reside in rural areas. In terms of GDP *per capita*, Qinghai ranks second to last among China's provinces. For our study, we randomly selected two counties, Ledu and Minhe, from six within Haidong City. Both counties, situated in eastern Qinghai, were designated as national-level poverty-stricken areas by the China State Council in 2012 and successfully emerged from poverty in 2020.

Following the identification of the specific locations of the sample counties, the research team initially acquired the roster of all students attending high schools in Ledu and Minhe counties from the local Bureau of Education office. Ledu County comprises four high schools, consisting of three ordinary high schools and one vocational high school. Similarly, Minhe County is home to five high schools, including four ordinary high schools and one vocational high school.

Utilizing a comprehensive student list, our objective was to inclusively select all students and their families registered in the high schools. In June 2023, we identified and obtained consent from 6,560 students and households to participate in our study. Out of the 6,560 enrolled student-caregiver dyads, 11 were excluded from the analysis due to incomplete data regarding the parenting style of the caregiver; these caregivers either declined or were unable to complete the survey form. Consequently, the total number of student-caregiver dyads in our sample is 6,549.

3 Sample size were as follows: $n$=1,191 in Kugler et al. (2022), $n$=431 in Loudová and Lašek (2015).

## 2.2 Data collection

In anticipation of the data collection phase, we recruited a total of 20 enumerators in April 2023. Enumerators were selected from postgraduate students at universities in Beijing and Qinghai Province. All enumerators underwent a comprehensive three-day training program, emphasizing the principles and techniques of survey administration. This training was conducted by a team of fieldwork professionals, including both enumerators and team leaders.

Data collection took place over a two-week period in May 2023, involving nine data collection teams. Each team, comprising a trained enumerator and a team leader, administered questionaires to students and primary caregivers. Vocational high schools have more classes, so the two vocational schools each had a trained enumerator, a team leader, and an assistant. All data collection procedures were conducted in the computer labs of each high school, with student and caregiver questionnaires completed under the supervision of an enumerator. The process involved alternating between one class and another. Initially, we gathered student questionnaires from each high school, obtaining data on the non-cognitive development of students. Subsequently, the school notified the primary caregiver of each student by class, who then completed primary caregiver questionnaires at the school. The primary caregiver, identified as the individual responsible for the student's daily care and nutrition, is typically a parent or grandparent. Information on parenting styles was collected from the primary caregivers' questionnaires.

### 2.2.1 Non-cognitive development of high school students

The non-cognitive abilities of students were assessed using the Big Five Inventory-Short (BFI-S), developed by Gerlitz and Schupp (2005). The Big Five model, widely accepted for describing personality (John et al., 2008), categorizes personality into five fundamental traits, represented by the acronym OCEAN: Openness refers to the tendency to be curious and pursue intellectual interests, reflecting an individual's inclination toward exhibiting imaginative, creative, unconventional, emotionally perceptive, and aesthetically sensitive qualities. Conscientiousness is the tendency to be hardworking and organized, pertaining to an individual's inclination toward being organized, possessing strong willpower, demonstrating persistence, exhibiting reliability, and adhering to laws and ethical principles. Extroversion is the tendency to be outgoing and sociable, signifying an individual's inclination toward sociability, warmth, activity, assertiveness, cheerfulness, and the pursuit of stimulation. Agreeableness is the tendency to be unselfish and friendly, encompassing the interpersonal component characterized by altruistic tendencies, trustworthiness, modesty, and cooperativeness. Emotional stability is the tendency to have consistency in emotional reactions.

As recommended by Hahn et al. (2012), we employed a BFI-S consisting of 15 items, with three items allocated to each personality dimension (detailed items can be found in Supplementary Table 1A). Participants rated their agreement with each statement on a 5-point Likert scale ranging from 1 = "strongly disagree" to 5 = "strongly agree." The original Spanish BFI-S form was translated into Mandarin Chinese by a native speaker and utilized in a comprehensive survey conducted in China, known as CFPS[4] (Wu and Gu, 2020). Following Wu and Gu's (2020) methodology, we adhered to the scoring procedure utilized by other researchers (Dehne and Schupp, 2007). Specifically, we evaluated the BFI-S dimensions using three items per dimension. Conscientiousness, extraversion, agreeableness, openness, and emotional stability are all positive indicators, meaning that high scores indicate high levels of non-cognitive abilities. In our sample, we assessed the internal consistency reliability of the BFI-S using Cronbach's alpha coefficient, revealing acceptable internal consistency among the caregivers with a Cronbach's alpha of 0.71. In the empirical analysis, the standardized score of five major dimensions was utilized.

### 2.2.2 Parenting style of primary caregivers

To evaluate parenting style, we administered the Parenting Styles and Dimensions Questionnaire-Short Version (PSDQ-S) survey to the primary caregivers of all sample students. The PSDQ-S questionnaire, developed by Robinson et al. (2001), serves to measure the parenting style of caregivers. The PSDQ-Short Version comprises six subgroups: three for authoritative and three for authoritarian parenting styles. The three components of an authoritative parenting style include Connection (warmth and support), Regulation (reasoning and induction), and Autonomy Granting (democratic participation). For authoritarian parenting style, the three elements are Physical Coercion, Verbal Hostility, and Non-Reasoning or Punitiveness. Due to the observed low reliability of indulgent and neglectful parenting style constructs within the Chinese cultural context (Chan et al., 2009; Ren and Pope Edwards, 2015; Wang et al., 2022), and the low prevalence of these styles among parents in China (Wu et al., 2002; Li and Xie, 2017), the data we collected does not include items related to permissive and neglectful parenting styles.

The PSDQ-S questionnaire comprises 27 items, requiring participants to assess the extent of their engagement in parenting activities by rating statements on a 5-point Likert scale, ranging from "never" (1) to "always" (5). We scored the PSDQ-S version using the same method as employed in prior studies (Kern and Jonyniene, 2012; Fu et al., 2013). Specifically, we utilized the Baumrind (1967) typologies, encompassing 15 questions measuring authoritative parenting and 12 measuring authoritarian parenting. A higher score on each dimension indicates a higher frequency of parenting practices aligning with the corresponding parenting style. In our study, we assessed the internal consistency and reliability of the PSDQ-Short Version using Cronbach's alpha coefficient. The results indicated alpha coefficients of 0.90 for the authoritative parenting style dimension, 0.89 for the authoritarian parenting style dimension, and 0.88 for the overall PSDQ scale.

4 In large-scale comprehensive surveys in China, as of 2018, there has never been a precedent for adding a personality test to a questionnaire. Although there are a small number of questions related to the personality description of the interviewees in the survey, but they are insufficient lack of systematic personality questionnaire data. In 2018, with a national representative the "China Family Panel Studies" of the representative sample was conducted in its latest issue. The same tests as BFI-S were introduced in the investigation measure the tool and adjust its options.

### 2.2.3 Student and household characteristics

Data on student and household characteristics were gathered through both a student-report questionnaire and a parent-report questionnaire. For student characteristics, we recorded their age in years, gender, boarding status, Hukou status (whether rural or not), and minority affiliation (Han or not). Additionally, we collected data on household characteristics, including family size, the number of siblings the student has, the relationship of the primary caregiver to the student (e.g., parents or grandparents), whether the household is categorized as poverty-stricken, paternal and maternal education levels, and household assets (e.g., whether the household had internet access or a flush toilet at home).

## 2.3 Statistical analysis

We conducted an analysis to examine the correlation between the parenting style of caregivers and high school students' non-cognitive development outcomes. As detailed in Section 2.2, parenting style is classified into authoritative and authoritarian categories to estimate these associations.

To achieve this objective, we initially estimate the relationship between specific subscales of parenting style and non-cognitive development outcomes. The regression specification is computed using the ordinary least squares (OLS) regression method (see Equation 1).

$$Y_{i,c} = \alpha_0 + \alpha_1 A_{i,c} + \eta X_{i,c} + \varepsilon_{i,c} \quad (1)$$

where the dependent variable, $Y_{i,c}$, refers to students' non-cognitive abilities: The standardized score of five specific dimensions of BFI-S. The variable $A_{i,c}$ represents the authoritative or authoritarian parenting style score of student *i* in class c. $X_{i,c}$ refers to student and household characteristics. Standard errors in all regression specifications are adjusted for clustering at the class level.

Second, following previous studies (Liu and Lachman, 2019), we put both authoritative and authoritarian parenting styles in the model to obtain the following OLS regression specification (see Equation 2):

$$Y_{i,c} = \alpha_0 + \alpha_1 A_{1,i,c} + \alpha_2 A_{2,i,c} + \eta X_{i,c} + \varepsilon_{i,c} \quad (2)$$

$A_{1,i,c}$ represents the authoritative parenting style score of student *i* in class c, and the $A_{2,i,c}$ represents the authoritarian parenting style score of student *i* in class c.

We further investigate differences in the relationships of parenting styles between boys and girls. For this exploratory analysis, we run the following OLS regression specification (see Equation 3):

$$Y_{i,c} = \alpha_0 + \lambda_1 G_{i,c} + \alpha_1 A_{1,i,c} + \beta_1 \left( A_{1,i,c} G_{i,c} \right) + \alpha_2 A_{2,i,c} + \beta_2 \left( A_{2,i,c} G_{i,c} \right) + \eta X_{i,c} + \varepsilon_{i,c} \quad (3)$$

where $G_{i,c}$ is a dummy indicator that takes the value of 1 if the student is male and the value of 0 if the student is female.

To further explore the correlations between various subgroups based on combinations of parenting styles—authoritative and authoritarian—with student non-cognitive development, we adopted a four-dimensional approach to classify parenting styles into more specific subgroups. To compare different combinations of "high" and "low" values for the two parenting styles, students were grouped based on their caregivers' ratings on the authoritative and authoritarian subscales, as established in previous studies (Zhang and Qin, 2019). Group 1 (high authoritative, low authoritarian) comprised caregivers whose ratings on the authoritative subscale were higher than the median but ratings on the authoritarian subscale were lower than the median. Group 2 (low authoritative, high authoritarian) included caregivers with ratings on the authoritative subscale below the median and ratings on the authoritarian subscale above the median. Caregivers scoring higher than the median on both the authoritative and authoritarian subscales were classified as Group 3 (high authoritative, high authoritarian). Group 4 consisted of parents and caregivers scoring below the median on both the authoritative and authoritarian dimensions, serving as a comparison group since their parenting methods were less authoritative and less authoritarian than the norm. For a comprehensive robustness assessment of the analysis, students were additionally categorized into four distinct groups based on cutoff values derived from the mean scores of the authoritative and authoritarian subscale ratings. The regression specification is estimated using the ordinary least squares (OLS) regression method (see Equation 4):

$$Y_{i,c} = \alpha_0 + \alpha_1 P_{2,i,c} + \alpha_2 P_{2,i,c} + \alpha_3 P_{3,i,c} + \eta X_{i,c} + \varepsilon_{i,c} \quad (4)$$

where $P_{1,i,c}$ is a dummy indicator that takes the value of 1 if the primary caregiver takes high authoritative and low authoritarian parenting styles and the value of 0 if else; $P_{2,i,c}$ is a dummy indicator that takes the value of 1 if the primary caregiver takes low authoritative and high authoritarian parenting styles and the value of 0 if else; and $P_{3,i,c}$ is a dummy indicator that takes the value of 1 if the primary caregiver takes high authoritative and high authoritarian parenting styles and the value of 0 if else. Standard errors are also adjusted for clustering at the class level.

To investigate the potential associations between specific student and household characteristics and authoritative and authoritarian parenting styles, we employed the following model (see Equation 5):

$$A_{i,c} = \beta_0 + \beta_1 X_{i,c} + \mu_{i,c} \quad (5)$$

where $A_{i,c}$ represents the dependent variable (which is either authoritative or authoritarian parenting style score of the primary caregiver of student i). As in the model above, the variable $X_{i,c}$ is a vector of covariates of student and household characteristics and $\mu_{i,c}$ is an error term.

# 3 Results

## 3.1 Student and household characteristics

Table 1 presents the socioeconomic and demographic characteristics of the sample students. The average age of the students was 17.61 years, ranging from 16 to 18. Approximately half of the students (48%) were male; 48% of the students resided in school, 75% had rural hukou, and 62% were Han minority. When examining household characteristics, the data revealed that the average family size

TABLE 1 Summary statistics for students and households.

| Variables | Mean (SD)/Percentage |
|---|---|
| **Student characteristics** | |
| (1) Age (in years) | 17.61 (1.19) |
| (2) Gender | |
| Male | 48% |
| Female | 52% |
| (3) Student is boarding | |
| Yes | 48% |
| No | 52% |
| (4) Hukou is Rural | |
| Yes | 75% |
| No | 25% |
| (5) Minority is Han | |
| Yes | 62% |
| No | 38% |
| **Household characteristics** | |
| (6) Family size (numbers) | 4.73 (1.32) |
| (7) Siblings (numbers) | 1.12 (0.79) |
| (8) Primary caregiver is parents | |
| Yes | 93% |
| No | 7% |
| (9) Paternal education level (years) | |
| <12 | 77% |
| >=12 | 23% |
| (10) Maternal education level (years) | |
| <12 | 83% |
| >=12 | 17% |
| (11) Poverty-stricken household | |
| Yes | 12% |
| No | 88% |
| (12) Family asset index | 0.04 (1.56) |
| **Parenting style** | |
| (13) Authoritative | 3.32 (0.71) |
| (14) Authoritarian | 2.16 (0.67) |

The table shows the mean and the standard deviation for age (row 1), family size (row 5), the number of siblings of students (row 6), family asset index (row 11), Authoritative score (row12), and Authoritarian score (row13), while shows the percent for other indictors. The construction of the family asset index involved the utilization of polychoric principal component analysis, which was based on a set of variables including tap water, toilet facilities, water heater, washing machine, television, computer, internet access, refrigerator, microwave oven, extractor, air conditioner, motor or electric bicycle, and car.

of the sample students is 4.73, the average number of siblings per student is 1.12, and in 93% of sample students, parents were the primary caregivers. Additionally, 12% of sample students were from poverty-stricken households, and only 23% of fathers and 17% of mothers had completed upper secondary education or above. The average score for authoritative parenting style, as reported by 6,549 caregivers regarding the students, was 3.32, while the average score for authoritarian parenting style was 2.16.

TABLE 2 Non-cognitive score of sampling high school student.

| | Full sample | Boys | Girls | *p*-value (boys vs. girls) |
|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | |
| **Non-cognitive abilities** | | | | |
| Conscientiousness | 3.32 | 3.37 | 3.25 | 0.000 |
| | (0.63) | (0.67) | (0.60) | |
| Extroversion | 3.27 | 3.29 | 3.25 | 0.039 |
| | (0.68) | (0.68) | (0.68) | |
| Agreeableness | 3.65 | 3.66 | 3.64 | 0.269 |
| | (0.61) | (0.60) | (0.60) | |
| Openness | 3.54 | 3.60 | 3.48 | 0.480 |
| | (0.68) | (0.69) | (0.67) | |
| Emotional stability[1] | 2.85 | 2.97 | 2.73 | 0.000 |
| | (0.70) | (0.69) | (0.70) | |
| Observations | 6,549 | 3,117 | 3,432 | |

[1]In order to keep consistency with the scores of other dimension of non-cognitive ability, the emotional stability dimension is also adjusted to a positive indicator, meaning that the higher the score, the more stable the student's emotions are.

## 3.2 Non-cognitive outcomes of high school student

Table 2 presents the high school students' non-cognitive developmental subscale scores in the full sample and sub-samples. The dimension scores for conscientiousness, extroversion, agreeableness, openness, and emotional stability are 3.32 (0.63), 3.27 (0.68), 3.65 (0.61), 3.54 (0.68), and 2.85 (0.70), respectively.

A comparison of the sub-samples of boys and girls reveals distinctions in non-cognitive outcomes. Specifically, boys, with a conscientiousness score of 3.37, an extroversion score of 3.29, an agreeableness score of 3.66, an openness score of 3.60, and an emotional stability score of 2.97, outperform girls in these subscales. Additionally, boys have substantially higher scores for extraversion, conscientiousness, and emotional stability.

## 3.3 Parenting style and non-cognitive outcomes

### 3.3.1 Two dimensions of parenting style and students' non-cognitive outcomes

The correlations between authoritative or authoritarian parenting style and student non-cognitive developmental outcomes as measured by the BFI-S are presented in Table 3. Notably, when controlling for student- and household-specific variables, authoritative measurement scores were significantly and positively associated with all sub-indexes at the 1% significance level, except for emotional stability. A one-point increase in authoritative measurement scores was linked to an increase in conscientiousness, extroversion, agreeableness, and openness by 0.108 SD, 0.069 SD, 0.101 SD, and 0.123 SD, respectively. In contrast, authoritarian measurement scores were significantly and negatively correlated with

TABLE 3 Association between two parenting styles dimensions and student's non-cognitive abilities.

| | Conscientiousness | Extroversion | Agreeableness | Openness | Emotional stability |
|---|---|---|---|---|---|
| Authoritative | 0.108** | 0.069** | 0.101** | 0.123** | 0.052 |
| | (0.011) | (0.016) | (0.016) | (0.006) | (0.027) |
| Adj. $R^2$ | 0.054 | 0.021 | 0.024 | 0.075 | 0.052 |
| Authoritarian | −0.110** | 0.008 | −0.062* | 0.002 | −0.053** |
| | (0.006) | (0.012) | (0.022) | (0.011) | (0.007) |
| Adj. $R^2$ | 0.054 | 0.019 | 0.021 | 0.068 | 0.052 |
| Controls | YES | YES | YES | YES | YES |
| Class fixed effect | YES | YES | YES | YES | YES |
| Observations | 6,549 | 6,549 | 6,549 | 6,549 | 6,549 |

Each cell is a separate regression. Five sub-scales of non-cognitive abilities score are standardized score. Controls included student age (in years), gender, Hukou, minority; family size, number of siblings of child, whether the student's parent was the primary caregiver, whether the household of the child is poverty-stricken households, educational attainment of father and mother, and a factor of household wealth. Class fixed effects added. All standard errors account for clustering at the class level. *$p < 0.05$; **$p < 0.01$.

TABLE 4 Association between parenting style and student's non-cognitive ability.

| | Conscientiousness | Extroversion | Agreeableness | Openness | Emotional stability |
|---|---|---|---|---|---|
| **Parenting style** | | | | | |
| Authoritative | 0.099** | 0.070** | 0.096** | 0.124** | 0.048 |
| | (0.013) | (0.015) | (0.015) | (0.007) | (0.028) |
| Authoritarian | −0.100** | 0.015 | −0.053 | 0.014 | −0.048** |
| | (0.006) | (0.013) | (0.023) | (0.014) | (0.006) |
| Controls | YES | YES | YES | YES | YES |
| Class fixed effect | YES | YES | YES | YES | YES |
| Adj. $R^2$ | 0.059 | 0.021 | 0.026 | 0.075 | 0.053 |
| Observations | 6,549 | 6,549 | 6,549 | 6,549 | 6,549 |

Five sub-scales of non-cognitive abilities score are standardized score. Controls included student age (in years), gender, Hukou, minority; family size, number of siblings of child, whether the student's parent was the primary caregiver, whether the household of the child is poverty-stricken households, educational attainment of father and mother, and a factor of household wealth. Class fixed effects added. All standard errors account for clustering at the class level. *$p < 0.05$; **$p < 0.01$.

student non-cognitive specific sub-indexes (conscientiousness, agreeableness, and emotional stability). A one-point increase in authoritarian measurement scores was associated with a decrease in the standardized conscientiousness score by 0.110 SD ($p < 0.01$), a decrease in the agreeableness score by 0.062 SD ($p < 0.05$), and a decrease in the emotional stability score by 0.053 SD ($p < 0.01$). The correlations between the six specific parenting style dimensions of authoritative and authoritarian are presented in Supplementary Table 2A, and the results are consistent with those in Table 3.

Table 4 demonstrates that both authoritative and authoritarian parenting styles are significantly associated with specific sub-index scales of non-cognitive development. Specifically, an authoritative parenting style was significantly and positively associated with conscientiousness, extroversion, agreeableness, and openness. A one-point increase in authoritative parenting style was associated with a 0.099 SD ($p < 0.01$) increase in the standardized conscientiousness score, a 0.070 SD ($p < 0.01$) increase in the standardized extroversion score, a 0.096 SD ($p < 0.01$) increase in the standardized agreeableness score, and a 0.124 SD ($p < 0.01$) increase in the standardized openness score. However, authoritarian parenting style was significantly associated with a narrower range of primary index scales than authoritative parenting style, including conscientiousness and emotional stability. Specifically, a one-point increase in authoritarian parenting style was associated with decreases in standardized scores for conscientiousness by 0.100 SD ($p < 0.01$) and emotional stability by 0.048 SD ($p < 0.01$).

### 3.3.2 Parenting style and students' non-cognitive outcomes for boys versus girls

The results of the regression analysis on different genders are presented in Table 5, confirming the significant impact of parenting style on non-cognitive development. The extent of the effect varies somewhat between male and female student groups: authoritative parenting style has a significant influence on several outcomes (conscientiousness and extroversion scores) for girls but has little effect on boys. Specifically, the coefficient on the interaction term (−0.045, −0.082) indicates a statistically significant difference in conscientiousness and extroversion scores between boys and girls ($p < 0.01$), suggesting that an authoritative parenting style was associated with conscientiousness and extroversion scores in a significantly different way among boys and girls. The difference in emotional stability scores between boys and girls was statistically significant ($p < 0.01$), as indicated by the coefficient on the interaction term (−0.067), suggesting that an authoritarian parenting style was

TABLE 5 Association between parenting style and students' non-cognitive ability based on subsamples.

| | Conscientiousness | Extroversion | Agreeableness | Openness | Emotional stability |
|---|---|---|---|---|---|
| Gender | 0.447* | 0.495** | 0.003 | 0.626** | 0.659** |
| (1 = male; 0 = female) | (0.119) | (0.054) | (0.154) | (0.104) | (0.094) |
| Authoritative | 0.120** | 0.110** | 0.104** | 0.167** | 0.071* |
| | (0.017) | (0.014) | (0.013) | (0.034) | (0.018) |
| Authoritative × gender | −0.045** | −0.082** | −0.019 | −0.090 | −0.048 |
| | (0.010) | (0.016) | (0.063) | (0.066) | (0.028) |
| Authoritarian | −0.082** | −0.053** | −0.077** | −0.047* | −0.015 |
| | (0.012) | (0.009) | (0.018) | (0.015) | (0.014) |
| Authoritarian × gender | −0.035 | −0.075 | 0.051 | −0.064 | −0.067** |
| | (0.034) | (0.038) | (0.053) | (0.057) | (0.016) |
| Controls | YES | YES | YES | YES | YES |
| Class fixed effect | YES | YES | YES | YES | YES |
| Adj. $R^2$ | 0.059 | 0.022 | 0.026 | 0.076 | 0.054 |
| Observations | 6,549 | 6,549 | 6,549 | 6,549 | 6,549 |

Five sub-scales of non-cognitive abilities score are standardized score. Controls included student age (in years), Hukou, minority; family size, number of siblings of child, whether the student's parent was the primary caregiver, whether the household of the child is poverty-stricken households, educational attainment of father and mother, and a factor of household wealth. Class fixed effects added. All standard errors account for clustering at the class level. *$p < 0.05$; **$p < 0.01$.

associated with emotional stability scores in a significantly different way for boys and girls.

### 3.3.3 Four parenting style categories and students' non-cognitive outcomes

The distribution of the four groups of combined parenting styles is presented in Supplementary Table 3A. Among the 6,549 students and their caregivers, 1825 primary caregivers (27.87%) exhibited a mainly authoritative parenting style (Group 1: highly authoritative, lowly authoritarian). Group 2 (high authoritarian, low authoritative) included 2074 families (31.67%), where the primary caregivers mostly adopted an authoritarian approach. Thousand five hundred and eighty-three primary caregivers (24.17%) reported using a style that was both authoritative and authoritarian when raising their children (Group 3: highly authoritative and highly authoritarian). Neither an authoritative nor an authoritarian caregiving style was found in the fourth group, which included 1,067 primary caregivers (16.29%).

The correlations between the four groups of combined parenting styles and students' non-cognitive development are reported in Table 6. The results presented in Table 6 indicate that students with primary caregivers who belonged to Group 1 had substantially higher scores on several non-cognitive measures than those with caregivers who belonged to Group 4. Specifically, these students had higher scores on the conscientiousness score ($\beta = 0.149$, $p < 0.01$), extroversion score ($\beta = 0.129$, $p < 0.05$), agreeableness score ($\beta = 0.129$, $p < 0.05$), and openness score ($\beta = 0.204$, $p < 0.01$). In contrast, students whose primary caregivers belonged to Group 2 exhibited significantly lower non-cognitive scores, including a conscientiousness score ($\beta = -0.094$, $p < 0.01$), an extroversion score ($\beta = -0.058$, $p < 0.01$), an agreeableness score ($\beta = -0.069$, $p < 0.01$), and an openness score ($\beta = -0.052$, $p < 0.01$). Students whose primary caregivers belonged to Group 3 had higher extroversion scores ($\beta = 0.136$, $p < 0.01$), agreeableness scores ($\beta = 0.070$, $p < 0.01$), and openness scores ($\beta = 0.200$, $p < 0.01$) than students whose primary caregivers belonged to Group 4. Correlations between the four categories of combined parental styles and students' non-cognitive development are displayed in Supplementary Table 4A, with means serving as dividing lines. The results are consistent with Table 6.

### 3.3.4 Student/demographic variables and parenting style

Table 7 presents the correlation between student and household characteristics and authoritative (or authoritarian) parenting styles. When examining student characteristics, we find that the age of the student and Hukou are significantly associated with an authoritative parenting style. Specifically, a one-year increase in the student's age corresponds to an increase in the authoritative parenting style score by 0.01 points ($p < 0.01$). Primary caregivers are less likely to adopt an authoritative style if the student has a rural Hukou ($\beta = -0.114$, $p < 0.01$). Additionally, we discovered gender differences in relation to a caregiver's authoritarian parenting style. It is more likely that the primary caregivers will adopt an authoritarian style if the student is a boy ($\beta = 0.132$, $p < 0.01$).

When examining household characteristics, we found that the number of siblings, the education level of both parents, and family asset value were significantly associated with authoritative parenting. Specifically, if the student has more siblings, primary caregivers are less likely to adopt an authoritative parenting style ($\beta = -0.050$, $p < 0.01$). Additionally, paternal education level ($\beta = 0.054$, $p < 0.05$), maternal education level ($\beta = 0.101$, $p < 0.01$), and primary caregivers from financially well-off households ($\beta = 0.021$, $p < 0.05$) were positively correlated with an authoritative style of parenting. However, paternal education level ($\beta = -0.036$, $p < 0.01$), maternal education level ($\beta = -0.071$, $p < 0.05$), and the parent's status as the primary caregiver ($\beta = -0.028$, $p < 0.05$) were negatively correlated with authoritarian parenting style.

## 4 Discussion

This study initially explored the relationship between parenting style and the non-cognitive development of high school students. The findings

indicate a strong and positive correlation between an authoritative parenting style and the non-cognitive development of high school students. Conversely, an authoritarian parenting style was found to be associated with contrasting effects. Specifically, students raised with an authoritative style exhibited higher levels of conscientiousness, extraversion, agreeableness, and openness, while those raised with an authoritarian style showed lower levels of conscientiousness and emotional stability. The current study's findings on this association are consistent with previous research conducted in both developed and urban China (Heaven and Ciarrochi, 2008; Deng and Tong, 2020; Zhang et al., 2020; Kugler et al., 2022). These studies have demonstrated that parents adopting an authoritative parenting style have a deeper understanding of their child's needs and capabilities, proving effective in fostering the child's non-cognitive development (Febiyanti and Rachmawati, 2021). In contrast, authoritarian parents employ harsh discipline and strict rules to assert their authority over their children, potentially leading to negative emotional states such as fear, frustration, confusion, and anxiety in the child. Children exposed to an authoritarian parenting style, or its characteristics, are more likely to experience adverse non-cognitive developmental outcomes (Hastings et al., 2007; Mensah and Kuranchie, 2013; Zhang and Qin, 2019).

The two-dimensional analysis revealed that primary caregivers scored highly ($M = 3.32$) on the authoritative parenting style but only moderately ($M = 2.16$) on the authoritarian parenting style. These results align with recent studies conducted in urban China (Xia, 2020; Lin et al., 2022). In comparison to two studies conducted in urban China, this study found a significantly lower use of authoritative parenting and a significantly higher use of authoritarian parenting, as evidenced by statistical tests ($t$-tests) comparing the means of authoritative and authoritarian parenting styles.

The current study investigated the relationship between parenting style and the non-cognitive development of high school students, specifically exploring gender differences. The findings indicated that an authoritative parenting style had positive effects on the non-cognitive developmental outcomes of both male and female high school students. Notably, the authoritative parenting style exhibited a more pronounced influence on the conscientiousness and extroversion of girls compared to boys. This result aligns with findings from other studies (Buchanan et al., 2016; Kugler et al., 2022). Moreover, authoritarian parenting was found to have a significant and negative impact on the non-cognitive abilities of both boys and girls, except for the emotional stability scale, suggesting that authoritarian parenting has a stronger effect on boys' emotional stability than on girls.

Regarding the relationships between parenting style and non-cognitive development in students, assessed through the four-dimensional framework, a significant and positive correlation was identified in a particular combination of parenting styles (referred to as Group 1) compared to a combined parenting style characterized by the absence of both authoritative and authoritarian practices (referred to as Group 4). Adolescents in Group 1, where primary caregivers employed an authoritative parenting style with minimal reliance on authoritarian practices, exhibited superior non-cognitive developmental outcomes. Conversely, Group 2, characterized by a parenting style predominantly authoritarian with infrequent authoritative behaviors, showed adverse correlations with the non-cognitive development of students. Additionally, students in Group 3, where the main caregiver employed a parenting approach combining both high authoritative and high authoritarian styles, demonstrated improved non-cognitive development, except in the case of emotional stability. Although the four-category method of measuring parenting styles has been less explored in studies on the relationship between parenting style and students' non-cognitive developmental outcomes, these findings align with existing research indicating a positive association between authoritative parenting and children's non-cognitive development (Deng and Tong, 2020; Zhang et al., 2020). Conversely, authoritarian parenting has been linked to poorer levels of non-cognitive development in students (Kugler et al., 2022). Interestingly, students raised by primary caregivers employing a combination of authoritative and authoritarian parenting styles scored higher in non-cognitive development (Dornbusch et al., 2016).

In our examination of the correlations between parenting styles and students' characteristics, we observed a tendency for primary caregivers

TABLE 6 Association between combinations of parenting styles and student's non-cognitive abilities.

| | Conscientiousness | Extroversion | Agreeableness | Openness | Emotional stability |
|---|---|---|---|---|---|
| Group 1(high authoritative, low authoritarian) | 0.149** | 0.129* | 0.129* | 0.204** | 0.060 |
| | (0.035) | (0.032) | (0.042) | (0.020) | (0.064) |
| Group 2 (low authoritative, high authoritarian) | −0.094** | −0.058** | −0.069** | −0.052** | −0.020 |
| | (0.019) | (0.009) | (0.013) | (0.008) | (0.029) |
| Group 3 (high authoritative, high authoritarian) | 0.011 | 0.136** | 0.070** | 0.200** | −0.001 |
| | (0.020) | (0.020) | (0.009) | (0.005) | (0.054) |
| Controls | YES | YES | YES | YES | YES |
| Class fixed effect | YES | YES | YES | YES | YES |
| Adj. $R^2$ | 0.057 | 0.021 | 0.025 | 0.075 | 0.052 |
| Observations | 6,549 | 6,549 | 6,549 | 6,549 | 6,549 |

Five sub-scales of non-cognitive abilities score are standardized score. Controls included student age (in years), gender, Hukou, minority; family size, number of siblings of child, whether the student's parent was the primary caregiver, whether the household of the child is poverty-stricken households, educational attainment of father and mother, and a factor of household wealth. Class fixed effects added. All standard errors account for clustering at the class level. *$p < 0.05$; **$p < 0.01$.

TABLE 7 Association between student and household characteristics and parenting style.

| | Authoritative parenting style | Authoritarian parenting style |
|---|---|---|
| **Student characteristics** | | |
| (1) Student Age (in years) | 0.010** | −0.023 |
| | (0.002) | (0.010) |
| (2) Student is male (1 = yes; 0 = no) | −0.011 | 0.132** |
| | (0.012) | (0.024) |
| (3) Student is boarding | 0.055 | −0.021 |
| | (0.022) | (0.021) |
| (3) Student's Hukou is Rural (1 = yes; 0 = no) | −0.114** | 0.063 |
| | (0.006) | (0.031) |
| (4) Student's Minority is Han (1 = yes; 0 = no) | −0.020 | −0.049 |
| | (0.030) | (0.024) |
| **Household characteristics** | | |
| (5) Family size (numbers) | 0.011 | −0.004 |
| | (0.005) | (0.007) |
| (6) Siblings (numbers) | −0.050** | 0.003 |
| | (0.008) | (0.009) |
| (7) Primary caregiver is parents | 0.013 | −0.028* |
| | (0.015) | (0.008) |
| (8) Paternal education level | 0.054* | −0.036** |
| (1 = upper secondary education or above; 0 = else) | (0.016) | (0.005) |
| (9) Maternal education level | 0.101** | −0.071* |
| (1 = upper secondary education or above; 0 = else) | (0.008) | (0.024) |
| (10) Poverty-stricken household (1 = yes; 0 = no) | −0.052 | −0.025 |
| | (0.042) | (0.013) |
| (11) Family asset index | 0.021* | −0.011 |
| | (0.006) | (0.015) |
| Class fixed effect | Yes | Yes |
| Adj. $R^2$ | 0.025 | 0.021 |
| Observations | 6,549 | 6,549 |

All standard errors account for clustering at the class level. *$p < 0.05$; **$p < 0.01$.

to adopt an authoritative parenting style as the child grows older, while being less inclined to employ an authoritarian approach. This shift might be attributed to parents gradually relinquishing control over their children's environments as they age and gain more autonomy in decision-making (Rosen et al., 2008; Hotz and Pantano, 2015). Additionally, our findings revealed that the use of an authoritarian style was more prevalent with boys than with girls. This aligns with previous research indicating that girls are often reasoned with, whereas boys are more likely to face physical punishment (Siegal, 1987; Wang et al., 2021). Notably, caregivers tend to employ an authoritarian parenting approach, as opposed to an authoritative one, when students have rural Hukou. This finding is consistent with Pinki and Singh's (2013) discovery that parents of urban students demonstrate more emotional warmth and understanding, while parents of rural students exhibit higher levels of rejection, punishment, and subject preferences.

In our exploration of the relationships between parenting styles and household characteristics, we identified notable patterns. Specifically, when primary caregivers have a larger number of children in the family, there is a decreased likelihood of employing an authoritative parenting style for each individual child. This finding aligns with a previous study (Lu and Chang, 2013). Furthermore, when parents, as opposed to grandparents, are not the primary caregivers, there is a higher probability of adopting an authoritarian parenting style. This result is consistent with research conducted on preschool-aged children in rural China, revealing that grandmothers, influenced by traditional Chinese culture, tend to exhibit emotional restraint, discourage warmth, and display reluctance in child-rearing (Wang et al., 2022). Moreover, parents with higher levels of education are more inclined to utilize an authoritative approach rather than an authoritarian one in raising their children. These findings align with prior research (Baumrind, 1971; Chen et al., 2000; Khanam and Nghiem, 2016), suggesting that well-educated parents are more likely to recognize the benefits of an authoritative parenting style and apply it in their child-rearing practices. Additionally, a positive correlation was observed between the family asset index and authoritative parenting, indicating that families with higher levels of wealth were more prone to adopting this style of parenting. This result is in accordance with international studies that have demonstrated a correlation between parents of higher socioeconomic status and a greater tendency to employ warm parenting practices (Cobb-Clark et al., 2019).

The study identified two primary limitations that impede the adoption of authoritative parenting styles in rural China: knowledge constraints and economic limitations. Firstly, a lack of knowledge regarding parenting styles and their impact on children may contribute to the observed deficiency in authoritative parenting and an over-reliance on authoritarian parenting (Xu et al., 2005). More educated parents, compared to those with less education, are more likely to value inductive reasoning and democratic methods of control over power assertion (Chen et al., 2000). Secondly, financial difficulties may exacerbate family conflicts, potentially harming the caregiver's physical and mental health. This, in turn, has the potential to negatively influence the caregiver's mindset and parenting approach (Liu and Lachman, 2019).

As the world's largest developing country, exploring the correlation between parenting styles and the non-cognitive development of high school students in rural areas of China holds significant value. Our findings provide evidence that an authoritative parenting style can effectively enhance the non-cognitive abilities of high school students. Conversely, an authoritarian parenting style, characterized by a lack of emotional contact and stringent demands, has been found to impede the non-cognitive development of children in rural areas of China. Therefore, we recommend that policymakers develop parenting education intervention programs to improve the quality of parenting styles in rural China. The results of our study also suggest that certain groups should be specifically targeted for such programs, notably poorer families, families where parents are not present or are not the primary caregivers, and those in which parents have lower education levels.

Studies of parenting style intervention programs in developed and developing settings have led to significant gains in non-cognitive skills among disadvantaged children (Gertler et al., 2014; Attanasio et al., 2020). Parenting training programs can be established with a set curriculum and with guidance provided by trained teachers, and these interventions offer educational support for parents, facilitating the development of positive parenting attitudes and the acquisition of high-quality childcare abilities. Parenting teachers could be nurses or doctors at local township hospitals, or they could be trained paraprofessionals from the local community. By implementing interventions of this nature, rural caregivers can build knowledge and practical skills to help children to develop their full potential.

This study contributes to the literature in three key ways. Firstly, it represents the inaugural and singular investigation into how parenting styles impact the non-cognitive developmental outcomes of high school students in rural China. The research provides significant and novel insights into how parenting styles may shape the non-cognitive development of children in low- and middle-income rural environments. Earlier studies have indicated that adolescents in such contexts typically undergo adverse non-cognitive developmental effects (Zhou, 2022). Second, this study is the first to examine the association between parenting style and non-cognitive developmental outcomes for high school students using a two-dimensions method and a four-categories approach. Third, this is the first study to investigate the different influences of parenting style on the non-cognitive developmental outcomes of high school students by gender, offering a crucial analysis in this emerging field of study.

## 5 Limitations and future directions

We acknowledge that this study has several limitations. First, caregivers' self-reports of their parenting style may have been subject to recall bias. Obviously, many previous studies also experienced this limitation. Second, the impact of students' non-cognitive development on caregivers' parenting styles was not examined. Therefore, the bidirectional relationship between students' non-cognitive development and parenting style cannot be identified through this study. Third, while there were associations between parenting style and students' non-cognitive abilities, we were unable to make causal implications.

The following suggestions for further research are provided with regard to the study's limitations: First, in order to avoid the influence of recall bias, other approaches, such as observing parent–child interactions or conducting in-person interviews with children, should be used to evaluate parenting style. Second, future research should concentrate on gathering information on student non-cognitive development and parenting style for additional waves and try to demonstrate whether there is a reciprocal connection between parenting style and students' non-cognitive development. Finally, future research could assess the causal chain of the connections by using longitudinal datasets of parenting style, student characteristics, and the non-cognitive development of students.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Ethics Committee of Renmin University of China. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

## Author contributions

SW: Formal analysis, Resources, Writing – original draft, Writing – review & editing, Conceptualization, Funding acquisition. LZ: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study was supported by the Science Research Fund Project of Renmin University of China (Grant number 22XNLG07).

## Acknowledgments

Many people assisted to make this project and paper possible. In particular, we would like to acknowledge Ruirui Dang for her work on editing.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1393445/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 13 August 2024
DOI 10.3389/fpsyg.2024.1451244



OPEN ACCESS

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RECEIVED 18 June 2024
ACCEPTED 30 July 2024
PUBLISHED 13 August 2024

CITATION
Predoiu R, Piotrowski A, Stan EA, Ciolacu MV, Bitang A, Croitoru D and Cosma G (2024) Explicit and indirect, latency-based measure of aggression in striking combat sports. *Front. Psychol.* 15:1451244. doi: 10.3389/fpsyg.2024.1451244



# Explicit and indirect, latency-based measure of aggression in striking combat sports

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**Introduction:** Aggression in sports is often perceived as a necessary trait for success, especially in martial arts. Aggression can be assessed both explicitly and implicitly, taking into account the dual processing model. The purpose of the research was to examine explicit and indirect, latency-based measure of aggression in competitive athletes practicing striking combat sports, according to gender and sports performance. At the same time, we verified whether aggression (implicit/unconscious and explicit) predicts sports performance in martial artists.

**Materials and methods:** A total of 85 athletes practicing striking combat sports took part in the research. For implicit, latency-based measure of aggression, an Implicit Associations Test (IAT) was used, while explicit aggression was assessed with the Romanian adaptation of the Makarowski's Aggression Questionnaire for martial arts athletes.

**Results:** Data analysis revealed (using multivariate analysis of variance) that athletes from striking combat sports having international sports performances registered significantly higher D-scores (IAT, $p = 0.014$) and lower values for Go-ahead factor ($p = 0.006$), compared to athletes without outstanding results. Goodman and Kruskal tau association test was used to check the existing associations between athletes' gender and martial arts athletes' level of explicit and implicit aggression. In addition, binomial logistic regression procedures were performed, predicting martial artists' likelihood to obtain higher sports results, based on explicit and indirect aggression.

**Conclusion:** A stronger association between Aggression and Others (at implicit/unconscious level) and a moderate level (generally) for Go-ahead factor of explicit aggression are associated with an increased likelihood of sports performances in athletes. In addition, male martial arts athletes are more persistent despite obstacles, remaining more on the offensive (no gender-related association were found in terms of indirect/unconscious aggression, and for Foul Play and Assertiveness factors of explicit aggression). The study underlines

the importance of addressing athletes' subconscious level to promote more constructive behaviors in competitions.

KEYWORDS

explicit aggression, martial arts, indirect aggression, IAT, sports performance

# 1 Introduction

Considering the forms of direct confrontation (see Predoiu et al., 2022a; Patenteu et al., 2023a), combat sports and martial arts can be divided in striking combat sports (e.g., karate, taekwondo, boxing, kickboxing, and fencing—working with weapons in this case) and grappling combat sports (e.g., jiu-jitsu, judo, and wrestling). Striking combat sports (SCS) represent heuristic sport disciplines where athletes must be aggressive and make quick and appropriate decisions to win. On the relationship between martial arts and combat sports, Kalina (2000) mentioned "every combat sport is martial arts but not vice versa" (p. 18).

Martial arts can be defined as "systems that blend the physical components of combat with strategy, philosophy, tradition, or other features, thereby distinguishing them from pure physical reaction" (Green and Svinth, 2010, p. 19). Despite the aggressive nature of athletes to win, combat sports convey moral values, a key element during training being the ethical, social, and moral development of practitioners (Kostorz and Sas-Nowosielski, 2021). In combat sports, the aim is to achieve non-aggressive goals (winning) through aggressive behavior (Martinkova and Parry, 2016).

Aggression can be defined as a negative behavioral trait that can be reflected in harmful physical or mental behavior against others (Keeler, 2007). In this context, defined as the intention to physically or psychologically harm someone who is motivated to avoid such treatment, aggression can be either hostile or instrumental (Wann, 2005). If the aggressive behaviors of athletes are within the boundaries/rules of the game (and not hostile—see, also, Silva (1983) for hostile and instrumental aggression), leading to a positive competitive outcome, this type of aggression is applauded and socially appreciated (Cashmore, 2008; Patenteu et al., 2023b). In sport context, it is important to distinguish between the types of aggression (Rydzik, 2022). Instrumental aggression can be observed, generally, in sports activities. Its goal is to score a point or to stop a rival from gaining an advantage, while the competitor complies with the rules. In this instance, the sole prerequisite is the absence of any desire to cause harm to others, or the display of hostile/violent aggression; however, in the case of instrumental aggression, it still has an intentional and calculated character (Krishnaveni and Shahin, 2018).

Research suggests that a combination of individual factors, such as personality traits (e.g., high levels of competitiveness or low impulse control), and situational factors, such as the competitive nature of the sport or the high stakes involved, can contribute to the occurrence of aggression in sports (Russell, 2008; Newman et al., 2021). Hernandez and Anderson (2015) investigated aggression, in martial arts, within the framework of the general aggression model (GAM) theory. In accordance with GAM (Anderson and Bushman, 2018), the aggressive behavior is influenced by one's decisions, arousal, by the biological factors together with the persistent environmental characteristics, by the existing cognitions and feelings, changing the knowledge structures of the individual. The significant role of the social knowledge structures in aggressive behavior is well known (Dodge, 1980). In sports, the persistent use of aggressive behaviors along with the trainer's encouraging reinforcement leads to an increase in aggression (Syrmpas and Bekiari, 2018). Frequently, athletes are encouraged by the coach to play a tough game, especially if it brings success. According to Petrovska et al. (2021), training in aggressive actions due to the specifics of activity and constant conflict of situations leads, as a rule, to an increase in the level of aggression of an athlete. In these conditions, it is very important that the athlete possess those qualities that would allow him/her to govern and control aggression. The social and cultural influences, the aggressive role models, shape, therefore, aggressive behavior in sports (Marwat et al., 2022).

## 1.1 Explicit and indirect measure of aggression

Aggression can be assessed both explicitly and implicitly (Gollwitzer et al., 2007) taking into account the dual processing model (Gawronski and Bodenhausen, 2006), existing two ways of processing information (Strack and Deutsch, 2004). Automatic (implicit) processing occurs in the absence of conscious control, individual's behavior being the result of the activation from memory of a set of associations (De Houwer et al., 2009). Explicit aggression involves overt, easily observed, direct manifestations, for example, verbal manifestations/threats and physical violence (Neuman and Baron, 1998). Implicit or indirect aggression is subtle, being less visible and obvious, can be triggered by situational characteristics (Todorov and Bargh, 2002), and being conceptualized as an automatically activated self-attitude (Uhlmann and Swanson, 2004; Gollwitzer et al., 2007). Implicit measurements explore a combination of traits and states, which are subjected to variation generated by situation-specific circumstances (Dasgupta and Greenwald, 2001), specialized literature emphasizing that aggression research might benefit from measuring (automatic) reactions (Blümke and Zumbach, 2007).

Human behavior is guided, therefore, by implicit and explicit processing (Gawronski and Bodenhausen, 2006), being essential to consider the role of both indirect, latency-based, and explicit measure of aggression. Both automated and conscious/deliberate ways of processing information contribute differentially and define aggressive behavior (Richetin and Richardson, 2008). Explicit aggression can be assessed through questionnaires, while indirect aggression can be measured with indirect measurement tools, for example, implicit association test (IAT).

IATs to measure implicit attitudes toward sport in elite athletes (Gerber et al., 2019), implicit exercise importance (Forrest et al., 2016), or beliefs about sport ability in basketball and swimming (Mascret

et al., 2016) have been used. However, to the best of our knowledge, very few articles explored IAT ability to predict sports performance (aggression being investigated), compared to explicit assessments, for example, Teubel et al. (2011) in basketball players and Predoiu et al. (2022b) in martial arts coaches. We mention, also, that IATs to measure implicit aggression have been used in previous research, with school children (Blümke and Zumbach, 2007) and adolescents (Gollwitzer et al., 2007), but unrelated to sports performance.

# 2 The current study

The aim of the research was to examine explicit and implicit aggression in competitive athletes practicing striking combat sports, according to gender and sports performance. At the same time, we wanted to verify whether aggression (unconscious/automatic aggression and also, explicit) predicts sports performance in martial artists.

## 2.1 Objectives

The objectives were as follows:

- Knowing the explicit and implicit aggression in martial artists from striking combat sports;
- Identifying the differences between martial artists, in terms of explicit and automatic aggression, taking into consideration athletes' sports performances;
- Establishing gender-related associations, in the case of martial artists, regarding direct and indirect aggression;
- Identifying predictors of sports performance, in the case of martial artists, starting from athletes' implicit and explicit aggression.

*Hypotheses*

The hypotheses were as follows:

> $H_1$: Investigation of explicit and indirect, latency-based measure of aggression reveals significant differences between martial arts athletes according to sports performances.
>
> $H_2$: There are significant associations between athletes' gender and martial arts athletes' level of explicit and implicit aggression.
>
> $H_3$: The results for implicit/automatic aggression represent a better predictor of sports performance, among martial artists, than the results obtained for explicit measure of aggression.

# 3 Materials and methods

## 3.1 Participants

A total of 85 athletes practicing striking combat sports, affiliated to different sports clubs in Romania, took part in the research, 62 male and 23 female athletes, aged 18–28 years ($M_{age}$ = 22.1, $SD$ = 3.06). Inclusion criteria were minimum 18 years old (seniors) and minimum 2 years of competitive experience. Athletes have been practicing martial arts for an average of 7.41 years, $SD$ = 3.28, and have between 2 and 9 years of competitive experience ($M$ = 4.68, $SD$ = 2.28, in the entire sample). Martial artists examined are systematically involved in training and competitions. The distribution of martial arts athletes according to sport discipline can be found below:

- karate: 28 athletes (32.9%)—19 male (M) and nine female athletes (F);
- kickboxing: 15 (17.6%)—13 M and 2 F;
- boxing: 14 (16.5%)—11 M and 3 F
- taekwondo: 14 (16.5%)—11 M and 3 F;
- fencing (Olympic combat sport, see Bagińska et al., 2022): 14 (16.5%)—8 M and 6 F.

According to division of the combat sports under forms of the direct confrontation (Kalina, 2000): hits (karate, kickboxing, boxing, taekwondo, etc.); workings of weapons (fencing); throws and grips of immobilization of opponent's body (e.g., Brazilian jiu-jitsu, judo, and freestyle wrestling). In the current study, we analyze hits and workings of weapons as conventional "striking combat sports," the same as in previous research (Predoiu et al., 2022a).

In terms of sports performances, athletes registered the following:

- International level performances (top ranks at World and/or European competitions): 28 athletes (32.9%) of which eight female athletes;
- National level results (top ranks at national competitions): 32 (37.6%) of which eight female athletes;
- Regional/local level sports results (at county level): 25 (29.4%) of which seven female athletes.

Athletes having international or national level performances were classified as elite/experts (according to the athletes' highest standard of performance—Swann et al., 2015), while a second group obtained regional or local level results.

The snowball sampling technique was used to identify and examine senior athletes practicing striking combat sports, boys and girls with minimum 2 years of competitive experience and various sports performances (international, national, and regional/local results).

## 3.2 Measures

For indirect, latency-based measure of aggression, an Implicit Associations Test (IAT) was created, using the classic 7-block version (Greenwald et al., 1998) and the 20 + 40 trials subdivision (Schnabel et al., 2008). Table 1 emphasizes the 7-block functioning, including the number of trials in each block and items assigned to the right-and left-key response. The IAT lasts 16 min.

According to Greenwald et al. (1998), the Implicit Association Test (IAT) is an online metric of response time that assesses unconscious/implicit associations between particular concepts. Numerous specialists have used IAT to investigate different forms of implicit social cognition (Greenwald and Banaji, 1995). In an IAT,

TABLE 1 Sequence of blocks in the IAT.

| Block | No. of trials | Function | Items assigned to left-key response | Items assigned to right-key response |
|---|---|---|---|---|
| 1 | 20 | Practice | Aggression | Non-aggression |
| 2 | 20 | Practice | Self | Others |
| 3 | 20 | Test | Aggression + Self | Non-aggression + Others |
| 4 | 40 | Test | Aggression + Self | Non-aggression + Others |
| 5 | 20 | Practice | Others | Self |
| 6 | 20 | Test | Aggression + Others | Non-aggression + Self |
| 7 | 40 | Test | Aggression + Others | Non-aggression + Self |

categories (e.g., "Aggression," "Non-Aggression," "good," and "bad") appear on the right versus left side of the screen, the participants assigning different stimuli (e.g., "fair play," "insult," "threat," and "patience") to the correct category by pressing the appropriate button on the keyboard (specified in the test instructions). IAT is a computerized dual-categorization task (a reaction-time-based classification task), the participants having to respond as quickly and accurately as possible (Sukhera et al., 2019). Richetin et al. (2010) suggested that IATs might reflect aggressive tendencies and intentions to harm in very indirect forms of aggression. Using an IAT, Grumm et al. (2011) measured "the association between the concept of self and the attribute aggressive by contrasting reaction times from two different response tasks." The final score (D-score) reflects the intensity of implicit associations between categories, which could be low, moderate, strong, or no association at all.

It seems that the IAT is less susceptible to faking than questionnaires (an explicit measure)—Steffens (2004), insensitive to procedural variation (Nosek et al., 2005), and demonstrated high test–retest reliability and good internal consistency (Greenwald and Nosek, 2001; Nosek et al., 2007). Researchers demonstrated the aggressiveness-IAT's ability to predict aggressive behavior beyond standard self-reported measures (Greenwald et al., 2009).

The IAT is a popular means of examining "hidden" biases, multiple versions of the Implicit Associations Test being created, investigating biases relating to race, age, or illness category, but all operating on the same principles (Sukhera et al., 2019). It seems that the predictive validity of the Implicit Associations Test can be affected by individual moderators (Nosek, 2005; Friese et al., 2008a), or contextual ones (Greenwald et al., 2009). In addition, it was found that IAT predicts better impulsive behaviors (Friese et al., 2008b).

In the present research, the following categories were used: Non-aggression, Aggression, Others, and Self. In IATs is common to use the object dimension Self-Others (Banse et al., 2015), the words specific to these categories being translated from previous studies (Greenwald and Farnham, 2000; Banse et al., 2015). In the current IAT, all words were in Romanian language.

The attributes are as follows: I, mine, my, me, self (for Self category); theirs, they, them, their, other (for Others category); threat, swear, hit, beat, insult (for Aggression category); fair play, discipline, respect, fairness, encouragement (for Non-aggression category). The IAT in the present study was used, also, in previous research with martial arts coaches (Predoiu et al., 2022b). For the detailed procedure validating the choice of appropriate attributes in the case of Aggression and Non-aggression categories, see Predoiu et al. (2022b).

To calculate the score on IAT, the improved D-scoring algorithm with error penalty 600 ms, labeled as $D_4$ (see Greenwald et al., 2003), was used. According to $D_4$, in the case of an error, it was replaced with mean(C) + 600 ms, where mean(C) is the block mean of correct-response latencies. A negative D-score highlights a stronger association between Aggression and Others, and a positive D-score highlights a stronger link between Aggression and Self.

In the case of D-score, specialized literature presents standard cutoffs (Chassot et al., 2015; Lee, 2017): 0.35 means a moderate link, 0.15 a slight/weak association, and 0.65 a strong association. However, being aware of the findings of Blanton et al. (2015), which discussed about the arbitrary character for the categorizations of D-scores, in the present study we will consider a weaker or a stronger association between Aggression and Self, or between Aggression and Others, avoiding being categorical in interpreting the D-score (as highlighting a moderate, weak or strong association). As Klein (2020) mentioned, even if the IAT and the D-scores spark controversy, the individual D-scores can reveal essential patterns at the group level.

The results of trials within the same test ($n = 85$) were used to calculate internal consistency. Considering IAT, Cronbach's alpha coefficient ($\alpha$) value was 0.67 in the current research.

Explicit aggression was assessed with the Romanian adaptation of the Makarowski's Aggression Questionnaire for martial arts athletes (Makarowski et al., 2021). The questionnaire consists of 15 items and evaluates 3D: Go-ahead, Assertiveness, and Foul Play. There are five items for each scale (no reverse-scored items). Athletes answered on a 5-point Likert scale, from 1—"Definitely not," to 5—"Definitely yes."

Considering "Go-ahead" factor, the athlete attacks, is courageous, breaks obstacles (e.g., "There is no argument that would turn me away from reaching my goal"). Assertiveness, as a personality characteristic, assumes that athletes are acting within the boundaries of the game, which can lead to success (Bredemeier, 1994), expressing themselves verbally or behaviorally in a constructive way, firmly but without offending others (opponents, peers, referees)—for example, "I'm not afraid to speak up to my supervisor or coach, if I know that he/she is wrong." Regarding "Foul play" factor of aggression, the athlete has no scruples, achieving the goal (winning) is what matters, regardless of the means, and, therefore, is willing to act in an unethical manner (outside the rules of the game)—for example, "I think that *anything goes* rule is appropriate to achieve the victory."

The internal consistency/reliability for the three factors of aggression investigated, in the present research, measured with Cronbach's alpha coefficient ($\alpha$) was 0.74 (Go-Ahead), 0.76 (Assertiveness), and 0.73 (Foul Play), respectively.

## 3.3 Procedure

In the early stages of the research, 94 eligible athletes (in terms of age and competitive experience) practicing striking combat sports were examined, but 85 remained for future analysis. Three martial arts athletes were removed from the study because they exceeded critical error rates of 35% in one of the combined blocks in the IAT, the same as in Banse et al. (2015). In addition, six athletes were excluded from the study having $|D| > 0.65$ (see Klein, 2020), "in order for the confidence intervals (in the case of D-scores) to span below the 0.65 cutoff, meaning a slight or moderate bias (not a strong bias)" (Predoiu et al., 2022b).

The IAT and the questionnaire use to evaluate explicit aggression were carried out in the period of 2023–2024, in the presence of the experimenter. The study was conducted in Romania. Athletes from striking combat sports completed the questionnaire (including socio-demographic data and regarding the highest sports performance registered) via Google forms (Google LLC, Mountain View, CA, United States). The IAT was made on a computer, with the help of the PsyToolkit platform (Stoet, 2010; Stoet, 2017). Athletes completed the test between 2 and 7 p.m. Similar, computers were used in the research, the screen resolution being the one recommended by the computer (1920 × 1,080 pixels). The research is cross-sectional (Predoiu, 2020) and is based on *ex post facto* design (Thomas and Nelson, 2001).

The correlations between D-score (IAT) and the scores obtained in the case of direct measure of aggression (the values for the three factors of explicit aggression) were very low (Pearson's $r = 0.009$, $p = 0.935$ – IAT/Go-Ahead; $r = 0.08$, $p = 0.465$ – IAT/Foul Play; $r = 0.13$, $p = 0.248$ – IAT/Assertiveness). This is in line with the specialized literature on associations between direct and indirect measures (see, e.g., the results of the meta-analysis by Hofmann et al., 2005). As Banse et al. (2015) asserted, also, low correlations with self-reported aggressiveness reflect the usefulness of indirect measure.

## 3.4 Statistical analysis

IBM SPSS Statistics Version 27.0 (Armonk, NY, IBM Corp) and Jamovi were used for the statistical analysis. In the case of MANOVA, Scheffe *post-hoc* test was reported due to Levene's test results (equality of variance, $p > 0.05$)—Popa (2010). *t*-test for independent samples was also used. Variables were normally distributed, with Skewness and Kurtosis coefficients (in absolute value) being <2 (George and Mallery, 2010). Following the recommendations of Argyrous (2005), Goodman and Kruskal tau association (an asymmetric test) was performed, at least one variable being categorical. Cramer's V coefficient (the effect size index) for 2 × 3 tables was interpreted: 0.10—weak association, 0.30—moderate, 0.50—strong association (Nyberg et al., 2023). Not least, analysis of the results involved using binomial logistic regressions, Nagelkerke $R^2$ (effect size) being interpreted as follows: 0.35 large effect size, 0.15 medium, 0.2 small effect size (Cohen, 1992).

# 4 Results

Stem-and-leaf and box-plot analysis revealed that no outliers were identified (preliminary data analysis). In the case of the present study, athletes automatically associated Aggression with Others, obtaining negative D-scores, the same as in previous research when martial arts coaches were examined, maybe due "to the words designated as representative for aggression in sports […] (threat, beat, hit, swear and insult)," which are, generally, closer to hostile aggression (Predoiu et al., 2022b).

The results registered by martial artists from striking combat sports for the dependent variables examined (at descriptive level), according to sports performances, are presented in Table 2.

Using multivariate analysis of variance, the differences between martial artists (in the disciplines of Striking) were verified, in terms of explicit and indirect, latency-based measure of aggression. Type I procedure (for group inequality) was selected for MANOVA. The *p*-value in the case of the Box M test is 0.012, the Wilks' Lambda test values being reported: Wilks' Lambda = 0.739, $F(8, 158) = 3.228$, $p = 0.002$, $eta^2 = 0.14$, observed power = 0.966. The Test of Between-Subjects Effects emphasizes that sports performance significantly influences the values for D-score ($F = 4.837$, $p = 0.010$, Partial Eta Squared = 0.10) and Go-ahead ($F = 7.831$, $p = 0.001$, Partial Eta Squared = 0.16). The homogeneity of variances condition was met, results for Levene's test: $F = 1.302$, $p = 0.278$ for D-scores, respectively, $F = 2.582$, $p = 0.082$ in the case of the Go-ahead factor of explicit aggression. Table 3 presents only the significant differences observed (Scheffe *post-hoc* test was interpreted).

In the case of implicit aggression, and for Go-ahead factor, significant differences were observed between athletes taking into consideration sports performances. Martial arts athletes from striking combat sports having international performances registered significantly higher D-scores ($p = 0.014$, $M_{INTERNATIONAL} = 0.41$, $SD = 0.13$) and significantly lower values for Go-ahead factor ($p = 0.006$, $M_{INTERNATIONAL} = 18.64$, $SD = 2.68$), compared to athletes without outstanding results: $M_{LOCAL/REGIONAL} = 0.28$, $SD = 0.16$ in the case of IAT, respectively $M_{LOCAL/REGIONAL} = 21.16$, $SD = 2.09$ for Go-ahead (Table 3). It is worth mentioning that the results for Go-ahead (athletes having international sports results) are, generally, moderate, according to the norms (Makarowski et al., 2021). In addition, athletes having national performances obtained significantly lower scores for Go-ahead factor ($p = 0.002$), compared to martial artists having local or regional sports results.

Next, the existing associations between athletes' gender and martial arts athletes' level of explicit and implicit aggression were verified. Goodman and Kruskal tau association test was used (at least one variable being categorical, the results for aggression—explicit and indirect representing the dependent variables). Table 4 includes only the significant association identified.

Out of the 62 male martial arts athletes, 30 athletes (48.3%) obtained average scores in the case of the Go-ahead factor of aggression, while 17 (or 27.4%) registered high values. Male athletes tend to obtain average and high scores for the "perseverance in reaching the goal despite numerous obstacles […]. They are expansive and dynamic. Athletes high in go-ahead are bold, remain on the offensive, and they do not hesitate" (Makarowski et al., 2021). In the case of the 23 female martial artists from striking combat sports, 13 athletes (56.5%) obtained low scores (Go-ahead factor), while six (26%) registered average values.

In the Directional measures table (Table 4) one can observe the Goodman and Kruskal tau association coefficient (0.050) and the adjacent threshold of significance ($p = 0.015$). A significant association can be highlighted between athletes' gender and the results for Go-ahead. Cramer's V coefficient is 0.306, emphasizing a moderate link between variables. In the case of implicit/

10.3389/fpsyg.2024.1451244

TABLE 2 Descriptive statistics—implicit and explicit aggression ($n = 28$, international results, $n = 32$, national performances, and $n = 25$, regional/local sports results).

| | | | |
|---|---|---|---|
| D-score (indirect aggression) | International results | Mean | 0.41 |
| | | SD | 0.13 |
| | National performances | Mean | 0.32 |
| | | SD | 0.17 |
| | Regional/local results | Mean | 0.28 |
| | | SD | 0.16 |
| Go-ahead | International results | Mean | 18.64 |
| | | SD | 2.68 |
| | National performances | Mean | 18.47 |
| | | SD | 3.27 |
| | Regional/local results | Mean | 21.16 |
| | | SD | 2.09 |
| Foul play | International results | Mean | 8.50 |
| | | SD | 2.95 |
| | National performances | Mean | 7.97 |
| | | SD | 3.71 |
| | Regional/local results | Mean | 9.92 |
| | | SD | 3.55 |
| Assertiveness | International results | Mean | 16.93 |
| | | SD | 3.66 |
| | National performances | Mean | 16.75 |
| | | SD | 5.52 |
| | Regional/local results | Mean | 17.16 |
| | | SD | 3.07 |

TABLE 3 *Post-hoc* Scheffe test—single-factor MANOVA.

| Dependent variable | | (I) Sports performance | (J) Sports performance | Mean difference (I–J) | *p* | 95% confidence interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | LB | UB |
| D-score | Scheffe *post-hoc* test | I | N | 0.0914 | 0.089 | −0.0107 | 0.1936 |
| | | | L/R | 0.1305* | 0.014 | 0.0218 | 0.2391 |
| | | N | I | −0.0914 | 0.089 | −0.1936 | 0.0107 |
| | | | L/R | 0.0390 | 0.654 | −0.0664 | 0.1444 |
| | | L/R | I | −0.1305* | 0.014 | −0.2391 | −0.0218 |
| | | | N | −0.0390 | 0.654 | −0.1444 | 0.0664 |
| Go-ahead | | I | N | 0.17 | 0.971 | −1.62 | 1.96 |
| | | | L/R | −2.52** | 0.006 | −4.42 | −0.61 |
| | | N | I | −0.17 | 0.971 | −1.96 | 1.62 |
| | | | L/R | −2.69** | 0.002 | −4.54 | −0.84 |
| | | L/R | I | 2.52** | 0.006 | 0.61 | 4.42 |
| | | | N | 2.69** | 0.002 | 0.84 | 4.54 |

I, international sports performances; N, national results; L/R, local/regional performances; LB, lower bound; UB, upper bound, *$p < 0.05$; **$p < 0.01$.

automatic aggression and for the other factors of explicit aggression investigated (Foul Play and Assertiveness), no gender-related association was found.

In the next phase, knowing that indirect, latency-based measure of aggression and Go-ahead are specific to martial arts athletes having international sports results (at World and European level), the extent

to which the two dimensions predict sports performances was investigated ($n = 53$). Two separate binomial logistic regressions were performed (Tables 5–8).

The models are significant ($p < 0.05$, Omnibus tests of model coefficients—Tables 5, 7). The $p > 0.05$ in the case of the Hosmer and Lemeshow goodness of fit test, meaning that the models are not a poor fit. The models correctly classified 66% (IAT) and 69.8% (Go-ahead) of cases.

Nagelkerke $R^2$ highlights a moderate to strong relation ($I^2 = 0.21$ – IAT, $R^2 = 0.28$—Go-ahead) between each dimension (implicit and explicit aggression) and sports performances.

In the case of martial artists from striking combat sports, both results—for implicit/indirect and explicit aggression (Go-ahead factor), represent important predictors of sports performance, representing valuable resources for sports psychologists, coaches, and

TABLE 4 Directional measures—Goodman and Kruskal tau association.

| | | Value | Asymp. std. error | Approx. sig. |
|---|---|---|---|---|
| Goodman and Kruskal tau | Gender | 0.094 | 0.067 | 0.019 |
| | Go-ahead dependent | 0.050 | 0.036 | 0.015 |
| Crosstabulation gender and go-ahead factor of aggression | | | | |
| | Go-ahead | | | Total |
| | Low | Average | High | |
| Male martial arts athletes | 15 | 30 | 17 | 62 |
| Female martial arts athletes | 13 | 6 | 4 | 23 |
| Total | 28 | 36 | 21 | 85 |

TABLE 5 Binomial logistic regressions analysis—IAT (D-scores).

| | Implicit aggression |
|---|---|
| Omnibus tests of model coefficients (Chi-square and *p*) | 9.141 (0.002) |
| Overall percentage (predicted—percentage correct) | 66% (accuracy) |
| Regional/local performances (predicted) | 64% (specificity) |
| International performances (predicted) | 67.9% (sensitivity) |
| Nagelkerke $R^2$ | 0.212 |
| Hosmer and Lemeshow test: Chi-square (*p*-value) | 6.294 (0.614) |

TABLE 6 Binomial logistic regressions analysis—variables in the equation (IAT).

| | B | S.E. | Wald | df | *p* | Exp(B)/odds ratio | 95% CI for Exp(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| D-score constant | 5.70 | 2.088 | 7.450 | 1 | 0.006 | 298.7 | 4.987 | 17895.3 |
| | −1.90 | 0.801 | 5.625 | 1 | 0.018 | 0.150 | | |

TABLE 7 Binomial logistic regressions analysis—Go-ahead (explicit aggression).

| | Explicit aggression |
|---|---|
| Omnibus tests of model coefficients (Chi-square and *p*) | 12.504 (0.000) |
| Overall percentage (Predicted—Percentage correct) | 69.8% (accuracy) |
| Regional/local performances (predicted) | 56% (specificity) |
| International performances (predicted) | 82.1% (sensitivity) |
| Nagelkerke $R^2$ | 0.281 |
| Hosmer and Lemeshow test: Chi-square (*p*-value) | 15.172 (0.084) |

TABLE 8 Binomial logistic regressions analysis—variables in the equation (go-ahead factor).

| | B | S.E. | Wald | df | *p* | Exp(B)/odds ratio | 95% CI for Exp(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Go-ahead constant | −0.410 | 0.131 | 9.779 | 1 | 0.002 | 0.664 | 0.513 | 0.858 |
| | 8.260 | 2.625 | 9.903 | 1 | 0.002 | 3866.4 | | |

athletes. A moderate level (generally) for Go-ahead and a stronger association between Aggression and Others (at implicit/unconscious level) are associated with an increased likelihood of international sports results in martial arts athletes.

## 5 Discussion

Sports, as a competitive activity, often involves a certain level of physicality and intensity, which can lead to the emergence of aggression within the sporting context (Krishnaveni and Shahin, 2018). Aggression in sport is determined by the most particular elements of this domain: high conflict scenarios, the thrill of certain sports, and the intense nature of competition (Bekiari et al., 2015). Aggressive behavior, in some sports (martial arts and sports games) is one of the instrumental means of achieving the main goal (Petrovska et al., 2021), instrumental aggression serving as a competitive advantage, but aggression in athletes combined with the desire to win can cause, also, violations of the rules of competition and departure from the rules of fair competition (Graczyk et al., 2010; Kostorz and Sas-Nowosielski, 2021).

In a first phase, the differences between martial artists were explored, taking into consideration sports performances. Significant differences were observed in the case of implicit/unconscious aggression, and for Go-ahead factor of explicit aggression, between athletes practicing striking combat sports. Martial arts athletes having international and national performances registered significantly lower values for Go-ahead factor, compared to athletes without outstanding sports results. It is worth mentioning that the results for Go-ahead (athletes having international or national performances) are, generally, moderate (according to the norms). These results can be explained through the Yerkes-Dodson law, a moderate level of arousal (Go-ahead factor in this case) enhancing performance in complex tasks (Chaby et al., 2015), and sport is characterized by stress (Mellalieu et al., 2009) and complex tasks. Martial artists who attack, persevere in achieving their objectives despite obstacles, and remain on the offensive (at a moderate level, generally) registered higher sports results in competitions. Previous research with Romanian martial arts athletes having performances at international and national level (Makarowski et al., 2021) underlined, also, an average level (generally) for Go-ahead dimension. Zivin et al. (2001) asserted that more experienced athletes (especially in martial arts) channels aggression in a more constructive way, controlling it better, while novices manifest higher levels of explicit aggression due to anxiety related to their new activity (Smith and Smoll, 1990). In addition, experienced athletes tend to perceive aggression more as a strategic component, while novices may show a lower level of self-control and higher levels of uncontrolled aggressive impulses (Jones et al., 2002). However, Rui and Cruz (2017) found no correlation between athletes' explicit aggression and sports performances, the results being inconclusive and contradictory. The specific culture of the sport practiced can influence aggression in athletes. A training environment that emphasizes self-control, respect, and discipline (as in martial arts) may reduce aggression (Twemlow et al., 2008). In fact, researchers underlined the importance of practicing combat sports and martial arts in reducing aggression (Daniels and Thornton, 1992; Steyn and Roux, 2009; Vertonghen and Theeboom, 2010), emphasizing, in the same time, a lack of studies considering the aggressive behavior of martial artists (Chen et al., 2019). In addition, incorporating internal techniques (breathing and self-control) into martial arts training can lessen the impact of this training on aggressive impulses and behavior (Hernandez and Anderson, 2015). However, every athlete has his/her own facilitative level of arousal and aggression (sports performance being idiosyncratic). Further studies need to shed more light on the level of different factors of aggression that facilitates sports results in a given setting.

Athletes having international performances obtained significantly higher D-scores (IAT), compared to martial artists having local or regional sports results, associating at a higher level Aggression with Others, at an unconscious/automatic level. This is in line with martial arts' coaches level of implicit aggression (martial arts coaches are, generally, former martial arts practitioners)—martial arts coaches having international sports results "automatically associated aggression with others at a higher level than novice coaches did" (Predoiu et al., 2022b). We argue that athletes having international sports performances (at World and/or European level), automatically associating Aggression (unconscious aggression) with Others at a stronger level (than athletes without outstanding results), manage to generate an emotional tension during trainings, closer to competitions, having embedded in their deep structures of the psychic system the information that sports performance is very difficult to be achieved, and all these in a stress-generating environment that sport entails (Gilbert et al., 2007). Stressors, in sport, often impact the way athletes feel, think, and behave in athletic field (Fraser-Thomas and Côté, 2009; Rice et al., 2016). Taking into consideration the General Aggression Model (GAM) theory (Anderson and Bushman, 2018), the knowledge structures of an athlete can be changed by the existing feelings and cognitions, by the persistent environmental/competition characteristics.

Furthermore, the existing associations between martial arts athletes' gender and athletes' level of explicit and implicit aggression were verified. A significant association was highlighted between athletes' gender and the results for Go-ahead factor, the effect size index emphasizing a moderate link between variables. In the case of male martial arts athletes, most of them (48.3%) registered average scores (the Go-ahead factor of explicit aggression), while 27.4% obtained high values. Most of the female athletes from striking combat sports (56.5%) obtained low scores, while 26% registered average values. Coulomb-Cabagno and Rascle (2006) emphasized that regardless of the level of competition, or the type of practiced sport, female athletes display lower levels of explicit aggression than male athletes. In terms of implicit/indirect aggression, and for the other factors of explicit aggression investigated (Foul Play and Assertiveness), no gender-related association was found in martial artists.

Not least, knowing that indirect, latency-based measure of aggression and Go-ahead factor are specific to martial arts athletes having international sports results (at World and/or European level), the extent to which the two dimensions predict sports performance was examined. We can argue that in the case of martial artists from striking combat sports, both results (for implicit/indirect and explicit aggression—Go-ahead factor) represent important predictors of sports performance. The two dimensions represent valuable resources for specialists in the field on sports science and psychology, working with athletes. A moderate level (generally) for Go-ahead and a stronger association between Aggression and Others (at implicit/unconscious level) are associated with an increased likelihood of sports performances in martial arts athletes. Predoiu et al. (2022b) highlighted that "implicit aggression is a better predictor of sports

performance than explicit (verbal) aggression," in coaches. However: (a) both models—for explicit and indirect measure of aggression, were significant (the differences being small, in favor of implicit aggression); (b) Go-ahead factor did not predict sports performances, but verbal aggression did (in the case of martial arts coaches). Indirect measures (an Aggressiveness IAT was used) were found, also, to be a better predictor of sports performance than direct measures (Teubel et al., 2011), the study exploring semi-professional male basketball players.

The results address gaps in the literature considering the role of indirect/unconscious measure of aggression and its connection with sports performance. The development and application of the IAT represent an essential advance in understanding the psychological dimensions of athletes, such as aggression. As Blümke and Zumbach (2007) mentioned, "although there are still many methodological problems to overcome, implicit measures have already added to our knowledge of preactivation of emotional and cognitive content in social encounters," with an increasing body of evidence for the predictive validity of IATs (see Greenwald et al., 2009, for an overview).

## 6 Limitations and directions for future research

The study is not without limits. For example, each striking combat sport discipline can be separately explored; therefore, larger samples should be examined in future and in a different setting (related to country and athletes' age). In addition, each weight class in boxing, kickboxing, or taekwondo can be separately addressed. The results could be different if athletes from grappling combat sports will be investigated (e.g., jiu-jitsu, judo, and freestyle wrestling), or athletes practicing mixed martial arts (MMA) which combines techniques from both fighting styles—striking and grappling. Aspects such as athletes' income, level of education, body mass index, or history of injuries can be, also, considered as limits of the current research. Regarding the injuries suffered by athletes, researchers found that athletes with a history of concussion were more impulsive (Goswami et al., 2016) and more physically aggressive (Gallant et al., 2018). Moreover, the phenomenon of rapid weight loss, commonly employed by combat sports athletes, should be addressed in future research. This phenomenon can lead to mood perturbations and perhaps enhance levels of aggression in athletes—for a systematic review considering the effects of rapid weight loss (RWL) on athletes' mood states, and the psychological ramifications of RWL, see Lakicevic et al. (2024).

With respect to explicit aggression, martial arts athletes took part in the study via a Google questionnaire; in these conditions, a limitation of the research can be considered the relatively small sample size. However, the athletes completed, also, the IAT to assess implicit aggression in the presence of the experimenter. Further research should examine other dimensions of explicit aggression, such as physical aggression, anger, verbal aggression, or hostility (see Buss and Perry, 1992) and their role in predicting sports performance, in martial arts being found that higher levels of anger facilitate athletes' performance (Terry and Slade, 1995; Wargo et al., 2007).

In addition, the results regarding the IAT (D-scores) could be different if other words were chosen as being representative for Aggression and Non-aggression, respectively, in the initial phases of the research, for example, warning (not threat), dispossession, or shout (not insults or swear). However, see Predoiu et al. (2022b) for the detailed procedure of stimuli selection in the current IAT, the selected words being in line with the opinion of sports specialists on what aggression and non-aggression in sport means. Not least, the conclusions could be different if various methods of measuring implicit/indirect aggression would be used (e.g., Conditional Reasoning Test or Picture Story Exercise).

Automatized assessments of individual's cognitive processing in sports advance knowledge (Strenge et al., 2020), the study of indirect, latency-based measure of aggression (and not only), in athletes and coaches, representing a goal to be achieved in future studies.

## 7 Conclusion

In summary, a moderate level (generally) for Go-ahead factor of explicit aggression and a stronger association between aggression and others (at implicit/unconscious level) are associated with an increased likelihood of sports performances in athletes from striking combat sports. In addition, a significant and moderate association was highlighted between athletes' gender and the results for Go-ahead factor. Male martial arts athletes are more expansive and dynamic, more persistent despite numerous obstacles, remaining more on the offensive. In terms of indirect/unconscious aggression, and for the other factors of explicit aggression investigated (foul play and assertiveness), no gender-related association was found.

The IAT offers a valuable window into understanding the complexities of aggression in sports. The differences between implicit/automatic and explicit/direct evaluations of aggression underscore the importance of addressing athletes' subconscious level to promote more constructive behaviors in training, competitions, and everyday life.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the local Ethics Committee of National University of Physical Education and Sport, Bucharest, approved the study (registered number: 556/9G). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

RP: Conceptualization, Formal analysis, Methodology, Writing – original draft. AP: Formal analysis, Supervision, Validation, Writing – original draft. ES: Resources, Supervision, Validation, Writing – review & editing. MC: Conceptualization, Methodology, Software, Writing – original draft. AB: Data curation, Resources, Validation, Writing – review & editing. DC: Methodology, Resources, Validation, Writing – review & editing. GC: Investigation, Supervision, Validation, Writing – original draft.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

We thank Mr. Gijsbert Stoet for this free-to-use toolkit for programming and running cognitive-psychological experiments, PsyToolkit - https://www.psytoolkit.org. We thank InnovaSport Craiova Interdisciplinary Laboratory, INCESA, Romania, the paper being part of the PhD thesis of the first author RP - Doctoral School of Social Science and Humanities, University of Craiova. Also, we thank the martial arts athletes for their involvement in this research.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 16 August 2024
DOI 10.3389/fpsyg.2024.1439252



OPEN ACCESS

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RECEIVED 27 May 2024
ACCEPTED 24 July 2024
PUBLISHED 16 August 2024

CITATION
Zhou X, Zhang M, Li B and Ma S (2024) Cross-lagged analysis of social support, physical activity behavior, and family relationships among university students. *Front. Psychol.* 15:1439252. doi: 10.3389/fpsyg.2024.1439252



# Cross-lagged analysis of social support, physical activity behavior, and family relationships among university students

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**Objective:** To explore the causal relationship between social support, physical activity behavior, and family relationships among university students.

**Methods:** Using the Social Support Rating Scale, the Physical Activity Behavior Self-Assessment Scale, and the Family Relationships Scale, a longitudinal follow-up survey was conducted on 412 college students in Sichuan Province at 2-month intervals in March 2024 (T1) and May 2024 (T2), to analyze the interaction mechanisms between college students' social support, physical activity behaviors, and family relationships through cross-lagging.

**Results:** (1) There are significant gender differences in social support, physical activity behavior, and family relationships among college students. Among the cross-lagged paths found, except for the path from T1 social support to T2 family relationships (β: 0.40 > 0.21), all other cross-lagged paths are smaller for female college students compared to male college students; (2) T1 social support was able to positively predict T2 physical activity behaviors ($\beta = 0.50$, $p < 0.001$), and T1 physical activity behavior can also positively predict T2 social support ($\beta = 0.18$, $p < 0.01$), but the path value T1 social support → T2 physical activity behavior is larger than T1 physical activity behavior → T2 social support. Therefore, social support is a causal variable for physical activity behavior; (3) T1 social support positively predicts T2 family relationships ($\beta = 0.26$, $p < 0.001$); (4) T1 family relationships positively predict T2 physical activity behavior ($\beta = 0.30$, $p < 0.001$). (5) Physical activity behavior is a mediating variable between family relationships and social support, with a mediating effect size of 0.054.

**Conclusion:** There are gender differences in social support, physical activity behavior, and family relationships among college students; there is a longitudinal causal relationship between social support, physical activity behavior, and family relationships; social support is a causal variable of physical activity behavior, and social support is also a causal variable of family relationships, and family relationships are the Social support is a causal variable for physical activity behavior, social support is also a causal variable for family relations, and family relations are a causal variable for physical activity behavior, which has a partially mediating role in family relations and social support.

KEYWORDS

**social support, physical activity behavior, family relationships, college students, cross-lagging**

# 1 Introduction

Physical activity behavior refers to the physical activities in which individuals actively participate to enhance their health, improve their motor skills, and promote good exercise habit (Garber et al., 2011). Physical exercise is essential to promoting the healthy development of an individual's body and mind. For college students, it is a crucial means of promoting their all-round development (Mandolesi et al., 2018). However, the physical fitness of college students in China is on the decline, and psychological problems are on the rise. The survey data from China Youth Network Campus Communication reveals a startling fact: a staggering 48.19% of college students exercise <3 times a week, while a whopping 58.7% of college students exercise for no more than 30 min at a time (http://txs.youth.cn)[1]. Moreover, the Chinese Academy of Sciences and other departments have released the 2022 Survey Report on the Mental Health Status of College Students, which shows that 21.4 percent of college students are at risk of depression and are affected by pressures such as further education and employment (http://www.psych.ac.cn) (Institute of Psychology, Chinese Academy of Sciences, 2022). The current situation is worrisome since the issue of the physical and mental health of college students is related to the development of the country. In recent years, the Chinese government has issued documents such as the National Physical Fitness Standard for Students, Basic Standard for Physical Education in Higher Education Schools, Measures for Monitoring and Evaluating Students' Physical Fitness and Evaluation, and Guidelines for Mental Health Education of Students in Higher Education Schools, aiming to promote college students' physical exercise, improve their psychological problems, and promote their all-round development. Several studies have indicated that the physical activity behaviors of college students are influenced by several factors, including family, peers, academic pressure, and gender (Garcia et al., 2016), among which, the family relationship plays a pivotal role in the formation of familial education and values. In addition, studies have found that the family and parents are the primary determinants of children's engagement in physical activity (Zhu et al., 2003). Meanwhile, social support, especially the family and peer support influences college students' physical activity behavior (Bandura, 2004). However, there is a lack of discussion in the academic community on the mechanism of influence between college students' physical activity behavior, social support, and family relationships, and some of the existing studies are mostly discussed in a cross-sectional way, which cannot determine the trend and pattern of individual changes over time and the dynamic relationship between variables. Hence, what is the longitudinal relationship between college students' physical activity behavior and family relationships and social support? This question has not been adequately argued so far. Based on this, the present study attempts to analyze the causal links between social support, physical activity behavior, and family relationships among college students from a longitudinal tracking perspective, which can enrich the research on the development of physical and mental health of college students and provide some references for the active participation of college students in physical activity and the improvement of physical activity behavior.

## 1.1 Social support and physical activity behavior

Social support is defined as an interactive relationship that encompasses providing emotional or material assistance between individuals, which is a crucial factor in the growth and maintenance of human physical and mental wellbeing (Feeney and Collins, 2015). Social support can provide individuals with material and spiritual help (Song et al., 2024), which is mainly manifested in enhancing the individual's ability to resist stress, providing positive emotions (Sun et al., 2023), and decreasing the probability of depressive symptoms, thus promoting the physical and mental health development of human beings (Kaitlin and Erin, 2018).

Physical activity behavior refers to physical activities in which individuals actively participate to enhance their health, improve their motor skills, and promote good exercise behavior (Garber et al., 2011). Studies have shown that the frequency of participation in physical activity is negatively associated with the risk of developing depression (Schuch et al., 2018). This is attributed to engaging in healthy physical activities conducive to fostering positive emotions, enhancing moral values, and shaping desirable characters among participants. Additionally, it serves as a distinct medium for promoting the development of socio-emotional proficiency (Zhang, 2021). At the same time, the higher the level of physical activity behaviors, the greater the subjective support and support utilization that can be gained, and the fewer the negative emotions that arise (Smith et al., 2017). The preceding studies indicate that physical activity behavior and social support commonly influence the reduction of depressive symptoms and negative emotions. To ascertain whether physical activity behavior can exert a direct effect on social support, some studies have demonstrated that among college students, physical activity can enhance the level of social support and psychological wellbeing of individuals (Chen, 2001; Cui et al., 2002; Fang and Zhao, 2005). Therefore, this paper proposes Hypothesis 1a: Physical activity behavior positively predicts social support across time in the college student population.

College is a transitional stage between adolescence and adulthood, and the development of physical activity behavior at this stage will have an important impact on future outcomes (Ji et al., 2022). A review of existing research indicates that the level of physical activity among college students in China is relatively low. This is evidenced by the low frequency of participation in physical activity, substandard exercise volume and intensity, and poor physical fitness (Wang et al., 2009). It has been shown that support through peer relationships is particularly important during physical activity in adolescents, mainly in the form of a greater impact of group exercise than solitary exercise on individual exercise persistence and development, i.e., the social support that individuals receive through group exercise during adolescence

1 China Youth Daily. *Sports survey of 25,000 college students finds: nearly 50 per cent exercise less than three times a week [EB-OL].* Available at: https://baijiahao.baidu.com/s?id=1774790002103436544&wfr=spider&for=pc.

contributes to increased persistence in exercise, which in turn influences life and habits in college (Dollman, 2018; Ma et al., 2023). At the same time, the study further pointed out that at the university level, the occurrence of physical activity behavior is influenced by subjective and objective factors, including the individual's interest in sports, the importance of sports, sports habits, etc., and objective factors, including social factors, school factors, and family factors (Huang and Zhang, 2020). Furthermore, social support among social factors, especially family and peer support influence college students' physical activity behavior (Bandura, 2004). Based on this, this paper proposes hypothesis 1b: For the college student population, social support positively predicts physical activity behavior over time.

## 1.2 Family relationships and physical activity behavior

Physical activity behavior is influenced by various aspects such as individual, family, and society (Pan et al., 2022). Previous studies have shown that the family is the initial place to cultivate individuals' physical activity behavior, and family relationships have an important influence on family members' physical activity behaviors and habits, and a good family atmosphere and family relationships can increase the frequency of individuals' participation in physical activity (Wang et al., 2016), and at the same time, familial relationships that are characterized by a high degree of closeness are more conducive to the formation of positive exercise habits among family members (Wang, 2019). It has also been suggested that the level of parental support can positively influence the attitude of children aged 10–22 toward physical activity, and parental sports participation can also promote children's sports participation (Rhodes et al., 2020). Therefore, this study proposes Hypothesis 2a: Family relationships can positively predict physical activity behavior.

The term "family sports" is used to describe a specific type of sports activity that originated from the family unit. This concept is based on the idea of family members engaging in physical exercise activities together, whether at home or in the surrounding environment (Pan et al., 2022). Family sports have a significant impact on the evolution of family relationships, and exercise activists among family members can drive other members to participate in physical exercise (Wang et al., 2016). However, considering that many Chinese college students reside primarily on campus, it is noteworthy that the frequency of exercising with their family members during the school term is significantly diminished (He and Yang, 2014). The development of family sports activities faces difficulties. In addition, related studies have emphasized that the physical activity of Chinese college students during school is more casual (Sánchez-Herrera et al., 2022), and their motivation for participating in physical activity during school is mainly to improve physical health, recreation, and weight loss (Sánchez-Herrera et al., 2022), with no strong correlation with the development of family relationships. Therefore, the influence of physical activity behaviors on family relationships in the college student population is constrained by time and space. Based on this, this study proposes Hypothesis 2b: Physical activity behavior does not positively predict family relationships in the college student population.

## 1.3 Family relationships and social support

Family has an important influence on the formation of individual character and psychological development (Ahlberg et al., 2020), and as the public's attention to the psychological development of individuals is gradually increasing, family construction is receiving more and more attention from all walks of life (Stark et al., 2021). Family relationship is an important part of family building, which refers to the contact and communication between family members, including intergenerational (vertical) and peer (parallel) relationships (Melton et al., 2022). The theory of family functioning holds that family intimacy and adaptability can reflect family relationships to a certain extent (Olson et al., 1979). In family relationships, good parent-child (intergenerational) relationships can cultivate children's outlook on life, values, and worldview, and promote the development of social interpersonal relationships (Gruijters, 2017). In addition, previous studies have shown that interpersonal relationships are closely related to social support, which is manifested in the fact that the higher the social support, the lower the interpersonal relationship distress (Cohen and McKay, 2020).

In the meantime, some studies have shown that social support is closely related to family relationships (Michel et al., 2010), and situational factors (e.g., family relationships) affect social support (Hartley and Coffee, 2022). The study further concluded that social support mainly comes from family, lovers, friends, etc. (Cobb, 1976). In the college student population, social support is influenced by several factors, including individual psychology, the school environment, societal norms, and familial dynamics. Family relationships, specifically those related to intimacy and adaptability, have been found to have a consistent and positive correlation with social support (Zhao et al., 2011; He et al., 2018; Li and Jiang, 2023), therefore, this study proposes Hypothesis 3a: College students' family relationships predict social support.

Family conflict has been conceptualized as a poor family relationship. Some studies have demonstrated that social support can mitigate family conflict and, as a consequence, enhance family relationships (Selvarajan et al., 2016). Meanwhile, the family capital theory suggests that: family relationships, including parental relationships, exert a profound influence on the development of children. Furthermore, social support plays a crucial role in shaping these relationships and fostering a sense of purpose and meaning in life (Wei et al., 2021). Research further shows that social support affects family parent-child relationships to a certain extent (Nan et al., 2015). Therefore, this study proposes Hypothesis 3b: Social support positively predicts family relationships.

Furthermore, by examining the interrelationships between family relationships and physical activity behavior, as well as between physical activity behavior and social support, it can be posited that college students' physical activity behavior may play a longitudinal and stable correlation role in family relationships and social support. Consequently, the present study proposes Hypothesis 4: When college students' family relationships affect

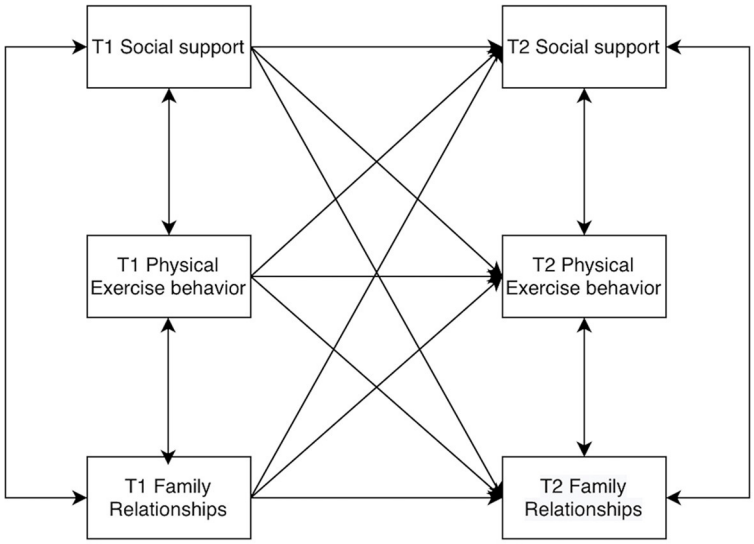


FIGURE 1
Cross-lagged structural model diagram.

social support, physical activity behavior may have a mediating role. Assume that the model is as shown in Figure 1.

## 2 Participants

The present study adopted the principle of convenience sampling, and the subjects were college students from Universities X and Y in S City, Sichuan Province, who were followed longitudinally for a period of 8 weeks from March to May, considering that college students have a certain degree of concentration of physical activity behavior during their school years. After informing the counselors of the introduction of the questionnaire and entrusting them to explain the purpose of the study to the subjects and to assure them that the information on the questionnaire would be kept strictly confidential, the questionnaires were answered and collected by the subjects within a specified period. The study was divided into two time points, a total of 461 questionnaires were distributed at each time point. Measurements at time point T1 were conducted offline from 5–7 March 2024, and based on the screening principles of "missing information" and "reverse questioning", a total of 23 invalid questionnaires were rejected, and 451 valid data sets were collected, with a valid recovery rate of 95.01%"; Due to various reasons, including illness and other objective factors, some subjects were unable to return to school in time for the T2 measurement (May 6–8, 2024). Consequently, the final recovery of valid questionnaires was 432, with an effective recovery rate of 93.7%. The final valid sample size was 412 individuals who completed the questionnaire twice and had their student ID numbers matched in the correct order. The effective rate was 89.3%. Among them, 201 male college students accounted for 48.8% of the total, and 211 female college students accounted for 51.2%, Mean age ($19.94 \pm 1.43$) years.

## 3 Method

### 3.1 Social support rating scale

The Social Support Rating Scale developed by Ye and Dai (2008) was used, which is based on Xiao (1994) theoretical model of social support, and includes three factors, subjective support, objective support, and support utilization. A total of 17 questions were included, with a 5-point Likert scale (1 = completely non-compliant, 5 = compliant completely). The higher the score on the scale, the higher the level of social support. In this study, the Cronbach α coefficients at the T1 and T2 time points were 0.873 and 0.876, respectively.

### 3.2 Physical activity behavior self-rating scale

The Self-Assessment Scale of Extracurricular Physical Activity Behavior (Zhao et al., 2015) compiled by Zhao and Fa and Li, which applies to current college students, was used, which includes three dimensions: psychological mechanisms, individual characteristics, and social environment. The scale has a total of 50 questions, due to the considerable number of questions, this study employed a method of equal censure for the three dimensions, ultimately utilizing 18 of them. Using a 5-point Likert scale (1 = not at all compliant, 5 = fully compliant), the higher the score on the scale, the higher the level of physical activity behavior. In the present study, the Cronbach alpha coefficients for the T1 and T2 time points were 0.879 and 0.892, respectively.

### 3.3 Family relationships scale

The Family Intimacy and Adaptability Scale (Fei et al., 1991) was chosen to evaluate the family relationships of college students. It contains 16 question items including the dimensions of intimacy and adaptability and is scored on a 5-point Likert scale (1 = completely non-compliant, 5 = compliant), with the 13–16 questions being reverse-scored. In the current study, the Cronbach alpha coefficients for the T1 and T2 time points were 0.914 and 0.920, respectively.

### 3.4 Statistical methods

Using SPSS27.0 and AMOS26.0, the common method bias test, descriptive statistics, correlation analysis, independent samples *t*-test, and ANOVA were performed sequentially through SPSS27.0; the cross-lagged model was constructed, and the autoregressive coefficients and cross-lagged coefficients were examined to analyze the longitudinal relationship between the college students' social support, physical activity behaviors, and family relationships using AMOS26.0.

## 4 Results

### 4.1 Common method bias test

In this study, the common method bias was examined by Harman's one-way test (Zhou and Long, 2004). The results of T1 extracted a total of 11 factors with characteristic root >1, of which the first factor cumulatively explained 29.36% of the total variance, which was less than the 40% criterion; the results of T2 extracted a total of 13 factors with Eigen roots >1, of which the first factor cumulatively explained 23.91% of the total variance, which is also less than the critical criterion of 40%. This indicates that there is no significant common method bias in both the initial and subsequent measurements of this study.

### 4.2 Descriptive statistics and correlation analysis of college students' social support, physical activity behavior, and family relationships

In this study, descriptive statistics and correlation analysis were performed on the three variables of social support, physical activity behavior, and family relationships, and the results are shown in Table 1. At the correlation analysis, it was found that the social support score, the physical activity behavior score, and the family relationship score showed a significant positive correlation ($P < 0.01$) at both T1 and T2. A significant positive correlation was found between the social support score at the 2-time points ($P < 0.01$); a significant positive correlation was found between the physical activity behavior score at the 2-time points ($P < 0.01$); and a significant positive correlation found between the family relationship score at the 2-time points ($P < 0.01$). Significant positive correlation ($P < 0.01$) was shown between family relationship scores (Table 1).

### 4.3 Independent samples *t*-test and ANOVA for social support, physical activity behavior, and family relationships among university students

In the current study, an independent samples *t*-test was conducted on the gender of the subjects at the two-time points (as shown in Table 2), and Levine's test of equivalence of variances for gender showed that T1 social support ($P < 0.01$) and T2 family relationships ($P < 0.01$), therefore, variance non-uniformity of data was used. In the *t*-test for equivalence of means, there was no significant difference in gender for social support and family relationships measured at the 2 time points ($P > 0.05$), whereas there was a significant difference in physical activity behaviors at T1 ($P < 0.05$), and therefore gender needs to be considered in subsequent model comparisons.

At the same time, an ANOVA was conducted to compare the age and academic level of the variables measured (as shown in Table 3), and it was found that there was no significant difference between the two-time points in terms of academic level and age ($p > 0.05$).

TABLE 1 Mean, standard deviation, and correlation analysis of social support, sports lifestyle, and family relationship among university students.

| | M ± SD | X1 | X2 | Y1 | Y2 | Z1 | Z2 |
|---|---|---|---|---|---|---|---|
| T1Social support | 3.11 ± 0.56 | 1 | | | | | |
| T2Social support | 3.09 ± 0.58 | 0.474** | 1 | | | | |
| T1Physical Exercise behavior | 3.16 ± 0.62 | 0.777** | 0.439** | 1 | | | |
| T2Physical Exercise behavior | 3.16 ± 0.61 | 0.782** | 0.405** | 0.675** | 1 | | |
| T1Family Relationships | 3.21 ± 0.66 | 0.631** | 0.256** | 0.554** | 0.682** | 1 | |
| T2Family Relationships | 3.17 ± 0.68 | 0.534** | 0.239** | 0.458** | 0.482** | 0.600** | 1 |

"*" indicates $p < 0.05$ and "**" indicates $p < 0.01$ (due to table space limitations, X1 = T1 social support, X2 = T2 social support, and so on).

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TABLE 2 Independent samples *t*-test for gender and Hukou location for T1 and T2.

| Grouping Variables | Implicit variable | HV-test | Levine's test of variance equivalence | | Equality of means *t*-test | |
|---|---|---|---|---|---|---|
| | | | F | P | t | P |
| Distinguishing between the sexes | T1 Social support | Variance non-chirality | 11.085 | 0.001** | −0.02 | 0.984 |
| | T2 Social support | Variance chi-square | 0.026 | 0.872 | 0.052 | 0.958 |
| | T1 Physical Exercise behavior | Variance chi-square | 8.804 | 0.003 | −0.134 | 0.893 |
| | T2 Physical Exercise behavior | Variance chi-square | 13.369 | <0.01** | 1.236 | 0.217 |
| | T1Family Relationships | Variance chi-square | 10.082 | 0.002 | 2.219 | 0.027* |
| | T2Family Relationships | Variance chi-square | 6.715 | 0.01 | 0.226 | 0.821 |

"*" indicates $p < 0.05$, "**" indicates $p < 0.01$.

TABLE 3 ANOVA for grade and age for T1 and T2.

| Grouping Variables | Implicit variable | Mean square | F | P |
|---|---|---|---|---|
| Grade | T1 Social support | 0.421 | 1.351 | 0.25 |
| | T2 Social support | 0.069 | 0.202 | 0.937 |
| | T1 Physical Exercise behavior | 0.457 | 1.175 | 0.321 |
| | T2 Physical Exercise behavior | 0.532 | 1.46 | 0.214 |
| | T1 Family Relationships | 0.575 | 1.344 | 0.253 |
| | T2 Family Relationships | 0.563 | 1.209 | 0.306 |
| Age | T1 Social support | 0.138 | 0.438 | 0.781 |
| | T2 Social support | 0.159 | 0.471 | 0.757 |
| | T1 Physical Exercise behavior | 0.366 | 0.939 | 0.441 |
| | T2 Physical Exercise behavior | 0.123 | 0.333 | 0.856 |
| | T1Family Relationships | 0.541 | 1.264 | 0.283 |
| | T2Family Relationships | 0.233 | 0.498 | 0.738 |

## 4.4 Cross-lagged processes and analysis of social support, physical activity behavior, and family relationships among university students

Models of college students' social support, physical activity behaviors, and family relationships were constructed by AMOS 26.0, allowing for residual correlations at the same time points. The baseline model was established first (Figure 2), and then the M2 to M8 models were constructed according to the cross-correlations and paths (Figures 3–9). The path addition and fit metrics for each model are as follows (Table 4).

Model comparison was conducted through AMOS26.0, and it was found that among models M1 to M8, the fit of models M1 to M5 was unsatisfactory, and the fit indicators of models M6 to M8 were satisfactory, in which the 2 cross-lagged paths in model M7, T1 Physical Activity Behavior → T2 Family Relationships, and T1 Family Relationships → T2 Social Support were not non-significant, so model M7 was deleted and model M8 was selected. To further compare the fit between the equivalent model M9 (Figure 10) and M8 (Figure 11), the cross-lagged path equivalence setting was carried out, and the two cross-lagged paths T1 social support → T2 physical activity behavior and T1 physical activity behavior → T2 social support was set to be a1 and b1, respectively, and it was found that after setting that all the indexes of the fit of the model M9 deteriorated, and there was a significant M8 and M9 difference ($p < 0.001$) (Table 5), therefore, this equilibrium restriction is not reasonable, and the final model in this study is the cross-lagged model M8 (e.g., Figures 9, 11).

In the cross-lagged model of college students' social support, physical activity behavior, and family relationship (Figure 12), the various fit indices of the model were $\chi^2/df = 1.294$, GFI = 0.995, CFI = 0.999, and RMSEA = 0.027, which indicated that the cross-lagged model of college students' social support, physical activity behavior and family relationship constructed in this study had a good fit. Bootstrap test analysis found that T1 social support was able to positively predict T2 physical activity behavior ($\beta = 0.50$, $p < 0.001$), and T1 physical activity behavior was also able to positively predict T2 social support ($\beta = 0.18$, $p < 0.01$), but the path value T1 social support → T2 physical activity behavior was greater than T1 physical activity behavior → T2 social support, therefore, the social support was a causal variable for physical activity behavior; T1 social support positively predicted T2 family relationships ($\beta = 0.26$, $p < 0.001$); and T1 family relationships positively predicted physical activity behavior ($\beta = 0.30$, $p < 0.001$).

To further test the gender differences between college students' social support, physical activity behaviors, and family relationships, cross-group comparisons were set up in AMOS, Group1, and Group2 were established to represent male and female college students, respectively, male and female autoregressive and cross-lagged path equivalents were set up. The results of the running comparisons showed that there was a significant difference between unrestricted models and restricted models ($\chi^2 = 241.29$, $\Delta df = 16$, $p < 0.001$), indicating that the cross-lagged models of social support, physical activity behavior and family relationships of college students differed by gender, as shown in Figures 13, 14.

After distinguishing gender, it was found that the cross-lagged paths of each cross-lagged path for female college students were larger than those of male college students, except for the path of T1

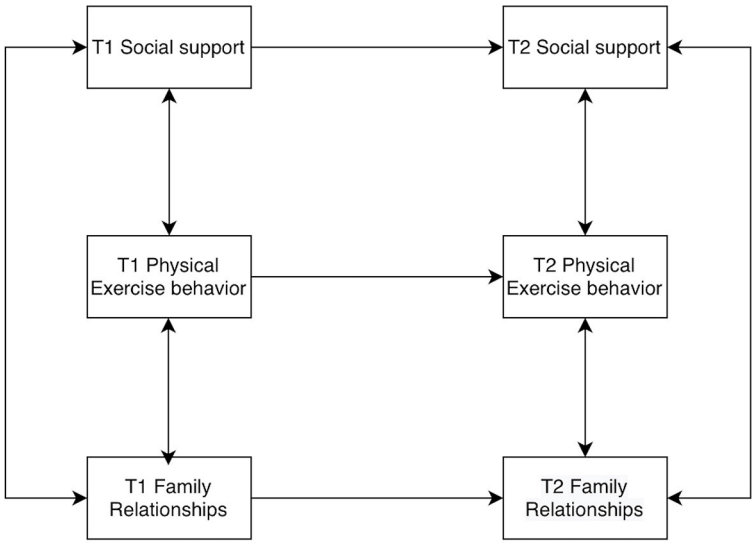


FIGURE 2
Baseline model M1.

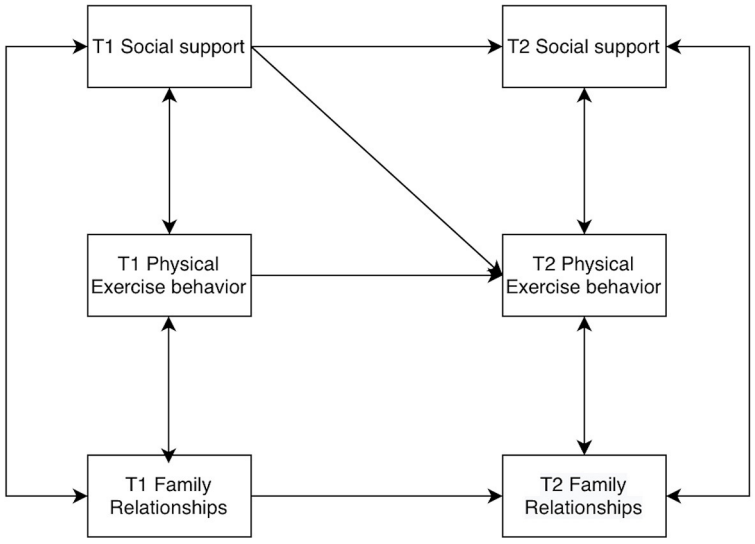


FIGURE 3
Model M2.

social support → T2 family relationship (β: 0.40 > 0.21); all other cross-lagged paths were smaller than those of male college students.

## 4.5 Analysis of vertical intermediation effects

According to the test of the amount of longitudinal mediating effects, the mediating effects of college students' family relationships and social support were analyzed across time (Li et al., 2022), and the Bootstrap method was applied to test the significance in AMOS26.0, with the sample size of 2,000 selected and the confidence interval set at 95%. Based on the cross-lagged model M8, T1 family relationship → T2 physical activity behavior was set as a1, T1 physical activity behavior → T2 social support as a2, T1 social support → T2 family relationship as c1, and T1 social support → T2 physical activity behavior as d1; the path coefficient of T1 family relationship → T2 physical activity behavior was 0.301, and the confidence interval was [0.173, 0.454], the path coefficient of T1 physical exercise behavior → T2 social support was 0.179, with a confidence interval of [0.014,0.336], and the longitudinal mediation effect size a1*a2 = 0.054, with a confidence interval of [0.009,0.121], $p < 0.05$, indicating that the longitudinal mediation effect was significant.

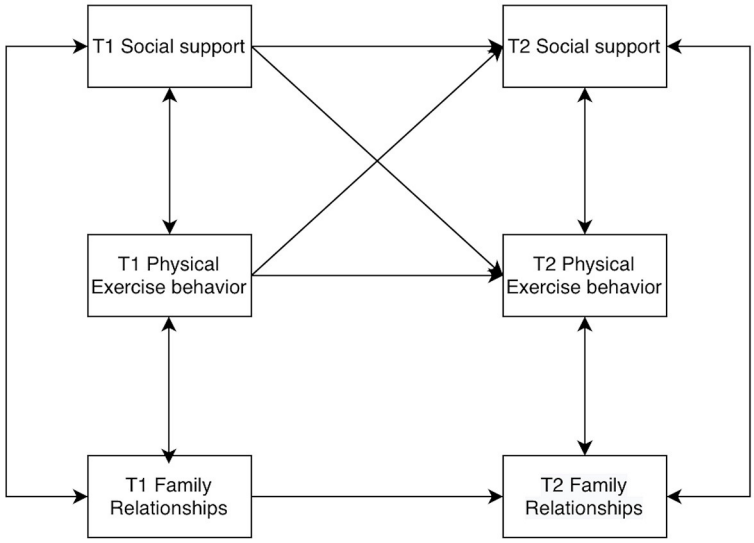


FIGURE 4
Model M3.

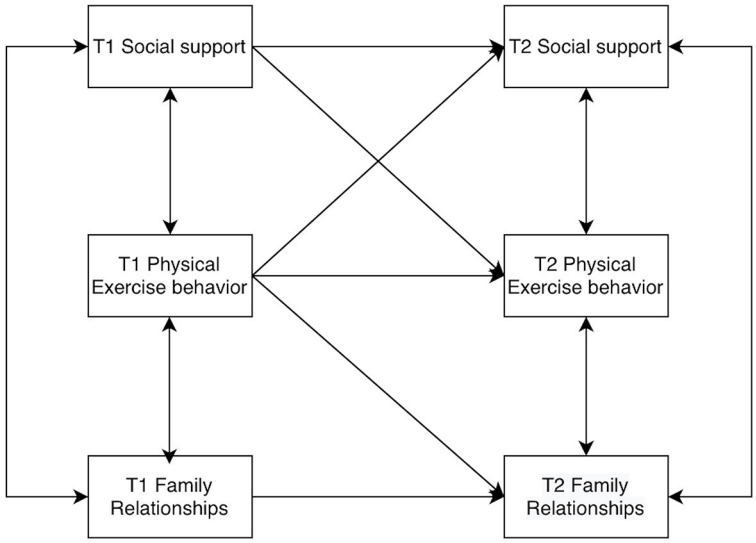


FIGURE 5
Model M4.

## 5 Discussion

This study reveals the longitudinal relationship between college students' social support, physical activity behaviors, and family relationships, as well as the mediating effect of physical activity behaviors in social support and family relationships, and it is a positive exploration of preventing and promoting the development of college students' physical and mental health. At the theoretical level, this study enriches the research on the factors and mechanisms influencing physical activity behavior and mental health and deepens the research results of physical education; at the practical level, it reveals the importance of physical exercise behavior, proves the intrinsic mechanism between college students' social support, physical activity behavior and family relationship, and provides a New Ideas.

### 5.1 The relationship between social support and physical activity behavior among university students

The findings of the current study indicate that college students' physical activity behavior significantly and positively

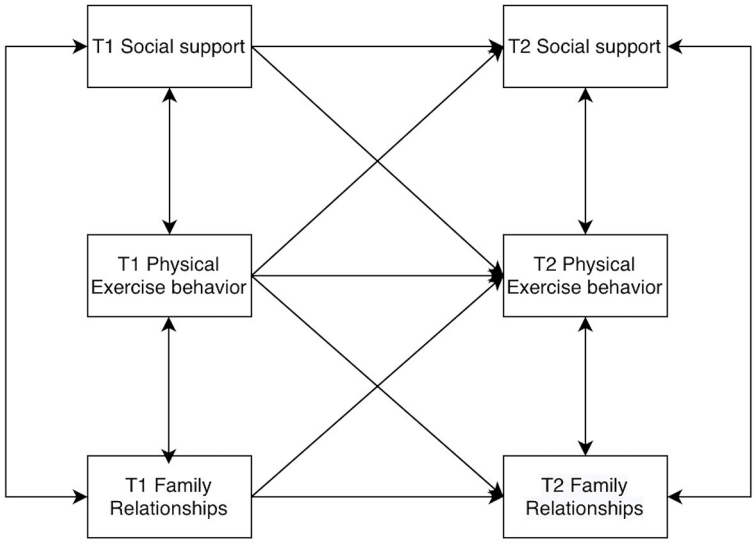


FIGURE 6
Model M5.

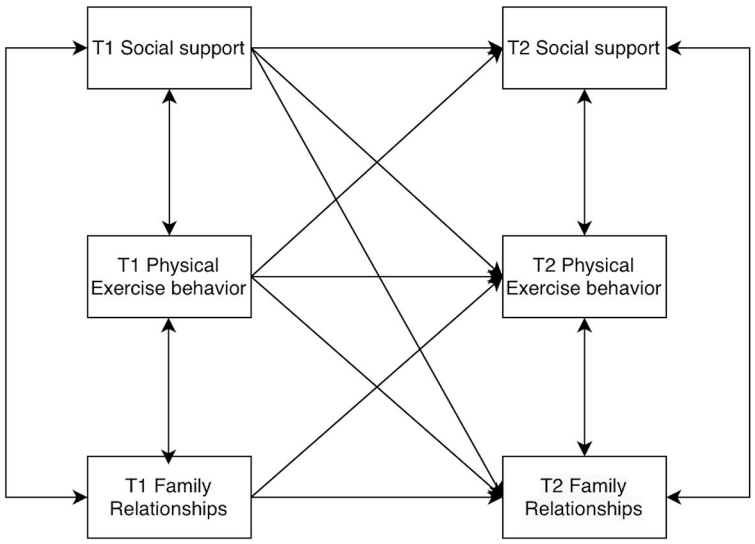


FIGURE 7
Model M6.

predicts social support, thereby supporting hypothesis 1a. This is consistent with other researchers (Chen, 2001; Smith et al., 2017; Xu and Li, 2017). As mentioned earlier, physical activity behavior and social support both share the common effect that social support can reduce the probability of depression (Qiu et al., 2021), and good physical activity behavior can also cultivate the participants' emotions, morality, and character, which is a unique vehicle to develop socio-emotional competence and reduce the risk of depression (Zhao et al., 2024). The study further pointed out that college students' social support is a mediating variable between physical activity behavior and depression, in other words, physical activity behavior can improve depression by influencing social support (Zhang et al., 2022), which indicates that there is a correlation between physical activity behavior and social support. Therefore, college students' physical activity behavior can positively predict social support.

Also, college students' social support positively predicted physical activity behavior, and Hypothesis 1b was supported. College is the transition stage between adolescence and adulthood, and the formation and development of physical activity behavior at this stage is very important (Ji et al., 2022). At present, the lack of physical exercise among college students in China leads to poor physical fitness (Wang

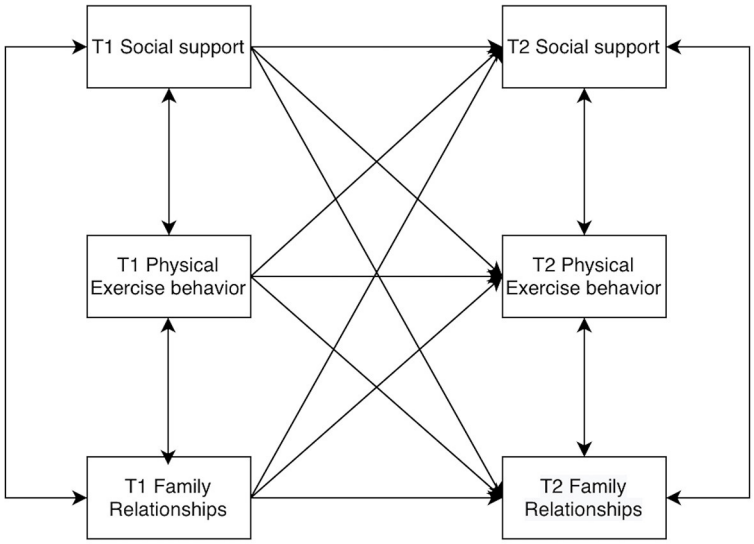


FIGURE 8
Full model M7.

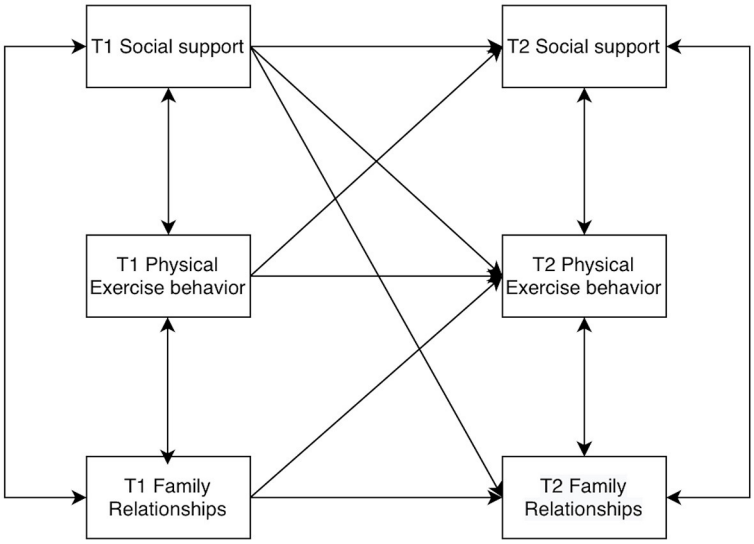


FIGURE 9
Final model M8.

et al., 2020), which requires colleges and universities, and education departments to encourage and support college students to engage in physical exercise from the perspective of influencing factors, thus laying a good foundation for the development of lifelong sports. Some studies have found that the formation and development of college students' physical activity behavior are influenced by various aspects such as family, peers, society, academic pressure, and gender (Pan et al., 2022), among which, social, family, and peer support influence college students' physical activity behaviors (Bandura, 2004; Beets et al., 2010; Rackow et al., 2014). Therefore, college students' social support can positively predict physical activity behavior.

## 5.2 The relationship between family relationships and physical activity behavior among university students

In this study, college students' family relationships positively predicted physical activity behavior, and Hypothesis 2a was established. This is in line with the views of previous researchers (Thompson and Meyer, 2013; Wang, 2019; Liu, 2021; Pan, 2022). Physical activity behavior is influenced by many aspects, including family, individual, and society (Pan et al., 2022). The family unit is the primary catalyst for an individual's growth and the foundation for the development of physical activity behaviors. Family systems theory posits that parents play a pivotal role in their children's

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TABLE 4 Indicators of fit for models M1-M8.

| Model name | Add Path | $\chi^2/df$ | GFI | CFI | RMSEA |
|---|---|---|---|---|---|
| M1 | Baseline model | 28.287 | 0.858 | 0.821 | 0.258 |
| M2 | X1→ Y2 | 28.490 | 0.874 | 0.840 | 0.259 |
| M3 | Y1→ X2 | 32.325 | 0.875 | 0.840 | 0.276 |
| M4 | Y1→ Z2 | 17.729 | 0.929 | 0.927 | 0.202 |
| M5 | Z1→ Y2 | 21.273 | 0.929 | 0.926 | 0.222 |
| M6 | X1→ Z2 | 2.815 | 0.991 | 0.995 | 0.066 |
| M7 | Full model | 1.119 | 0.997 | 1.000 | 0.017 |
| M8 | Remove insignificant paths | 1.294 | 0.995 | 0.999 | 0.027 |

X, Y, and Z represent social support, physical activity behavior, and family relationships, respectively, with the corner marker 1 representing the T1 time point and 2 representing the T2 time point. The process of adding cross-lagged paths is such that the latter model is added on top of the former model, e.g., M2 is added on top of M1 with path X1→ Y2.

maturation (Bowen, 1966), which is manifested in the fact that the support given to children by family members (e.g., parents) improves the individual's physical fitness (Tandon et al., 2012; Dong et al., 2018), so families should give individuals the opportunity to participate in physical exercise support, thus promoting the overall development of individuals and laying a good foundation for lifelong sports. Concurrently, positive familial dynamics can facilitate children's development of the three essential perspectives (Calatrava et al., 2023). This approach also serves to establish the correct values of sports and improve the level of individual physical activity behavior. Therefore, college students' family relationships can positively predict physical activity behavior.

In addition, college students' physical activity behaviors do not predict family relationships, Hypothesis 2b holds. Research in the current field focuses on the relationship between family sports and individual sports participation (Pan, 2022; Liu et al., 2023). Although research proposes that family physical activity can influence family relationships through intergenerational transmission effects (Wang et al., 2016), the current situation of college students in China is manifested by the fact that students are mainly boarding on-campus (He and Yang, 2014), and participation in physical activity with family members during the school year is limited by time and space. At the same time, as mentioned earlier, improving physical health, recreation, and weight loss are the motives for college students to participate in physical activity during school (Li et al., 2022), and there is no strong correlation with the development of family relationships. Therefore, college students' physical activity in school does not significantly affect family intimacy (family relationships), i.e., college students' physical activity behavior does not directly predict family relationships.

## 5.3 The relationship between family relationships and social support for college students

The results of the current study indicated a significant positive correlation between social support and family relationships at the same time point. However, cross-lagging analysis revealed that college students' family relationships did not predict social support, and Hypothesis 3a was not supported. Additionally, T1 family relationships did not predict T2 social support across time, which differed from previous studies (Zhao et al., 2011; He et al., 2018; Wei et al., 2021). Previous studies have only explored the link between family relationships and social support individually and in cross-sectional studies. Meanwhile, the individual's ability to appreciate social support is affected by the individual's social experience (Hartley and Coffee, 2022; Ma et al., 2023), college students have less social experience and make little use of social support (Liu, 1998), and in the group of college students, social support is affected by many aspects such as individual psychology, school, society, and family, etc. Due to the special nature of college students' living environment, they tend to be in on-campus accommodation during their school years (He and Yang, 2014), and the connection with family members is reduced, which is also an objective reason why family relationships of college students cannot predict social support. Therefore, this study introduces another variable: physical activity behavior, aiming to deeply analyze the correlation mechanism between college students' social support, physical activity behavior, and family relationships. The fact that family relationships do not directly predict social support suggests that there may be a deeper longitudinal relationship between social support, physical activity behavior, and family relationships.

Meanwhile, the results of the current study indicate that college students' social support can positively predict family relationships, and Hypothesis 3b is supported. This is consistent with previous studies (Gruijters, 2017; Wei et al., 2021). On the one hand, social support can alleviate individuals' negative emotions and negativity in life, which in turn improves psychological wellbeing (Tabatabaei et al., 2018; Cohen and McKay, 2020), and individuals who maintain a pleasant mood are more willing to communicate with their family members, which in turn promotes the development of family relationships. Social exchange theory suggests that the acquisition of social support must be maintained in a balanced view with the provision of support (Ahmad et al., 2023), meaning that people can obtain support from their social relationships and need to provide support for others (Clark et al., 1987). Family is the constituent unit of society, and social support includes mutual support among family members, while individuals are supported by their family members, they also need to provide support for their family members, which promotes the development of family relationships in the process of mutual support. Therefore, social support for college students can positively predict family relationships.

## 5.4 An analysis of the underlying mechanisms of social support, physical activity behavior, and family relationships among university students

Despite the lack of predictive power of family relationships on social support in the present investigation and the absence of a direct temporal predictive link between physical activity behavior and family relationships, owing to the unique nature

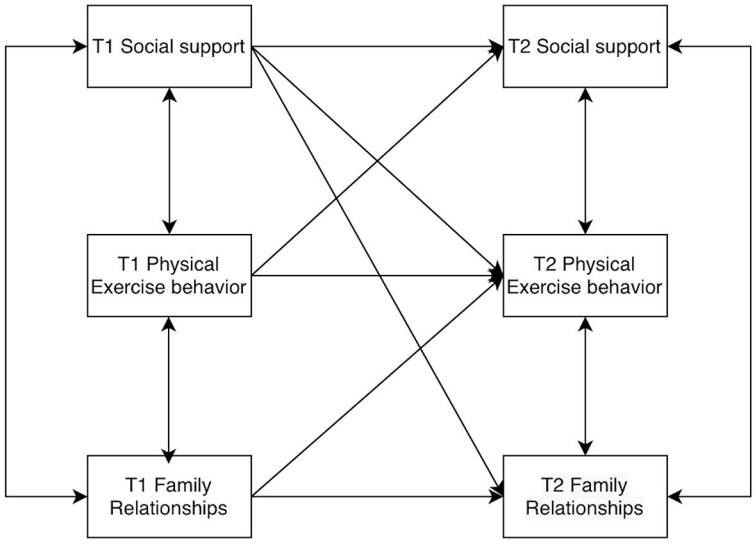


FIGURE 10
Final model M8.

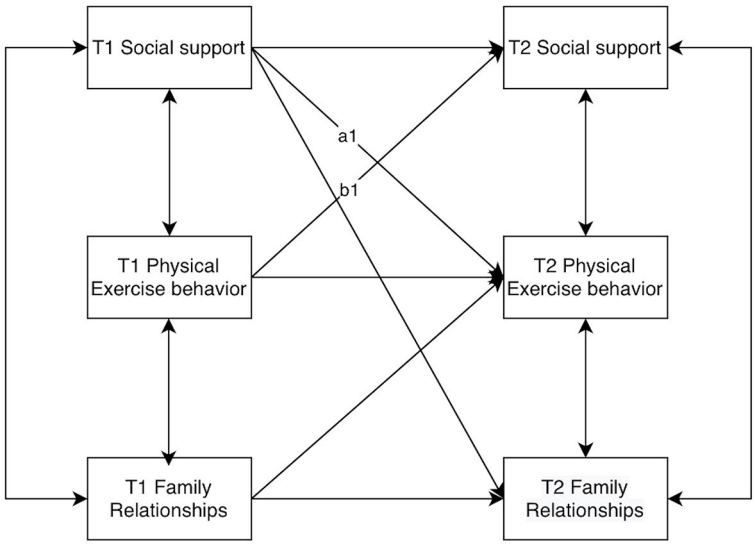


FIGURE 11
Equivalent model M9.

of the academic environment encountered by university students, the present study analyzed the mediating effects among social support, physical activity behavior, and family relationships among this cohort, drawing upon the outcomes of the cross-lagged analysis. It was found that in the college student population, physical activity behavior was the mediating effector between family relationships and social support, and Hypothesis 4 was supported. This demonstrated that although college students' family relationships cannot directly influence social support, they can further have an impact on social support through physical activity behaviors. Perfection theory suggests that family relationships can influence the behavior of individuals (Liu, 2021),

TABLE 5 Comparison of indicators for models M8 and M9.

| Model name | $\chi^2/df$ | GFI | CFI | RMSEA | |
|---|---|---|---|---|---|
| M8 | 1.294 | 0.995 | 0.999 | 0.027 | $P = 0.000^{***}$ |
| M9 | 4.455 | 0.978 | 0.985 | 0.092 | |

"*" indicates $p < 0.05$, "**" indicates $p < 0.01$, "***" indicates $p < 0.001$.

whereas family support in family relationships can influence students' physical activity behavior (Davison et al., 2004). Similarly, some studies have shown that the higher the frequency of

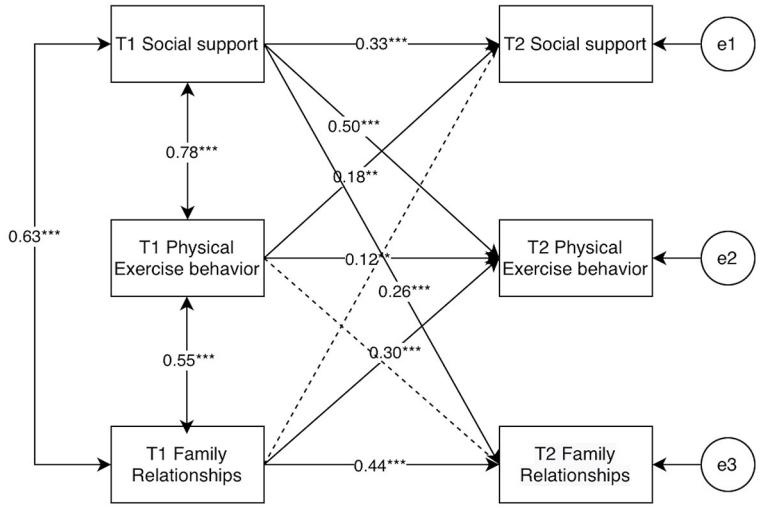


FIGURE 12
Results for each pathway for M8. "**" indicates $p < 0.01$, "***" indicates $p < 0.001$.

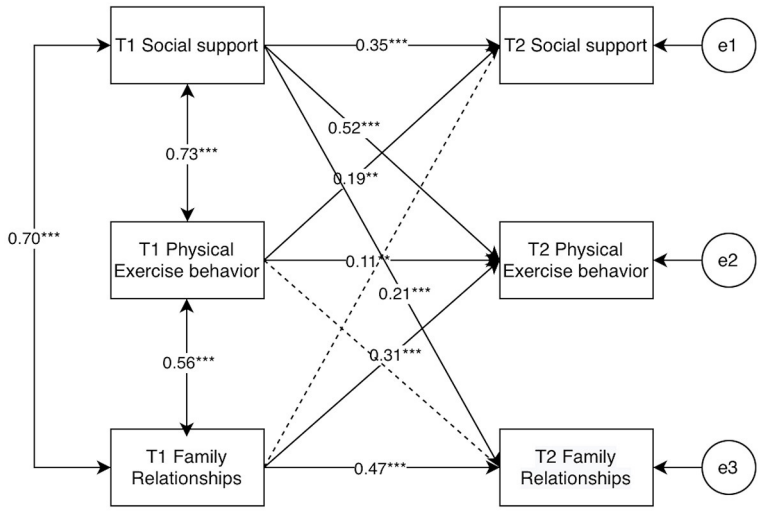


FIGURE 13
Results of each path for model M8 for male university students. "**" indicates $p < 0.01$, "***" indicates $p < 0.001$.

participation in physical activity, the greater the subjective support and support utilization that can be obtained (Xu and Li, 2017), and physical activity behavior shows a significant positive correlation with social support (Sun et al., 2023). As further mentioned in previous studies, family relationships (e.g., family closeness and adaptability) are associated with social support, and family relationships can indirectly influence social support (Luo and Zhang, 2015). This indicates that physical activity behavior can act as a mediating variable between family relationships and social support. In other words, the family relationships of college students must influence the availability of social support through physical activity behavior.

## 5.5 Strengths of the study and future directions

This study explored the interrelationships between college students' social support, physical activity behaviors, and family through a cross-lagged design. First, this study longitudinally tracked and collected two rounds of data from the college student population with a 2-month interval to provide a more detailed analysis of this phase of the college student population. Second, we discussed the relationship between different variables by gender, which is conducive to understanding the unique roles of these variables across genders. Finally, in the design of the methodology,

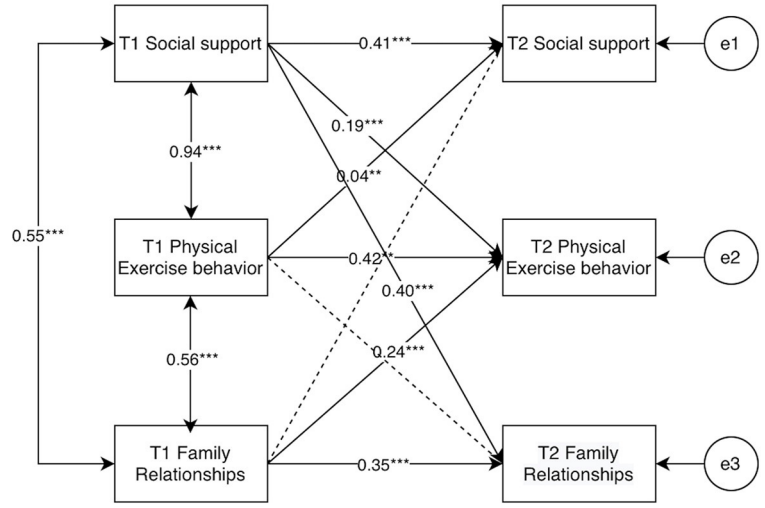


FIGURE 14
Results of each path for model M8 for female university students. "**" indicates $p < 0.01$, "***" indicates $p < 0.001$.

the differences were first compared by independent samples *t*-test and ANOVA, then the best model was selected by comparing the fit of the model, and the differences between the male and female gender models were compared based on the best model, which resulted in a more robust methodological design and a more in-depth analysis of the data.

## 6 Conclusion

The cross-lagged study led to the conclusions of this paper that (1) there are gender differences in college students' social support, physical activity behaviors, and family relationships; (2) college students' social support is a causal variable for physical activity behaviors; (3) social support positively predicts family relationships; (4) family relationships positively predict physical activity behaviors; and (5) physical activity behaviors are a mediator variable between family relationships and social support.

Therefore, this study suggests that colleges and universities should pay attention to college students' school communication and family relationships, and through regular psychological lectures, let college students learn how to communicate with their relatives and friends, reduce the occurrence of family conflicts and friendship conflicts among college students, and encourage college students to actively participate in sports, through participation in sports activities, college students can make new friends, expand their social circle, and enhance their interpersonal communication skills and teamwork.

In summary, this study explored the mechanism of college students' social support, physical activity behavior, and family relationship through longitudinal tracking survey and cross-lagged model design and analysis, but it still needs to be paid attention to and improved in future research: (1) the tracking length of the study can be further extended, for example, future researchers can conduct 2–3 surveys through half a year or 1 year; (2) in addition to exploring the mechanism underlying the social support and physical activity behavior, social support and family relationship, and the intrinsic mechanism of physical activity behavior and family relationship, there is still a need to pay attention to and consider the possible roles and influences of other factors on the social support, physical activity behavior and family relationship of college students, and there is a need to further consider other variables in the future for research.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by the Ethics Review Committee of Chengdu Sport University Research Office. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

XZ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Writing – original draft, Writing – review & editing, Supervision. MZ: Supervision, Validation, Writing – review & editing. BL: Conceptualization, Supervision, Validation, Writing – review & editing. SM: Supervision, Writing – review & editing.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2024.1439252/full#supplementary-material

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 21 August 2024
DOI 10.3389/fpsyg.2024.1443419



OPEN ACCESS

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RECEIVED 04 June 2024
ACCEPTED 08 August 2024
PUBLISHED 21 August 2024

CITATION
Qiu S and Wang Z (2024) The influence of home environment on 2-year-old Chinese children's language development: the mediating effect of executive function and the moderating effect of temperament. *Front. Psychol.* 15:1443419. doi: 10.3389/fpsyg.2024.1443419



# The influence of home environment on 2-year-old Chinese children's language development: the mediating effect of executive function and the moderating effect of temperament

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Prior research highlighted the effect of home environment on the language development of young children. Recent research has mainly discussed the moderating effect of personality traits like temperament. Nevertheless, the precise mechanism about the relationship between home environments to children's language development remains incompletely understood. This study explored how home environment impacts the language development of 2-year-old toddlers and the role of temperament and executive function in this relationship. We used the Chinese Child Adaptive Behavior Scale, the Temperament Scale for 1–3 years old of toddlers and the Home Environment Scale for Infants' and Toddlers' families to assess children's language development, temperament, and home environment. Simultaneously, the research used the Stroop-like day-night task and the multiple location search task to evaluate children's executive function. A total of 117 2-year-old children as well as their parents were involved in the study. The results revealed that home environment significantly predicts children's language ability with executive function as a mediating role. Temperament dimensions including extraversion, independence, reactivity, and social inhibition play a moderating role between home environment and executive function. The findings contributed to the improved implementation of home education tailored to children with different temperament traits, offering effective support for the cognitive and language development of young children.

KEYWORDS

**home environment, language ability, executive function, temperament, children**

## 1 Introduction

Home environment has a significant impact on the language development of young children (Peterson et al., 2019), which comprises both material and psychosocial dimensions (Sarsour et al., 2011). In addition, substantial research has presented the correlation between the executive function and language development of children at an early age (Shokrkon and Nicoladis, 2022). The early language development secures its

foothold in executive function (Cartwright, 2012) and home environment (Bus et al., 1995). Nevertheless, developmental pathways among home environment, executive function, and language ability have been seldom explored (Segers et al., 2016). As a result, there lacks understanding toward the precise connections among these. Recent years have witnessed growing attention from researchers to the moderating effect of individual differences on young children (Cuevas et al., 2014; Wang et al., 2021), but no research has been made with a focus on the moderating effect of different temperaments and home environments on the individual executive function. Thus, it is worth exploring why different children benefit differently from their home environment in early childhood. This study sought to comprehensively explore the role of home environments in language development by examining whether executive function and temperament mediate or moderate the impact of environmental factors on language development in Chinese children aged 2 years.

## 1.1 Home environment and children's language development

Based on Brownian Brunner's (1979) ecosystem theory of developmental psychology, the microenvironment of human development is the institutions and groups with the most immediate, directly impact on children's development, such as family, school, religious institutions, neighborhood, and peers, among which home environment (HE) is the most influential microsystem on early childhood development.

Family socioeconomic status is a significant indicator of home environment (Chow et al., 2017). Family SES reflecting the resources and assets possessed by a household includes both material and intangible resources (Bradley and Corwyn, 2002). Prior studies have primarily examined the influence of the family socioeconomic status on early childhood language development (Bradley and Corwyn, 2002). Infants from high-SES families are exposed to more child-directed speech (Hart et al., 1997). However, those of low-SES families may be exposed to fewer, less diverse and simpler words and gain fewer conversational opportunities (Huttenlocher et al., 1991, 2010; Hoff, 2003; Rowe, 2012; Romeo et al., 2018). Similar conclusions have been drawn among Chinese families in which the impact of family SES has been verified in both Pinyin writing (Hoff, 2003; Dulay et al., 2018) and Chinese language (Zhang et al., 2013; Su et al., 2017). It is widely believed that the vocabulary disparity between those of low-SES households and high-SES households is resulted from different quantity and quality of their exposure to language (Ralph et al., 2020). In general, the home environments of those growing up in low-SES backgrounds are featured with chaotic organizations, the absence of structures and routines, various stressors (Hoff-Ginsberg, 1998; Hoff and Tian, 2005; Pace et al., 2017), and excessive background noises and crowding (Evans et al., 2005; Evans, 2006). This eventually makes the children to be inferior than their counterparts in access to language resources.

In sum, home environment provides young children with more opportunities and stimuli. Despite the empirical basis proving that home environment can predict the language development of young children, the exact mechanism for Chinese children aged 2 remains unclear and it has not been verified whether this conclusion can be equally applied to the children of different temperaments.

## 1.2 A potential mediator: executive function

Executive function (EF) means a group of top-down mental processes required for someone to concentrate when it is ill-advised, insufficient, or impossible to rely on instincts or intuition (Miller and Cohen, 2001). Three core EFs are universally recognized (Miyake et al., 2000; Lehto et al., 2003; Diamond, 2013): inhibition refers to the capacity to delay a well-learned prepotent response and replace it with a more appropriate one (Smith and Jonides, 1997; Baddeley, 1998); working memory represents the capability of keeping and controlling complex information in mind (Barkley, 2001); cognitive flexibility refers to the capacity to adapt individual behavior to the changing situation in a rapid, flexible manner (Davidson et al., 2006; Diamond, 2006).

Preschool years witness the boom of both Language and EF whose association has been verified by substantial (Shokrkon and Nicoladis, 2022). EF plays a big part in language skill acquisition and development of children as it prompts them to pay attention to different information streams, monitor errors, and make decisions accordingly (Diamond, 2013). EF, intrinsically involved in language functioning, is crucial in semantic control (Mirman and Britt, 2014). Although many cross-sectional (Gathercole and Pickering, 2000; Carlson et al., 2005; Kuhl, 2014) and longitudinal research (Gooch et al., 2016; Pérez-Pereira et al., 2020) as well as intervention studies (Guttentag et al., 2014; Jones et al., 2014) have demonstrated the bidirectional relation, few studies have concentrated on the direction of the developmental pathways between EF and language. Thus, their association remains unclear (Shokrkon and Nicoladis, 2022).

The relation between the home environment and executive function of children is well-documented (Sarsour et al., 2011). Home environment can exert both direct and indirect influences on a children's EF. For instance, a rich home literacy environment with regular book reading sessions may enhance the working memory and language processing capacity of a child (Boerma et al., 2017). Furthermore, positive parenting practices within the home environment, such as providing consistent routines and opportunities for problem-solving, can contribute to the inhibitory control of children (Sanders et al., 2019). In essence, home environment's direct influences on EF skills are evident through its capacity to shape the working memory, cognitive flexibility, and inhibitory control, and all of them are integral to language development (Diamond, 2013). With a growing number of findings about its significant roles, it becomes imperative to further examine the role of EF on the relationship between the HE and children language ability. Hence, this important variable is included in this study.

### 1.3 A potential moderator: temperament dimensions

As the biological differences of individuals, temperament is an enduring biological composition under the influence of heredity, maturation, and experiences (Rothbart et al., 2001; Rothbart and Derryberry, 2013). The evolution of children's executive function is influenced by both external and internal factors from the ecosystem (Bronfenbrenner, 1979; Tu and Yang, 2018). Regarding internal factors, temperament as a stable individual characteristic serves as the foundation for individual differences and can regulate the relation between the external environment and children's development (Rioux et al., 2016). Temperament serves as the innate foundation for children's reactivity and self-regulation (Bornstein et al., 2015). Children with certain temperament traits probably be more subject to environmental influences (Belsky et al., 2007). In studies on children aged 0–4, it has been found that children with high arousability temperament characteristics perform better in favorable environments compared to unfavorable environments. On the other hand, children with low arousability temperament characteristics show stable development in their executive functions and are less influenced by the environment (Willoughby et al., 2013). The temperament acts as a filter for stimuli, influencing the sensitivity of children to stimuli, and subsequently affecting their executive function (Xie et al., 2021). However, previous research has not provided answers to which components of temperament filter the impact of various environmental factors on executive function. The missing piece in executive function research is how temperament and environmental factors jointly influence the executive function of children (Suor et al., 2019). Hence, this potential moderator is included in this study.

### 1.4 Current study

To conclude, some studies have already discovered the significant impact of home environment on early linguistic competence development of young children. In addition, executive function of young children can predict their language development. However, the exact mechanism through which home environment influences the language development of children has not been fully understood, and there is limited evidence on the moderating effects of individual differences such as temperament dimensions. To close up the gap, it is predicted that executive function is a potential mediating factor, and children's temperament could function as a potential moderating factor. The study focused on 2-year-olds. Language development is pivotal for the future success of children (Visser-Bochane et al., 2020). Language acquisition at the age of 2 when children learn language and communication rapidly naturally serves as a crucial foundation for individual development (Suryanti et al., 2023). It has been well documented that the language development of children aged 2 to 3 varies with family factors (Linberg et al., 2020). In addition, given that 2-year-old children have not yet undergone formal schooling, the family serves as the primary setting for them to acquire fundamental skills and receive the necessary resources. As a result, home environment is the most influential microsystem on early childhood development (Leng et al., 2023). Therefore, selecting 2-year-old children as the subjects can deepen the understanding of early language development and optimize family education for young children with different types of temperament.

Specifically, the following hypotheses were developed and then tested: (1) EF acts as a mediator between the HE and 2-year-old children's language ability; (2) temperament plays the moderating role between HE and EF.

## 2 Methods

### 2.1 Participants

We selected 151 parents from a childcare institution of average local standards in Xuzhou City, Jiangsu Province, China, and permitted by the principals to account for potential dropouts and ensure robustness of our findings based on the sample sizes of previous related research (Wang et al., 2021; Xie et al., 2021). Both online and offline procedures were carried out to collect data. Online procedures were conducted through anonymous electronic questionnaires on *Wenjuanxing*, a public online platform. For the offline procedure, one-on-one tests were conducted with the children and their parents within the childcare institution. Online and offline sessions took place from September to October 2022.

Participants were all voluntary for the study, and written consent was submitted by parents. The study has been approved by the Ethical Committee of Jiangsu Normal University. 117 (77.5%) parents of children aged 2 ($M = 31.06, SD = 3.27$ months, 55 boys, 62 girls) responded effectively and contributed to the data analysis.

### 2.2 Procedures and measures

The measures of EF were organized into an offline test, and the measures of HE, temperament dimensions, and language ability were used to make an online questionnaire. The participants would receive a link of the questionaire and complete it at their convenience.

#### 2.2.1 Home environment

The three aspects of the home environment include the family socioeconomic status, family material environment, and family non-material environment. Specifically, each of these components was normalized and then summed to derive the overall *home environment* variable (Bradley and Corwyn, 2002).

*Family SES.* Parents were asked about their education level and vocational type (Linghao Xie and Fong, 2022). A total of seven education levels could be selected, from the lowest level of *not having attended school* (1 point) to the highest level of *master degree or higher* (7 points). A total of five types of occupations were classified while the lowest level was *temporary workers* (1 point) and the highest was *senior professionals* (5 points). The total score was obtained by adding the points gained by both mother and father from the above questions together. As a result, the total score

should range from 4 to 24, and a higher total score demonstrates a higher family SES. Household income was not taken into account since it was proved that it could not accurately reect SES among the Chinese population by a prior report (Xu et al., 2006).

*Family material environment and family non-material environment.* These measures were derived from the Korean Home Environment Scale for Infants' and Toddlers' Homes (Kim et al., 2012) with Caldwell and Bradley's ECHOME scale (Caldwell and Bradley, 2001) as well as the research conducted by Kim and Gwak as its basis (Kim and Gwak, 2007). The scale used in this study has been adapted appropriately based on the local situation in China to assess the caregiving environment for children related to two factors: material environment (4 items) and non-material environment (4 items). The adaptations included modifications to reflect Chinese living habits, such as the types of media, videos, and toys commonly used. In these 8 items, the response scale of 6 items that were positively scored (e.g., *I usually read with my child a lot*) ranged from never true (1 point) to always true (5 points), 2 items that were negatively scores (e.g., *my child is usually exposed to media screen*) ranged from never (5 points) to everyday (1 point). The total score of each factor was used, while a high score indicates that those children are exposed to more diverse developmental environments than those of lower scores. The Cronbach's $\alpha$ of each factor ranged from 0.71 to 0.84.

### 2.2.2 Children's language ability

We used a family self-report questionnaire to measure children's language ability, which was selected from the language development section in the Development of National Norms of Chinese Child Adaptive Behavior Scale (Yao and Gong, 1993).

After modification, our study encompasses several dimensions: First, it evaluates vocabulary size by assessing how many objects the child can name in daily life. Second, it examines self-identification by determining the child's awareness of their name and gender. Third, it assesses descriptive ability by evaluating the child's capability to describe pictures. Lastly, it considers the recognition of size and color by determining the child's ability to identify these attributes in objects. Finally, it evaluates functional vocabulary by assessing how many object uses the child can articulate. The Cronbach's $\alpha$ of each factor ranged from 0.90 to 0.99.

### 2.2.3 Executive function

This study focuses on two primary components of executive function, that is, the working memory and inhibition. We used tasks that are suitable for children aged 2 and have been widely used and proved to have good measurement indicators.

- *Working memory.* This test is derived from multiple location search task (Carlson, 2016). The experimental materials consist of three cartoon stickers and six boxes with different shapes, colors, and sizes. The experimenter evenly placed six boxes with different colors and shapes on the table. The stickers were placed inside the boxes and covered with lids, and the entire process was performed while the children were watching. After closing the lids, the boxes were shuffled in random order, and then, the child was asked to find out the boxes that had the stickers hidden inside. The task consisted of 3 trials, with 1, 2, and 3 stickers at each level. Children will be awarded one point for correctly finding a sticker, with a total of six points available. The working memory of those of high scores is higher than those of lower scores.
- *Inhibition.* This test is derived from Stroop-like day-night task (Gerstadt et al., 1994). During the task, the experimenter first introduced two pictures to the participants, one representing day and the other representing night. In the case that the experimenter took out the day picture, the child needs to say "night"; when the night picture was shown, the child needs to say "day". After ensuring that the child had understood the experiment rules, they would go through four practice trials (day-night-night-day). Once the child can answer correctly for all 4 consecutive trials, they will proceed to the formal experiment, which consists of 10 trials in total. Inhibition of those with high scores is higher than those with lower scores.

### 2.2.4 Temperament dimensions

The parents were required to report the temperament of their children based on the 1- to 3-year-old Infants Temperament Scale (Li, 2011), which was developed based on the temperament characteristics of 1–3 year old in China. Seven temperament dimensions were explored in this study, namely, emotionality, activity, reactivity, social inhibition, focus, independence, and extroversion:

- Activity (e.g., *the child enjoys climbing and running around*), reactivity (e.g., *the child quickly engages in physical activities like crawling, walking, or running*), and social inhibition (e.g., *the child shows shyness when meeting new friends*) each consist of seven items rated on a scale from 1 (never true) to 5 (always true).
- Emotionality (e.g., *the child expresses strong emotions when their desires are not met immediately*) and focus (e.g., *the child can maintain focus on a task despite distractions such as doorbells or phone calls*) each include five items, also rated on a scale from 1 (never true) to 5 (always true).
- Independence (e.g., *the child comes up with unexpected ideas or expresses opinions different from adults*) and extroversion (e.g., *the child is comfortable meeting and playing with new children*) each comprise four items, which rated on a scale from 1 (never true) to 5 (always true).

A higher mean score on these items indicates a stronger manifestation of the specific temperament trait assessed. The Cronbach's $\alpha$ for each factor ranged from 0.74 to 0.84, demonstrating good internal consistency reliability.

## 3 Statistical analysis

First, descriptive statistics involving mean, standard deviations, and the range of all pivotal variables and bivariate relationships among Home Environment, Executive Function, and Language Ability were analyzed with SPSS version 26.0 on macOS 12.0 Monterey. Table 1 presents the descriptive statistics for children's

TABLE 1 Descriptive statistics for children's age, home environment, language ability, and temperaments.

| Variable | *M* | *SD* | *Q1* | *Median* | *Q3* | *Range* |
|---|---|---|---|---|---|---|
| Age in months | 31.06 | 3.27 | 29.00 | 31.00 | 34.00 | 24 – 36 |
| Home environment | 27.71 | 3.79 | 25.00 | 28.00 | 31.00 | 19 – 35 |
| Language ability | 18.87 | 3.78 | 17.00 | 20.00 | 22.00 | 6 – 22 |
| Independence | 14.64 | 2.59 | 13.00 | 15.00 | 16.00 | 3 – 20 |
| Focus | 3.31 | 0.52 | 3.00 | 3.40 | 3.60 | 2 – 4.6 |
| Extroversion | 14.10 | 2.73 | 12.00 | 14.00 | 16.00 | 4 – 20 |
| Emotionality | 2.58 | 0.70 | 2.00 | 2.60 | 3.00 | 0 – 4.6 |
| Activity | 3.66 | 0.66 | 3.14 | 3.57 | 4.00 | 2.29 – 5 |
| Reactivity | 3.90 | 0.65 | 3.43 | 3.86 | 4.43 | 2.29 – 5 |
| Social inhibition | 2.39 | 0.73 | 1.86 | 2.43 | 2.86 | 1 – 4.43 |
| Executive function | 8.07 | 5.31 | 5.00 | 9.00 | 14.00 | 0 – 16 |

TABLE 2 Inter-correlations between home environment, executive function, and language ability.

| | Home environment | Executive function | Language ability |
|---|---|---|---|
| Home environment | 1 | | |
| Executive function | 0.279* | 1 | |
| | 95%CI = [0.103, 0.438] | | |
| Language ability | 0.395** | 0.331** | 1 |
| | 95%CI = [0.230, 0.538] | 95%CI = [0.160, 0.484] | |

$^{**}p < 0.01$, $^{*}p < 0.5$.

age, home environment, language ability, and temperament, and Table 2 presents the inter-correlations between home environment, executive function, and language ability. Due to the skewed distribution of Executive Function, we have used Spearman's rank correlation coefficient to measure bivariate relations.

Second, to estimate both direct and indirect effects of Home Environment and Linguistic competence with Executive Function serving as the mediating variable, the Hayes PROCESS macro (Model 4) within the IBM SPSS Statistics 26.0 software package on macOS 12.0 Monterey was employed (Hayes, 2013). This analytical approach involved estimating these effects through the utilization of a bootstrapping technique with 5,000 resamples, facilitating the derivation of 95% confidence intervals for the coefficients associated with each path. The validity of mediation was determined by examining whether the value 'zero fell outside the confines of the 95% confidence interval.

Then, to investigate the moderating effect of temperament variables on the relationship between Home Environment and Executive Function, the Hayes PROCESS macro (Model 7) was applied. This analysis involved the assessment of the effects of Home Environment, temperament variables, and their interactive effects. Results are presented in Figure 1. Furthermore, 95% Confidence Intervals were computed for these interaction effects. Similar to the mediation analysis described earlier, the validity of moderation was determined by examining whether the value "zero" fell beyond the boundaries of the 95% Confidence Interval for the interactions (Hayes, 2013).

Finally, the simple slop test was used to test and facilitate the presentation of the complex-mediated moderation analyses. Four linear prediction graphs (see Figure 2) were constituted by two separate graphs depicting Executive Function ($y$-axis) as a function of Home Environment at different temperament levels.

# 4 Results

## 4.1 Descriptive statistics and correlations

The descriptive analyses and Pearson correlation results are shown in Tables 1, 2. Home environment was significantly and positively associated with both executive function ($r(117) = 0.279, p < 0.05$) and language ability ($r(117) = 0.395, p < 0.01$). In addition, executive function was also positively related to language ability ($r(117) = 0.331, p < 0.01$).

## 4.2 Mediating role of executive function

We use SPSS macro-PROCESS (Hayes, 2013) (model 4) to explore the mediating effect of executive function on the link between home environment and language ability (Table 3). Home environment was significantly positively correlated with language ability with a regression coefficient of $\beta = 0.39, p < 0.01$. When the mediating variable was considered, executive function was significantly positively correlated to home environment ($\beta =$

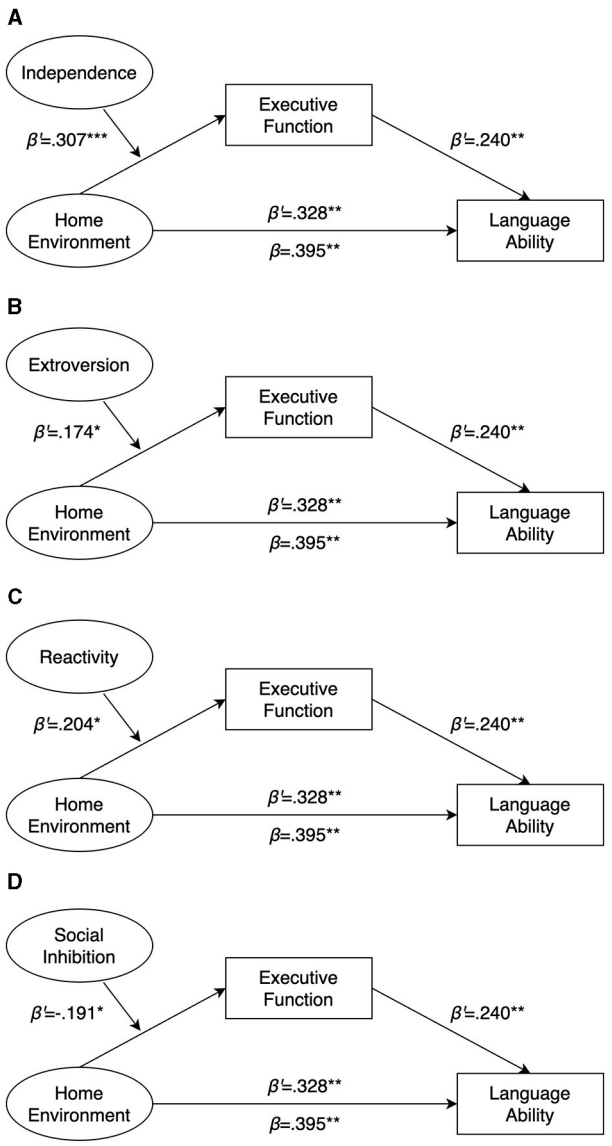


FIGURE 1
Mediated moderation model of executive function on language ability through home environment with temperament variables as moderators. **(A)** Independence as temperament variable. **(B)** Independence as temperament variable. **(C)** Reactivity as temperament variable. **(D)** Social inhibition as temperament variable. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

$0.28, p < 0.01$), and language ability was also correlated to executive function ($\beta = 0.240, p < 0.01$) and was significantly positively correlated with home environment ($\beta = 0.33, p < 0.01$).

The upper and lower bounds of the bootstrap (95% confidence interval) for the mediating effect of executive function did not contain zero (Table 4), demonstrating that executive function plays a mediating role in the link between home environment and language ability, where mediating effect accounted for 17% of the total effect. It is important to note that this mediation effect is partial, indicating that in addition to executive function, other factors may also play a role in the relationship between home environment and language development. Future research could explore these additional factors to fully understand the complex relationship.

## 4.3 Moderation effect of temperaments

Using SPSS macro-PROCESS, the moderation effect of seven temperament traits was estimated (Table 5) within the mediation model. The direct correlation between home environment and language ability was consistent with the mediation model discussed earlier. Five of the seven temperament traits (independence, extroversion, reactivity and social inhibition) acted as moderators in the regression equation, and three did not have significant moderating effect: the interaction between focus and home environment was not significant ($\beta = 0.041, p > 0.05$), as was the interaction between activity ($\beta = 0.135, p > 0.05$) and emotionality ($\beta = -0.017, p > 0.05$). These findings indicates that with moderators of independence, extroversion, reactivity and social inhibition, executive function could still mediate the relationship between home environment and language ability.

Moreover, the interaction of home environment and independence ($\beta = 0.307, p < 0.001$), extroversion ($\beta = 0.174, p < 0.05$) and reactivity ($\beta = 0.204, p < 0.05$) had significantly positive effect on executive function, while the interaction of home environment and social inhibition ($\beta = -0.191, p < 0.05$) had significantly negative effect. To further explore the moderating role of temperament, the Johnson-Neyman method (Hayes, 2013) was adopted for a simple slope analysis (see Table 6).

Figures 2A–C show that this effect was significant for children with higher levels of independence (simple slope = 0.557, $p < 0.001$), extroversion (simple slope = $0.442, p < 0.001$), and reactivity (simple slope = $0.472, p < 0.001$). For children with low independence, extroversion, and reactivity, this effect was not significant. Figure 2D shows a significant effect for children with lower social inhibition (simple slope = $0.479, p < 0.001$). Thus, high levels of independence, extroversion, and reactivity, together with low level of social inhibition, strengthen the association between family environment and execution function.

# 5 Discussion

Prior studies have explored the relationship between home environment and linguistic competence (Chow et al., 2017; Shokrkon and Nicoladis, 2022), home environment and executive function (Sarsour et al., 2011; Han et al., 2023), and executive function and language ability (Segers et al., 2016; Shokrkon and Nicoladis, 2022). However, there is a notable gap in the research studies regarding the simultaneous examination of these three variables. The current study is aimed to close up this gap by investigating the mediating effects of executive function and the moderating role of seven dimensions of temperament. The results of this study deepen the understanding toward the influence of the above-mentioned factors on the language development of children, which contributes to gain a deeper

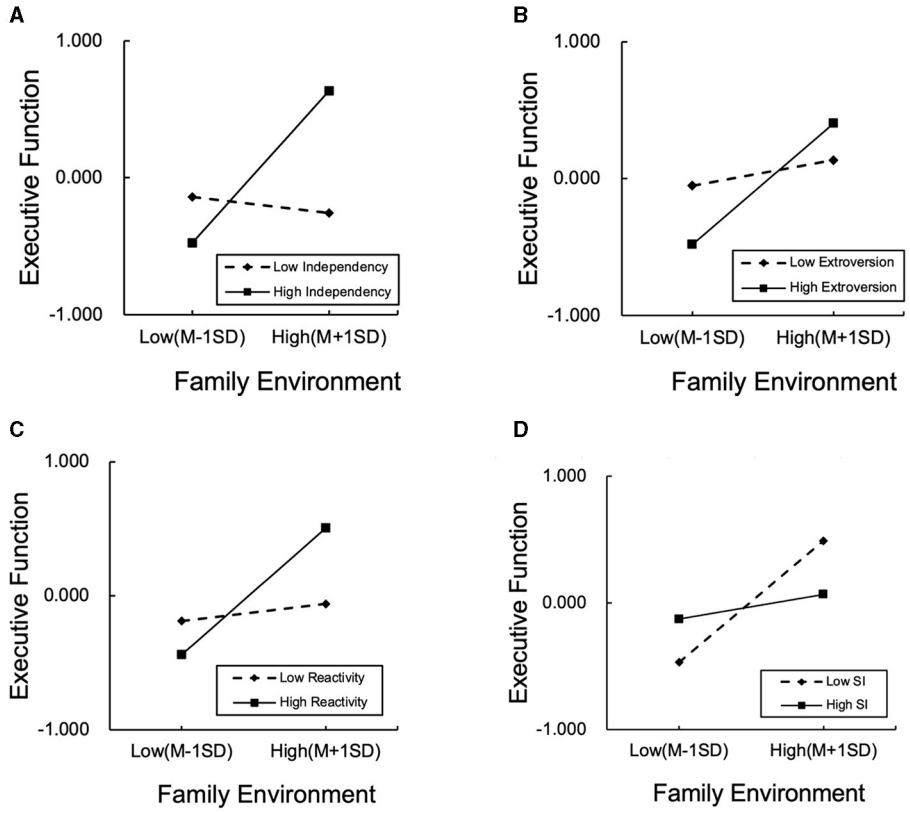


FIGURE 2
Home environment by executive function, with temperaments (*independence, extroversion, reactivity, and social Inhibition*) as moderators. **(A)** Independence. **(B)** Extroversion. **(C)** Reactivity. **(D)** Social Inhibition.

TABLE 3 Results for the mediating effect of executive function (HE, home environment; LA, language ability; EF, executive function).

| Outcome variable | | $R$ | $R^2$ | $F$ | df(1) | $p$ | $\beta$ | $t$ |
|---|---|---|---|---|---|---|---|---|
| Language ability | HE | 0.3949 | 0.1560 | 21.2534 | 1 | < 0.0001 | 0.39 | 4.61** |
| Executive function | HE | 0.2789 | 0.0778 | 9.7007 | 1 | 0.0023 | 0.28 | 3.11** |
| Language ability | HE | 0.4573 | 0.2091 | 15.0690 | 2 | < 0.0001 | 0.33 | 3.78** |
| | EF | | | | | | 0.24 | 2.77** |

**$p < 0.01$.

TABLE 4 Mediation effect breakdown.

| Home environment → Language ability | $\beta$ | Boot SE | Boot LLCI | Boot ULCI | Percentage |
|---|---|---|---|---|---|
| Total effect | 0.3949 | 0.0857 | 0.2253 | 0.5646 | - |
| Direct effect | 0.3280 | 0.0867 | 0.1562 | 0.4998 | 83.06% |
| Indirect effect (executive function) | 0.0669 | 0.0362 | 0.0124 | 0.1529 | 16.94% |

appreciation of the intricate dynamics involved in early childhood language development and provide customized supports for different children.

First, our findings align with Bronfenbrenner's ecological systems theory, which emphasizes that development is influenced by various environmental systems. We found that executive

TABLE 5 Testing the moderating effect of temperament variables on home environment.

| Temp Var | HE $\beta$ | Temp. $\beta$ | Interaction $\beta$ | Lower | Upper | $R^2$ | $F$ |
|---|---|---|---|---|---|---|---|
| Indep. | 0.248** | 0.140 | 0.307*** | 0.130 | 0.485 | 0.172 | 7.810*** |
| Extro. | 0.268** | −0.040 | 0.174* | 0.009 | 0.339 | 0.113 | 4.785** |
| React. | 0.268** | 0.078 | 0.204* | 0.013 | 0.395 | 0.120 | 5.125** |
| Social. | 0.288** | −0.021 | −0.191* | −0.347 | −0.035 | 0.124 | 5.328** |
| Focus. | 0.258** | 0.134 | 0.041 | −0.144 | 0.227 | 0.098 | 4.111** |
| Act. | 0.285** | −0.051 | 0.135 | −0.038 | 0.309 | 0.099 | 4.142** |
| Emo. | 0.277** | −0.159 | −0.017 | −0.183 | 0.150 | 0.103 | 4.310** |

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

TABLE 6 Marginal effects on linear predictions of executive function.

| | Independence | | Extroversion | | Reactivity | | Social inhibition | |
|---|---|---|---|---|---|---|---|---|
| | Slope | $p$ | Slope | $p$ | Slope | $p$ | Slope | $p$ |
| M - 1SD | −0.059 | 0.644 | 0.094 | 0.457 | 0.064 | 0.623 | 0.479*** | < 0.001 |
| Mean | 0.248** | 0.005 | 0.268** | 0.003 | 0.268** | 0.004 | 0.289** | 0.002 |
| M + 1SD | 0.557*** | < 0.001 | 0.442*** | < 0.001 | 0.472*** | < 0.001 | 0.097 | 0.405 |

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

function partially mediates the relationship between the home environment and language development, supporting our first hypothesis. According to Bronfenbrenner's model, the home environment, part of the microsystem, provides essential resources and interactions that promote children's executive function and language development. Higher quality home environments are better equipped to offer consistent routines, positive parenting practices, and material resources, which are crucial for enriching activities that stimulate both executive function and language development (Kroenke, 2008). This supports the notion that the immediate environment plays a pivotal role in child development. Furthermore, executive function serves as an intermediary mechanism that partially mediates the impact of the home environment on language ability by increasing children's engagement in relevant interactions and activities (Bohlmann and Downer, 2016). This partial mediation suggests that other factors may also play a role, aligning with the ecological model's acknowledgment of multiple interacting influences on development. Future research could explore these additional factors to fully understand the complex relationship.

To illustrate, children with better inhibition capacity would behave more appropriately during their conversation with adults, which helps them retain adult vocabulary and syntax (Hanno and Surrain, 2019). Moreover, children more flexible in cognition would be more skilled in the application of the variable linguistic rules (Gathercole and Baddeley, 1989). To illustrate, the same words may have different meanings in different contexts, while some linguistic conventions can only be used in certain contexts (Hanno and Surrain, 2019). Moreover, evidence reveals that working memory contributes to children's vocabulary development, especially its phonological short-term component (Gathercole and Baddeley, 1989; Gathercole and Pickering, 2000; Gathercole, 2006).

Secondly, we found that out of the seven types of temperament, four types (i.e., independence, extroversion, reactivity, and social inhibition) were moderating variables to moderate the impact of home environment on executive function. Our hypothesis (2) has been supported partially. Some research has indicated that children with extroverted traits and children with negative emotional and active traits are more susceptible to environmental influences (Pluess and Belsky, 2013). Individuals with high extraversion are able to actively seek problem-solving strategies from their environment, but they are also easily attracted to novelty and more sensitive to rewards, which can lead to impulsivity and a lack of persistence in uninteresting tasks (Xie et al., 2021). This is consistent with the findings of our study on extraversion but inconsistent with the results on emotionality and activity. This may be due to the emotionality and activity dimensions indirectly affect executive functions by other factors or mechanisms. In addition, emotionality may have some other effects on the relationship between home environment and executive functions, rather than having a direct moderating effect. Such effects may require more complex research methods to uncover.

Extraversion at different levels may be influential in guiding cognition (Campbell et al., 2011). It is believed that executive functions are improved by biological processes in respect to extraversion (Rammsayer, 1998). Regarding independence dimension, children with high level of independence tend to have a greater ability to self-regulate and adapt to independent learning. They are more likely to utilize external support within the family, which contributes to an improvement in their executive function (Wang and Zhou, 2021). In terms of reactivity, children with high reactivity are more likely to exhibit a heightened sensitivity and positive response to external stimuli (Ellis et al., 2011). This means that they are more easily attracted to various learning opportunities, challenges, and new experiences in their environment, as they

are more keenly aware of these changes, thereby enhancing their cognitive development. With regard to social inhibition, children with low social inhibition may indicate more positive social engagement, allowing them to effectively utilize social resources in their family environment, leading to improved executive function. Lastly, concerning the dimension of focus, it is possible that there is some overlap between it and executive function, so its moderating effect is not significant, which needs to further explore.

In conclusion, our study found that home environment significantly predicts children's language ability, with executive function playing a mediating role and temperament moderating the impact of home environment on executive function. This suggests that a rich family environment can promote the linguistic competence development of children aged 2. Children who are more independent, extraverted, responsive, and socially uninhibited are more likely to actively engage in language interactions using family resources. This participation influences 2-year-old children's language development by enhancing their executive function. The findings of this study can contribute to better family education for children with different temperaments and provide personalized and effective support for their cognitive and language development.

Notably, several limitations existed in our study. First, our study focused exclusively on Chinese children, which may limit the generalizability of the findings to other cultural contexts and populations. Second, as all of our participants came from an urban city, their SES gap may not be typical across the country. Hence, families from a wider range of communities or countries should be included in future studies. Third, language and temperament measurements relied on self-reported data from parents, which may result in response bias and social desirability bias. Further research can adopt objective measures or observational data, which could enhance the validity of the results. Finally, the influence of children's temperament may be a mixture rather than a single factor. This study primarily focuses on examining the moderating role of a single temperament trait. Future research can consider investigating the combined effects of multiple temperament traits.

## 6 Conclusion

Our study demonstrates a significant positive association between home environment and language development in 2-year-olds, with executive function serving as a key mediator. The influence of the home environment on language ability is further moderated by temperamental traits such as independence, extroversion, reactivity, and social inhibition. These insights suggest that enhancing social support and nurturing specific personality traits could mitigate the adverse effects of a less-than-ideal home environment, thereby promoting better language outcomes. The research underscores the need for further investigation into how individual differences can be leveraged to optimize early childhood development, potentially leading to more effective interventions and support strategies.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Ethical Committee of Jiangsu Normal University. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

## Author contributions

SQ: Writing – original draft, Conceptualization, Data curation, Investigation, Methodology, Visualization. ZW: Funding acquisition, Resources, Writing – review & editing, Conceptualization, Project administration, Supervision.

## Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. This research was supported by grants from the Postgraduate Research and Practice Innovation Program of Jiangsu Province (SJCX24_1504).

## Acknowledgments

We thank families and parents for their participation in this study. We thank Linghao Xie for her valuable suggestions and insights during the writing and revision of this study. Her contributions have greatly enhanced the quality of this study.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 20 September 2024
DOI 10.3389/fpsyg.2024.1463557



OPEN ACCESS

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RECEIVED 12 July 2024
ACCEPTED 10 September 2024
PUBLISHED 20 September 2024

CITATION
Peng Y and Zhang C (2024) The influence of achievement motivation on the educational practice ability of pre-service teachers: the multiple mediating role of professional identity and learning engagement.
*Front. Psychol.* 15:1463557.
doi: 10.3389/fpsyg.2024.1463557



# The influence of achievement motivation on the educational practice ability of pre-service teachers: the multiple mediating role of professional identity and learning engagement

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**Objective:** According to Bronfenbrenner's bioecological model of human development, focus on exploring the mechanism of person characteristics (achievement motivation) in their own development (improvement of educational practice ability).

**Method:** A survey was conducted on 1,225 pre-service teachers in Anhui Province, China, using the Achievement Motivation Scale, Professional Identity Scale, Learning Engagement Scale, and Educational Practice Ability Scale.

**Results:** (1) Achievement motivation can significantly and positively predict pre-service teachers' educational practice ability; (2) Achievement motivation can indirectly affect pre-service teachers' educational practice ability through the mediating effects of professional identity and learning engagement; (3) Professional identity and learning engagement play a chain mediated role in the impact of achievement motivation on pre-service teachers' educational practice ability.

KEYWORDS

**pre-service teachers, educational practice ability, achievement motivation, professional identity, learning engagement**

## 1 Introduction

Teachers are one of the most influential and powerful forces in promoting educational equity, accessing educational opportunities, and improving educational quality, and are key to global sustainable development. Countries around the world attach great importance to improving the quality of teachers, and China regards it as the most important foundation work for building an education powerhouse strategy. Pre-service teachers are the reserve force of the teaching community, and their ability cultivation is the foundation and guarantee of teacher quality. Educational practice ability is the core manifestation of pre-service teachers' professional competence and the key to their future competence in teaching. Exploring effective paths for cultivating and enhancing the educational practice ability of pre-service teachers is an important topic in the research field. Through literature review, it was found that existing research mainly focuses on analyzing environmental factors such as professional training objectives, training models (Fitriati et al., 2024), curriculum design (Zhang, 2020),

teacher teaching philosophy and methods, attitudes and behaviors (Castaño et al., 2015), and teaching practical knowledge (Tian and Huo, 2015). Only a very small number of scholars have explored from aspects such as a reflective mindset (Goldman and Grimbeek, 2015), subjective consciousness (Bi and Qi, 2022) and personality (Biermann et al., 2015) of pre-service teachers.

Educational practice ability is the sum of psychological characteristics necessary for pre-service teachers to engage in teacher education work in the future, and is an organic unity of multiple abilities (Zhang et al., 2013). According to the bioecological model of human development by Bronfenbrenner (2001), person characteristics play an important role in their own development, which is achieved through a mechanism called the proximal processes (Bronfenbrenner and Morris, 2006). The proximal processes are a persistent interaction between the person (characteristics) and their immediate environment, and is considered to be the main driving force of individual development, influenced by both person characteristics and the environment. Bronfenbrenner described three types of person characteristics. Among them, the characteristic of force [or 'disposition'; Bronfenbrenner (1995) is considered the most likely to influence a person's developmental outcomes (Rosa and Tudge, 2013)]. Achievement motivation is a learned and relatively stable personality trait that serves as an internal drive to pursue and achieve goals (Wu et al., 2017). Its strength can cause individuals to have different emotional responses when facing different work or learning tasks, which can have different effects on an individual's professional values (Yu and Huang, 2023), learning engagement (Froiland and Worrell, 2016; Cheng et al., 2022), work responsibility (Zhong et al., 2024), and the potential development of individual abilities (Ye and Kunt, 1992). Therefore, it can be seen that professional identity and learning engagement can be viewed as a sustained interaction between the person and the environment, i.e., the proximal process. Therefore, this study aims to explore the specific mechanisms by which achievement motivation (person characteristics) influences the proximal processes (professional identity and learning engagement) and promotes the improvement of pre-service teachers' educational practice ability, providing empirical evidence for exploring effective ways to improve the educational practice ability of Chinese pre-service teachers.

## 1.1 The relationship between achievement motivation and educational practice ability

Achievement motivation is a personality psychological tendency derived from the need for achievement, which is an internal driving force that motivates individuals to be willing to engage in work they consider important or valuable, and strive for success (Feng et al., 2000). The Atkinson achievement motivation theory suggests that an individual's achievement motivation consists of two parts: the motivation to pursue success and the motivation to avoid failure. People with high motivation to pursue success aspire to success, have confidence in doing things, are not afraid of difficulties, are brave in taking risks, dare to challenge, and are willing to unleash their abilities; People with high motivation to avoid failure tend to avoid possible failures or uncertainties, worry about failure, be easily uneasy, worry and fear (Ye and Kunt, 1992; Yang, 2013) and do not value to unleash their abilities. Therefore, individuals with stronger achievement motivation May also have stronger abilities. Qarri (2023) found through a survey of "Prenk Jakova" music high school students in Pristina that achievement motivation has a significant impact on the music skills and abilities of music high school students. The study by Zhong et al. (2024) confirmed that achievement motivation has a significant positive predictive effect on teachers' differential teaching ability; Li (2016) found through investigation that there is a significant correlation between achievement motivation and the professional ability of educational technology interns. Although previous studies have not specifically focused on the group of pre-service teachers, nor have they specifically focused on achievement motivation and educational practice ability, pre-service teachers belong to the group of college students and are the preparatory force for the teacher group. Educational practice ability is the core component of the professional ability of normal university students. Based on this, this study proposes the first hypothesis:

> *H1*: Achievement motivation has a significant positive influence on the educational practice ability of pre-service teachers.

## 1.2 The mediating role of professional identity, learning engagement, and their combination

Professional identity refers to an individual's perception and experience of the profession they are engaged in Wang et al. (2010). It is not only a process of continuous and dynamic interaction between individuals and their professions, but also a state (Fan, 2009). It is a comprehensive professional psychological state composed of individual professional cognition, emotions, motivation, expectations, etc., closely related to their professional motivation and achievement needs. According to the basic viewpoint of achievement motivation theory, individuals with high achievement motivation have a higher pursuit of professional goals and are more likely to develop professional identity. The study by Luo et al. (2024) indicates a positive correlation between achievement motivation and professional identity among Chinese health students. In addition, professional identity can effectively promote the professional development of individuals. An individual's positive cognition of their profession has a significant impact on their future professional motivation and professional effectiveness, and is a necessary condition for improving their professional abilities (Heinz, 2015). Sica et al. (2022) found based on survey data of undergraduate students from universities in southern Italy that professional identity is positively correlated with their planned skills. The study by Dong et al. (2024) shows a significant positive correlation between professional identity and the professional competence of university counselors. The higher the level of professional identity of a counselor, the stronger their professional ability. Wu et al. (2020) further found through investigation that professional identity is a mediating variable between achievement motivation and the development of research ability among nursing undergraduate interns. Based on the review of the above literature, this study speculates that the relationship between achievement motivation, professional identity, and

individual ability May also exist in the group of pre-service teachers. Therefore, a second hypothesis is proposed:

> *H2*: Professional identity plays a mediating role between achievement motivation and educational practice ability of pre-service teachers.

Learning engagement refers to the ability of students to recognize the value and significance of learning, actively and continuously participate in learning activities, not afraid of challenges and setbacks, and accompanied by positive emotional experiences, exhibiting typical characteristics of vitality, dedication, and focus (Schaufeli et al., 2002). The achievement motivation theory holds that individuals with strong achievement motivation are very active in their work and study, good at controlling themselves, trying not to be influenced by the external environment, making full use of time, and achieving excellent work and study results. Chang et al. (2022) found through a survey of graduates from two science and technology universities in northern Taiwan that achievement motivation has a positive impact on graduate students' active learning. A survey conducted by Liu (2021) on high school students found that achievement motivation has a significant predictive effect on learning engagement. Cheng et al. (2022) found in his research that there is a significant positive correlation between academic achievement motivation and technical learning engagement among students majoring in technical subjects in physical education departments. Numerous studies have confirmed a correlation between students' achievement motivation and learning engagement, and there are differences between different levels of achievement motivation and students' learning engagement. In addition, learning engagement is an important indicator of individual learning adaptation and an important predictor of individual academic achievement, which has a significant impact on individual future educational opportunities, professional development, and other aspects (Jia et al., 2020; Kuncel et al., 2004). Avsec and Jagiello-Kowalczyk (2018) found that active learning is an important predictor of pre-service teacher innovation ability. Zhang's (2017) research found that learning engagement has a significant positive influence on the professional development ability of college students. Based on this, this study speculates that achievement motivation May affect pre-service teachers' professional abilities through learning engagement, and proposes a third hypothesis:

> *H3*: Learning engagement plays a mediating role between achievement motivation and educational practice ability of pre-service teachers.

Professional identity refers to an individual's subjective perception and attitude toward their profession (Yan, 2010). Attitude plays an important role in stimulating and guiding individual psychology and behavior, therefore, professional identity is closely related to individual behavior and has a profound impact on what individuals learn and do (Bullough and Gitlin, 2001). Individuals with high professional identity often have higher learning motivation (Zhang et al., 2016) and more self-directed learning (Xu et al., 2023). Liu et al.'s (2023) survey of Chinese engineering students showed that professional identity has a positive predictive effect on their learning engagement. Liao et al. (2024) confirmed that professional identity significantly predicts the learning engagement of vocational college students. The research by Yao and Xu (2022) and Yuan et al. (2022) found that professional identity has a significant positive impact on the learning engagement of pre-service teachers. The stronger the sense of professional identity among students, the more they engage in learning. Therefore, based on hypotheses H1, H2, and H3, this study proposes a fourth hypothesis:

> *H4*: "Professional identity -learning engagement" has a chain like mediating effect between achievement motivation and educational practice ability of pre-service teachers.

In summary, this study is based on the bioecological model of human development proposed by Bronfenbrenner, and is aimed at the pre-service teacher level in China. A model is constructed with achievement motivation as the independent variable, professional identity and learning engagement as the mediating variables, and pre-service teacher educational practice ability as the dependent variable (see Figure 1), in order to explore the impact mechanism of achievement motivation on pre-service teacher educational practice ability, and provide reference for broadening the path of improving pre-service teacher educational practice ability in China and improving the quality of pre-service teacher training.

# 2 Methods

## 2.1 Participants and procedures

This study used a convenient sampling method to select students from a normal university in Anhui Province, China. We use online questionnaires to collect data, and the data collection is conducted on an online platform.[1] The specific data collection is implemented in two steps: one is to Targeted distribute questionnaires through the Wenjuan.com, and the other is to organize participants to answer collectively online in the school computer room. The experimenter were members of a highly trained research team. Before conducting the test, the experimenter first explain the research purpose to the subjects, emphasizing that the questionnaire is anonymous and strictly confidential, and the data obtained is only used for scientific research and not for other purposes. During the testing process, they can withdraw at any time according to their own wishes and issue an informed consent form. The subjects can resume testing after obtaining informed consent to ensure the authenticity and validity of the information filled in. Then the experimenter will explain the methods and precautions for filling out the questionnaire. Finally, read out the instructions and ask the participants to answer.

A total of 1,566 questionnaires were distributed in this study. Questionnaires with careless responses and invalid lie detection were excluded, and 1,225 valid questionnaires were retained, with an effective rate of 78.22%. Among them, 205 males (16.73%) and 1,020 females (83.27%); 424 sophomores (34.61%), 368 juniors (30.04%), and 433 seniors (35.35%); 674 students in humanities (55.02%) and 551 students in science (44.98%); 434 people in urban areas (35.43%) and 791 people in rural areas (64.57%). The mean age of the participants was 21.00 years (SD = 0.84; min = 20, max = 22).

1 https://www.wenjuan.com/

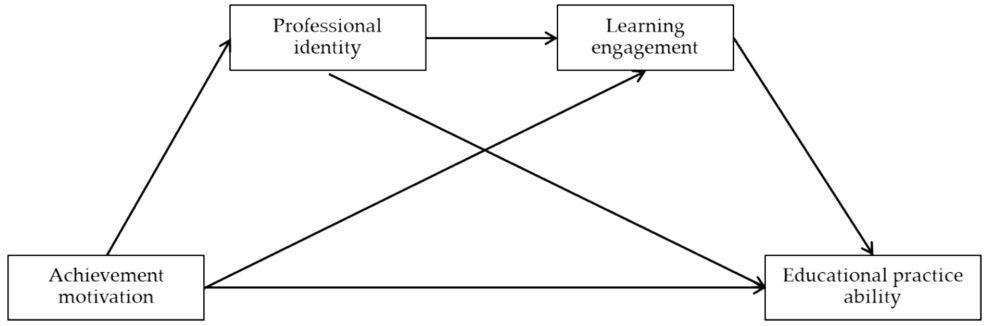


FIGURE 1
Theoretical model.

## 2.2 Measures

### 2.2.1 Educational Practice Ability Scale

We use a self-designed scale of educational practice ability for pre-service teachers, which was developed based on the understanding of pre-service teacher educational practice ability by Chinese and foreign scholars, as well as the professional ability standards for pre-service teachers issued by the Chinese Ministry of Education. The scale consists of 39 questions from three dimensions: teaching ability, educational ability, and reflective research ability. Among them, teaching ability includes 19 questions that describe the teaching design ability, teaching implementation ability, and teaching research ability of pre-service teachers, such as "I am able to determine appropriate classroom teaching objectives based on curriculum standards"; The ability to educate students includes 11 questions that describe the pre-service teacher's abilities in class guidance, subject education, and activity education, such as "I have mastered the methods of providing initial guidance for student development"; The reflective research ability includes 9 questions that describe the educational and teaching research ability and reflective ability of pre-service teachers, such as: "I am able to write educational and teaching research papers or reports." Using a five-point scoring system ranging from "1- very inconsistent" to "5- very consistent," the higher the score, the higher the level of educational practice ability of pre-service teachers. In this study, the three dimensions of teaching ability, educational ability, and reflective research ability in the scale, as well as the overall scale were included, Cronbach's $\alpha$ are 0.97, 0.95, 0.94, and 0.98 respectively, indicating a good fit in the construct validity index ($\chi^2/df$ = 4.06; NFI = 0.94; CFI = 0.95; TLI = 0.95; SRMR = 0.01; RMSEA = 0.05).

### 2.2.2 Achievement Motivation Scale

The Achievement Motivation Scale revised by Ye and Kunt (1992) was adopted, which consists of 30 questions in two dimensions: the motivation to pursue success and the motivation to avoid failure. Among them, the motivation for pursuing success includes 15 questions that measure the motivation related to achieving success, involving positive evaluations of the situation and expectations of the outcome, such as "I enjoy novel and difficult tasks, even willing to take risks." The motivation for avoiding failure includes 15 questions that measure the motivation related to preventing failure, involving negative evaluations of the situation and expectations of the outcome, such as "I hate working in situations where it is completely uncertain whether failure will occur." Using a four-point scoring system from "1- completely disagree" to "4- completely agree," Achievement motivation score = Pursuit of success score – Avoidance of failure score. The higher the score, the stronger the achievement motivation; conversely, the weaker the achievement motivation. In this study, the two dimensions of the motivation to pursue success and the motivation to avoid failure in the scale, as well as the overall scale were included, Cronbach's $\alpha$ are 0.86, 0.89, and 0.88, respectively.

### 2.2.3 Professional Identity Scale

The Professional Identity Scale of pre-service teachers developed by Wang et al. (2010) was used, which was developed based on the understanding of professional identity by Chinese and foreign scholars, which not only draws on international classic structures, but also considers pre-service teachers and local characteristics in China. The scale consists of 12 questions from four dimensions: professional intention and expectation, professional volition, professional value, and professional efficacy. Among them, professional intention and expectation include three questions that describe pre-service teachers' expectations and willingness to prepare for the teaching profession, such as "I have a willingness to communicate with frontline teachers"; Professional volition includes three questions, describing the persistence of pursuing a teaching profession in the future before graduation, such as "If there is an opportunity to choose another profession after graduation, I would still choose to be a teacher"; The professional value includes three questions, describing the value judgments of pre-service teachers toward the teaching profession and their own pre-service teacher identity, such as "I believe that teachers have a high social status"; Professional efficacy includes three questions that describe the self-efficacy of pre-service teachers in the teaching profession, such as "I believe I can become an excellent teacher." Using a five-point scoring system from "1- completely disagree" to "5- completely agree," the higher the score, the higher the level of professional identity of pre-service teachers. In this study, the four dimensions of Professional intention and expectation, Professional volition, Professional value, and Professional efficacy in the scale, as well as the overall scale were included, Cronbach's $\alpha$ are 0.85, 0.70, 0.77, 0.83, and 0.87, respectively.

### 2.2.4 Learning Engagement Scale

The Learning Engagement Scale was developed by Schaufeli et al. (2002) and revised by Fang et al. (2008), which consists of 17 questions

in three dimensions: vitality, focus, and dedication. Among them, vitality includes 6 questions that describe an individual's sustained investment of energy, time, and effort in learning tasks, such as "When I wake up in the morning, I am filled with the power of learning"; Focus includes 6 items that describe an individual's wholehearted dedication to learning, such as "When learning, I reached a state of selflessness"; Dedication includes 5 questions that describe an individual's belief in the significance of learning and their willingness to accept challenges in learning, such as "I think learning is valuable and meaningful."

Using a seven-point scoring system from "1- never" to "7- always," the higher the score, the higher the level of learning engagement. In this study, the three dimensions of vitality, focus, and dedication in the scale, as well as the overall scale were included, Cronbach's $\alpha$ are 0.89, 0.87, 0.83, and 0.95, respectively.

## 2.3 Data analysis

This study used SPSS 26.0 to conduct descriptive statistics and correlation analysis on the data; Using Amos 26.0 to verify the validity indicators of the self-designed "Pre-service teachers Educational Practice Ability Scale"; Perform mediation analysis using the SPSS macro program PROCESS 4.1 developed by Hayes.

# 3 Results

## 3.1 Common method bias test

This study used Harman's single factor test to test for possible common method biases. Exploratory factor analysis using SPSS 26.0 was conducted on all questions integrated into various scales, and it was found that 13 factor eigenvalues were all greater than 1. The first factor explained a variance of 29.71%, which is below the basic standard of 40%. This indicates that the common method bias of the data in this study is not significant.

## 3.2 Descriptive statistics and correlation analysis of variables

A correlation analysis was conducted between achievement motivation, professional identity, learning engagement, and the educational practice ability of pre-service teachers. The results showed that there was a significant positive correlation between achievement motivation, professional identity, learning engagement, and educational practice ability of pre-service teachers. Please refer to Table 1 for details.

TABLE 1 Description statistics and correlation relationships of each variable.

| | *M* | SD | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1. Achievement motivation | −0.029 | 0.441 | 1 | | | |
| 2. Professional identity | 3.851 | 0.492 | 0.231** | 1 | | |
| 3. Learning engagement | 5.434 | 0.754 | 0.474** | 0.431** | 1 | |
| 4. Educational practice ability | 3.618 | 0.524 | 0.264** | 0.452** | 0.499** | 1 |

*$p < 0.05$, **$p < 0.01$.

## 3.3 The mediating role of professional identity and learning engagement

This study used the SPSS macro program PROCESS 4.1 developed by Hayes to examine the mediating effects of professional identity and learning engagement on the relationship between achievement motivation and educational practice ability of pre-service teachers, under control of grade, gender, and place of origin. Using the deviation corrected percentile Bootstrap test, with a sampling frequency of 5,000, calculate the 95% confidence interval. The results indicate (as shown in Table 2) that achievement motivation has a significant positive predictive effect on the educational practice ability of pre-service teachers ($\beta = 0.267$, $p < 0.001$) indicates significant overall utility. After incorporating the mediating variables of professional identity and learning engagement, the direct effect of achievement motivation on the educational practice ability of pre-service teachers is not significant ($\beta = 0.029$, $p > 0.05$), achievement motivation significantly positively predicts professional identity ($\beta = 0.233$, $p < 0.001$) and learning engagement ($\beta = 0.396$, $p < 0.001$), professional identity can significantly positively predict learning engagement ($\beta = 0.340$, $p < 0.001$) and the education practical ability of pre-service teachers ($\beta = 0.279$, $p < 0.001$), learning engagement significantly positively predicts the educational practice ability of pre-service teachers ($\beta = 0.365$, $p < 0.001$). This indicates that professional identity and learning engagement play a fully mediating role between achievement motivation and pre-service teacher educational practice ability, and a chain mediation between professional identity and learning engagement is established.

The results of the mediation effect test (as shown in Figure 2 and Table 3) indicate that the total mediation effect value of professional identity and learning engagement is 0.238, accounting for 89.139% of the total mediation model effect. The Bootstrap 95% confidence interval does not include 0, indicating that the mediation effect is significant.

The mediating effect of professional identity and learning engagement is specifically composed of the indirect effects generated by the following three paths: Ind1: the indirect effect generated by the path of achievement motivation → professional identity → educational practice ability, with an effect value of 0.065, accounting for 24.345% of the total effect of the mediating model; Ind2: the indirect effect generated by the path of achievement motivation → learning engagement → educational practice ability, with an effect value of 0.144, accounting for 53.933% of the total effect of the mediation model; Ind3: the indirect effect generated by the path of achievement motivation → professional identity → learning engagement → educational practice ability, with an effect value of 0.029, accounting for 10.861% of the total effect of the mediation model. And the Bootstrap 95% confidence intervals for all three paths do not include 0, indicating that the mediating effects of all three paths are significant.

TABLE 2 Chain mediation model analysis of professional identity and learning engagement between achievement motivation and educational practice ability of pre-service teachers.

| Regression equation | | Overall fit index | | | Regression coefficient significance | |
|---|---|---|---|---|---|---|
| Result variables | Predictive variables | $R$ | $R^2$ | $F$ | $\beta$ | $t$ |
| Professional identity | Achievement motivation | 0.243 | 0.059 | 19.137*** | 0.233 | 8.382*** |
| Learning engagement | Achievement motivation | 0.579 | 0.335 | 122.867*** | 0.396 | 16.466*** |
| | Professional identity | | | | 0.340 | 14.111*** |
| Educational practice ability | Achievement motivation | 0.584 | 0.341 | 105.019*** | 0.029 | 1.091 |
| | Professional identity | | | | 0.279 | 10.782*** |
| | Learning engagement | | | | 0.365 | 12.808*** |

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

# 4 Discussion

## 4.1 The influence of achievement motivation on educational practice ability

Research has found that achievement motivation has a significant positive predictive effect on the educational practice ability of pre-service teachers. Research hypothesis 1 has been validated and is generally consistent with the research findings of Qarri (2023) and Li (2016). The educational practice ability of pre-service teachers is related to their achievement motivation. The stronger the achievement motivation, the higher the level of educational practice ability of pre-service teachers. Mcclelland's (1975) theory of social achievement motivation suggests that individuals with stronger needs for achievement motivation tend to perform more positively in their actions. Achievement motivation is the internal force that drives individuals to tirelessly strive to maximize their self-worth (Mcclelland, 1975). Pre-service teachers will encounter many learning tasks with different levels of difficulty during their growth process. Pre-service teachers with strong achievement motivation are more eager to achieve success and tend to accept more challenging tasks. They view learning challenges as opportunities for self-worth realization and actively respond to them. The likelihood of completing learning tasks with high quality will increase. In the process of completing tasks, the knowledge learned will be applied in practice, skills will be fully honed, and their abilities will also be significantly improved (Feng, 2013).

## 4.2 The independent mediating role of professional identity

This study found that professional identity plays a mediating role between achievement motivation and pre-service teacher educational practice ability. Hypothesis 2 of the study was validated, which is basically consistent with the research results of Wu et al. (2020). Professional identity not only plays a mediating role in the influence of achievement motivation on the research ability of medical students, but also serves as an important mediating variable between achievement motivation and the educational practice ability of pre-service teacher in educational research. Specifically, achievement motivation cannot only directly affect the educational practice ability of pre-service teachers, but also indirectly influence their educational practice ability through professional identity. Achievement motivation is a social motivation, which is an internal driving force for individuals to strive for excellence in order to achieve higher goals (Yuan, 2020). Individuals with high achievement motivation have a clearer understanding of their own goals (Wang et al., 2022) and a more mature understanding of their professions (Wang et al., 2015). To meet social expectations, gain social recognition and approval, one can be more proactive in making their behavior more in line with social requirements (Zhang, 2005). Therefore, pre-service teachers with stronger achievement motivation are more inclined to view their teaching work as an important way of self-realization, and their goal of becoming a socially recognized excellent teacher is clearer and their desire is stronger. This desire will promote their internalization of professional identity and norms (Porteous and Machin, 2018), enhance their positive perception and experience of the teaching profession, and improve their sense of identity with the teaching profession. Pre-service teachers with a stronger sense of professional identity have a deep understanding and recognition of the teaching profession they will engage in and their current pre-service teacher identity (Izadinia, 2013; Trent, 2011; Luo et al., 2024; Zhu and Wang, 2017), the stronger the willingness to engage in the teaching profession (He et al., 2022), and the more positively one can view the teaching profession, overcome difficult learning environments, and focus on learning and improving professional skills (Abednia, 2012), better grasp the necessary knowledge and educational teaching abilities for the teaching profession, and prepare for future competent teaching work.

## 4.3 The independent mediating role of learning engagement

This study found that achievement motivation can indirectly affect pre-service teachers' educational practice ability through learning engagement. Hypothesis 3 was validated, which is consistent with the research results of Liu (2021) and Zhang (2017).

On the one hand, achievement motivation is an important psychological driving factor in personality that affects an individual's level of effort (Yang et al., 2016), and has a significant promoting effect on students' learning. Individuals with high achievement motivation often have higher achievement goals and successful experiences, and become more optimistic and positive in the process of striving toward their goals (Wang et al., 2022), reducing the perception of academic fatigue (Moghadam et al., 2020), enhance academic confidence

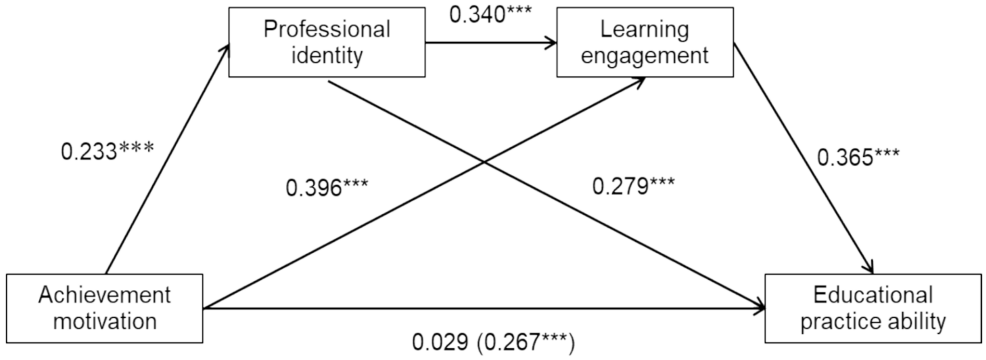


FIGURE 2
Chain mediated effect of professional identity and learning engagement on achievement motivation and educational practice ability of pre-service teachers. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

TABLE 3 Bootstrap analysis of the mediating effect of the chain mediation model.

| Path | Effect value | Effect proportion % | Boot CI 95% | |
|---|---|---|---|---|
| | | | Lower limit | Upper limit |
| Achievement motivation → educational practice ability (total effect) | 0.267 | | 0.254 | 0.381 |
| Achievement motivation → educational practice ability (direct effects) | 0.029 | 10.861 | −0.027 | 0.096 |
| Achievement motivation → educational practice ability (total indirect effects) | 0.238 | 89.139 | 0.201 | 0.276 |
| Ind1 achievement motivation → professional identity → educational practice ability | 0.065 | 24.345 | 0.044 | 0.088 |
| Ind2 achievement motivation → learning engagement → educational practice ability | 0.144 | 53.933 | 0.117 | 0.174 |
| Ind3 achievement motivation → professional identity → learning engagement → educational practice ability | 0.029 | 10.861 | 0.020 | 0.039 |

(Chang et al., 2022), so as to be more proactive and actively engaged in learning. Therefore, students with stronger achievement motivation have more learning engagement. On the other hand, learning engagement is an important manifestation of students' initiative and level of effort in participating in learning activities (Zhu, 2022) and it is also an important influencing factor in the development of students' abilities. The educational practice ability of pre-service teachers is a necessary professional core ability for them to be competent in teaching work in the future, and its formation and development are closely related to the learning of educational knowledge and skills. Pre-service teachers with stronger achievement motivation are more proactive in learning educational knowledge and work harder in learning and training educational skills, which can better improve their educational practice abilities. Moreover, the improvement of educational practice ability brought about by learning engagement will give pre-service teachers a sense of success, stimulate their more learning engagement, and further promote the development of their educational practice ability.

## 4.4 The chain mediating role of professional identity and learning engagement

This study also found that achievement motivation can indirectly affect the educational practice ability of pre-service teachers through the mediating chain of professional identity and learning engagement, which verifies research hypothesis 4. Previous studies have shown that achievement motivation is an important antecedent variable for professional identity. Achievement motivation can promote pre-service teachers to have a positive view of the teaching profession they will engage in, and enhance their sense of identity with the teaching profession. The social identity theory holds that when an individual adopts the membership qualifications of a certain social group to establish their social identity, they will endow themselves with characteristics that conform to the internal group. Therefore, individuals with a strong professional identity will endow themselves with the characteristics of the professional group they identify with, and have more motivation to improve their professional skills through learning and training (Dong et al., 2024). The stronger the professional identity of pre-service teachers, the stronger their learning dynamic, and thus they are more enthusiastic, focused, and hardworking in their professional knowledge learning and related professional skills training (Lin, 2019), gradually improving their professional abilities through systematic learning activities and solid skills training (Wang, 2018).

## 4.5 Implications and limitations

This study is based on Bronfenbrenner's theory of bioecology of human development, and verifies the mechanism by which person characteristics promote their own development by influencing proximal processes. This study found that achievement motivation can directly predict pre-service teachers' educational practice ability, but more indirectly through the mediating effect of professional identity and

learning engagement. The results of this study provide a practical reference path for teacher training institutions to improve the educational practice ability of pre-service teachers. Research enlightenment: It is necessary to enhance achievement motivation and provide internal motivation for improving the educational practice ability of pre-service teachers. Strengthening professional identity and laying a solid foundation for enhancing the educational practice ability of pre-service teachers. Enhance learning engagement and inject lasting strength into enhancing the educational practice ability of pre-service teachers.

There are also some shortcomings in this study. Our research findings are based on a survey of pre-service teachers in China, and their promotion May be limited. Based on cross-sectional data, the study only provides a static snapshot of the achievement motivation, professional identity, learning engagement, and educational practice ability level of pre-service teachers, which cannot reflect the dynamic development process of their educational practice ability over time. Future research can supplement the tracking survey of pre-service teachers, examining the dynamic process of their educational practice ability over time, influenced by achievement motivation, professional identity, and learning engagement, further enriching the research on the mechanism of the influence of pre-service teacher educational practice ability.

## 5 Conclusion

The following conclusions are drawn from this study: (1) achievement motivation can significantly positively predict the educational practice ability of pre-service teachers; (2) professional identity and learning engagement play a mediating role in the influence of achievement motivation on the educational practice ability of pre-service teachers; (3) professional identity and learning engagement have a chain like mediating effect between achievement motivation and educational practice ability of pre-service teachers.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants or patients/participants legal guardian/next of kin was obtained to participate in this study in accordance with the national legislation and the institutional requirements.

## Author contributions

YP: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Writing – original draft. CZ: Data curation, Formal analysis, Resources, Supervision, Validation, Visualization, Writing – review & editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was supported by the National Education Science 14th Five Year Plan 2021 Key Project of the Ministry of Education is "Research on Strategies for Enhancing the Education Practice Ability of Normal Students Based on Learning Communities" (Project Number: DIA210367).

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 26 September 2024
DOI 10.3389/fpsyg.2024.1463981



OPEN ACCESS

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RECEIVED 12 July 2024
ACCEPTED 12 September 2024
PUBLISHED 26 September 2024

CITATION
Rus M, Călin MF, Sandu ML and Tasențe T (2024) Predictive factors regarding bullying behavior in Romanian schools. *Front. Psychol.* 15:1463981. doi: 10.3389/fpsyg.2024.1463981



# Predictive factors regarding bullying behavior in Romanian schools

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**Introduction:** The present study investigates the phenomenon of bullying in schools in the city of Constanta, Romania.

**Method:** From the age point of view, we have had $n = 210$ 12-year-old subjects and 193 13-year-old subjects, and from the biological gender point of view, there were 234 girls and 169 boys. The study's main objective was to investigate aggressive behavior in adolescents in a school context. The study is cross-sectional and aims to analyze behaviors and interpersonal relationships having as dependent variable "Conflicts in the school environment" and two independent variables, respectively "Aggressive Manifestations" and "Aggressive Behaviors," used in proving the first hypothesis, dependent variable "Verbal attacks as an aggressor" and the predictive variables "Social exclusion" and "Conflicts within the school environment" used to demonstrate the second hypothesis and the dependent variable "Bullying behavior" and the predictor variables "Acceptance of unethical behaviors," "Violation of privacy as an aggressor" and "Dissemination of information without authorization" used to demonstrate the third hypotheses.

**Result:** The results indicate significant correlations between aggressive behaviors and conflicts in the school environment ($r=0.596$, $p<0.001$), suggesting that interventions must be integrated and address the underlying causes of aggressive behaviors and associated manifestations. The association between "Conflicts in the school environment" and "Aggressive behaviors" revealed a significant correlation ($r=0.387$, $p<0.001$) and a moderate correlation between "Perception of conflicts" and "Aggressive manifestations" ($r=0.423$, $p<0.001$).

**Conclusion:** The conclusions emphasize the importance of understanding the complexity of aggressive behavior dynamics and predictive factors for developing effective strategies for prevention and intervention in the educational environment. As a limitation of the study, it is advisable to follow the group of subjects from a longitudinal point of view to identify changes in the behavioral manifestations of these adolescents, in a school context.

KEYWORDS

**bullying, aggression, adolescence, school environment, conflict**

## 1 Introduction

In Romania, bullying is a major problem in the school environment. According to the study carried out by the World Vision Romania Foundation (2021), approximately 46% of students reported that they were victims of bullying, while 82% of them witnessed such behaviors in their schools. The most common form of bullying identified is verbal, followed

by social exclusion and physical violence. This situation is also confirmed by a study by the "Alexandru Ioan Cuza" University in Iași (2022), which shows that the prevalence of the phenomenon is high in both secondary and high schools, with a significant negative impact on mental health and academic performance of the students.

Research shows that boys are more often involved in physical bullying, while girls are more vulnerable to relational and online bullying. These forms of violence lead to serious psychological consequences, including anxiety and depression, and can contribute to lower school performance and school drop-out (World Vision Romania, 2021; Alexandru Ioan Cuza University, 2022).

In 2023, Save the Children Romania pointed out that almost 50% of students are exposed to bullying, and 4 out of 5 students have witnessed such incidents, highlighting the need for effective prevention and intervention programs (Save the Children Romania, 2023).

Order no. 6235/2023 approved by the Romanian Ministry of Education regulates the procedure for managing cases of violence against pre-schoolers, pre-schoolers, pupils, and school staff. This order sets out the steps to be followed by teachers and school management when a case of violence occurs, either inside or outside the school.

The present study mainly uses the social-cognitive theory of antisocial behavior to analyze the antisocial behaviors of adolescents in Romania. This theory was used to explore how environmental factors and cultural context influence the development and manifestation of antisocial behaviors in adolescents.

According to the social-cognitive theory, antisocial behaviors are acquired through observation and imitation in social interactions. They are influenced by the rewards and punishments that the individual perceives in his environment. This study validates the Spanish version of a self-report questionnaire of antisocial behaviors. It compares the results obtained between two distinct populations, highlighting both cultural differences and similarities in the manifestation of these behaviors (Espejo-Siles et al., 2023).

For a more detailed understanding, the authors discuss environmental influences and how changes over time and in different cultural contexts can shape antisocial behavior, thus supporting the importance of the contextual approach in the development and implementation of antisocial behavior prevention programs.

The diversity of predictive factors for bullying behaviors includes both individual characteristics, such as early aggression and behavior problems, as well as socioeconomic factors. According to the studies carried out by Jansen et al. (2011) and Hwang et al. (2017), aggression in the preschool period, low socio-economic status, and divorce represent significant elements that can lead to the involvement of adolescents in bullying behaviors.

These findings highlight the phenomenon's complexity and indicate the need for an integrated effort in prevention and intervention.

Individual variables such as externalizing and internalizing behavior, along with contextual factors such as parental supervision and peer rejection, play a critical role in the development and extent of bullying. The studies carried out by De Sousa et al. (2021) and Fujikawa et al. (2018) emphasize the mediating importance of social skills and parenting practices in addressing these behaviors.

Research by Li et al. (2024), Fu and Zhang (2020), and Marciano et al. (2020) emphasize the importance of complex variables, from sleep problems and childhood abuse to parental psychological control and substance use, in influencing deviant behaviors, including bullying. These studies highlight the need for a holistic approach to understanding and combating bullying.

Negative childhood experiences and individual and social factors are considered predictors of bullying. Li et al. (2023) and Gilreath et al. (2022) identified a close link between bullying, sleep problems, childhood abuse, and psychosocial difficulties. Negative interactions with peers in the school environment are associated with maladaptive adjustments. These observations highlight the importance of early interventions and psychosocial support in preventing bullying behaviors.

Studies identify that gender differences and sexual orientation, along with physical and mental health factors, influence specific bullying behaviors. The study by Wang et al. (2023) indicates that adolescents with different sexual orientations face varying risks for eating disorders, which are related to bullying. Moreover, negative perceptions of the school climate contribute to the manifestation of violence, including bullying in the school context, according to Del Moral et al. (2019).

The influence of social context and personality traits on the dynamics of interpersonal relationships in bullying is significant. Research conducted by Schuetz et al. (2022) reveals that students with special educational needs are more susceptible to occupying roles as aggressors or victims. Saarento et al. (2015) emphasize that the prevalence of bullying varies based on demographic factors, group culture, and the behavior of observers, suggesting the need for an approach that includes both individual and contextual factors.

The determinants of interpersonal relationships in bullying include peer rejection, insufficient parental supervision, and deficient social skills. The study by Low et al. (2018) demonstrates a correlation between inadequate parental supervision, peer rejection, and antisocial behaviors, including bullying, highlighting the importance of a positive school environment and healthy interpersonal relationships. Tsang and Hui (2015) stress the necessity of multi-level interventions, from individual to school-wide, to effectively address bullying.

The influence of social context and personality traits on the dynamics of interpersonal relationships in bullying is significant. Research conducted by Schuetz et al. (2022) reveals that students with special educational needs are more likely to occupy bully or victim roles. Saarento et al. (2015) point out that the prevalence of bullying varies depending on demographic, cultural, and observational behavioral factors, suggesting the need for an approach that includes individual and contextual factors.

Determinants of interpersonal relationships in bullying include peer rejection, insufficient parental supervision, and poor social skills. The study by Low et al. (2018) demonstrates a correlation between inadequate parental supervision, peer rejection, and antisocial behaviors, including bullying, highlighting the importance of a positive school environment and healthy interpersonal relationships. Tsang and Hui (2015) emphasize the need for multi-level interventions, from individual to school, to effectively address bullying.

Interpersonal relationships in the context of bullying are shaped by a balance between risk and protective factors. The research of Dugre et al. (2021) identifies cannabis use and victimization experiences as key elements in differentiating behaviors. At the same time, Pereda et al. (2022) show that corporal punishment and bullying in childhood can negatively influence later relationships. These

findings highlight the importance of early support and socio-emotional interventions.

Thus, the impact of victimization, empathy, and socio-emotional skills on the dynamics of interpersonal relationships in cases of bullying is very well emphasized, a fact also demonstrated by the study of Espejo-Siles et al. (2020), who show that while victimization increases the risk of violent behavior, empathy, and socio-emotional skills are activated as protective factors.

They emphasize the value of educational programs that promote the development of these skills to improve interpersonal relationships and reduce violence.

Perceptions of authority and social reputation significantly influence the complexity of interpersonal relationships in cases of bullying. Del Moral et al. (2019) note that adolescents involved in child-parental violence often display a negative attitude toward authority and aspire to a social reputation as non-conformists. This indicates an essential role of the social and school environment in the formation of aggressive behaviors and emphasizes the need for a comprehensive approach to prevent bullying.

At the same time, personal experiences and the cultural and social context play a particularly important role in the formation of attitudes and perceptions toward bullying and aggressive behaviors, as well as about the notions of morality and social responsibility. According to Kasimova et al. (2022), clinical and social factors contribute to the manifestation of suicidal behavior, highlighting a direct connection between bullying experiences and negative attitudes, such as despair and lack of coping mechanisms. In a similar study, Sitnik-Warchulska et al. (2021) acknowledge the essential role of temperament and family environment in influencing reactions to bullying and adolescents' propensity to seek support. This indicates that intervention strategies need to address a diverse range of factors to promote beneficial attitudes and behaviors.

Emergent factors, including racial discrimination and bullying experiences, along with wider socio-cultural influences, shape adolescent attitudes and perceptions, as evidenced by research, which shows that cumulative exposure to discrimination and bullying can exacerbate socio-emotional problems and risk of obesity, thus highlighting the interconnection between mental health and bullying experiences.

The interaction between individual behaviors and social attitudes, influenced by personal experiences and cultural context, is complex. The studies of Kulis et al. (2019) and Fu et al. (2018) highlight that alcohol consumption and prosocial behavior have significant effects on cultural values and attitudes toward bullying, which demonstrates the need for a deep understanding of social and cultural dynamics to develop effective prevention programs for adolescents.

Sexual and gender minorities face unique challenges related to bullying and personal safety, as shown by studies by Reisner et al. (2014) and Taliaferro et al. (2019). Issues related to gender identity and sexual orientation require special attention in the development of bullying prevention strategies, emphasizing the importance of a safe and inclusive environment for all adolescents.

Gender differences play a significant role in the manifestation of violence, either in school or in relationships, as indicated by Baier et al. (2021).

This suggests that attitudes and behaviors related to bullying require a specific approach, sensitive to the context and demographic characteristics of adolescents, to effectively address the phenomenon of bullying.

## 2 Research objective and research questions

The objective of the research is to identify and analyze the specific behaviors that can be considered predictors of aggression among adolescents in the school context in Romania. This approach involves a detailed investigation of behavioral variables and how they contribute to the manifestation of bullying behavior.

The initiated study was structured around the following fundamental questions, formulated to analyze the phenomenon of bullying and associated aggressive manifestations in the educational environment:

### 2.1 Research question 1 (RQ1): what are the predictive factors that contribute to the emergence and intensification of specific bullying behaviors?

Bullying is a complex phenomenon influenced by a variety of factors, including individual, family, group, school, socio-economic, and cultural.

#### 2.1.1 Individual factors

Individual factors are among the most studied when discussing bullying. For example, children with an aggressive or impulsive temperament are more likely to become bullies in the school context. These children may have difficulty controlling their emotions, which makes them more likely to react violently (Smith et al., 2019). Also, lack of empathy and a thinking style based on hostility have been correlated with an increased risk of aggressive behavior (Olweus, 1993).

#### 2.1.2 Family factors

The family environment plays an essential role in the development of bullying behaviors. An authoritarian parenting style, lack of affection, or exposure to domestic violence are factors that can contribute to these behaviors. Studies have shown that children who are raised in a dysfunctional family environment, where there is frequent conflict or abuse, are more likely to exhibit bullying behaviors (Lereya et al., 2013). On the other hand, low parental supervision and poor communication between parents and children are also predictors of bullying (Baldry and Farrington, 2000).

#### 2.1.3 Group and school factors

The school environment and group dynamics play a significant role in the propagation of bullying. A school culture that tolerates violence or a lack of appropriate intervention by school personnel can intensify these behaviors. Additionally, belonging to a social group where bullying is seen as a way to gain status or power may encourage children to adopt these behaviors in order to fit in (Salmivalli, 2010). Also, peer pressure and social norms supporting aggression are significant risk factors (Espelage and Swearer, 2003).

### 2.1.4 Socio-economic and cultural factors

Low socio-economic status and social marginalization are also factors that can contribute to bullying. Children who come from low-income families or who belong to minority groups can become targets of bullying, but at the same time, they can develop aggressive behaviors as a form of defensive reaction (Hong and Espelage, 2012). The cultural context, including community values and norms, influences the perception and acceptability of bullying behaviors (Gini and Pozzoli, 2009).

## 2.2 GAP literature

Socio-economic and cultural factors are often considered among the least studied compared to individual, family, and group factors. Although there is research that explores the impact of socioeconomic status and cultural context on bullying, it is not as numerous or detailed as studies that look at individual psychological aspects, family dynamics, or school environment influences.

More specifically, studies of how cultural norms and community practices influence bullying or how socioeconomic factors contribute to vulnerability or aggressive behaviors are less frequent. Most research focuses on specific socio-cultural environments and does not provide a global overview. Also, the impact of cultural differences on the perception of bullying and the effectiveness of interventions is an area that needs more attention.

## 2.3 Research question 2 (RQ2): are social exclusion and conflicts in the school environment predictors of bullying behavior?

Social exclusion and conflicts in the school environment are important predictors of bullying behaviors. These aspects highlight the need for a complex intervention that addresses not only individual behaviors but also group dynamics and the school climate as a whole. Promoting an inclusive school environment and effective conflict management are essential to reducing bullying and improving student well-being.

### 2.3.1 Social exclusion

Social exclusion is a major factor that can favor the emergence of bullying behaviors. Studies show that students who are excluded or marginalized in peer groups are more likely to be victims of bullying, but may also become bullies as a way to gain power or social acceptance (Twenge et al., 2007). Feeling isolated and lacking social support in the school environment creates a fertile ground for the development of aggression, as students may seek to assert control negatively by bullying others (Bukowski and Sippola, 2001).

In addition, social exclusion can reinforce bullying behaviors, especially when peer groups encourage or tolerate such attitudes. Excluded students are often perceived as different or not conforming to group norms, making them easy targets for bullying (Nansel et al., 2001).

### 2.3.2 Conflicts in the school environment

Frequent conflicts in the school environment, whether between students or between students and teachers, are strong predictors of bullying behaviors. Research suggests that a school climate characterized by unresolved conflict, tension, and violence increases the likelihood that students will resort to bullying as a way to manage these conflicts or express frustration (Swearer et al., 2010).

Constant interpersonal conflicts can create a hostile school environment where bullying behaviors are seen as a solution to gain superiority or cope with social pressures. Studies show that when students are frequently exposed to conflict, either as witnesses or participants, it can normalize aggression and reduce empathy for victims (Espelage and Swearer, 2004).

### 2.3.3 The interaction between social exclusion and school conflicts

Social exclusion and conflict in the school environment do not operate in isolation. In fact, these two phenomena can influence each other, increasing the likelihood of bullying behaviors. For example, social exclusion can lead to frustration and resentment, which, when combined with a conflictual school environment, can quickly escalate into bullying behaviors (Juvonen and Graham, 2014). At the same time, a student involved in frequent conflicts may be marginalized by his peers, which may amplify the desire to reaffirm his status through acts of bullying.

## 2.4 GAP literature

Although there are studies that examine bullying in various cultural contexts, how specific cultural norms influence the relationship between social exclusion and bullying behaviors has not been sufficiently investigated. Research could examine in more detail how cultural values, such as individualism or collectivism, affect both the perception and prevalence of social exclusion and bullying.

The impact of social exclusion in the digital environment, such as social media, and how this interacts with conflicts in the school environment to promote bullying, is a relatively new and underexplored field. For example, how does exclusion from online groups or group chats contribute to school bullying behaviors?

There is a lack of longitudinal studies tracking the long-term impact of social exclusion and school conflict on the development of bullying behaviors and on the lives of adults who have been either bullies or victims. Further research in this area could provide essential information about long-term bullying prevention.

## 2.5 Research question 3 (RQ3): how is tolerance toward unethical behaviors and the publication of unauthorized information related to bullying behaviors among students?

The literature suggests that the tolerance of unethical behaviors and the publication of unauthorized information play a significant role in the increase of bullying behaviors in schools. Understanding these relationships is essential for developing effective prevention and intervention strategies that address not only bullying but also the moral and ethical norms of the school community.

### 2.5.1 Tolerance of unethical behaviors

Tolerance of unethical behaviors such as lying, betrayal of trust or manipulation can create an environment where bullying is more likely to occur and persist. When students perceive that such behaviors are acceptable or overlooked by teachers and peers, the moral norms that discourage aggression become eroded.

According to research, in an environment where unethical behaviors are tolerated, students may become more likely to resort to bullying to gain social advantages or to strengthen their status (Rigby and Slee, 2008).

Studies suggest that when group moral norms are weak, students who might have moral qualms about bullying are encouraged to participate in or tolerate such behaviors (Thornberg, 2010). For example, if students see that minor moral transgressions are not sanctioned, they may perceive bullying as an extension of accepted behavior.

### 2.5.2 Publication of unauthorized information

Publishing unauthorized information, especially in the digital context, is a critical aspect of modern bullying. When students share their peers' personal information, images or messages without permission, this behavior not only violates privacy, but can lead to public humiliation and social isolation for the victims. These actions are often considered a form of cyberbullying, which has become an increasingly serious problem in contemporary schools (Kowalski et al., 2014).

Research indicates that students who engage in unauthorized posting are not only bullies, but also potential victims, as such behaviors create a cycle of revenge and retaliation. Tolerance of such actions in the school environment can amplify bullying as students learn that they can harm others without suffering serious consequences (Hinduja and Patchin, 2010).

### 2.5.3 The interaction between tolerance of unethical behaviors and the publication of unauthorized information

Tolerance of unethical behavior and the publication of unauthorized information are often interconnected and can feed into each other in the context of bullying. For example, in an environment where unethical behaviors are tolerated, students may feel free to share unauthorized information without fear of repercussions. At the same time, success in achieving a positive social reaction by sharing compromising information can further reinforce unethical norms (Tokunaga, 2010).

## 2.6 GAP literature

Although the link between tolerance toward unethical behaviors and bullying is recognized, the specific psychological mechanisms through which these two phenomena influence each other have not been sufficiently researched. In particular, it would be important to investigate how students' perceptions of the group's moral and ethical norms influence their decisions to engage in bullying.

Limited longitudinal research examines the long-term effects of tolerance of unethical behaviors and involvement in whistleblowing on students' psychosocial development. Studies could explore how these experiences influence individuals' behaviors and ethical values in adulthood.

Little has been studied about how tolerance of unethical behavior and the publication of unauthorized information varies by cultural context. It would be interesting to explore how different cultural norms influence students' perception and reaction to these behaviors.

Despite the increased attention to cyberbullying, there is a lack of research on the legal and ethical consequences of publishing unauthorized information in the school environment. A more detailed exploration of how school legislation and policy addresses these issues and the effect they have on student behavior would be useful.

Based on the analysis of the specialized release, the following hypotheses were proposed:

> Hypothesis 1 (*H1*): The existence of correlations between aggressive behavioral manifestations determines the emergence of bullying behaviors in the Romanian educational environment.
>
> Hypothesis 2 (*H2*): The existence of relationships between social exclusion and conflicts in the school environment are predictors of verbal bullying behavior in students acting as aggressors.
>
> Hypothesis 3 (*H3*): The existence of correlations between tolerance toward unethical behaviors and the publication of unauthorized information/violation of privacy are predictors of bullying behavior in students.

# 3 Materials and methods

## 3.1 Participants

The analysis of gender distribution within the studied sample indicates a preponderance of female participants, they represent 58.1% ($n = 234$) of the total subjects ($n = 403$). The percentage of male participants is 41.9% ($n = 169$). Valid percentages, which exclude missing cases from the calculation, maintain the same distribution, thus illustrating a balanced composition of the sample, with a slight overrepresentation of women. Cumulatively, valid percentages reach the 100% threshold, indicating that all participants were classified into one of the two gender categories, with no cases omitted or unclassified.

## 3.2 Instruments

The applied tool aims to evaluate the manifestations of bullying in the educational context. Its methodology is based on a questionnaire structured around Likert-type questions, offering five response options, and includes a total of 55 items grouped into three scales: Bullying behaviors and interpersonal relationships (14 items, with a Cronbach's alpha coefficient of 0.833); Evaluation of behaviors related to bullying (22 items, with a Cronbach's alpha coefficient of 0.894); Evaluation of attitudes and perceptions related to aggressive behavior (19 items, with a Cronbach's alpha coefficient of 0.859).

For better structuring and understanding, each scale was subdivided into subscales by applying exploratory factor analysis,

using the Varimax technique for optimization, and assessing the internal consistency of each subscale.

Thus, the Bullying Behaviors and Interpersonal Relations Scale was segmented into three distinct subscales: Conflicts in the school environment (five items, internal consistency of 0.739); Aggressive Behaviors (five items, internal consistency of 0.647, indicating a relatively low value) and Aggressive Manifestations (four items, internal consistency of 0.751).

The Bullying-related behavior assessment scale includes five subscales: Violation of privacy as an aggressor (five elements, with an internal consistency coefficient of 0.872); Social exclusion (six items, with a Cronbach's alpha coefficient of 0.809); Verbal attacks as an aggressor (five items, internal consistency of 0.759).

Publishing information without authorization (three items, internal consistency of 0.747); Violation of privacy as a victim (three elements, internal consistency of 0.751).

Finally, the scale Evaluation of attitudes and perceptions related to aggressive behaviors is divided into three subscales: Aggression/violence (seven items, with a Cronbach's alpha coefficient of 0.812); Perception/attitude toward bullying (seven items, Cronbach's alpha coefficient of 0.733); Tolerance of unethical behaviors (five items, internal consistency of 0.674).

This detailed structuring facilitates a deeper understanding and a more rigorous analysis of the phenomenon of bullying in educational settings.

## 3.3 Procedure

For the implementation of the research, permission was obtained from the management of the schools that were part of our study. The questionnaire was completed both physically, by the students, and through the Google Forms platform, the students had access to the questionnaire through a link that was sent to them with the help of the class leader. Thus, non-probabilistic methods were used through the convenience samples method as well as through the quota method (maintaining an approximately equal proportion for the biological gender variable) to recruit students from the 5th and 6th grades, respectively, from different schools.

## 3.4 Data analysis

Dependent variables identified in the present research include conflicts in the educational context, verbal attacks, and bullying behavior.

The predictive elements that contribute to the phenomenon of bullying are represented by aggressive behaviors, conflict in the school environment, the phenomenon of social marginalization, as well as tolerance toward unethical behavior, the violation of the right to privacy in the position of the aggressor, and the dissemination of information without the explicit consent of the targeted persons.

The data analysis process was carried out through a set of statistical procedures, ranging from elementary to the most complex methods, applied specifically for each variable, to measure characteristic descriptive parameters.

To evaluate the degree of interdependence between the studied variables, the method of correlation analysis was used. In parallel, confirmatory factor analysis was used to identify the significant predictive factors influencing and shaping bullying behavior.

The variability of one variable about another was examined using ANOVA (analysis of variance), while the regression model was used to estimate the values of one variable according to another variable.

# 4 Results

> Hypothesis 1 (*H1*): The existence of correlations between aggressive behavioral manifestations determines the emergence of bullying behaviors in the Romanian educational environment.

Statistical examination of the collected data sets, relating to the variables "Conflicts in the school environment," "Aggressive behaviors" and "Aggressive manifestations," in the context of a sample of 403 subjects, reveals diversity in the distribution of values. The mean values calculated for "Conflicts in the school environment" were 8.98, with a standard deviation of 4.007, indicating a moderate dispersion of responses around the mean value. In the case of the "Aggressive Behaviors" variable, the calculated mean was 6.33, with a standard deviation of 2.052, highlighting a narrower variation in the data. Regarding the variable "Aggressive Manifestations," the recorded mean was 7.49, with a standard deviation of 3.427, illustrating a distribution with a relatively moderate dispersion.

From a psychological perspective, these results suggest that, within the educational context, the phenomenon of "Conflicts" is perceived as having the highest frequency and variability, followed by "Aggressive Manifestations" and subsequently by "Aggressive Behaviors."

The higher average value associated with "Conflicts in the school environment" shows a general recognition of conflicts as a notable and problematic element in the educational environment. This, coupled with a significant standard deviation, indicates that individuals' experiences of conflict vary considerably. "Aggressive behaviors," recording the lowest mean and standard deviation, can be interpreted as less prevalent and more consistent among the analyzed sample.

However, the responses to the "Aggressive Manifestations" scale suggest that paying more attention to how aggression manifests and is perceived in the school setting is imperative. In conclusion, these findings emphasize the need to adopt different and personalized strategies to understand and effectively intervene in the problem of conflicts and aggressive behaviors in educational institutions.

In the analysis of the Pearson correlation coefficients for the variables "Conflicts in the school environment," "Aggressive behaviors" and "Aggressive manifestations" in a sample composed of 403 subjects, the following significant results were obtained:

- The interaction between "Conflicts in the school environment" and "Aggressive manifestations" registered a correlation coefficient of 0.596, significant at the 0.00 level, reflecting a positive correlation of moderate to high intensity.
- This significant relationship suggests a significant association between the perception of conflicts and the frequency of aggressive manifestations, indicating the possibility that environments characterized by heightened conflicts favor the emergence of aggressive behaviors.

- The association between "Conflicts in the school environment" and "Aggressive behaviors" revealed a correlation coefficient of 0.387, significant at the 0.00 level, suggesting a positive correlation, but of weak to moderate intensity.
- The moderate correlation between "Aggressive behaviors" and the other two variables (having coefficients of 0.387 and 0.423) suggests that although there is a significant connection between aggressive behaviors, conflicts, and aggressive manifestations, this interconnection is not as strong as that observed between perceptions of conflicts and aggressive manifestations. This could indicate that the variable of aggressive behaviors is influenced by a wider spectrum of factors, not only by conflict dynamics or direct aggressive manifestations.

In conclusion, these findings emphasize a significant interdependence between conflicts in the school environment, aggressive behaviors, and aggressive manifestations.

These results emphasize the need to adopt integrated and well-founded strategies within educational interventions, to reduce the level of aggression and effectively manage conflicts in educational institutions. Thus, a thorough understanding of how these variables interact and influence each other in the specific context of the educational environment is essential.

The KMO coefficient is 0.649 (Table 1), which allows us to moderately consider that these existing correlations between the studied variables are not due to chance and allows us to apply factor analysis to determine the degree of influence of conflicts in the school environment, an influence that is also determined by the aggressive behaviors manifested in the school.

The model presented in Table 2 investigates the association between the dependent variable "Conflicts in the school environment" and two independent variables, namely "Aggressive Manifestations" and "Aggressive Behaviors." The coefficient of determination, R Square ($R^2$), recorded at the value of 0.377, illustrates the proportion of variation in the dependent variable ("Conflicts in the school environment") that can be attributed to the influence of the combination of the two independent variables. The value of 0.377 indicates that approximately 37.7% of the dispersion of school conflicts is explained by the variability of aggressive manifestations and behaviors.

From a psychological perspective, these results indicate that, although aggressive manifestations and behaviors are relevant factors in the elucidation of conflicts in the school environment, there are other factors, that represent approximately 62.3% of the variation in school conflicts, and which are not included in this model.

These factors may include elements such as the climate of the educational institution, the dynamics of interpersonal relationships, external pressures, or the individual characteristics of students.

In conclusion, the statistical model underlines a moderate but significant association between "Conflicts in the school environment" and the independent variables "Aggressive Manifestations" and "Aggressive Behaviors."

The Adjusted R-Square coefficient attests to an adequate fit of the model, and the F-statistic analysis confirms a notable contribution of the independent variables in explaining the observed variation in the dependent variable.

The statistical evaluation presented in Table 3 reveals that the results of the analysis of variance (ANOVA) are significant (with a Sig. value = 0.00), thus highlighting the relevance of investigating and systematically addressing aggressive behaviors and manifestations within educational interventions, to mitigate conflicts. Aggression, conceptualized through the prism of manifestations and behaviors, plays a significant role in the structure and evolution of conflicts in the school context. These findings suggest that prevention and intervention programs should aim not only at effective conflict management and resolution but also at identifying and addressing predisposing factors for aggressive behaviors and manifestations. A proactive strategy could include implementing social skills education programs, organizing workshops focused on anger and frustration management, and promoting programs aimed at cultivating empathy and awareness.

In conclusion, the results of the ANOVA analysis indicate a strong and statistically significant association between aggressive behaviors and manifestations and the frequency of conflicts in the school environment, thus constituting a robust foundation for the development and implementation of targeted and effective strategies aimed at improving the educational climate.

Examination of the coefficients of the regression model, presented in Table 4, provides a detailed insight into the relational dynamics between the independent variables ("Aggressive Behaviors" and "Aggressive Manifestations") and the dependent variable ("Conflicts in the school environment"). The interpretation of these data underlines the determining role of perceptions, attitudes, and social norms prevailing within educational institutions in shaping the behavior of students. In this context, aggressive manifestations can contribute to establishing a climate conducive to the development or escalation of conflicts.

In the multiple regression, the potential predictors of bullying behavior were entered in the ascending order of the correlation coefficients obtained by each of them with conflicts in the school environment. The regression equation of bullying behaviors in the educational environment has the following elements:

- The Adjusted *R*-squared value of 0.374 means that the regression model explains 37.4% of the total variation in the dependent variable "conflicts in the school environment" based on the predictors included in the model. This represents a modified version of the $R^2$ coefficient, adjusted for the number of predictors present in the model and the sample size.

The proximity of the Adjusted $R^2$ value to the $R^2$ value suggests that adding additional predictors to the model was relevant and appropriate, without causing significant overestimation. The remaining variation refers to the proportion of the dependent variable's variance that is not explained by the current model.

In this case, the remaining variation is 62.6% (100–37.4%), which means there are factors or confounding variables that could influence "conflicts in the school environment" but were not included in the

TABLE 1 KMO and Bartlett's Test.

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy. | | 0.649 |
| Bartlett's test of sphericity | Approx Chi-square | 268.093 |
| | df | 3 |
| | Sig. | 0.000 |

TABLE 2 Model summary—the association between the dependent variable and the independent variables.

| Model | *R* | *R* square | Adjusted *R* square | Std. error of the estimate | Change statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | *R* square change | *F* change | df1 | df2 | Sig. *F* change |
| 1 | 0.614 [a] | 0.377 | 0.374 | 3.171 | 0.377 | 121,055 | 2 | 400 | 0.000 |

[a]Predictors: (Constant), Aggressive manifestations, Aggressive behaviors. [b]Dependent Variable: Conflicts in the school environment.

TABLE 3 ANOVA analysis of variance, between the dependent variable and the predictor variable.

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2434.205 | 2 | 1217.102 | 121,055 | 0.000 [b] |
| | Residual | 4021.636 | 400 | 10,054 | | |
| | Total | 6455.841 | 402 | | | |

[a]Dependent variable: conflicts in the school environment. [b]Predictors: (Constant), aggressive manifestations, aggressive behaviors.

current regression model. These factors include personal factors, such as students' personality traits, for example, impulsivity and empathy, family factors, including family dynamics, parenting style, and the family's socio-economic status, cultural and socio-economic factors, including cultural norms regarding aggressive behavior and the community's socio-economic level, the influence of the online environment and social media, such as exposure to cyberbullying and the influence of social networks, school policies and programs, referring to the effectiveness of anti-bullying programs and the school's disciplinary policies, interpersonal interactions, including relationships with peers and teachers and social support from friends and mentors.

- *F*-test (ANOVA) values and significance coefficients having values less than 0.000 confirm that the model is valid

Knowing the level of aggressive manifestations in the educational environment and aggressive behaviors using the regression equation - *conflicts in the school environment = 2.339 + (0.322) aggressive behaviors + (0.615) aggressive manifestations* - we obtain the level of bullying behaviors in the school environment.

The conclusions drawn from the data analysis suggest that both behaviors and aggressive manifestations are significant predictors of the incidence of conflicts in the school environment, with a relatively stronger influence exerted by aggressive manifestations. The coefficients of the model, the level of significance, and the established correlations confirm the existence of a robust and significant interaction between these variables and the frequency of conflicts in the educational environment (Figure 1).

Examination of the scatterplot indicates that the regression model is appropriate for the data set analyzed, given that the residuals are generally evenly distributed with no evidence of heteroscedasticity or non-linearity. This infers that the regression model provides a reliable predictive estimate for the variable "Conflicts in the school environment," except for potential extreme values (outliers) that may require further analysis. In the present case, the plot shows no pronounced patterns, suggesting that the variance of the residuals is relatively stable.

> Hypothesis 2 (*H2*): The existence of relationships between social exclusion and conflicts in the school environment are predictors of verbal bullying behavior in students acting as aggressors.

The statistical analysis was performed on a data set comprising three variables: "Verbal attacks as an aggressor," "Social exclusion" and "Conflicts in the school environment," each with several 402 observations. For the indicator "Verbal attacks as an aggressor," the average of 6.02 reflects a moderate incidence of this type of behavior. This level of verbal aggression could signal the existence of tensions or communicative dysfunctions among students and can be interpreted as a marker of self-control deficits or of an institutional culture that does not sufficiently discourage aggressive behavior. In the case of the "Social exclusion" indicator, the average of 9.36 is the highest among the three variables, signaling a strong presence of the phenomenon of social marginalization among the participants. A standard deviation of 4.276 indicates a significant dispersion of experiences of social exclusion, suggesting notable differences between participants in this regard. A high mean in the context of wide dispersion may reflect a widespread problem with profound adverse psychological effects, such as feelings of isolation, depression, and anxiety, affecting individuals differently.

For the indicator "Conflicts in the school environment," the mean of 8.96 suggests that conflicts are a significant problem, with a standard deviation of 3.992, also indicating a variety of students' experiences related to these conflict situations. This value proximity between the media for conflict and that for social exclusion emphasizes that both phenomena are frequent and relevant problems, having the potential to negatively influence both academic performance and the emotional well-being of students.

The analysis of the data suggests that the phenomenon of social exclusion and conflicts in the school environment are more prominent than verbal aggression, although all three variables are present and could be interrelated. The high variability observed for social exclusion and school conflicts indicates a significant diversity of individual experiences, providing a starting point for the development of tailored interventions.

Although this analysis provides insight into the prevalence of these behaviors, it would be prudent to consider other variables, such as educational background, family relationships, and social support, to gain a deeper understanding of the causal factors and dynamics of these problems.

The correlational study examined the relationships between the variables "Verbal attacks as an aggressor," "Social exclusion" and "Conflicts in the school environment," using the Pearson correlation coefficient and evaluating the statistical significance of these correlations for several 402 observations for each variable.

The analysis revealed a positive correlation of moderate intensity (0.581) between the frequency of verbal attacks and the incidence of social exclusion, indicating a trend of simultaneous growth of these

TABLE 4 Coefficients–the regression coefficient between the dependent variable and the predictor variables.

| Model | | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *B* | Std. error | Beta | | | Zero-order | Partial | Parthian | Tolerance | VIV |
| 1 | (Constant) | 2,339 | 0.535 | | 4,371 | 0.000 | | | | | |
| | Aggressive behaviors | 0.322 | 0.085 | 0.165 | 3,788 | 0.000 | 0.387 | 0.186 | 0.149 | 0.821 | 1,217 |
| | Aggressive manifestations | 0.615 | 0.051 | 0.526 | 12,078 | 0.000 | 0.596 | 0.517 | 0.477 | 0.821 | 1,217 |

[a]Dependent variable: conflicts in the school environment.

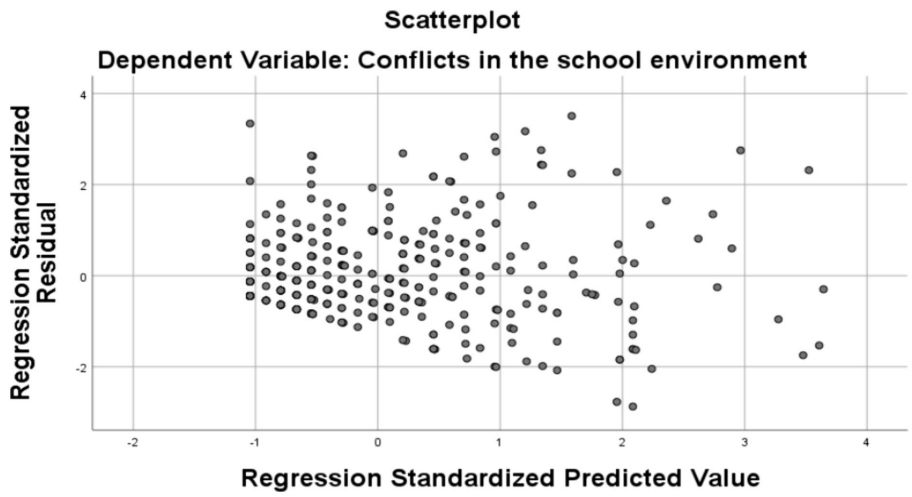


FIGURE 1
Scatterplot.

phenomena. This association suggests a potential interdependence between verbally aggressive behavior and social marginalization within the study population.

The relationship between "Verbal attacks as an aggressor" and "Conflicts in the school environment" was identified as positive, but of lower intensity (0.329), signaling a less obvious connection between verbal aggression and school conflicts. This suggests that although there is an association between the two variables, other factors may contribute significantly to the dynamics of conflict in the educational environment.

The correlation between "Social Exclusion" and "School Conflicts" (0.585) is comparable to that between verbal attacks and social exclusion, illustrating a moderate association. This correlation underlines a possible significant relationship between experiences of social exclusion and involvement in school conflicts, suggesting that marginalized students may be more susceptible to participating in conflicts or, conversely, conflicts may facilitate exclusion phenomena.

The statistical significance of all correlations at the 0.000 level (one-tailed) confirms the improbability of these relationships being the product of randomness, emphasizing the significant interdependence between verbal attacks, social exclusion, and school conflicts. These findings emphasize not only the coexistence of these behaviors but also the possibility of mutual influence.

In the context of educational interventions, it is essential to recognize the interconnected nature of these issues and to address common underlying factors such as institutional climate, social–emotional skills, and student support. The results emphasize the need for a holistic approach to managing school problems, rather than an exclusive focus on a single type of disruptive behavior.

Since the KMO coefficient is 0.603 (Table 5), we can moderately consider that these existing correlations between the studied variables are not due to chance, which allows us to apply factor analysis to determine the percentage of influence of verbal attacks exerted by the aggressor based on conflicts in the school environment and the social exclusion they experience.

The study of the relationship between the predictor variables ("Social exclusion" and "Conflicts in the school environment") and the dependent variable ("Verbal attacks as an aggressor"), as presented in Table 6, requires a detailed analysis of each element of the model summary, addressing both statistical aspects and psychological implications. The multiple correlation coefficient ($R = 0.581$) denotes a correlation of moderate intensity between the predictor variables and the dependent variable, indicating that the level of social exclusion and the frequency of school conflicts have a moderate association with the prevalence of verbal attacks as a form of aggression. From a psychological perspective, this moderate correlation suggests that the

social context and conflict situations in which students find themselves contribute significantly to the adoption of verbally aggressive behavior, possibly reflecting a self-defense mechanism or a means of expressing accumulated frustrations. The coefficient of determination (*R* Square = 0.337) illustrates that approximately 33.7% of the variance of verbal attacks as an aggressor can be attributed to the influence of the combination of the predictor variables of social exclusion and school conflicts. The Adjusted *R*-Square index (0.334), which adjusts the *R*-Square for the number of predictors in the model and the amount of data, provides a more accurate assessment of the model's predictive ability in the sample. The closeness of the Adjusted *R* Square value to *R* Square reaffirms the fit of the model and suggests that it is not over-fitted.

The observation that the model explains approximately 33.7% of the variance in verbally aggressive behavior emphasizes that, although social exclusion and school conflicts are influential elements, there are other contributing variables, such as individual traits, family context, reference group influences, or other environmental factors.

The summary of the model shows a moderate but significant connection between social exclusion, school conflicts, and verbal attacks as an aggressor. The results emphasize the importance of analyzing social and environmental factors in understanding and addressing verbally aggressive behavior, while recognizing the contribution of other variables in this behavioral spectrum, which indicates the need for an integrated and exhaustive perspective in research and practice.

To investigate the existence of a significant statistical difference in the frequency of "Verbal attacks as an aggressor," in the context of the influence of the predictor variables "Conflicts in the school environment" and "Social exclusion," the analysis of variance (ANOVA) was applied, as presented in Table 7. The significance of the model, evidenced by a *p*-value (Sig. = 0.000) below the 0.05 threshold, confirms the statistical relevance of the model, indicating a significant association between the mentioned variables and the dependent variable.

In the context of the influence of the predictor variables on the frequency of verbal attacks, the ANOVA results show that the model including the variables "Conflicts in the school environment" and "Social exclusion" explains an important portion of the variation in "Verbal attacks as an aggressor." This demonstrates that the negative interactions characteristic of the school environment, in the form of conflicts and social exclusion, can have a considerable contribution to the manifestation of verbally aggressive behavior among students.

The evaluation of the coefficients within the regression model, according to the data presented in Table 8, contributes to the elucidation of the degree of influence exerted by each predictive variable on the dependent variable, in this context, "Verbal attacks as an aggressor."

In the multiple regression, the potential predictors of the bullying behavior of students in the position of aggressors were entered in the ascending order of the correlation coefficients obtained by each of them with the conflicts in the school environment. The regression equation of bullying behaviors in the educational environment has the following elements:

- The adjusted $R^2$ is 0.33, which means that 33% of the variation in bullying behaviors in the educational environment is explained by the predictors included in the regression model. The rest of the variance, 67% (100–33%), is explained by other variables that were not investigated in the present study (confounding variables). This indicates that there are other variables or factors influencing bullying behaviors that were not measured or included in this study, such as:
  - Personal factors, including students' personality traits, such as impulsivity and empathy,
  - Family factors, such as family dynamics, parenting style, and the family's socio-economic conditions,
  - Cultural and socio-economic factors, including cultural norms regarding violence and aggressive behavior, as well as the community's socio-economic level,
  - The influences of the online environment and social networks, such as exposure to cyberbullying and the intensive use of social media platforms.

Other confounding variables could include the effectiveness of anti-bullying programs and school disciplinary policies, interpersonal relationships with peers and teachers, social support from friends and mentors, and the mental and emotional state of the students.

- *F*-test (ANOVA) values and significance coefficients having values less than 0.000 confirm that the model is valid

Knowing the level of aggressive manifestations in the educational environment and aggressive behaviors using the regression equation – *verbal attacks as an aggressor = 3.343 + (0.294) social exclusion – (0.008) conflicts in the school environment* – we obtain the level of bullying behaviors of students from the aggressor position.

The consistent and statistically significant coefficient associated with social exclusion reconfirms the relevance of this variable as the main predictor in the manifestation of verbal attacks. This implies that

TABLE 5 KMO and Bartlett's test.

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy | | 0.603 |
| Bartlett's test of sphericity | Approx. Chi-Square | 331.546 |
| | df | 3 |
| | Sig. | 0.000 |

TABLE 6 Model summary[b] the association between the dependent variable and the predictor variables.

| Model | *R* | *R* Square | Adjusted *R* square | Std. error of the estimate | Change statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R square change | F change | df1 | df2 | Sig. *F* change |
| 1 | 0.581 [a] | 0.337 | 0.334 | 1,738 | 0.337 | 101,546 | 2 | 399 | 0.000 |

[a]Predictors: (Constant), conflicts in the school environment, social exclusion. [b]Dependent variable: verbal attacks as an aggressor.

the phenomena of isolation or social marginalization are catalytic factors of verbally aggressive behavior.

In contrast, the insignificant and reduced coefficient for the variable "Conflicts in the school environment" suggests that, in this specific model and the context of the analyzed data, school conflicts lack a direct and significant influence on verbal attacks, especially compared to the impact exerted by exclusion social. This does not denote the insignificance of school conflicts *per se*, but rather a secondary role in this analytical framework.

The conclusions of the regression model emphasize the significance of social exclusion as an essential determinant in the etiology of verbal attacks as an aggressor. Although the variable "Conflicts in the school environment" did not demonstrate a significant influence in this model, its role in understanding the complexity of aggressive behavior in the educational sphere should not be neglected. Preventive and intervention strategies should recognize and address this complexity, focusing on strengthening social cohesion and improving the school climate to diminish manifestations of verbal aggression and cultivate a conducive and supportive educational environment.

Figure 2 shows a relatively uniform scatter of the points in the plot, which suggests that the model exhibits the property of homoscedasticity, i.e., it exhibits a constant variance of the residuals over the entire range of predicted values. The absence of a visible pattern of expansion or contraction of the residuals according to the standardized predicted values is a positive indicator and suggests a good fit of the model to the data.

The regression model assumes a linear relationship between the predictor variables and the dependent variable.

The fact that no systematic or skewed pattern is observed in the distribution of points on the plot supports the hypothesis that the assumption of linearity is properly met within this data set.

TABLE 7 ANOVA[a] analysis of variance, between the dependent variable and the predictor variable.

| Model | | Sum of squares | df | Mean square | *F* | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 613,528 | 2 | 306,764 | 101,546 | 0.000 [b] |
| | Residual | 1,205,350 | 399 | 3,021 | | |
| | Total | 1818,878 | 401 | | | |

[a]Dependent variable: verbal attacks as an aggressor. [b]Predictors: (Constant), conflicts in the school environment, social exclusion.

In conclusion, the graph indicates an adequate performance of the regression model, but also signals the possibility of improvement, especially due to the presence of extreme values (outliers) that can influence the results of the model. For a more comprehensive assessment and to make informed decisions about the model, it would be beneficial to check other regression diagnostics, such as the level of leverage and measures of influence, as well as a detailed analysis of outliers to understand why these observations deviate from the general trend of the model.

> Hypothesis 3 (*H3*): The existence of correlations between tolerance toward unethical behaviors and the publication of unauthorized information/violation of privacy are predictors of bullying behavior in students.

Examination of the descriptive statistics provides detailed insight into the data collected regarding aggressive behavioral manifestations and associated predictive factors, such as breach of confidentiality, dissemination of information without authorization, and acceptance of unethical behaviors, in a sample of 401 students.

The average values recorded, especially the average of 6.33 for the variable "Bullying behavior," indicate a significant prevalence of aggression among students. The standard deviation of 2.056 for this variable reflects moderate variability in responses, suggesting differences in the degree of aggression reported by students.

The average value of 5.39 for the "Violation of privacy" variable highlights the presence of this phenomenon, although at a lower level compared to bullying behavior. A standard deviation of 1.659, less than that associated with bullying behavior, suggests greater consistency in student responses regarding privacy violations.

The mean of 3.50 for the variable "Dissemination of information without authorization" indicates a perception of a low frequency of this type of behavior among students. Conversely, the mean of 5.84 for the variable "Tolerance of unethical behaviors" suggests a moderate to high acceptance of unethical behaviors among students. The standard deviation of 2.381 for this variable indicates diverse opinions among students regarding the acceptability of unethical behaviors.

These values suggest that although bullying behaviors and tolerance of unethical behaviors are reported to be relatively common, the phenomena of privacy violations and unauthorized dissemination of information are perceived as less common. This could reflect a culture where certain forms of bullying and ethical violations are more accepted or overlooked compared to others.

TABLE 8 Coefficients[a]-the regression coefficient between the dependent variable and the predictor variables.

| Model | | Unstandardized coefficients | | Standardized coefficients | *t* | Sig. | Correlations | | | Collinearity statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *B* | Std. error | Beta | | | Zero-order | Partial | Parthian | Tolerance | VIV |
| 1 | (Constant) | 3,343 | 0.233 | | 14,356 | 0.000 | | | | | |
| | Social exclusion | 0.294 | 0.025 | 0.590 | 11,736 | 0.000 | 0.581 | 0.507 | 0.478 | 0.658 | 1,521 |
| | Conflicts in the school environment | −0.008 | 0.027 | −0.016 | −0.312 | 0.755 | 0.329 | −0.016 | −0.013 | 0.658 | 1,521 |

[a]Dependent variable: verbal attacks as an aggressor.

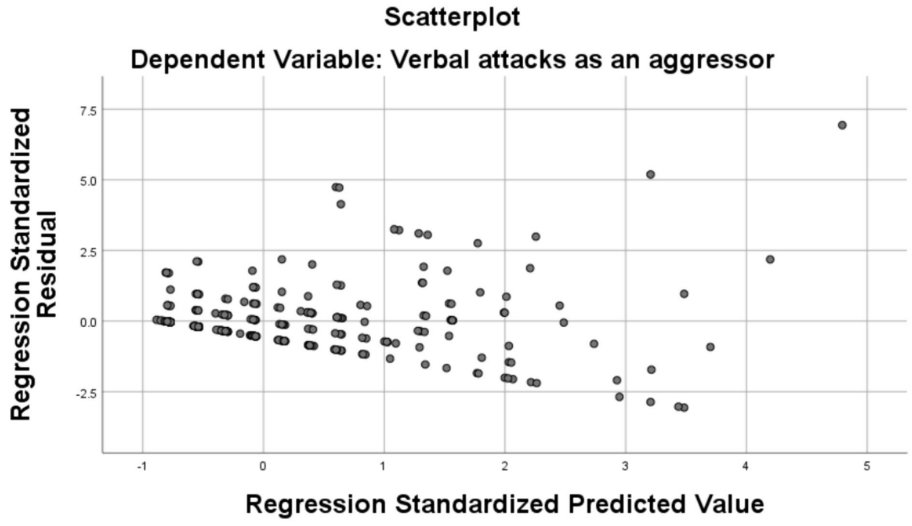


FIGURE 2
Regression graph.

Greater variability in tolerance of unethical behaviors could signal divergence within the school community regarding ethical norms and values. Differences in students' perceptions of what is ethical or acceptable can influence both individual behavior and collective reactions to bullying by others.

The reduced mean value for disseminating information without authorization could indicate a clearer awareness of privacy and privacy issues in the digital space or the perception of more serious consequences for such actions.

Applying Pearson correlation analysis in this context reveals the magnitude and directionality of linear associations between four distinct variables: "Bullying behavior" "Invasion of privacy as a bully" "Dissemination of information without authorization" and "Acceptance of unethical behaviors" on a sample of 401 cases.

The moderate and positive correlations identified between "Violation of privacy as an aggressor" (0.388) and "Dissemination of information without authorization" (0.412) suggest a concurrent association between these behaviors; that is, the presence of aggressive behavior is frequently associated with the presence of other forms of aggression.

This observation could indicate common personality traits or a school environment that facilitates the manifestation of these behaviors.

The low correlations between "Acceptance of unethical behavior" (0.176) and the other variables involved in the study suggest that permissive attitudes are not necessarily direct predictors of aggressive manifestations. However, even a correlation of low strength can have important meanings in a sample of considerable size.

Except for the relationship between "Acceptance of unethical behaviors" and "Violation of privacy as an aggressor," all correlations are statistically significant at the 0.000 or 0.002 level (one-tailed test), signaling a minimal probability that these associations are the result of chance.

Thus, the observed correlations highlight interconnections between various types of aggressive behaviors among students, the strongest relationship being between "Violation of privacy as an aggressor" and "Dissemination of information without authorization". Although the correlation with "Acceptance of unethical behaviors" is significant, the intensity of this association is lower, which suggests that the permissive attitude is not as predictive of aggressive behaviors as the presence of other forms of aggression.

TABLE 9 KMO and Bartlett's test.

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin measure of sampling adequacy. | | 0.685 |
| Bartlett's test of sphericity | Approx. Chi-Square | 233.968 |
| | df | 6 |
| | Sig. | 0.000 |

Since the KMO coefficient is 0.685 (Table 9), we can moderately consider that these existing correlations between the studied variables are not due to chance, which allows us to apply factor analysis to determine the percentage of influence of bullying behaviors based on tolerance toward unethical behaviors, privacy violations by the aggressor, and the publication of unauthorized information.

The summary model evaluation, presented in Table 10, explores the dynamics between three predictor variables: "Acceptance of unethical behaviors," "Violation of privacy as a bully" and "Dissemination of information without authorization" — and the dependent variable "Bullying behavior." The multiple correlation coefficient *R*, with a value of 0.470, reveals a correlation of moderate intensity between the predictor variables and the dependent variable, meaning that there is a tendency to increase the manifestations of bullying with the intensification of the values of the predictor variables. The coefficient of determination R Square, registering the value of 0.221, illustrates that the model explains approximately 22.1% of the variation in aggressive behavior. This suggests that although the model provides insight into aggressive behaviors, a significant percentage of variance is still not explained. A correlation of moderate intensity and an explanatory proportion of about 22% underlines the fact that attitudes toward unethical behaviors and online manifestations, such as privacy violations and dissemination of information without authorization,

TABLE 10 Model summary–the association between the dependent variable and the predictor variables.

| Model | *R* | *R* square | Adjusted *R* square | Std. error of the estimate | Change statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | *R* square change | *F* change | df1 | df2 | Sig. *F* change |
| 1 | 0.470[a] | 0.221 | 0.215 | 1,822 | 0.221 | 37,487 | 3 | 397 | 0.000 |

[a]Predictors: (Constant), tolerance toward unethical behaviors, violation of privacy as aggressor, publication of unauthorized information. [b]Dependent variable: bullying behavior.

exert a recognized influence on bullying behaviors. However, these variables are not the only factors contributing to this behavioral dynamic.

The analysis of variance (ANOVA) study, according to the data in Table 11, is implemented to assess the existence of statistically significant differences between the means of various groups. In the context of regression analysis, ANOVA is used to test whether the proposed regression model that includes the predictor variables is significantly different from a null model—a model that assumes no relationship between the predictor variables and the dependent variable.

The ANOVA results demonstrate that the regression model, integrating the three predictors, contributes significantly to explaining the variation in aggressive behaviors. This observation indicates that the variables "Acceptance of unethical behaviors," "Violation of privacy as an aggressor" and "Dissemination of information without authorization" have notable importance in decoding the dynamics of bullying behaviors within the examined population.

Table 12 shows the coefficients obtained in the multiple linear regression model, which investigates the impact of three independent variables — "Violation of privacy as an aggressor," "Dissemination of information without authorization" and "Acceptance of unethical behaviors"— on the dependent variable "Bullying behavior."

In the multiple regression, the potential predictors of bullying behavior in students were entered in the ascending order of the correlation coefficients obtained by each with privacy violation as the aggressor. The regression equation of bullying behaviors in the educational environment has the following elements:

- The adjusted $R^2$ is 0.221, which means that 22% of the actual cases of bullying in the educational environment are explained by this model, indicating a significant impact on bullying behavior and explaining part of its variance. Variables such as aggressiveness, privacy violations, and unauthorized dissemination of information (as inferred from the previous context) have a significant impact on bullying behavior and can explain part of its variation.
- The remaining 78% of the variance represents the part of bullying behavior variance that is not explained by the variables included in the current model. This highlights the existence of other confounding variables or factors that influence bullying behaviors that were not included in the study, such as:
- Family factors, including family dynamics, parenting style, and the presence of domestic conflicts,
- Socio-economic factors, such as parent's education and income levels and the community's economic conditions,
- Online environment influences, including exposure to cyberbullying and the use of social networks,
- Cultural factors, referring to cultural and social norms regarding violence and aggression,
- Individual personality traits, such as empathy and impulsivity,
- Aspects of the school environment, including school culture, anti-bullying policies, and teacher-student relationships,
- Peer group influences, such as peer pressure and belonging to social groups,
- Psychological factors, such as students' mental and emotional states and the presence of psychological disorders.

TABLE 11 ANOVA[a]- analysis of variance, between the dependent variable and the predictor variable.

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 373,179 | 3 | 124,393 | 37,487 | 0.000 [b] |
| | Residual | 1,317,370 | 397 | 3,318 | | |
| | Total | 1,690,549 | 400 | | | |

[a]Dependent variable: aggressive behaviors. [b]Predictors: (Constant), tolerance toward unethical behaviors, violation of privacy as aggressor, publication of unauthorized information.

*F*-test (ANOVA) values and significance coefficients having values less than 0.000 confirm that the model is valid.

Knowing the level of aggressive manifestations in the educational environment and aggressive behaviors using the regression equation – *bullying behaviors = 2.883 + (0.291) violation of privacy as an aggressor + (0.407) publication of unauthorized information + (0.078) tolerance toward unethical behaviors* – we obtain the level bullying behaviors of students in the educational environment.

In the analyzed model, the coefficient B of 0.291 indicates that a unit increase in "Violation of privacy as an aggressor" predicts an average increase of 0.291 units in bullying manifestations. This suggests a close association between privacy-violating behaviors and general aggression, highlighting the need to address respect for privacy in anti-bullying interventions.

The B-coefficient of 0.407 indicates that a unit increase in "Dissemination of information without authorization" is correlated with an average increase of 0.407 units in bullying behavior. This observation suggests that the influence of unauthorized dissemination of information on bullying is even more pronounced than that of invasion of privacy. This strong predictor could indicate a direct connection between disregard for the privacy of others and the propensity for aggressive behavior, thus directing educational programs to emphasize understanding of the repercussions of online activities.

The coefficient B of 0.078 reflects the fact that a unit increase in "Acceptance of unethical behaviors" is associated with an average increase of 0.078 units in bullying manifestations. Although this effect is smaller compared to the other two variables, a positive influence persists. This underlines the fact that permissive attitudes toward unethical behaviors can foster an environment conducive to aggressive manifestations.

In summary, the three variables—violation of privacy, unauthorized dissemination of information, and acceptance of unethical behaviors—are found to be significant predictors of bullying behavior. However, disseminating information without authorization stands out as having the most pronounced impact, followed by invasion of privacy, while accepting unethical behaviors has the least impact.

Figure 3 illustrates a scatterplot of the standardized residuals compared to the standardized predicted values obtained from a regression model with "Bullying Behavior" as the dependent variable.

The pronounced residuals could reflect situations where the model failed to adequately capture student bullying behavior, possibly due to the omission of relevant factors from the analysis. An increase in the variance of the residuals consistent with the predicted values may signal a reduced fit of the model for subjects with more pronounced aggressive manifestations, which could be attributed to complex elements governing these behaviors.

Students associated with extreme values (outliers) could be characterized by particular circumstances or face a distinct social dynamic, which predisposes them to bullying behaviors.

Exploring and interpreting these cases could provide valuable insights essential for designing educational interventions.

The graph indicates a moderate ability of the regression model to predict bulling behavior, while also signaling the possibility of optimization of the model. This could involve the inclusion of new predictor variables or a deeper analysis of atypical cases. From the perspective of educational psychology, these findings can be applied to the development and implementation of more effective anti-violence programs, adapted to the diversity of students' experiences and behaviors.

## 5 Discussions and conclusion

The analysis of bullying behaviors among adolescents, in the context of this study, reflects the complex interaction between individual and environmental factors. The results obtained emphasize the significant role of aggression, violation of privacy, and unauthorized dissemination of information, in line with the existing

TABLE 12 Coefficients[a].

| Model | | Unstandardized Coefficients | | Standardized coefficients | *t* | Sig. | Correlations | | | Collinearity statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *B* | Std. error | Beta | | | Zero-order | Partial | Parthian | Tolerance | VIV |
| 1 | (Constant) | 2,883 | 0.366 | | 7,884 | 0.000 | | | | | |
| | Violation of privacy as an aggressor | 0.291 | 0.064 | 0.235 | 4,557 | 0.000 | 0.388 | 0.223 | 0.202 | 0.739 | 1,352 |
| | Publication of unauthorized information | 0.407 | 0.077 | 0.276 | 5,313 | 0.000 | 0.412 | 0.258 | 0.235 | 0.727 | 1,375 |
| | Tolerance toward unethical behaviors | 0.078 | 0.039 | 0.090 | 1,993 | 0.047 | 0.176 | 0.100 | 0.088 | 0.961 | 1,040 |

[a]Dependent variable: bullying behaviors.

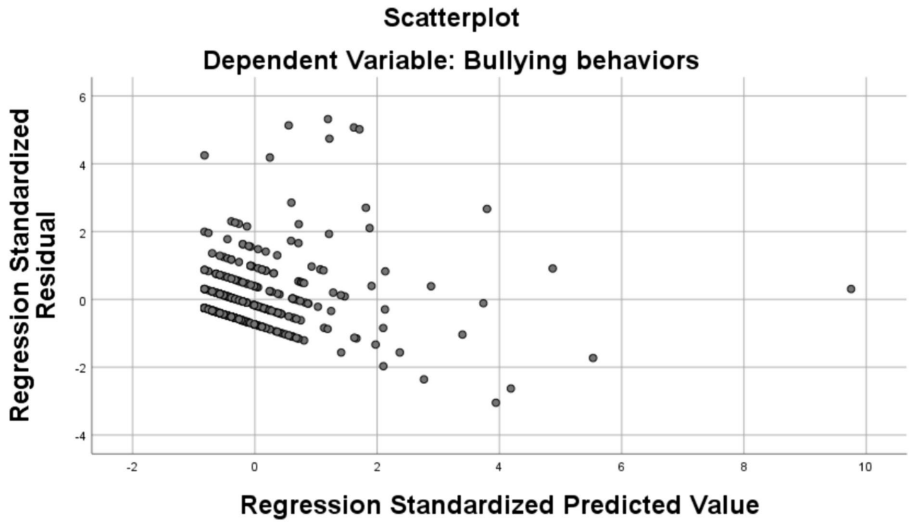


FIGURE 3
The regression scatterplot.

literature that identifies these aspects as relevant to bullying manifestations (Li et al., 2024; Del Moral et al., 2019).

The finding that social exclusion and conflicts in the school environment significantly contribute to the escalation of bullying behaviors reiterates the importance of creating an inclusive and safe school environment. These findings are consistent with previous research emphasizing the need to proactively address conflict and promote social integration to reduce the prevalence of bullying (Schuetz et al., 2022; Saarento et al., 2015).

Interestingly, although the acceptance of unethical behaviors seems to have a lower impact compared to the previously mentioned variables, this aspect does not diminish the importance of cultivating a robust ethical framework among students. This result suggests that although attitudes toward unethical behaviors are not direct predictors of bullying behaviors, they contribute to the general climate that may favor or discourage such manifestations.

The results also indicate a significant association between aggressive behaviors and the dissemination of information without authorization, underscoring the importance of education on the responsible use of technology. This aspect is essential in today's context, where technology plays an increasing role in the lives of teenagers.

It is important to note that this study has specific limitations, being a cross-sectional rather than a longitudinal research. This limits our ability to establish causal relationships between variables and to observe the evolution of bullying behaviors over time. Data were collected at a single point in time, which may affect the interpretation and generalization of the results.

In the context of this study, it was noted that interventions should target both the aggressive behaviors themselves and the contextual factors that may influence them. Promoting socio-emotional skills and empathy, along with encouraging ethical behavior, are essential to address the phenomenon of bullying effectively.

The present study contributes to the existing literature by exploring in detail the predictors of bullying among adolescents, providing an integrated perspective on the interaction between individual characteristics and the socio-school context. The obtained results underline a complex set of variables that influence bullying behavior, among which aggression, violation of privacy, and dissemination of information without authorization stand out as having a significant impact.

The current study extends the literature by investigating the predictive factors of bullying among adolescents, providing an integrated analysis of the interactions between personal characteristics and the socio-school context (Gómez-Ortiz et al., 2019).

The finding that social factors, such as social exclusion and conflicts in the school environment, exacerbate the manifestations of bullying highlights the importance of building an educational environment based on inclusion and effective conflict management. These findings reiterate the need for a multidisciplinary approach to the prevention and intervention against bullying, involving not only formal education but also the development of socio-emotional skills and the promotion of a positive school culture.

The study results highlight a complex array of variables that influence bullying behavior. Notably, aggression, invasion of privacy, and unauthorized dissemination of information are noted to have a substantial impact (Clarke and Kiselica, 1997).

Previous studies confirm that social factors, such as social exclusion and school conflicts, amplify the manifestations of bullying, thus emphasizing the need for an inclusive and effective educational environment in conflict management (Johnson and Smith, 2021).

At the same time, the influence of technology on bullying behaviors, especially the violation of privacy and the dissemination of information without authorization, underlines the importance of digital education among adolescents. This suggests that prevention programs should include components that encourage responsible use of technology and promote awareness of the consequences of online actions.

The study identified the significant influence of technology on bullying behaviors, particularly in the areas of invasion of privacy and dissemination of information without consent. These findings are consistent with research that emphasizes the importance of digital education for adolescents (Miller and Connelly, 2021).

Although the study identified a relatively smaller influence of tolerance toward unethical behaviors on bullying, this aspect should not be neglected in the development of effective interventions. Promoting a strong moral framework and encouraging ethical behaviors can help create a school environment where bullying is explicitly discouraged.

Although a reduced influence of tolerance toward unethical behaviors on bullying was observed, this aspect remains crucial in the development of effective interventions. Interventions must be personalized and tailored to the specific needs of school communities, an aspect supported by the need for collaboration between educators, parents, and students to ensure a safe and supportive environment (Williams et al., 2022).

At the same time, interventions must be personalized and adapted to the specific needs of school communities, considering the variety of factors that contribute to the phenomenon of bullying. Collaboration between educators, parents, and students is essential to the successful implementation of these strategies, thereby ensuring a safe and supportive environment for all adolescents.

The present study has theoretical implications, among which we mention:

The study can contribute to the expansion of existing theories about aggression, through the specific contextualization of cultural, social, and economic factors in Romania that influence bullying behavior. This can lead to adaptations of aggression theories that take into account specific local and regional variables.

The results of the study can validate the effectiveness of the socio-emotional competence model in the Romanian context, indicating the need to adapt educational programs to include specific components that address aggression and bullying behaviors.

By identifying the link between social exclusion and bullying, the study adds an important dimension to theories of social inclusion. This suggests that effective interventions must promote better social integration in schools as a strategy to prevent bullying.

We also highlight the practical implications, based on the results of the study, schools in Romania could develop and implement educational programs that incorporate education for socio-emotional skills, with an emphasis on empathy, anger management, and resilience. These programs can be integrated into the national curriculum as preventive measures against bullying.

Another practical implication refers to the involvement of teachers in recognizing early signs of bullying behavior and appropriate intervention is crucial.

Professional training should include specific modules on early intervention strategies and conflict management, adapted to the cultural and social context in Romania.

The implementation of clear and strict school policies on bullying can deter bullying behaviors and stabilize a safe and inclusive school environment, which can be seen as a third practical implication of the study. These policies should be well communicated to all members of the school community, from students to parents and school staff.

These theoretical and practical implications underline the importance of an integrated and well-grounded approach to combating bullying in Romanian schools, with potential benefits both at the individual level and at the level of the entire educational community.

Recommendations for future research include adopting a longitudinal design to observe the evolution of bullying behaviors and associated factors over an extended period, thus providing a deeper understanding of causal relationships. It is necessary to expand the sample to include a wider variety of schools and regions, thereby enhancing the representativeness and generalizability of the obtained results.

Integrating additional variables, such as the influence of the family environment and the impact of media, could provide a more complete perspective on the factors contributing to bullying behaviors.

Additionally, investigating gender differences in the manifestations and perceptions of bullying is essential for developing tailored interventions that address the specific needs of boys and girls.

In conclusion, our study adds a valuable contribution to understanding the bullying phenomenon, providing clear recommendations for future research and practical applications.

The continuation of research in this field is essential for the adaptation and constant improvement of scientific approaches in the prevention and intervention against bullying, with the ultimate goal of ensuring adolescents' well-being and positive development in healthy and inclusive educational environments (Harris and Jones, 2019).

## 5.1 Limitations of the study

Like any other research, the present study involves certain limitations. Firstly, the study was cross-sectional, with all instruments used in the study being completed at a single time point. Future studies could be conducted in multiple waves so that causal inferences can be drawn about the investigated relationships.

Secondly, all studied variables were measured with self-report questionnaires. In future research, performance could be measured based on objective indicators.

Thirdly, the study was cross-sectional, therefore no causal conclusions can be drawn. The investigated relationships may have meaning in several directions. Future research could use longitudinal designs in which data are collected at multiple time intervals to estimate the causal order of the investigated relationships.

The unexplained variance in this study suggests that there are a significant number of additional variables influencing bullying behaviors that were not included in this study. This underscores the need to extend the research to identify and measure these confounding variables in a longitudinal study so that more precise regression models can be developed and more effective interventions and policies for preventing and managing bullying in the educational environment can be created.

We intend to transform this study into a longitudinal one by conducting annual measurements on the studied cohort. This approach will allow for the comparison of results over time and an in-depth observation of the stability of bullying behaviors.

A longitudinal study offers a detailed perspective on the evolution and persistence of bullying behaviors among students. By collecting annual data, we will be able to analyze changes and constants in participants' behaviors, providing a clearer understanding of the dynamics of bullying in an educational context.

Repeated measurements on the same cohort will allow for the observation of changes in behavior and the assessment of the long-term impact of contextual and individual variables. We will collect annual data on bullying incidents, including verbal attacks, and correlate these data with factors such as social exclusion, school conflicts, academic performance, and psychosocial health.

Longitudinal analysis will detect patterns of stability or change in bullying behaviors, providing a solid basis for recommendations on educational policies and intervention strategies. The results obtained will contribute to a deeper understanding of the bullying phenomenon and support the development of better-founded prevention and intervention programs.

# Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

# Ethics statement

The studies involving humans were approved by University Ethics and Deontology Commission, Ovidius University, Constanta, Romania No 7/10.07.2024. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

# Author contributions

MR: Conceptualization, Supervision, Validation, Writing – review & editing. MC: Supervision, Visualization, Writing – review & editing. MS: Methodology, Writing – original draft, Writing – review &

editing. TT: Conceptualization, Investigation, Supervision, Writing – original draft, Writing – review & editing.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

The authors would like to thank the participants who were involved in the present research.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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frontiers | Frontiers in Psychology

TYPE Original Research
PUBLISHED 08 January 2025
DOI 10.3389/fpsyg.2024.1439478



OPEN ACCESS

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RECEIVED 28 May 2024
ACCEPTED 19 December 2024
PUBLISHED 08 January 2025

CITATION
Li Q, Du X, Chen H and Zhou X (2025) How can graduate students' research pressure be transformed into motivation and innovative behavior? The role of graduate students' mentorship homegate (or team) support.
*Front. Psychol.* 15:1439478.
doi: 10.3389/fpsyg.2024.1439478



# How can graduate students' research pressure be transformed into motivation and innovative behavior? The role of graduate students' mentorship homegate (or team) support

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**Introduction:** This study explores how graduate students' mentorship homegate (or team) support (GSMTS) and challenging-hindering pressures impact their intrinsic motivation for research, identification with research roles, and innovative behaviors.

**Methods:** Data from 548 graduate students were collected using convenience sampling and analyzed using Amos and SPSS statistical software package via questionnaires distributed to universities in SiChuan province of China.

**Result:** The findings reveal that (1) research stress can not directly and positively predict innovative behaviors among graduate students, while intrinsic research motivation and research role identification mediate the relationship between research stress and graduate students' innovative behavior; (2) hindering research pressure negatively impacts the intrinsic motivation for research, whereas challenging research pressure has a positive effect; (3) GSMTS directly fosters innovative behaviors among graduate students, with intrinsic motivation and roles' identification for research as sequential mediators; and (4) GSMTS positively moderates the relationship between challenging research pressure and both the intrinsic motivation for research and role identity.

**Discussion:** This suggests that higher education institutions should cultivate an optimal research and innovation environment for graduate students by increasing challenging research pressure and reducing hindering pressure. They should also emphasize the development of graduate students' intrinsic motivation for research and identification with research roles. Concurrently, the role of GSMTS should be highlighted to facilitate both the direct and indirect development of graduate students' innovative behaviors.

KEYWORDS

**challenging-hindering research pressure, graduate students' mentorship homegate (or team) support, intrinsic research motivation, research role identity, innovative behavior**

# Introduction

As global competition intensifies and a knowledge economy has emerged, fostering innovation among graduate students has become a focal point of postgraduate education. Chinese higher education institutions are continually elevating academic expectations for graduate students; yet a substantial shortfall exists in meeting the practical demands of society regarding innovative thought, behavior, and output (Wang and Sun, 2022). Consequently, fostering creativity in graduate students is a formidable challenge, as they face escalating academic and research pressures. For example, graduate students are expected to engage in research projects and publish papers, with publication often linked to academic rewards and graduation requirements. Many universities explicitly mandate a certain number of publications for graduation (Zhao et al., 2024), which creates tremendous academic pressure and anxiety among students. Additionally, these publications invoke rigorous double-blind reviews, markedly increasing research pressure (Li and Li, 2023). Previous research indicates that research pressure can create divergent outcomes, either stimulating intrinsic motivation and enhancing research output or, conversely, resulting in psychological health issues and academic misconduct (Li et al., 2018). Thus, transforming research pressure into intrinsic research motivation and innovative behavior has become a focal point of attention in graduate education.

# Literature review

## Relationship between challenging-hindrance research pressure and innovative behavior

Graduate students' innovative behavior primarily refers to the process by which students not only apply their specialized theoretical knowledge, guided by innovative consciousness and creative thinking, to solve problems in novel ways but also place creative thought into practice to achieve innovative results (Zhang et al., 2022). The relationship between stress and innovative behavior has always been a research focus but is highly controversial, and most studies have focused on corporate employees. Although stress can promote innovative behavior (Sun et al., 2018), it can also affect it negatively (Cao et al., 2021). As these contrasting findings may be due to the lack of differentiation in previous studies, this study further explores the relationship between challenging-hindrance research pressure and innovative behavior.

Research pressure on graduate students can be divided into challenging and hindering pressures. Challenging research pressures are characterized by heavy research tasks, high standards for research innovation, and urgency; whereas hindering research pressures manifest as a scarcity of learning resources and an unclear and unfair distribution of research tasks by mentors (Liu, 2017). Empirical studies from the perspectives of social exchange, social cognition, and the conservation of resources (Chen et al., 2021) have demonstrated that challenging pressure can facilitate innovative employee behavior, whereas hindering pressure can inhibit it (Peng, 2021; Xu et al., 2021). Specifically, employees facing challenging pressures may perceive opportunities for personal growth or development (Du et al., 2014), which can ignite their enthusiasm to overcome these pressures, and consequently, they exhibit innovative behavior. This suggests that graduate students facing challenging research pressure may be more inclined to proactively seek novel solutions to problems, potentially benefiting their innovative behavior; however, graduate students confronted with hindering pressure may respond to research tasks passively and negatively, which could adversely affect their innovation.

Accordingly, this study proposes Hypothesis 1a (H1a): Challenging research pressure positively predicts graduate students' innovative behavior, whereas hindering research pressure negatively predicts graduate students' innovative behavior.

## Mediating role of intrinsic research motivation and research role identity

Intrinsic research motivation refers to graduate students' internal, spontaneous, and enduring passion and commitment to research activities (Dong et al., 2021). According to the conservation of resources theory, graduate students may be inspired to invest more resources in future research activities due to the sense of academic achievement gained from completing challenging research tasks. In contrast, graduate students who face hindering research pressure may perceive these pressures as insurmountable, reducing their passion for research and leading them to adopt a resource-conservation approach (Zhang et al., 2018). Empirical studies have also revealed that hindering research pressure can weaken graduate students' research motivation (Van den Broeck et al., 2010). This suggests that differences may exist in the relationship between challenging-hindering research pressures and graduate students' intrinsic research motivation.

Additionally, intrinsic motivation is a crucial internal factor for graduate students to engage in innovative behavior (Cheng et al., 2013), encouraging them to actively participate in research and achieve more with less effort. The self-determination theory emphasizes intrinsic motivation' s influence on behavior (Deci et al., 1999). Further, Amabile and Pratt (2016) considered the dynamic componential theory of creativity to further emphasize that innovative behavior depends on the synergy between individual intrinsic motivation and the external environment. Meta-analyses indicate a significant, positive relationship between intrinsic motivation and creative performance (Cerasoli et al., 2014; de Jesus et al., 2013; Liu et al., 2016). Therefore, a close relationship may exist between challenging-hindering scientific research pressures and graduate students' intrinsic motivation and innovative behavior in research.

Identifying the research role involves graduate students incorporating research into their self-concept (Yin et al., 2016). Scholars have found that challenging research pressures can enhance graduate identification, whereas hindering pressures can reduce it (Li et al., 2018b). The role identity theory posits that aligning individual behavior with expected social roles is central to role identification (Albert et al., 2000; Wang, 2010). This implies that once graduate students identify with a research role, they may be driven to engage in innovative activities. Previous research also indicates that research role identification positively influences creativity and resilience (Perez et al., 2014), which are foundational for innovative behavior. Therefore, research role identification likely has a close relationship with innovative behavior.

Moreover, challenging and hindering scientific research pressures may differently affect the relationships among intrinsic motivation,

research role identification, and innovative behavior. Studies in corporate settings suggest that while challenging pressures can boost self-efficacy and encourage innovation, obstructive pressures might lower self-efficacy and dampen creativity (An et al., 2021). Self-efficacy not only propels motivation but also forms the basis of research role identification. Moreover, intrinsic motivation is foundational to research role identification, as it drives graduate students' passion for and engagement in scientific activities, facilitating the recognition of their researcher identity in the academia (Zhao and Jia, 2022).

Therefore, this study proposes Hypotheses 2a–2c (H2a-H2c): Hypothesis 2a posits that internal research motivation mediates the relationship between research pressure and the innovative behavior of graduate students. Hypothesis 2b states that research role identity mediates the relationship between research pressure and graduate students' innovative behavior. Finally, Hypothesis 2c proposes that both internal research motivation and research role identity sequentially mediate the relationship between research pressure and the innovative behavior of graduate students.

## Role of graduate students' mentorship homegate (or team) support

According to Eisenberger and Huntington's (1986) organizational support theory, graduate students' mentorship homegate (or team) support (GSMTS) is the assistance and support those graduate students receive from their mentors or peers during their academic and research endeavors. The "mentor's gate" is an important venue where graduate mentors and students interact and communicate, thereby educating and influencing students. It is significant in the graduate education process (Liu, 2021). Graduate students primarily conduct academic exchange activities within graduate students' mentorship homegate. The academic discussions, intellectual meetings, and emotional exchanges between mentors and graduate students, as well as among fellow students, are key influencing factors for research innovation behavior. For instance, Hu (2017) suggested that mentors and peers are the closest contacts for graduate students within the university, significantly impacting their learning and research activities. Further, graduate students' innovative behavior results from the interplay of external and internal factors (Wu et al., 2014), with GSMTS being a significant external influence. Hou et al. (2016) observed that autonomy support from mentors can effectively predict and enhance graduate students' innovative behavior. Therefore, GSMTS may directly foster innovation among graduate students.

Moreover, such support closely connects to graduate students' intrinsic motivation and identification with their research. GSMTS fosters a sense of belonging while encouraging a proactive approach to research challenges (Zhu et al., 2016). This sense of belonging is a key pathway to forming a research role identity; being proactive is a significant manifestation of intrinsic research motivation, suggesting that GSMTS can influence both. In university research activities, graduate students' interactions with mentors and peers within their research team and the support they receive can further promote their self-identification as researchers and their active participation in research activities (Li et al., 2018).

Additionally, GSMTS may further modulate the relationship between scientific research pressure and innovative behavior, intrinsic motivation, and research role identification. Studies on employees indicate that challenging work pressures, moderated by perceived organizational support, enhance proactive innovative behaviors (Yang et al., 2019), with organizational support acting as a buffer in stressful situations (Zhang, 2020). Hence, perceived organizational support moderates the relationship between stress and innovative behavior (Janssen, 2000; Du et al., 2014); subsequently, GSMTS could also buffer graduate students' research pressure. Moreover, educators' support has been shown to predict students' motivation and academic performance (Ahmed et al., 2018), indicating that research pressure might boost graduate students' intrinsic motivation and strengthen research role identification through the moderation of GSMTS.

Thus, this study proposes Hypotheses 1b (H1b): GSMTS has a positive predictive effect on graduate students' innovative behavior. Further, Hypothesis 3 (H3) states that this also positively moderates the relationship between scientific research pressure and graduate students' innovative behavior, intrinsic motivation, and research role identification.

# Research methods

## Participants

A questionnaire survey was administered utilizing both group and individual methodologies among graduate students. A total of 548 graduate students from various universities in Sichuan Province participated in the survey, with all participants having been enrolled for a minimum duration of 6 months. The gender distribution was as follows: 275 males (50.2%), 267 females (48.7%), and 6 missing (1.1%). The grade distribution was as follows: first-year (251 students, 45.8%), second-year (158, 28.8%), and third-year and above (138, 25.2%), with 1 missing student (0.2%). The distribution by academic discipline was as follows: humanities and social sciences (201 students, 36.7%), science (87, 15.9%), engineering (256, 46.7%), and medicine (3, 0.5%), with 1 missing (0.2%). The distribution by degree type was professional degrees (212 students, 38.7%) and academic degrees (335, 61.1%), with 1 missing (0.2%).

## Survey questionnaire

The challenging-hindering scientific research pressure scale has been revised based on the scale developed by Yao and Ma (2021). It includes five items on challenging research pressure, such as undertaking challenging tasks, heavy research responsibilities, mastering numerous research methods, feeling time-pressured, and having a high volume of research tasks. The obstructive research pressure subscale also includes five items: unclear task allocation, unfair resource distribution, vague evaluation standards, cumbersome processes, and a sense of stagnation in one' s academic career. The questionnaire consists of 10 items scored on a five-point scale, with responses ranging from 1 (completely disagree) to 5 (completely agree).

The administered questionnaire underwent an exploratory factor analysis, retaining 10 items with factor loadings between 0.66 and 0.87. These were aggregated into two factors: the first dimension, or "hindering research tasks," accounted for 41.77% of the variance, and the second dimension, "challenging research tasks," accounted for 20.02%. The total explained variance of the questionnaire was 61.79%,

as presented in Table 1. Scores were calculated by summing the items within each dimension, with higher scores indicating greater research pressure experienced by the graduate students. The mean and standard deviation of the scale scores are shown in Table 2.

The GSMTS questionnaire was adapted from Devine and Hunter (2016) organizational support questionnaire and was culturally revised to focus on the GSMTS experienced by graduate students. Items such as When I encounter problems, my mentor group provides help and My mentor group values my goals and beliefs were included. The questionnaire consists of six items scored on a five-point scale, ranging from 1 (completely disagree) to 5 (completely agree). After administering the questionnaire, an exploratory factor analysis was conducted on the valid responses, retaining six items that loaded onto one factor with loadings between 0.74 and 0.85, explaining 65.06% of the variance, as presented in Table 3. The total score was obtained by summing the item scores, and reflects the level of support perceived by the graduate students, with higher scores indicating a greater sense of support. The mean and standard deviation of the scale scores are shown in Table 2.

Zhang and Bartol (2010) developed a questionnaire on graduate students' intrinsic motivation for scientific research that included a five-item research-related intrinsic motivation scale (e.g., "I am engaged in the pursuit of resolving intricate scientific research challenges"). They adopted a five-point scoring system, with responses ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the greater the intrinsic motivation for scientific research. The mean and standard deviation of the scale scores are shown in Table 2.

This study also adopted the research role identity scale developed by Robnett et al. (2015), which exhibits good reliability and validity in the domestic research population (Yin et al., 2016). This questionnaire consists of five items (e.g., "I am innately disposed to the vocation of scientific research"), with a five-point scoring system and responses ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the greater the graduate student' s recognition of their research role. The mean and standard deviation of the scale scores are shown in Table 2.

Su et al. (2021) considered the innovation behavior scale developed by Scott and Bruce (1994) to make corresponding revisions to measure graduate students' innovation behavior; the resulting adapted scale exhibits good reliability and validity. This questionnaire includes eight items (e.g., "I consistently contribute innovative ideas and concepts to my research endeavors"). And adopts a five-point scoring method, with responses ranging from 1 (completely disagree) to 5 (completely agree). The higher the score, the greater the impact on graduate students' innovation behavior. The mean and standard deviation of the scale scores are shown in Table 2.

## Data analysis

The relevant data analysis and processing were completed using SPSS 26.0 and AMOS 17.0 statistical software.

# Results

## Construct validity and reliability

The structural validity of the five scales is presented in Table 4. The results of the confirmatory factor analysis (CFA) for the Challenging-Obstructive Research Pressure Scale indicate a good model fit ($\chi^2 = 106.20$, $df = 30$, $p < 0.001$, CFI = 0.95, TLI = 0.97, RMSEA = 0.068), with factor loadings ranging from 0.34 to 0.94. The Cronbach's $\alpha$ coefficients for the two factors are 0.78 (Challenging Research Pressure) and 0.89 (Hindering Research Pressure).

The CFA results for the Graduate Students' Mentorship Homegate Support Scale ($\chi^2 = 27.99$, df = 6, $p < 0.001$, CFI = 0.97, TLI = 0.99, RMSEA = 0.082) showed that the data fit of the model was acceptable, with factor loadings ranging from 0.54 to 0.84. The Cronbach's α coefficient for this scale is 0.89.

For the Intrinsic Research Motivation Scale, the CFA results ($\chi^2 = 16.74$, $df = 3$, $p < 0.001$, CFI = 0.97, TLI = 0.99, RMSEA = 0.091) show an acceptable data fit. Factor loadings range from 0.48 to 0.93, with a Cronbach's α coefficient of 0.90, indicating good internal consistency.

The CFA results for the Research Role Identity Scale ($\chi^2 = 27.28$, $df = 5$, $p < 0.001$, CFI = 0.98, TLI = 0.99, RMSEA = 0.090) show an

TABLE 1 Exploratory factor structure of challenging and hindering research pressure.

| Questionnaire entries | Factor load | |
|---|---|---|
| | Challenging research pressure | Hindering research pressure |
| 1. I am in the research group and need to undertake challenging scientific research tasks. | 0.79 | |
| 2. I am in the research group and need to take on a heavy research responsibility. | 0.84 | |
| 3. To engage in scientific research work, I need to master many research methods. | 0.58 | |
| 4. In scientific research work, I often feel that time is tight. | 0.66 | |
| 5. I have a large amount of research tasks to complete. | 0.70 | |
| 6. In my research group, the allocation of scientific research tasks is unclear. | | 0.83 |
| 7. My research group has an unfair allocation of scientific research resources. | | 0.87 |
| 8. The evaluation criteria for the scientific research work I am engaged in are vague. | | 0.87 |
| 9. My academic career seems to have come to a standstill. | | 0.74 |
| 10. In the process of conducting scientific research work, I must go through cumbersome procedures. | | 0.79 |

TABLE 2 Descriptive statistics and correlation analysis of various research variables.

| | $M \pm SD$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1. Challenging research pressure | 3.11 ± 0.71 | 1 | | | | | |
| 2. Hindering research pressure | 2.37 ± 0.85 | 0.32** | 1 | | | | |
| 3. GSMTS | 3.83 ± 0.64 | −0.01 | −0.41** | 1 | | | |
| 4. Intrinsic motivation in scientific research | 2.97 ± 0.93 | 0.23** | −0.14** | 0.25** | 1 | | |
| 5. Identification of scientific research roles | 2.56 ± 0.91 | 0.21** | −0.12** | 0.18** | 0.72** | 1 | |
| 6. Innovation behavior of graduate students | 3.28 ± 0.67 | 0.16** | −0.15** | 0.27** | 0.56** | 0.48** | 1 |

*$p < 0.05$; **$p < 0.01$.

TABLE 3 Exploratory factor structure of graduate students' mentorship homegate (or team) support.

| Questionnaire entries | Factor load |
|---|---|
| 1. My mentorship homegate (or team) cares about my opinions. | 0.74 |
| 2. My mentorship homegate (or team) is concerned about my mental health. | 0.81 |
| 3. My mentorship homegate (or team) values my goals and values. | 0.85 |
| 4. When I encounter problems, my mentorship homegate (or team) can provide assistance. | 0.84 |
| 5. My mentorship homegate (or team) will forgive my unintentional mistakes. | 0.80 |
| 6. If I need special assistance, my mentorship homegate (or team) is willing to assist me. | 0.79 |

acceptable data fit. Factor loadings range from 0.48 to 0.93, with a Cronbach's α coefficient of 0.94, indicating good internal consistency.

The CFA results for the Innovative Behavior Scale ($\chi^2 = 90.42$, $df = 18$, $p < 0.001$, CFI = 0.95, TLI = 0.97, RMSEA = 0.086) show an acceptable data fit. Factor loadings range from 0.65 to 0.80, with a Cronbach's α coefficient of 0.90, indicating good internal consistency.

## Common method bias (CMB)

The present study employed Harman's single-factor test to assess the presence of common method bias. The results revealed six common factors with eigenvalues greater than 1, with the primary common factor accounting for 28.75% of the variance. This percentage falls below the critical threshold of 40%, indicating that there is no significant common method bias present in this study.

## Descriptive statistics and correlation analysis of each research variable

Descriptive statistics and correlational analyses were conducted on the variables, as presented in Table 2. The results indicate significant correlations among the challenging scientific research pressure, hindering scientific research pressure, intrinsic motivation for research, research role identification, and graduate students' innovative behavior ($p < 0.01$). GSMTS did not significantly correlate with challenging scientific research pressure ($p > 0.05$) but did significantly correlate with all other research variables ($p < 0.01$).

## Mediation analysis

Challenging-hindering research stress and GSMTS are independent variables, with research motivation and role identification as mediators and graduate innovation as the dependent variable. As shown in Figure 1, the data fit was acceptable ($\chi^2/df = 3.34$, GFI = 0.98, AGFI = 0.96, NFI = 0.98, CFI = 0.98, and RMSEA = 0.07).

The SEM results showed that hindering research pressure had a weakly negative association with intrinsic research motivation ($\beta = -0.16$, $p < 0.05$), with a small effect size. GSMTS was positively associated with intrinsic research motivation ($\beta = 0.18$, $p < 0.05$), graduate students' innovative behavior ($\beta = 0.14$, $p < 0.05$), research role identity and graduate students' innovative behavior ($\beta = 0.16$, $p < 0.05$), with small effect sizes. Challenging research pressure had significantly positive association with intrinsic research motivation ($\beta = 0.29$, $p < 0.05$), intrinsic research motivation and research role identity ($\beta = 0.72$, $p < 0.05$), and graduate students' innovative behavior ($\beta = 0.41$, $p < 0.05$), with moderate to large effect sizes.

Bootstrapping ($N = 2{,}000$) was used to test the significance of each path in the model, and Table 5 presents the results. All the model paths have confidence intervals that do not include zero, indicating significance, and the model' s total effect size is 0.38. Hence, GSMTS directly and positively predicts graduate students' innovative behavior. Additionally, both challenging-hindering research stress and GSMTS indirectly predict graduate students' innovative behavior through the mediating variable of intrinsic research motivation. Intrinsic research motivation and research role identification also serve as chained mediators between challenging-hindrance research stress, GSMTS, and graduate students' innovative behavior.

## Moderating analysis

A hierarchical regression was employed to assess the moderating role of GSMTS in the relationships between challenging-hindrance research stress and intrinsic research motivation, research role identification, and graduate students' innovative behavior. First, independent t-tests and analysis of variance (ANOVA) were conducted to examine significant differences in innovative behavior across different academic majors and years, while controlling for gender, academic year, and major. Second, hindering-challenging research pressure and mentor support were treated as independent

TABLE 4 Confirmatory factor analysis results for the scales.

| | | $\alpha$ | $\chi^2$ | $\chi^2/df$ | $p$ | $df$ | CFI | TLI | RMSEA |
|---|---|---|---|---|---|---|---|---|---|
| Scientific Research Pressure Scale | Challenging | 0.78 | 106.20 | 3.54 | 0.000 | 30 | 0.97 | 0.95 | 0.068 |
| | Hindering | 0.89 | | | | | | | |
| GSMTS Scale | | 0.89 | 27.99 | 4.66 | 0.000 | 6 | 0.99 | 0.97 | 0.082 |
| Intrinsic Motivation for Scientific Scale | | 0.90 | 16.74 | 5.58 | 0.000 | 3 | 0.99 | 0.97 | 0.091 |
| Research Role Identity Scale | | 0.94 | 27.28 | 5.46 | 0.000 | 5 | 0.99 | 0.98 | 0.090 |
| Innovation Behavior Scale | | 0.90 | 90.42 | 5.02 | 0.000 | 18 | 0.97 | 0.95 | 0.086 |

*$p < 0.05$; **$p < 0.01$.

TABLE 5 Bootstrap analysis of the significance test of path effects.

| Path | Estimated value of standardized effects | 95% confidence interval | |
|---|---|---|---|
| | | lower limit | upper limit |
| Hindering research pressure → intrinsic motivation in research → innovative behavior of graduate students | 0.16 × 0.41 = 0.07 | −0.08 | −0.002 |
| Hindering research pressure → intrinsic motivation for research → identification of research roles → innovative behavior of graduate students | 0.16×0.72×0.16 = 0.02 | −0.05 | −0.02 |
| Challenging research pressure → intrinsic motivation in research → innovative behavior of graduate students | 0.29 × 0.41 = 0.12 | 0.06 | 0.09 |
| Challenging research pressure → intrinsic motivation for research → identification of research roles → innovative behavior of graduate students | 0.29 × 0.72 × 0.16 = 0.03 | 0.01 | 0.07 |
| GSMTS → Graduate student innovation behavior | 0.14 | 0.07 | 0.22 |
| GSMTS → Intrinsic motivation in scientific research → Innovative behavior of graduate students | 0.18 × 0.41 = 0.07 | 0.03 | 0.14 |
| GSMTS → intrinsic motivation for scientific research → identification of scientific research roles → innovative behavior of graduate students | 0.18 × 0.72 × 0.16 = 0.02 | 0.00 | 0.05 |

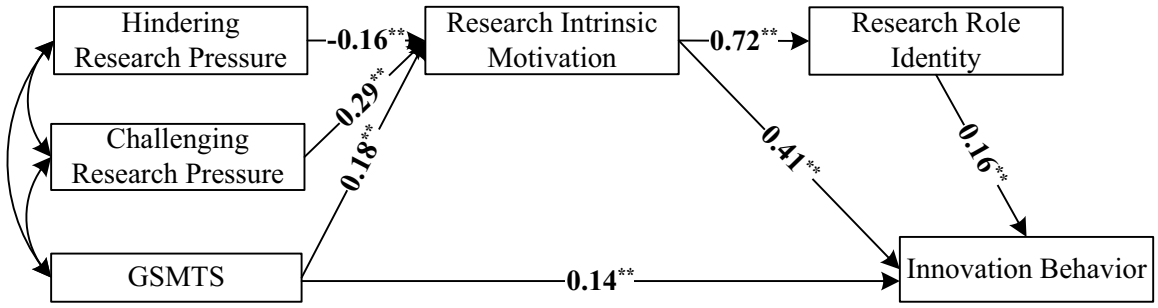


FIGURE 1
Mediation effect model (M1).

variables, with innovative behavior serving as the dependent variable to evaluate the main effects. Finally, intrinsic research motivation and research role identity were considered as moderating variables to investigate their moderating effects. The interaction terms of hindrance research stress with intrinsic research motivation, challenging research stress with intrinsic research motivation, hindrance research stress with research role identification, challenging research stress with research role identification, hindrance research stress with graduate students' innovative behavior, and challenging research stress with graduate students' innovative behavior were tested for their moderating effects. Table 6 presents the outcomes.

The interaction effect of GSMTS and challenging research stress significantly influences intrinsic research motivation ($\beta = -0.10$, $p < 0.05$) and notably increases the explained variance in intrinsic research motivation ($\Delta R^2 = 0.01$, $p < 0.01$). The interaction effect also significantly affects research role identification ($\beta = -0.12$, $p < 0.01$), with a significant increase in the explained variance for research role identification ($\Delta R^2 = 0.02$, $p < 0.01$). However, the moderating effect of GSMTS on the relationship between challenging research stress and graduate students' innovative behavior was not significant ($p > 0.05$), nor was the moderating effect of GSMTS on the relationship between hindrance research stress and research intrinsic motivation, research role identification, and graduate students' innovative behavior ($p > 0.05$).

Further analysis of simple slopes revealed that when GSMTS was one standard deviation below the mean, the predictive effect of

challenging research pressure on intrinsic research motivation was significant (simple slope = 0.34, $t = 6.26$, $p < 0.01$). Similarly, when GSMTS was one standard deviation above the mean, the predictive effect of challenging research pressure on intrinsic research motivation remained significant (simple slope = 0.53, $t = 3.80$, $p < 0.001$), as shown in Figure 2.

Further analysis of simple slopes revealed that when GSMTS was one standard deviation below the mean, the predictive effect of challenging research pressure on research role identity was significant (simple slope = 0.29, $t = 5.28$, $p < 0.01$). Conversely, when GSMTS was one standard deviation above the mean, the predictive effect of challenging research pressure on research role identity was also significant (simple slope = 0.48, $t = 3.48$, $p < 0.01$), as shown in Figure 3.

Figures 2, 3 demonstrate that within the high GSMTS group, a linear upward trend occurs in graduate students' intrinsic research motivation and research role identification as challenging research stress increases. In contrast, within the low GSMTS group, the increase in challenging research stress results in a more gradual change in intrinsic research motivation and research role identification.

# Discussion

This study constructed a moderated mediation model to confirm the chained mediating role of intrinsic research motivation and research role identification between research stress, GSMTS, and graduate innovative behavior. This confirmed the positive effect of GSMTS. The findings contribute to a deeper understanding of the mechanisms by which research stress affects graduate students' innovative behavior and the conditions that enhance this mechanism.

## Intrinsic motivation and role identity as mediators in scientific research

This study revealed that challenging-hindrance research stress does not directly predict graduate students' innovative behavior; thus, Hypothesis H1a was not supported. However, hindrance research stress has a significant, negative correlation with graduate students' innovative behavior, whereas challenging research stress has a significant, positive correlation. This finding aligns with previous research indicating that challenging work stress can enhance employees' innovative behavior, whereas hindering work stress can inhibit it (Cao et al., 2021). For employees, challenging work stress can be overcome by stimulating their coping ability and creative enthusiasm, whereas the negative impact of hindering work stress can prevent them from completing tasks (Zhao and Yang, 2020). For graduate students, however, both challenging and hindering research stress can cause significant psychological burdens. Although previous studies have demonstrated that challenging research stress can positively promote graduate students' academic achievements (Du et al., 2019) and that hindrance research stress can negatively inhibit graduate students' research performance (Liu, 2017), graduate students are just beginning their research activities, and their research foundation is relatively weak. Therefore, research stress may not directly affect their innovative behavior.

This study confirms that intrinsic research motivation and research role identification mediate the relationship between research stress and graduate students' innovative behavior, supporting Hypothesis H2c. Specifically, intrinsic research motivation significantly mediates this relationship, thus supporting Hypothesis H2a; while Hypothesis H2b is not supported. Research role identification positively influences graduate innovation, consistent with previous research (Yin et al., 2016). Challenging research stress promotes innovation by enhancing intrinsic motivation and role identification, whereas hindrance stress inhibits innovation by diminishing these factors. Prior empirical studies have noted that challenging research stress positively affects graduate research performance by stimulating the achievement motivation (Wang et al., 2014), and hindrance stress exacerbates anxiety by reducing it (Yao and Ma, 2021). Intrinsic motivation is an active internal factor for graduate students, driving their engagement in research—and ultimately, innovation. Additionally, intrinsic motivation fosters research role identification, likely due to the internal and external recognition gained during research activities (Mantai, 2017). Thus, research stress indirectly impacts graduate innovation through the mediating roles of intrinsic motivation and research role identification.

## Direct and indirect roles of graduate students' mentorship homegate (or team) support

This study revealed that GSMTS positively predicts graduate students' innovative behaviors, confirming Hypothesis 1b. This finding aligns with previous research, which generally agrees that organizational support positively influences employees' creativity (Hu, 2019; Huang et al., 2020). Graduate students' innovative behaviors are inseparable from the support of their mentors and peers, whether by stimulating research ideas or providing guidance and suggestions throughout the research process. Both mentors and peers are significant, increasing the effectiveness of students' research innovation; peer support enables graduate students to proactively face pressure and more actively address problems that arise in research innovation. However, the moderating role of GSMTS between research pressure and innovative behavior is not significant, possibly because as research pressure increases, GSMTS alone is insufficient to meet graduate students' needs to successfully cope with research pressure.

GSMTS can significantly and positively modulate the relationship between challenging research pressure and both the intrinsic motivation for research and identification with the research role, partially confirming Hypothesis 3. Specifically, high GSMTS conditions demonstrate a more linear increase in graduate students' intrinsic motivation for research and identification with the research role as challenging research pressure increases than low GSMTS. This may be because such support gives graduate students a sense of confidence and security when facing challenging research pressures; once these pressures are overcome, it enhances their intrinsic motivation for research and identification with the research role.

Previous empirical studies have also noted that support positively affects various research fields. For example, organizational support can positively predict employee performance (Wang and Chen, 2021), increase individuals' motivation for development (Lin, 2022),

TABLE 6 Stepwise regression analysis of research intrinsic motivation, research role identification, and graduate students' innovative behavior.

| Step | independent variable | Model a1 | Model a2 | Model a3 | Model b1 | Model b2 | Model b3 | Model c1 | Model c2 | Model c3 |
|---|---|---|---|---|---|---|---|---|---|---|
| Step1 | Gender | −0.10* | −0.12* | −0.12* | −0.09 | −0.10* | −0.10* | −0.12* | −0.14** | −0.14** |
| | major | 0.05 | 0.05 | 0.04 | 0.03 | 0.03 | 0.03 | −0.03 | −0.03 | −0.03 |
| | grade | 0.06 | 0.01 | 0.01 | 0.11* | 0.07 | 0.07 | 0.17** | 0.14** | 0.13** |
| Step 2 | Challenging research pressure (T) | | 0.27** | 0.26** | | 0.24** | 0.23** | | 0.16** | 0.16** |
| | Hindering research pressure (Z) | | −0.16** | −0.15** | | −0.17** | −0.16** | | −0.12* | −0.12* |
| | GSMTS (S) | | 0.20** | 0.21** | | 0.12** | 0.13** | | 0.23** | 0.24** |
| Step 3 | S x T | | | 0.10* | | | 0.12** | | | 0.05 |
| | S x Z | | | −0.00 | | | −0.01 | | | −0.06 |
| $\Delta R^2$ | – | 0.02 | 0.16 | 0.17 | 0.03 | 0.11 | 0.13 | 0.05 | 0.15 | 0.15 |
| $F$ | – | 4.39** | 16.31** | 13.17** | 5.19** | 11.38** | 9.54** | 8.87** | 15.71** | 12.10** |

*$p < 0.05$; **$p < 0.01$.

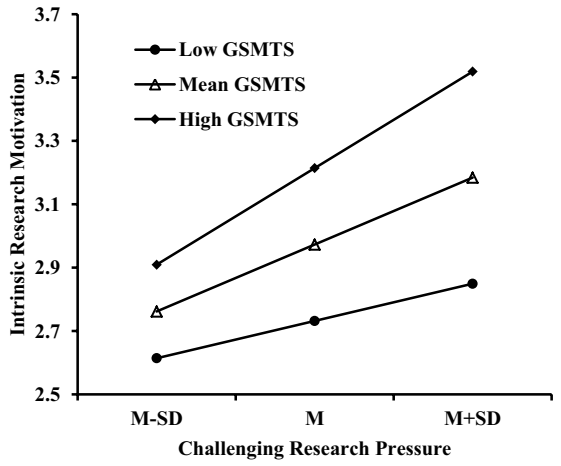


FIGURE 2
Moderation of challenging research pressure and intrinsic motivation by GSMTS.

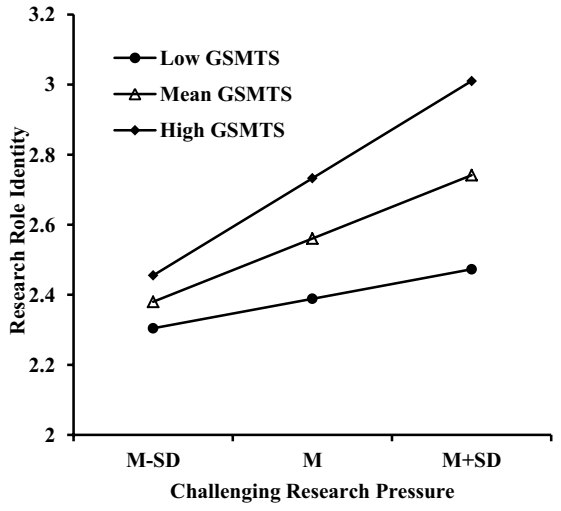


FIGURE 3
Moderation of challenging research pressure and research role identification by GSMTS.

and reduce individuals' levels of anxiety and depression (Zhou et al., 2022). Thus, the positive role of GSMTS is significant in graduate students' innovative behavior as well as their overall development. GSMTS indirectly influences graduate students' innovative behavior by modulating the relationship between challenging research pressure and intrinsic motivation for research and identification with the research role. However, such support cannot modulate the relationship between hindering research pressure and intrinsic motivation for research or identification with the research role. This is possibly because obstructive research pressure leads to a greater loss of psychological resources and a more negative impact on graduate students, to the extent that it cannot be alleviated through GSMTS.

## Limitations

This study also has certain limitations. First, it did not employ a cross-sectional study design; thus, causality cannot be established. Future research could use longitudinal and experimental studies to further explore causal relationships. Second, this study did not integrate a variety of different methods due to various constraints, but the data was based on graduate students' self-reports. In the future, more objective methods could be used to collect data. Last, the study was conducted only in the field of education and was limited to a specific geographical area, which restricts the results' generalizability. Therefore, research conducted by other teams and processing data obtained at different times may lead to different outcomes.

## Implications

As the relationship between research pressure and graduate students' innovative behavior indicates that stress is not entirely negative, our results offer the following implications. First, higher education institutions should establish appropriate graduate training

models, create effective evaluation systems, and formulate related policies to support innovation training requirements, achieving a "top-down policy, bottom-up motivation" efficient transmission chain (Zhu and Zhou, 2018). Second, the mentor' s role should be emphasized. Given challenging research pressure, mentors can provide graduate students with more research opportunities and tasks and demanding rigor while offering guidance; by allowing students to experience personal growth during the task completion process, this will enhance their intrinsic motivation for research and role identification. However, under obstructive research pressure, mentors should strive to provide learnable resources for graduate students, reduce unnecessary red tape, and allocate research tasks clearly and fairly, ensuring that students have sufficient interest and energy when participating in research activities.

The chain-mediating role of intrinsic motivation for research and identification with the research role between research pressure and innovative behavior suggests that intrinsic motivation profoundly affects whether graduate students engage in research and the type of results they wish to achieve. First, as guides on the research journey, mentors allocate research tasks with guidance and assistance, which endows graduate students with a sense of self-efficacy in research, thereby fostering their intrinsic motivation for research. This passion for research itself, when gradually transformed into innovative behavior and achieved research outcomes, promotes students' identification with the researcher' s identity. Identification with the research role will further motivate them to continuously engage in research activities, promoting the generation of innovative research outcomes and creating a virtuous cycle. Second, while an appropriate level of challenging research pressure is necessary, obstructive research pressure not only dampens the enthusiasm of graduate students for research but also damages their identification with the research role.

The positive correlation among GSMTS and graduate students' innovative behavior, intrinsic motivation for research, and identification with the research role indicates that mentors and peers are essential sources of support for graduate students' research. From the proposal of ideas to the determination and implementation of specific research content, mentors provide technical guidance as well as feedback on research revisions, which is undoubtedly crucial for graduate students. Therefore, mentors should encourage students to actively express their ideas and explore their interests, laying the groundwork for future innovative research. Additionally, mentors should learn to appreciate and recognize students' inspiration, and peers should encourage and accept each other' s views; this will facilitate students' intrinsic motivation for research and identification with the research role. Thus, leveraging GSMTS alleviates research pressure on graduate students while directly or indirectly promoting their innovative behavior.

## Conclusion

The study offers the following conclusions. First, challenging research stress can not directly and positively foster graduate students' innovative behavior, hindering research stress also fails to directly and negatively predict it. Nevertheless, both intrinsic motivation for research and identification with the research role serve as a chain of multiple mediators between research pressure and innovative behavior, this suggests that research stress indirectly impacts graduate innovation through the mediating roles of intrinsic motivation and research role identification. Second, challenging research pressure positively predicts the intrinsic motivation for research, whereas hindering research pressure negatively predicts it. Third, graduate students' mentorship homegate support can directly and positively predict graduate students' innovative behavior. Last, GSMTS positively modulates the relationship between challenging research pressure and intrinsic motivation for research, as well as between challenging research pressure and identification with the research role. Specifically, high GSMTS enhances the effect of challenging research pressure on intrinsic motivation for research and identification with the research role more than low GSMTS.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by Academic Ethics Review Committee of the Psychological Research and Counseling Center, Southwest Jiaotong University. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

QL: Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Data curation, Methodology. XD: Conceptualization, Data curation, Investigation, Methodology, Writing – review & editing, Writing – original draft. HC: Conceptualization, Data curation, Investigation, Writing – review & editing. XZ: Conceptualization, Funding acquisition, Project administration, Supervision, Writing – review & editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This work was supported by the Major Project of the Council of Presidents of Graduate Schools of China in 2021: "Strategy Research on Multi-dimensional Competencies of Graduate Supervisors and Paths for Their Training Enhancement" (ACGS03-2021004). The Soft Science Project of Sichuan Province Science and Technology Department: "Impacts of Alienation in Advisor-Student Relationship Under the Background of 'Double First-Class' Initiative on Graduate Students' Mental Health and Strategies for Countermeasures Construction" (2023JDR0238). The Project of Sichuan University's Center for

Education Research on College Students' Ideological and Political Education (CSZ23099). The Southwest Jiaotong University's New Interdisciplinary Cultivation Fund (2682024ZDPY002). The research outcomes of the 2023 Annual Project (SZSWJTU23-07) undertaken by the Training and Research Center for Ideological and Political Work Cadres in Higher Education Institutions (Southwest Jiaotong University).

## Acknowledgments

Grateful acknowledgement is due to study participants and colleagues who provided valuable feedback and English language editing for this work.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note



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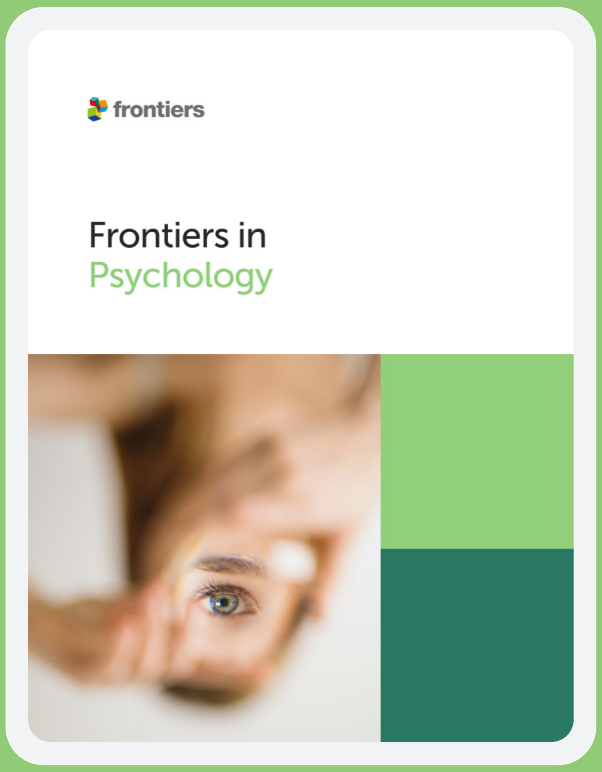


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