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Interplay between sex, age, BMI, health-related quality of life, and coping strategies in amateur and professional athletes

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Background/Objectives: The psychological well-being of athletes has garnered increasing interest due to its strong association with physical performance. While somatic indicators such as Body Mass Index (BMI) are routinely monitored in sports, the role of psychological resources—especially coping strategies—in shaping Health-Related Quality of Life (HRQoL) remains underexplored. This study aimed to investigate the influence of psychological and physical factors on HRQoL among amateur and professional athletes, controlling for sex, age, and BMI.

Methods: A cross-sectional design was adopted, involving 537 athletes (326 males, 211 females; mean age = 32.44, SD = 13.64), aged 18–76 years. Participants were recruited via online platforms and sports organizations and completed a battery of self-report questionnaires, including the SF-36 to assess HRQoL and the COPE-NVI-25 to evaluate coping strategies. BMI was calculated from self-reported height and weight. Hierarchical multiple regression analyses were performed to assess the relative contributions of demographic, anthropometric, and psychological variables to HRQoL.

Results: Demographic variables and BMI explained a limited proportion of the variance in HRQoL. In contrast, coping strategies significantly contributed to HRQoL outcomes, accounting for up to 22.5% of the variance in the global SF-36 score. Positive attitude and social support were associated with better physical and mental health, while avoidance strategies showed consistent negative associations across all HRQoL dimensions.

Conclusion: Adaptive coping strategies, particularly positive attitude and social support, play a pivotal role in enhancing athletes' HRQoL, surpassing the

influence of BMI, sex, and age. These findings support the development of tailored psychological interventions to foster athlete wellbeing across competitive levels.

KEYWORDS

health-related quality of life, coping strategies, athletes, Body Mass Index, physical activity, amateur and professional sports

1 Introduction

The relationship between Health-Related Quality of Life (HRQoL), coping strategies, and physical indicators such as Body Mass Index (BMI) has been widely examined across various populations (Lerdal et al., 2011; Mason et al., 2017; Torrente-Sánchez et al., 2021; Janiczak et al., 2022; Moon and Han, 2022; Paunescu et al., 2024; Stefanovics et al., 2024). However, these dynamics remain insufficiently explored within athletic populations, despite the pivotal role of physical activity in promoting both physical and psychological well-being (Martinsen, 2000; Rebar et al., 2015; McKeon et al., 2022; Pearce et al., 2022; Mahindru et al., 2023; Singh et al., 2023; Sánchez-Alcalá et al., 2023; Limone et al., 2024; Liu C. et al., 2024). This aspect gains further relevance in light of studies highlighting the cognitive implications of excess weight, including alterations in executive functioning (La Marra et al., 2022c; La Marra et al., 2022d; La Marra et al., 2022a; Ilardi et al., 2024). Athletes, whether amateur or professional, constitute a heterogeneous group characterized by specific anthropometric features and physical demands that often differ substantially from those of the general population (Silva et al., 2013; Michalsik et al., 2015; Menargues-Ramírez et al., 2022; Pfeifer et al., 2022; Larkin et al., 2023). Physical activity is broadly recognized as a cornerstone of health promotion, contributing to enhanced cardiovascular function, metabolic efficiency, and mental health (Chieffi et al., 2017; Lavie et al., 2019; Schuch and Vancampfort, 2021). Nevertheless, its impact can vary significantly depending on the intensity, frequency, and type of sport practiced (Warburton, 2006; Poitras et al., 2016; Bull et al., 2020; Fyfe et al., 2022; Trajković et al., 2023; Jaekel, 2024). HRQoL, commonly assessed through validated instruments such as the SF-36 questionnaire, offers a multidimensional evaluation of health by encompassing both physical and psychological domains. These tools facilitate a comprehensive understanding of athletes' health profiles by addressing not only somatic parameters but also emotional and cognitive dimensions essential for overall well-being (Geithner et al., 2006; Chieffi et al., 2014; Chieffi et al., 2019; Grosprêtre and Lepers, 2016; Scharfen and Memmert, 2019; Yongtawee et al., 2022; Staśkiewicz-Bartecka et al., 2023). The psychological dimensions of physical activity are particularly relevant in the athletic context. Regular engagement in sports fosters mental resilience, emotional regulation, and effective stress management. In this regard, coping strategies, defined as the cognitive and behavioral efforts employed to manage internal or external stressors, emerge as a fundamental determinant of psychological health (Sarkar and Fletcher, 2014; Dahlstrand et al., 2021; Forresi et al., 2022; Daley and Reardon, 2024; Liu M. et al., 2024; Sandi et al., 2024; Schinke et al., 2024). Adaptive coping mechanisms, such as problem-solving, positive reframing, and seeking social support, are positively associated with reduced psychological distress, improved emotional balance, and enhanced recovery processes (Schut and Schut, 1999; Bjørlykhaug et al., 2022). Conversely, maladaptive strategies, including avoidance, denial, or emotional suppression, have been linked to increased vulnerability to stress-related disorders and may adversely affect both health and performance (Ruggiero et al., 2017; McNeil et al., 2024; Miller et al., 2024; Rogers et al., 2024; Sapuppo et al., 2024c; Dišlere et al., 2025). Furthermore, psychological well-being is closely intertwined with an athlete's ability to cope with the pressures of competition, recover from setbacks, and remain committed over time (Büttner et al., 2021; Martín-Rodríguez et al., 2024; Sanz-Matesanz et al., 2024; Sapuppo et al., 2024a). Physical activity has also been shown to alleviate symptoms of anxiety and depression, enhance mood states, and support cognitive function, contributing to greater self-efficacy and overall life satisfaction (Dalkiliç, 2017; Krenn et al., 2018; Scharfen and Memmert, 2019; Ilardi et al., 2020; Yongtawee et al., 2022; Logan et al., 2023). For athletes, fostering a robust psychological foundation is essential not only for optimizing performance but also for promoting long-term health and personal development. Mental and emotional well-being represent integral components of a sustainable and healthy lifestyle (Chang et al., 2020; Varghese et al., 2022; Eather et al., 2023). A critical aspect in this context is the observed disparity in quality of life between athletes and non-athletes. Generally, athletes report higher levels of physical well-being due to the physiological benefits of regular exercise, such as improved cardiovascular capacity, muscular strength, and aerobic fitness. However, those engaged in high-intensity or professional sports are also exposed to specific risks, including chronic injuries, overuse syndromes, and elevated psychological stress, which can detract from their overall quality of life (Kucharski et al., 2018; Penttilä et al., 2022; Rose et al., 2023; Taheri et al., 2023; Sapuppo et al., 2024b). In contrast, non-athletes may be less exposed to sport-related risks but are often more susceptible to chronic conditions linked to sedentary behaviors, such as obesity, type 2 diabetes, and cardiovascular disease (Arocha Rodulfo, 2019; Lautenbach et al., 2021; Fruchart and Rulence-Pâques, 2022; Kim and Choi, 2022). This duality underscores the necessity for a nuanced understanding of quality of life, one that considers the interplay between physical, psychological, and contextual factors. The present study aims to investigate the relationships among HRQoL and coping strategies in a cohort of athletes, comprising both amateur and professional individuals. To ensure a comprehensive analysis, sex, age, and BMI were included as control variables, given their potential influence on health-related outcomes. By addressing these elements, the study seeks to provide an integrated perspective on the health status of athletes and the complex interrelations among their physical, psychological, and

social needs. As physical activity continues to be emphasized as a public health priority, understanding the specific challenges and protective factors in athletic populations can offer valuable insights not only for sports science but also for broader health promotion strategies.

2 Methods

2.1 Participants

For a deeper understanding of the topic presented a cross-sectional study was conducted. Participants were recruited from the general population and through contact with some professional and semi-professional teams and clubs on a totally voluntary basis. Subjects were recruited through online platforms (e.g., social media, e-mail), and the whole battery of questionnaires was administered online. In the following study, adult subjects (i.e., aged 18 years old or more) taking part in sport at a competitive or amateur level, or having done so in the past, were considered. This research was conducted on a group of 537 athletes (amateur and professional). Moreover, inclusion criteria required participants to be actively engaged in training and competition for at least 1 year prior to the study. The current study is part of a larger research aimed at assessing cognitive characteristics, coping strategies, general health and well-being and supplements consumption in athletes.

2.2 Instruments

The study was conducted using the following instruments:

1. Health-Related Quality of Life (HRQoL): Assessed using the 36-Item Short Form Survey (SF-36) which evaluates physical and mental health domains. The questionnaire consists of 36 item that can be considered as a single scale (global score) or divided into 8 subscales: physical functioning (PF) (10 items), limitations due to physical health (Role Physical - RP) (4 items) limitations due to Emotional issues (Role Emotional - RE) (3 items), energy and dissatisfaction (Vitality - VT) (4 items), psychological well-being (Mental Health - MH) (5 items), social engagement (Social Functioning - SF) (2 items), pain (Bodily Pain - BP) (2 items), and general health perception (General Health - GH) (5 items). Higher scores indicate better quality of life (Apolone and Mosconi, 1998).
2. Coping strategies (Coping Orientation to Problems Experienced–New Italian version; COPE-NVI-25): This is a 25-item self-report questionnaire divided into 5 scales, each consisting of 2 items. The questionnaire is scored from 1 to 4, ranging from "Not at all" to "Very much", and is designed to measure effective and ineffective coping mechanisms for stressful life events. Every scale is examined independently: (1) avoidance strategies, (2) transcendent orientation, (3) positive attitude, (4) social support, (5) problem orientation. Higher scores indicate a more persistent use of the strategies assessed (Caricati et al., 2015).
3. 24-item ad hoc self-report survey: For this cross-sectional study, a 24-item questionnaire was specifically developed to collect participants descriptives data on the following domains: (1) level of physical activity, (2) type of sport practiced, and (3) frequency and duration of sport participation. Additionally, basic demographic and anthropometric information, such as nationality, age, gender, weight, and height, was collected to allow for a comprehensive characterization of the study population. Additionally, the data gathered were used to measure participants BMI, calculated as weight (kg) divided by height squared (m^2). It should be noted that the questionnaire was not based on a previously validated or standardized instrument. Rather, it was designed ad hoc to address the specific objectives of the study and to gather targeted information relevant to the research questions.

2.3 Study design and procedure

This is a non-clinical cross-sectional study conducted between June 2024 and March 2025. Subjects were recruited through online, sport clubs and gyms and the questionnaire were completed digitally through the platform "Google Forms". Before completing the questionnaire, subjects were asked to give their consent to participate in the study by agreeing to an informed consent regarding data processing for scientific and research purposes. Participants were informed about the purpose of the study and anonymity of the data collection and analysis.

2.4 Statistical analysis

First, descriptive statistics were computed on the data. Then, one-sample t-tests were conducted to compare the mean values obtained from our sample with those derived from the general population regarding health-related quality of life domains and coping strategies. Chi-squared tests of independence were used to assess the association between demographical and physical-activity related dimensions. Nine hierarchical multiple regression analyses were also conducted. Regression provided an understanding of how much variance in health-related quality of life could be accounted for by coping strategies and allowed to examine patterns and determine which strategies are significant, unique predictors of different domains of health-related quality of life. One regression predicted the global SF-36 score as the criterion variable, and the remaining eight regressions each predicted either the role physical, role emotional, social functioning, physical functioning, vitality, bodily pain, general health or mental health subscale scores of the SF-36. Demographic variables (i.e., age and gender) as well as BMI were entered in the first block of predictors to control for their potential effect as covariates. All five of the COPE-NVI-25 subscales scores were entered in the second block of predictors. Normality was evaluated using the Shapiro–Wilk test and visual inspection of Q-Q plots. The statistical significance cut-off level was set at $p < 0.05$, 2-tailed. Data analysis was conducted utilizing statistical software, specifically IBM SPSS Statistics (Version 29.0.2.0).

2.5 Ethics

The study, along with the questionnaires used and the methods of data collection and storage, was approved by the Ethics Committee of Sigmund Freud University, Ethics Commission of the Faculty of Psychotherapy Science and the Faculty of Psychology; BD5VKJDAC4UJIC91006; 30 July 2024. The reference for this approval is GCP4Q7JFBO3P6I90070.

3 Results

3.1 Descriptive statistics

A total of 537 athletes (326 males and 211 females) participated in the survey. The vast majority of them were Italian (98.4%), while the remaining (1.6%) reported to come from France (n = 2; 0.4%), Switzerland (n = 2; 0.4%), India (n = 1; 0.2%), Peru (n = 1; 0.2%), Russia (n = 1; 0.2%), and Slovenia (n = 1; 0.2%). The mean age of the sample was 32.44 (±13.64) years, ranging from 18 to 76 years of age. The mean BMI recorded within the sample was 24.22 (±4.07) kg/m^2, ranging from a minimum of 15.21 kg/m^2 to a maximum of 42.45 kg/m^2. Health-related quality of life scores extracted from the SF-36, as well as the coping strategies investigated through the COPE-NVI-25 are outlined in Table 1.

One sample t-tests highlighted statistically significant differences between our sample and the mean scores retrieved from the general population in the following health-related quality of life domains: *role physical* ($t(536) = 2.32$, $p < 0.05$, Cohen's $d = 0.10$), *role emotional* ($t(536) = 3.75$, $p < 0.001$, Cohen's $d = 0.25$), *social functioning* ($t(536) = 12.30$, $p < 0.001$, Cohen's $d = 0.53$), *physical functioning* ($t(536) = 22.43$, $p < 0.001$, Cohen's $d = 0.97$), *bodily pain* ($t(536) = 10.44$, $p < 0.001$, Cohen's $d = 0.45$), vitality (t (536) = 9.16, $p < 0.001$, Cohen's $d = 0.40$), and *mental health* ($t(536) = 3.74$, $p < 0.001$, Cohen's $d = 0.16$). Moreover, statistically significant differences between our sample and the mean scores extracted from the general population were detected in most coping strategies, including *avoidance* ($t(536) = 4.20$, $p < 0.001$, Cohen's $d = 0.18$), *transcendent orientation* ($t(536) = 22.01$, $p < 0.001$, Cohen's $d = 0.95$), *positive attitude* ($t(536) = 3.77$, $p < 0.001$, Cohen's $d = 0.16$), and *problem orientation* ($t(536) = 13.92$, $p < 0.001$, Cohen's $d = 0.60$).

In the remaining part of the assessment, participants reported having practiced regular physical activity for a mean of 16.71 (±12.08) years, ranging from a minimum of 1 to a maximum of 60 years. Additional descriptive statistics on more specific facets of physical activity were calculated, including the regularity of physical activity, the prevailing motivation behind physical effort, and the competitive or professional level at which physical activity was practiced. Frequencies were broken down by gender and summarized in Table 2.

Chi-squared tests of independence showed significant associations between sex and the following physical activity-related domains: physical activity regularity ($\chi^2(2) = 8.02$, $p < 0.05$), prevailing motivation behind practicing physical activity ($\chi^2(4) = 24.16$, $p < 0.001$), agonist level physical activity ($\chi^2(2) = 17.42$, $p < 0.001$), and professional level physical activity ($\chi^2(2) = 7.52$, $p < 0.05$).

Subjects reported to be engaged in different athletic disciplines, including: Fitness activities (29.5%), Rugby (19.9%), Soccer (9.8%), Basketball (8.7%), Martial Arts (5.4%), Volleyball (4.9%), Swimming (4.5%), Cycling (3.4%), Tennis (2.0%), Gymnastics (1.9%), Breakdance (1.7%), Track and Field (1.7%), Skiing (1.5%), Rowing (1.1%), Skating (0.9%), Horse Riding (0.7%), Climbing (0.6%), Padel (0.4%), Table Tennis (0.4%), Badminton (0.2%), Baseball (0.2%), Hockey (0.2%), Water Polo (0.2%), and Target Shooting (0.2%). Those who participated in the above-mentioned athletic disciplines had practiced so for an average of 12.27 years (±10.16), ranging from 1 to 55 years.

3.2 Interplay among BMI, coping strategies, and health-related quality of life

Hierarchical multiple regression analyses were conducted to examine the linear relationships among athletes' demographic characteristics (i.e., age and sex), BMI, their commonly employed coping strategies, and their levels of health-related quality of life.

3.2.1 Global score

At step one, age, sex, and BMI accounted for a significant 6.4% of the variance in health-related quality of life. At step two, coping strategies accounted for a significant, additional, 22.5% of the variance ($\Delta R^2 = 0.16$, ΔF (5, 527) = 21.90, $p < 0.001$), indicating medium effect size ($f^2 = 0.29$). Besides age ($\beta = 0.19$, $p < 0.001$), two coping strategies were significant unique predictors (see Table 3). Namely, heightened employment of *positive attitude* was associated with higher levels of health-related quality of life ($\beta = 0.10$, $p < 0.05$). Conversely, heightened recourse to *avoidance* was associated with lower levels of health-related quality of life ($\beta = -0.35$, $p < 0.001$).

3.2.2 General health

At step one, age, sex, and BMI accounted for a non-significant 0.1% of the variance in *general health*. At step two, coping strategies accounted for a significant, additional, 10.2% of the variance ($\Delta R^2 = 0.10$, ΔF (5, 527) = 11.89, $p < 0.001$), indicating a small effect size ($f^2 = 0.11$). Two coping strategies were significant unique predictors (see Table 3). Specifically, heightened reliance on *social support* was associated with higher levels of *general health (GH)* ($\beta = 0.11$, $p < 0.05$). On the contrary, heightened recourse to *avoidance* was associated with lower levels of *general health (GH)* ($\beta = -0.24$, $p < 0.001$).

3.2.3 Bodily pain

At step one, age, sex, and BMI accounted for a significant 3.0% of the variance in *bodily pain (BP)*. At step two, coping strategies accounted for a significant, additional, 8.8% of the variance ($\Delta R^2 = 0.05$, ΔF (5, 527) = 6.16, $p < 0.001$), indicating a small effect size ($f^2 = 0.09$). Besides age ($\beta = 0.15$, $p < 0.01$) and BMI ($\beta = -0.16$, $p < 0.01$), three comping strategies were significant unique predictors (see Table 3). Namely, heightened employment of *social support* ($\beta = 0.10$, $p < 0.05$) and *positive attitude* ($\beta = 0.10$, $p < 0.05$) were associated with ameliorated *bodily pain (BP)*. Conversely, heightened reliance on *avoidance* was associated with worsened *bodily pain (BP)* ($\beta = -0.20$, $p < 0.001$).

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TABLE 1 Summary of the health-related quality of life scores and coping strategies of the athletes.

Variable	Mean	Standard Deviation	Range	α	Mean[a]	Standard Deviation[a]
SF-36						
Role Physical	81.19	29.73	0.00–100	0.77	78.21	35.93
Role Emotional	69.96	38.30	0.00–100	0.79	76.16	37.25
Social Functioning	64.34	24.67	0.00–100	0.41	77.43	23.34
Physical Functioning	94.55	10.43	25.0–100	0.82	84.46	23.18
Bodily Pain	82.25	19.93	10.0–100	0.79	73.27	27.65
General Health	66.41	15.05	20.0–100	0.60	65.22	22.18
Vitality	55.76	15.50	5.00–100	0.71	61.89	20.69
Mental Health	63.90	16.64	5.00–100	0.82	66.59	20.89
COPE-NVI-25						
Avoidance Strategies	2.28	0.82	1.00–5.80	0.68	2.43	1.02
Transcendent Orientation	1.61	1.14	1.00–6.00	0.97	2.7	1.61
Positive Attitude	4.30	0.98	1.17–6.00	0.86	4.46	0.94
Social Support	3.74	1.24	1.00–6.00	0.91	3.67	1.2
Problem Orientation	3.91	0.91	1.00–6.00	0.79	4.46	0.94

[a]Values in general population extracted from (Apolone and Mosconi, 1998; Caricati et al., 2015).

3.2.4 Social functioning

At step one, age, sex, and BMI accounted for a significant 8.5% of the variance in *social functioning (SF)*. At step two, coping strategies accounted for a significant, additional, 14.9% of the variance ($\Delta R^2 = 0.06$, ΔF (5, 527) = 7.86, $p < 0.001$), indicating a medium effect size ($f^2 = 0.18$). Besides age ($\beta = 0.24$, $p < 0.001$), two coping strategies were significant unique predictors (see Table 3). Indeed, heightened employment of *positive attitude* was associated with higher levels of *social functioning* ($\beta = 0.10$, $p < 0.05$). On the contrary, heightened recourse to *avoidance* was associated with lower levels of *social functioning* ($\beta = -0.20$, $p < 0.001$).

3.2.5 Mental health

At step one, age, sex, and BMI accounted for a significant 6.2% of the variance in *mental health (MH)*. At step two, coping strategies accounted for a significant, additional, 18.8% of the variance ($\Delta R^2 = 0.13$, ΔF (5, 527) = 16.47, $p < 0.001$), indicating a medium effect size ($f^2 = 0.23$). Besides age ($\beta = 0.12$, $p < 0.01$) and sex ($\beta = -0.17$, $p < 0.001$), two coping strategies were significant unique predictors (see Table 3). Namely, heightened reliance on *positive attitude* was associated with higher levels of *mental health* ($\beta = 0.16$, $p < 0.001$). Conversely, heightened recourse to *avoidance* were associated with lower levels of *mental health* ($\beta = -0.29$, $p < 0.001$).

3.2.6 Vitality

At step one, age, sex, and BMI accounted for a significant 6.8% of the variance in *vitality (VT)*. At step two, coping strategies accounted for a significant, additional, 20.4% of the variance ($\Delta R^2 = 0.14$, ΔF (5, 527) = 18.08, $p < 0.001$), indicating a medium effect size ($f^2 = 0.26$). Besides age ($\beta = 0.15$, $p < 0.01$) and sex ($\beta = -0.12$, $p < 0.05$), two coping strategies were significant unique predictors (see Table 3). Indeed, heightened employment of *positive attitude* was associated with improved *vitality* ($\beta = 0.11$, $p < 0.05$). On the contrary, heightened reliance on *avoidance* was associated with worsened *vitality* ($\beta = -0.31$, $p < 0.001$).

3.2.7 Role emotional

At step one, age, sex, and BMI accounted for a significant 6.0% of the variance in *role emotional* (RE). At step two, coping strategies accounted for a significant, additional, 12.6% of the

TABLE 2 Self-report summary of physical activity-related specifications.

Variable	Males	Females	Total
Physical activity regularity			
My physical activity has been generally constant over the years	220 (40.97%)	117 (21.79%)	337 (62.76%)
I used to practice more physical activity than I do now	83 (15.46%)	72 (13.41%)	155 (28.86%)
I used to practice less physical activity than I do now	23 (4.28%)	22 (4.09%)	45 (8.38%)
Prevailing motivation behind practicing physical activity			
Competition	32 (5.96%)	12 (2.23%)	44 (8.19%)
Entertainment and social occasions	37 (6.89%)	18 (3.35%)	55 (10.24%)
Improvement of body image	17 (3.17%)	36 (6.70%)	53 (9.87%)
Improvement of physical and psychological health	208 (38.73%)	133 (24.77%)	341 (79.89%)
Improvement of athletic performance	31 (5.77%)	13 (2.43%)	44 (8.19%)
Agonistic level physical activity			
I've never competed at the agonistic level	44 (8.19%)	43 (8.01%)	87 (16.20%)
Not currently, but I have competed at the agonistic level in the past	169 (31.47%)	71 (13.22%)	240 (44.69%)
I currently compete at the agonistic level	113 (21.04%)	97 (18.07%)	210 (39.11%)
Professional level physical activity			
I've never competed at the professional level	306 (56.98%)	109 (29.30%)	496 (92.36%)
Not currently, but I competed at the professional level in the past	16 (2.98%)	21 (3.91%)	37 (6.89%)
I currently compete at the professional level	4 (6.83%)	0 (0.0%)	4 (0.75%)

variance (ΔR^2 = 0.07, ΔF (5, 527) = 7.89, $p < 0.001$), indicating a small effect size (f^2 = 0.14). Besides age (β = 0.16, $p < 0.001$), one coping strategy was a significant unique predictor (see Table 3). Accordingly, heightened employment of *avoidance* was associated with worsened *role emotional* (β = −0.25, $p < 0.001$).

3.2.8 Role physical

At step one, age, sex, and BMI accounted for a non-significant 0.8% of the variance in *role physical* (RP). At step two, coping strategies accounted for a significant, additional, 5.8% of the variance (ΔR^2 = 0.05, ΔF (5, 527) = 5.63, $p < 0.001$), indicating a small effect size (f^2 = 0.06). One out of the five coping strategies was a significant unique predictor (see Table 3), i.e., heightened recourse to avoidance was associated with worsened *role physical* (β = −0.19, $p < 0.001$).

3.2.9 Physical functioning

At step one, age, sex, and BMI accounted for a non-significant 0.7% of the variance in *physical functioning* (PF). At step two, coping strategies accounted for a significant, additional, 9.3% of the variance (ΔR^2 = 0.09, ΔF (5, 527) = 9.95, $p < 0.001$), indicating a small effect size (f^2 = 0.10). Three out of the five coping strategies were significant unique predictors (see Table 3). Specifically, heightened reliance on *social support* (β = 0.10, $p < 0.05$) and *positive attitude* (β = 0.20, $p < 0.001$) were associated with higher levels of *physical functioning*. Conversely, heightened employment of *avoidance* was associated with diminished *physical functioning* (β = −0.20, $p < 0.001$).

4 Discussion

Our analyses investigated the impact of age, sex, BMI, and coping methods on diverse health-related quality of life (HRQoL) outcomes across athletes from multiple disciplines and competitive levels. While age, sex, and BMI contributed minimally to the variance in HRQoL (between 0.1% and 8.5%), coping techniques proved to be the most significant predictors, explaining up to 22.5% of the variance. These findings highlight the importance of psychological coping strategies in influencing subjective health and well-being in athletes. Among the adaptive strategies, both a *positive attitude* and reliance on *social support* emerged as key protective factors across several HRQoL domains. These strategies likely facilitate emotional regulation, injury recovery, and adherence to training routines, highlighting their relevance for psychological resilience in sports contexts (Murray et al., 2019; Budimir et al., 2021; Huang et al., 2021; Prior et al., 2024).

TABLE 3 Summary of the hierarchical multiple regressions.

	Global Score			General Health			Bodily Pain		
	t-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value
Step 1									
Age	5.29	0.24	<0.001	0.27	0.01	0.79	3.33	0.15	<0.001
Gender	−1.72	−0.08	0.09	−0.62	−0.03	0.54	0.31	0.01	0.76
Body Mass Index	−1.08	−0.05	0.28	−0.01	0.00	0.99	−3.49	−0.17	<0.001
Step 2									
Age	4.30	0.19	<0.001	−0.41	−0.02	0.68	3.07	0.15	<0.01
Gender	−1.78	−0.08	0.08	−0.90	−0.04	0.37	0.16	0.01	0.88
Body Mass Index	−0.32	−0.01	0.75	0.59	0.03	0.56	−3.25	−0.16	<0.01
Avoidance Strategies	−8.80	−0.35	<0.001	−5.51	−0.24	<0.001	−4.57	−0.20	<0.001
Transcendent Orientation	−0.85	−0.03	0.40	−0.69	−0.03	0.49	−0.32	−0.01	0.75
Positive Attitude	2.30	0.10	<0.05	1.86	0.09	0.06	1.93	0.09	0.06
Social Support	1.51	0.07	0.13	2.26	0.11	<0.05	1.96	0.10	<0.05
Problem Orientation	0.37	0.02	0.71	0.80	0.04	0.43	−1.64	−0.09	0.10
	Social Functioning			Mental Health			Vitality		
	t-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value
Step 1									
Age	6.20	0.28	<0.001	3.70	0.17	<0.001	4.68	0.21	<0.001
Gender	−1.47	−0.07	0.14	−3.59	−0.17	<0.001	−2.42	−0.11	<0.05
Body Mass Index	−0.62	−0.03	0.54	−0.91	−0.04	0.36	−0.24	−0.01	0.81
Step 2									
Age	5.19	0.24	<0.001	2.69	0.12	<0.01	3.28	0.15	<0.01
Gender	−1.32	−0.06	0.19	−3.83	−0.17	<0.001	−2.58	−0.12	<0.05
Body Mass Index	−0.08	0.00	0.93	−0.33	−0.02	0.75	0.44	0.02	0.66
Avoidance Strategies	−4.72	−0.20	<0.001	−7.00	−0.29	<0.001	−7.55	−0.31	<0.001
Transcendent Orientation	−0.96	−0.04	0.37	−0.25	−0.01	0.80	0.63	0.03	0.53

(Continued on the following page)

TABLE 3 (*Continued*) Summary of the hierarchical multiple regressions.

	Social Functioning			Mental Health			Vitality		
	t-value	standardized *β*	*p*-value	*t*-value	standardized *β*	*p*-value	*t*-value	standardized *β*	*p*-value
Positive Attitude	1.92	0.10	<0.05	3.40	0.16	<0.001	2.47	0.11	<0.05
Social Support	0.13	0.01	0.90	1.36	0.06	0.17	0.77	0.04	0.44
Problem Orientation	0.83	0.04	0.41	−0.14	−0.01	0.89	1.05	0.05	0.30
	Role Emotional			Role Physical			Physical Functioning		
	t-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value	*t*-value	Standardized *β*	*p*-value
Step 1									
Age	4.57	0.21	<0.001	2.00	0.09	<0.05	−0.62	−0.03	0.54
Gender	−1.57	−0.07	0.12	0.13	0.01	0.90	0.19	0.01	0.85
Body Mass Index	0.32	0.02	0.75	−0.43	−0.02	0.67	−1.28	−0.06	0.20
Step 2									
Age	3.36	0.16	<0.001	1.76	0.09	0.08	−0.78	−0.04	0.44
Gender	−1.27	−0.06	0.20	0.14	0.01	0.89	0.06	0.00	0.95
Body Mass Index	0.86	0.04	0.39	−0.03	0.00	0.97	−0.92	−0.05	0.36
Avoidance Strategies	−5.76	−0.25	<0.001	−4.36	−0.19	<0.001	−4.50	−0.20	<0.001
Transcendent Orientation	0.26	0.01	0.80	−1.56	−0.07	0.12	−1.41	−0.06	0.16
Positive Attitude	−0.57	−0.03	0.57	0.43	0.02	0.66	4.05	0.20	<0.001
Social Support	−0.60	−0.03	0.55	1.56	0.08	0.12	2.05	0.10	<0.05
Problem Orientation	1.21	0.06	0.23	−0.04	0.00	0.97	−1.79	−0.09	0.08

t-value, t statistic from regression analysis; Standardized β, standardized beta coefficient; p-value, significance level. Step 1, regression model including only sociodemographic and anthropometric variables. Step 2, regression model including sociodemographic, anthropometric, and psychological variables.

Additionally, these results underline the importance of social connections, including those with coaches, teammates, family, or peers, for emotional processing, stress management, and compliance with training and recuperation regimens. Moreover, access to supportive connections can provide affirmation, diminish feelings of isolation, and strengthen adaptive actions (Graber et al., 2016; Sbrizzi and Sapuppo, 2021). In structured team settings or among professionals, the pursuit of social support may significantly influence both well-being and performance stability (Uchino, 2006; Koelmel et al., 2017; Hadebe and Ramukumba, 2020; Koch and Krenn, 2021; Wong et al., 2024). Conversely, avoidance coping consistently predicted poorer outcomes across physical and psychological domains, likely due to reduced emotional processing and help-seeking behaviors, which can foster chronic stress and undermine recovery (Nippert and Smith, 2008; Bányai et al., 2021; McLoughlin et al., 2024). These findings, in line with previous research indicating that coping techniques significantly influence the impact of stress on HRQoL in sports (Budimir et al., 2021; Fullerton et al., 2021; Huang et al., 2021; Prior et al., 2024). The disparities in stress management between professional and

amateur athletes indicate that structured mental health support and coping mechanisms might alleviate stress in competitive contexts. Professional athletes may gain from structured mental health resources, while amateurs are more susceptible to maladaptive coping mechanisms, adversely impacting HRQoL (Jacobson and Matthaeus, 2014; Wong et al., 2024). Moreover, gender disparities were observed in the *mental health* and *vitality* subscales of the SF-36. Our findings indicate that female athletes exhibited diminished *mental health* scores, potentially due to increased susceptibility to psychological distress or sociocultural pressures concerning body image and performance expectations (Gattino et al., 2015; Tomaszek and Muchacka-Cymerman, 2019; Toselli et al., 2022). Conversely, men indicated elevated *vitality* scores, potentially attributable to variations in fatigue perception or recovery methodologies. Unlike in general population trends, BMI did not significantly predict most HRQoL outcomes in our sample, likely due to sport-specific physical profiles and the moderating role of coping strategies.

Although BMI was first employed as a covariate, our results indicate that it does not exhibit a unidirectional connection with HRQoL in athletes. Unlike in general population trends, BMI did not significantly predict most HRQoL outcomes in our sample, likely due to sport-specific physical profiles and the moderating role of coping strategies (Hopman et al., 2007; Milanović et al., 2022; Knettel et al., 2023; Rose et al., 2023). In fact, regression analysis indicated that BMI was not a significant predictor of *general health* or *social functioning*, but it exhibited a negative correlation with *bodily pain*. These findings indicate that a higher BMI may be associated with musculoskeletal strains without necessarily affecting the perception of overall health (Crewther et al., 2012; Martin and Beckham, 2020; Ruscello et al., 2024). Athletes participating in strength or contact sports often have high BMI values, which can improve physical function and performance (Harty et al., 2021; Van Baak et al., 2021; Entwistle et al., 2022; University of Girona, University School of Health and Sport, Girona, Spain et al., 2022; Baceviciene et al., 2023; Borowiec et al., 2023; Habay et al., 2023; Berengüí et al., 2024). Results obtained in this study suggest that a higher BMI does not necessarily correlate with diminished HRQoL in athletes, especially when considering their coping mechanisms and the nature of their sport. However, it is important to note that this finding should not be interpreted as evidence of an "obesity paradox" in the athletic population. In fact, in this context, the term may be misleading, as BMI does not accurately reflect body composition and cannot be reliably used to diagnose obesity in athletes. Instead, higher BMI values in athletes often reflect increased lean mass rather than excess fat (Walsh et al., 2018; Afzal et al., 2021; Villano et al., 2021b; Quesada et al., 2022; Monda et al., 2024; Monda et al., 2017; Simati et al., 2023; Zwartkruis et al., 2023; La Marra et al., 2024; Sparks et al., 2024; Yang et al., 2024; Zhao et al., 2025; Banack and Stokes, 2017; Childers and Allison, 2010; Simati et al., 2023). Body weight perceptions and self-acceptance fluctuate according to sports culture and role expectations (Koc, 2017; Paixão et al., 2021; Villano et al., 2021a; Ruiz-Turrero et al., 2022; Ahsan and Ali, 2023; Gao et al., 2023; Krupa-Kotara et al., 2023; Martín-Talavera et al., 2023; Zaccagni and Gualdi-Russo, 2023). Moreover, these findings demonstrated that the motivations for participating in sports are also significant. Most athletes in our sample indicated health-related motivations (79.89%), which exhibited a positive correlation with adaptive coping and HRQoL (Orbach et al., 2021; Aznar-Ballesta et al., 2022; Villano et al., 2022; Nuetzel, 2023). In contrast, athletes influenced by social or aesthetic expectations were more susceptible to maladaptive coping strategies, especially *avoidance*, resulting in diminished well-being (Bányai et al., 2021; McLoughlin et al., 2024). These trends emphasize the importance of fostering a sports culture that promotes health and psychological well-being rather than appearance or performance metrics (Sheehan et al., 2018; González et al., 2019; Koch and Krenn, 2021; Logan et al., 2023). Finally, emphasis must be placed on the post-athletic transition phase, wherein elevated BMI and diminished HRQoL have been commonly reported (Kelly et al., 2014; Buckley et al., 2019; Filbay et al., 2019; Silva et al., 2022; Le Roux et al., 2023; Street et al., 2023). Psychological challenges, such as body dissatisfaction and depressive symptoms, frequently arise during this phase due to alterations in identity and lifestyle (Iavarone, 2015; La Marra et al., 2022b; Furie et al., 2023; Pena-Pérez and Portela-Pino, 2023; Fatt et al., 2024; Runacres and Marshall, 2024). Researchers have suggested therapies that integrate physical activity, psychological counseling, and nutritional support to tackle these issues (Michaels et al., 2023; Voorheis et al., 2023; Vasileva et al., 2022; Claussen et al., 2024; Reinebo et al., 2024). Our data indicates that *social support* and a *positive attitude* continued to provide protection post-athletic retirement, so underscoring the enduring advantages of adaptive coping. Fostering a *positive attitude* and *social support* while reducing *avoidance* strategies may improve mental and physical health across all phases of an athletic career. These results could indicate the importance of creating athlete-centered preventative programs and establish a foundation for longitudinal studies examining the correlation between coping techniques and HRQoL.

4.1 Limitations

This study presents several limitations that should be acknowledged. Firstly, the cross-sectional nature of the design prevents causal inferences regarding the relationship between coping strategies and HRQoL. Longitudinal studies are needed to examine how coping mechanisms evolve over time and influence health outcomes throughout different stages of an athletic career. Secondly, the reliance on self-reported data may introduce potential biases, including recall inaccuracies and social desirability effects. This concern is particularly relevant for anthropometric variables, such as self-reported height and weight used to calculate BMI, as well as for coping strategies, which may reflect aspirational or socially acceptable responses rather than actual behavioral patterns. Future studies would benefit from incorporating objective measures (e.g., direct anthropometric assessments) and qualitative approaches to validate and complement self-reported data, thereby enhancing the reliability and ecological validity of the findings. Thirdly, although the sample included both amateur and professional athletes across a wide age range, it was not stratified by sport type, training intensity, or career stage, all of which may differentially impact coping and HRQoL. Furthermore, cultural, psychological, and socio-economic variables were not considered, limiting the generalizability of the findings to broader populations. Lastly,

although the COPE-NVI-25 is a validated tool, the complex and dynamic nature of coping could benefit from a mixed-methods approach, integrating qualitative data to better capture individual experiences.

5 Conclusion

The present study highlights the central role of coping strategies, particularly positive attitude and social support in enhancing health-related quality of life among athletes. These adaptive mechanisms demonstrated a stronger association with HRQoL outcomes than physical indicators such as BMI, age, or sex. In contrast, the use of avoidance strategies was consistently linked to poorer physical and psychological health. These findings underscore the importance of promoting athlete-centered mental health interventions that encourage positive coping and reduce maladaptive behaviors. Practical implications include the integration of early psychological screening protocols within training settings to identify athletes at risk of maladaptive coping. Furthermore, tailored interventions, led by sports psychologists in collaboration with coaching staff, can foster the development of adaptive coping skills, such as positive reframing and effective help-seeking. Such efforts may contribute to enhanced well-being, injury recovery, and long-term engagement in sport. Future longitudinal and multi-method research is recommended to better elucidate the temporal dynamics of coping and to guide the implementation of evidence-based psychological support programs across all stages of an athletic career.

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 study, along with the questionnaires used and the methods of data collection and storage, was approved by the Ethics Committee of Sigmund Freud University, Ethics Commission of the Faculty of Psychotherapy Science and the Faculty of Psychology. The reference for this approval is BD5VKJDAC4UJIC91006; 30 July 2024. 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

WS: Writing – original draft, Writing – review and editing, Supervision. DG: Writing – original draft, Writing – review and editing. AMo: Investigation, Writing – review and editing, Formal Analysis. AMe: Data curation, Writing – review and editing, Resources. DS: Writing – review and editing, Data curation, Investigation. CM: Visualization, Software, Data curation, Writing – review and editing. MC: Writing – review and editing, Formal Analysis, Software, Investigation. SA: Visualization, Data curation, Validation, Writing – review and editing. GM: Visualization, Investigation, Writing – review and editing, Data curation, Formal Analysis. RG: Writing – review and editing, Software, Data curation. VM: Project administration, Conceptualization, Funding acquisition, Resources, Writing – review and editing. JL: Resources, Visualization, Writing – review and editing, Data curation. MF: Data curation, Writing – review and editing, Resources. GD: Data curation, Validation, Conceptualization, Writing – review and editing. MM: Supervision, Writing – review and editing, Funding acquisition, Project administration. ML: Writing – original draft, Supervision, Writing – review and editing.

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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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