

SPORT AND PSYCHOSOCIAL HEALTH/WEELL-BEING AFTER THE COVID-19 LOCKDOWN

EDITED BY: Amy Chan Hyung Kim, James Du and Rochelle Eime

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SPORT AND PSYCHOSOCIAL HEALTH/WEELL-BEING AFTER THE COVID-19 LOCKDOWN

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Editorial: Sport and Psychosocial Health/Well-Being After the COVID-19 Lockdown

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Keywords: COVID-19, mental health, physical activity, active lifestyle, psychological wellbeing, mental wellbeing, social wellbeing

Editorial on the Research Topic

Sport and Psychosocial Health/Well-Being after the COVID-19 Lockdown

Since late 2019, the COVID-19 pandemic has significantly impacted one's active lifestyle (Kim et al., 2022). On the one hand, social distancing/isolation restrictions prevented the public from being physically active in that sports events were suspended, postponed, or paused. Sports facilities such as senior centers, recreation centers, and fitness centers were closed, and school-based extracurricular physical activity and sport programs were canceled (Du et al., 2021). On the other hand, new opportunities for active lifestyles emerged. Individual home-based training using technologies such as cycling equipment with virtual roads and virtual classes has boomed. In addition, outdoor-based activities such as hiking, walking, or backpacking have become more popular.

Whilst sport play and competitions were canceled individuals turned to other non-sporting activities. The articles in this Research Topic included the psychosocial health and wellbeing of participation in a range of different activities including sport, non-sporting activities and nature-based outdoor activities. Further, the research studies included a range of different population groups including general population, elite athletes, Paralympic athletes, patients with health conditions and sports volunteers. Below provides a summary of the Research Topic articles.

This Research Topic is about investigating the impact of the COVID-19 pandemic on the association between these (un)changed active lifestyles (e.g., formats, involvement levels, patterns) and psychosocial outcomes of the COVID-19 pandemic from a public health perspective. Authors representing various academic disciplines, such as sport management, sport science, health and behavioral science, and medicine have contributed to this Research Topic by introducing empirical findings, and methodological innovations. In this Editorial, we offer an overview of the diverse contents of the present Research Topic.

Several empirical studies examined various types of physical activity, and one's psychosocial health and wellbeing during and after the COVID-19 restrictions across the world. For example, Wendtlandt and Wicker investigated how nature-based, natural resource-using, and nature-neutral sport activities and different types of environmentally sustainable behaviors, including recycling, ecological consumption, energy-saving, and mobility were associated with subjective wellbeing before and during the COVID-19 lockdown in Germany. The findings showed that nature-based and nature-neutral sport activities significantly decreased during the first COVID-19 lockdown in Germany, while environmentally sustainable behaviors increased. Notably, a decrease in nature-based and nature-neutral sport activities significantly predicted a decline in individuals' subjective wellbeing.

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Cindrich et al. explored the impact of COVID-19 restrictions on spending time outside April 2020 and how it was associated with stress and positive mental health in the United States. The findings reported that participants with increased or maintained outside time reported a lower level of stress and a higher level of positive mental health compared to those who decreased outside time, implying being active outside would benefit one's psychological well-being.

Nagarathna et al. investigated if yoga is beneficial for physical and mental health and assessed the lifestyle of yoga practitioners that may be critical in coping with stress was associated with COVID-19 lockdown in India. The findings showed that yoga practitioners reported good physical ability and endurance, lower levels of anxiety, stress, and fear than the non-Yoga group. Additionally, the yoga group showed a better ability to cope with the stress associated with lockdown and COVID-19 than the non-Yoga group.

Some articles examined the influence of COVID-19-related restrictions and lockdowns on individuals psychosocial health and wellbeing status among specific populations, including patients with major depression, infertile women, children with neurodevelopmental disorders, Paralympic athletes, and intercollegiate student-athletes. Cody et al. explored whether data gathered before and during/after the lockdown in Switzerland among in-patients with major depression would be different in terms of psychosocial health, physical activity, and related attitudes. The findings indicated no differences between before and during/after the COVID-19 in terms of psychosocial health, including stress, sleep quality, and both physical and mental elements of health-related quality of life, self-reported physical activity. Cao et al. studied infertile women to investigate their anxiety levels in the quarantined and non-quarantined areas in China during the COVID-19 pandemic. The results showed that quarantined participants tended to have more negative emotions and worse family relationships compared to non-quarantined participants. Ueda et al. studied children with neurodevelopmental disorders who had altered sleep patterns and its effect on quality of life in Japan. The results showed that ~50% of participants experienced changes in sleep patterns. The changes were associated with decreased quality of life, which

resulted in a higher level of depression and lowered current mood status.

Hu et al. investigated the athlete identity of Paralympic athletes during the COVID-19 in the United States. Even during the training and competition cessation resulting from the COVID-19 pandemic, athletes with a strong athlete identity tended not to be affected by the pandemic. Floyd et al. explored changes of sentiment in student-athletes at the Division I institutions in the United States during the COVID-19. The findings of machine-learning-based natural language processing techniques of the user-generated Twitter posts suggested that positive sentiment outweighed negative sentiment overall, whereas there was a noticeable spike in negative sentiment in May and June 2020.

Power and Nedvetskaya investigated the theory-practice divide in the volunteer-management relationship in the United Kingdom and how it may impact volunteer experiences and volunteer program outcomes during the COVID-19 pandemic. While the results showed that most research participants expressed an intent to return to sport event volunteering post-pandemic, the authors highlighted some sociodemographic factors such as age or the level of safety protocol might impact future participation in volunteering.

Lastly, You et al. reviewed exercise intervention studies in treating depression among teenagers between 2000 and 2020. The authors identified four future directions in the area of this study: research on the effect of specific exercise intervention, research on the essence of exercise and sports, research on the combination mode of exercise and other elements, and research on the micro and molecular level.

The articles published in this Research Topic are positioned across the various academic fields embracing a broad range of themes related to active lifestyle and mental health during the COVID-19 pandemic.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Associations Between Change in Outside Time Pre- and Post-COVID-19 Public Health Restrictions and Mental Health: Brief Research Report

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The novel coronavirus disease 2019 (COVID-19) and associated pandemic has resulted in systemic changes to much of life, affecting both physical and mental health. Time spent outside is associated with positive mental health; however, opportunities to be outside were likely affected by the COVID-19 public health restrictions that encouraged people not to leave their homes unless it was required. This study investigated the impact of acute COVID-19 public health restrictions on outside time in April 2020, and quantified the association between outside time and both stress and positive mental health, using secondary analyses of cross-sectional data from the COVID and Well-being Study. Participants ($n = 3,291$) reported demographics, health behaviors, amount of time they spent outside pre/post COVID-19 public health restrictions (categorized as increased, maintained, or decreased), current stress (Perceived Stress Scale-4), and positive mental health (Short Warwick-Edinburgh Mental Well-being Scale). Outside time was lower following COVID-19 restrictions ($p < 0.001$; Cohen's $d = -0.19$). Participants who increased or maintained outside time following COVID-19 restrictions reported lower stress ($p < 0.001$, 5.93 [5.74–6.12], Hedges' $g = -0.18$; $p < 0.001$, mean = 5.85 [5.67–6.02], Hedges' $g = -0.21$; respectively) and higher positive mental health ($p < 0.001$, 24.49 [24.20–24.77], Hedges' $g = 0.21$; $p < 0.001$, 24.78 [24.52–25.03], Hedges' $g = 0.28$) compared to those who decreased outside time. These findings indicate that there are likely to be negative stress and mental health implications if strategies are not implemented to encourage and maintain safe time outside during large-scale workplace and societal changes (e.g., during a pandemic).

Keywords: outside time, stress, positive mental health, COVID-19, coronavirus

INTRODUCTION

The COVID-19 pandemic has resulted in a global disturbance in daily living patterns. In the US, COVID-19-related public health restrictions, including isolation, stay-at-home or shelter-in-place orders, and physical/social distancing requirements, were implemented by March 13th to reduce disease transmission (1). Empirical evidence supports that public health interventions such as home quarantine after infection, restricting mass gatherings, travel restrictions, and social distancing, are associated with reduced transmission rates (2–4). However, restrictions may result in adverse unintended consequences. For example, previous reports suggest that these restrictions were accompanied by changes in health-related behaviors (e.g., decreased physical activity and increased sitting time), and poor mental health (5–11).

Spending time outside is associated with lower stress and positive mental health outcomes (12, 13). Despite these reported benefits, outside time was likely affected by COVID-19 public health restrictions that encouraged people to not leave their home unless essential. Orders varied in severity, including encouragement to stay inside, allowing time outside on one's property or in the community for necessary activities outside the home (e.g., essential work, exercise), and further "non-essential" movement in the community in some states and localities [(14, 15)]. Change in outside time (i.e., the average difference of minutes per day spent outside condensed into categorical variables) may contribute to or mitigate worsening mental health, but how COVID-19-related public health restrictions influenced the amount of outside time, and how resulting change in outside time influenced stress and positive mental health [PMH; a construct encompassing hedonic and eudaimonic well-being; Tennant et al. (16)], is unknown. Findings from such a study would inform public health messages regarding outside time, as it could be useful in mitigating stress and promoting PMH when public health restrictions are necessary to prevent the spread of disease. Therefore, this study: (1) investigated differences in self-reported outside time pre- and post-COVID-19-related public health restrictions, (2) quantified differences in current stress and PMH based on change in outside time, and (3) examined the potential interaction effects of physical activity and COVID-19 related public health restriction on outside time. We hypothesized that outside time would be significantly lower following public health restrictions, and that maintained or increased outside time would be associated with lower stress and better PMH.

METHODS

Procedures

This study investigated cross-sectional data recorded April 3rd–April 9th from the COVID-19 and Well-being (Cov-Well) Study, a population-based survey that investigated inter-relationships between COVID-19 mitigation strategies, health behaviors, and mental health. Full methods were previously published (9). Briefly, participants were recruited by convenience sampling using mass emails to Iowa State University affiliated individuals

(e.g., students, faculty, staff, alumni), referrals, and posts to social media platforms. Interested participants consented and enrolled in the study by clicking an electronic link and completing a 20–30-min survey. Procedures were reviewed and approved as exempt by the local Institutional Review Board (#20-144).

The questionnaire included: demographics (e.g., gender, age, race, relationship status, children in household, current employment status, and community environment), chronic health conditions, current COVID-19-related public health restrictions being followed (i.e., self-quarantine/self-isolation, under a shelter-in-place or stay-at-home order, or social/physical distancing), pre and post-restriction moderate-to-vigorous activity (MVPA) levels, and mental health questionnaires.

Health-Related Behaviors

To assess pre/post-restriction outside time and MVPA, participants responded to two questions (pre-COVID changes and post-COVID changes) for each behavior (outside time, moderate, and vigorous activity): "How much time on an average day have you spent [outside, in moderate activity, in vigorous activity] [before *and* since] making COVID-related behavioral changes." For Aims 2 and 3, data were coded categorically based on outside time pre-post public-health restrictions as: increased, decreased, or maintained (i.e., the same time was reported pre- and post-restrictions) outside time, respectively. Similarly, for MVPA, participants were categorized based on meeting aerobic US Physical Activity Guidelines (i.e., 150 min of moderate activity, 75 min of vigorous activity, or an equivalent combination) [(17, 18)] pre- and post-restrictions as: increased MVPA (e.g., not meeting guidelines pre but meeting guidelines post), decreased MVPA (i.e., meeting guidelines pre but not post), maintained high MVPA (i.e., meeting guidelines pre and post), or maintained low (i.e., not meeting guidelines pre or post). For cleaning, standard International Physical Activity Questionnaire (IPAQ) data cleaning rules were followed which resulted in the exclusion of anyone reporting ≥ 960 min/day of MVPA. For Aim 3, participants were categorized based on the highest level of COVID-19 related public health restriction that was endorsed (self-quarantine/self-isolation > under a shelter-in-place or stay-at-home order > social/physical distancing).

Mental Health Outcomes

Based on their previously demonstrated association with outside time (12, 13), stress and PMH were selected as outcomes. Current stress was assessed using the four-item Perceived Stress Scale-4 (Cronbach's $\alpha = 0.60$ – 0.82 ; (19); current sample $\alpha = 0.87$) and current PMH was assessed using the seven-item Short Warwick-Edinburgh Mental Well-being Scale ($\alpha = 0.83$ – 0.87 ; (20); current sample $\alpha = 0.85$), with higher scores indicating higher stress and better PMH, respectively.

Statistical Analysis

The base stats package in R was used to analyze the data. For Aim 1, the normality of the data was tested with the Shapiro-Wilks test. The results indicated a significant difference ($p < 0.0001$) between outside time pre- and post-restrictions, indicating non-normally distributed data. A Wilcoxon Signed-Rank Test was

used to compare outside time pre-post COVID. For Aim 2, a one-way ANCOVA assessed differences between change of outside time (i.e., decreased, maintained, or increased) on stress (Model 1) and PMH (Model 2). *Post-hoc* comparisons using the Tukey HSD procedure were used to compare the groups for each outcome. Cohen's d (21) effect sizes were used to compare change in outside time pre-post restrictions, while Hedges' g (22) was used to compare groups based on mental health outcomes. Finally, E-Value analyses were used to analyze how strong the confounders would have to be to nullify the results of the main effect. For Aim 3, the ANCOVA models in Aim 2 were used with the addition of MVPA and COVID-19-related public health restriction as interaction terms on outside time. Alpha was set at 0.05 for all analyses.

RESULTS

After excluding responses with incomplete data ($n = 127$), participants ($n = 3,291$; 62% female) were predominately white (94%), resided in suburban communities (56%), married (65%), and generally healthy (i.e., 63% reported never having a chronic health condition). Participants reported following a variety of COVID-19 public health guidelines, with 17% quarantined or self-isolating, 47% sheltered in place or staying at home, and 34% social distancing. Most of the participants reported a change in their work with 41% working from home when they were not before. **Supplementary Table 1** presents participant characteristics and descriptive statistics for exposures, outcomes, and covariates.

Aim 1

Overall, outside time post-restrictions was significantly lower ($W = 1318802$, $p < 0.001$) than outside time pre-restrictions, though the overall effect was small ($d = -0.19$).

Aim 2

Participants were categorized into increased ($n = 885$), decreased ($n = 1,375$), or maintained ($n = 1,031$) outside time from pre to post public health restrictions. Changes in outside time were significantly associated with stress ($F_{(2,3,261)} = 14.78$, $p < 0.001$) and PMH ($F_{(2,3,261)} = 23.78$, $p < 0.001$). Compared to decreased outside time (adjusted means, stress: 6.44 [95% CI: 6.29–6.59], PMH: 23.60 [95% CI: 23.38–23.83]), Tukey's *post-hoc* tests showed increased or maintained outside time were significantly associated with lower stress ($p < 0.001$, 5.93 [5.74–6.12], $g = -0.18$; $p < 0.001$, mean = 5.85 [5.67–6.02], $g = -0.21$; respectively) and significantly associated with higher PMH ($p < 0.001$, 24.49 [24.20–24.77], $g = 0.21$; $p < 0.001$, 24.78 [24.52–25.03], $g = 0.28$, respectively) (**Figure 1**). An E-value analysis was conducted to test how strong the unmeasured confounding variables would have to be to nullify the observed results. The results of the E-value analysis provide further support for the main effect for both stress and PMH on maintained time outside ($E_{\text{stress}} = 1.56$; $E_{\text{PMH}} = 2.64$) and increased outside time outside ($E_{\text{stress}} = 1.65$; $E_{\text{PMH}} = 1.90$). There was not a significant difference in stress or PMH for those reporting either increased

or maintained outside time ($p > 0.05$). Full model results are available as supplementary material (**Supplementary Table 2**).

Aim 3

The main effect of outside time remained significant with the addition of the interaction terms (MVPA and COVID-19-related public health restrictions) with outside time using Type II sum of squares for stress ($F_{(2,3,251)} = 14.77$, $p < 0.001$) and PMH ($F_{(2,3,251)} = 23.76$, $p < 0.001$). However, the interaction terms of outside time by MVPA and by COVID-19-related public health restrictions were not significant for stress ($F_{(6,3,251)} = 0.64$, $p = 0.69$; $F_{(4,3,251)} = 0.86$, $p = 0.49$; respectively) or PMH ($F_{(6,3,251)} = 0.73$, $p = 0.63$; $F_{(4,3,251)} = 0.73$, $p = 0.57$; respectively).

DISCUSSION

Consistent with hypotheses, our findings showed that US adults reported significantly less outside time per day following COVID-19-related public health restrictions. Moreover, maintaining or increasing outside time were associated with lower stress and higher positive mental health, regardless of the amount of physical activity engaged in or the degree of COVID-19 related public health restrictions. Transportation to and from work, social gatherings, and leisure activities often occur outside, and abrupt shifts to working from home, practicing social distancing, and limits on social gatherings likely contribute to these findings. Fear of disease transmission and attempting to comply with government mandates are additional factors that may influence the time people spend outside (23). More research is needed to understand which factors most impact outside time when public health restrictions are in place to inform public health messaging.

Moreover, individuals who were able to maintain or increase outside time each day reported less stress and higher PMH, regardless of physical activity or COVID-19 related public health restriction, although the effects were small. This is consistent with prior evidence of lower stress and improved mental health when more time is spent in a natural environment or outside (24–26). Understanding that maintaining or increasing outside time still has an effect on stress and PMH after controlling for public health restriction is especially important during the pandemic when stress may increase due to employment changes or loss, changes to childcare (e.g., online schooling), financial instability, and/or reduction of stress-mitigating hobbies (8, 27, 28) and local restrictions may need to be implemented at any time. Increasing outside time (e.g., being outdoors, walking, biking, and gardening) may be an essential component of managing stress and maintaining PMH during a global pandemic. Examining change in outside time and their association with mental health as these behaviors further change across time and in response to easing of restrictions warrants further research.

Strengths of this study are the robust sample size, psychometrically strong measures of stress and PMH, and estimates of outside time pre- and post-public health restrictions. As these were observational data, a limitation was the clarity of direction of the relationship between outside time and stress/PMH. It is plausible those high stress and poor positive

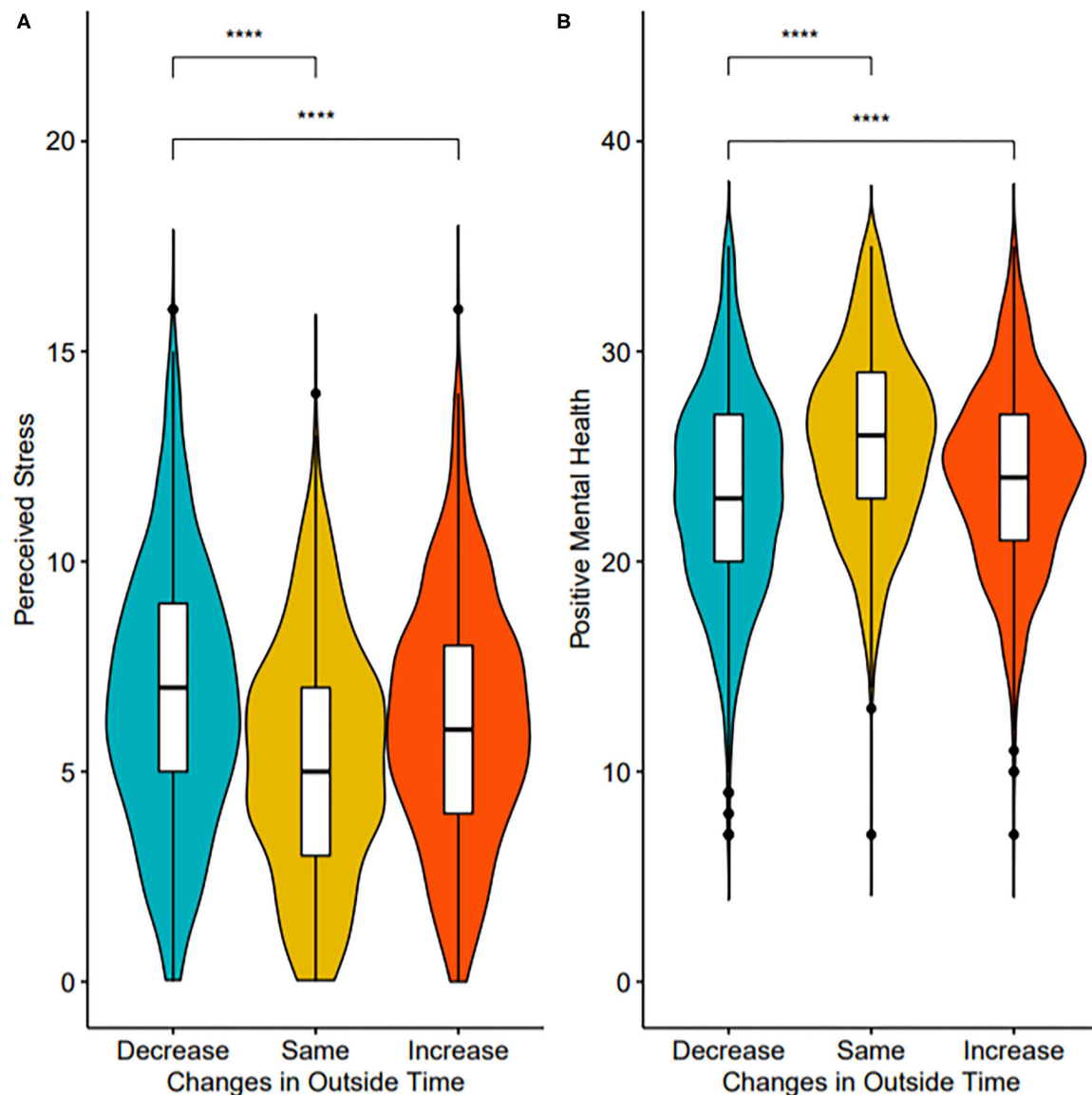


FIGURE 1 | Violin and box plots of stress (A) and PMH (B) by outside time groups. Significance values indicate results of pairwise comparisons. **** $p < 0.0001$.

mental health may lead people to be outside less. Other limitations include a predominately white and female sample, which is not an accurate representation of the total U.S. population, and retrospective report of outside time pre-COVID; therefore recall bias may have influenced these results. The state of national emergency was declared on March 13th and data was collected from April 3rd to April 9th, therefore participants had a brief recall period when self-reporting outside time prior to the restriction implementation which reduces the potential magnitude of this bias. Additionally, many participants reported a “0” value for the amount of outside time both before and after public health restrictions, which means the present effect sizes are likely to underestimate the true effect of the pandemic on outside time and its association with mental health. Finally, due to the anonymous nature of the survey, we were unable to

identify possible duplicate responses or get a clear understanding of response rate and cooperation rate.

Public Health Implications

Current findings of decreased outside time due to COVID-19 public health restrictions (coupled with previously reported reductions in physical activity and increased sedentary time), could have serious implications for the long-term mental health of the general population. The finding that increasing or maintaining outside time benefits stress and positive mental health regardless of level of physical activity or degree of COVID-19-related public health restriction in these largely active adults underlines the importance of developing strategies, programs, and messages that encourage and facilitate safe outside time throughout the current pandemic. Proposed recommendations

of making parks and green spaces more accessible during the pandemic, including expanding green spaces in urban areas, installing bicycle lanes, building parks that are in closer proximity to homes, and planning for more frequent evaluations of park sanitation (29), could have a significant beneficial impact on population mental health. Implementation and evaluation of these and other strategies designed to increase outside time may be of public health value in mitigating both short-term and long-term pandemic-induced negative mental health effects.

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 human participants were reviewed and approved by Human-Institutional Review Board Iowa State

University. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

The data collection of the project was done by CB, JM, and JL. The idea for the paper, the data cleaning, the data analysis, and the writing was done by SC and JL. The data analysis and figures were done by JM. The review of the paper and suggested ideas were done by JM, JL, MH, CM, and CB. The review and final edits of the paper were done by SC. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpubh.2021.619129/full#supplementary-material>

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The Effects of Sport Activities and Environmentally Sustainable Behaviors on Subjective Well-Being: A Comparison Before and During COVID-19

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This study examined the effects of sport activities and environmentally sustainable behaviors on the subjective well-being of working-age adults (18–64). Specifically, it analyzes the effects of different types of sport activities, including nature-based, natural resource-using, and nature-neutral sport activities and different types of environmentally sustainable behaviors such as recycling, ecological consumption, energy-saving, and mobility on subjective well-being. The study conducts comparisons between the period before the COVID-19 pandemic and during the first lockdown in Germany. Quantitative survey data were collected using a convenience sampling approach ($n = 412$). Sport activities were captured with the number of hours spent on nature-based, natural resource-using, and nature-neutral activities. Environmentally sustainable behaviors were measured across four areas, including recycling, ecological consumption, energy-saving, and mobility. Subjective well-being was measured using the scale of the World Health Organization (WHO-5). Differences between the periods before and during COVID-19 were analyzed using t -tests. A set of multivariate regression models were estimated with subjective well-being as the dependent variable and sport activities, environmentally sustainable behaviors, and socio-demographics as independent variables. The results show that nature-based and nature-neutral sport activities significantly decreased during the first COVID-19 lockdown, while environmentally sustainable behaviors increased. The regression analyses reveal that nature-based and nature-neutral sport activities as well as ecological consumption significantly added to individuals' subjective well-being in the pre- and during-COVID-19-period. A decrease in nature-based and nature-neutral sport activities significantly predicted a decrease in individuals' subjective well-being. The findings of this study might help people understand the role and importance of active living for psychosocial outcomes during the COVID-19 pandemic.

Keywords: environment, nature, sport participation, sustainability, well-being

INTRODUCTION

In terms of social policy, environmental protection as well as physical and mental health are important issues. For example, the Green Party was elected in the 2019 European elections with 20.5% of all votes and an increase of 9.8% compared to the 2014 election, signaling an increasing interest in sustainability (State Center for Political Education, 2019). Now, if sustainability is to be promoted, the cumulative effect of individual environmentally sustainable behaviors should not be underestimated (Dietz et al., 2009; EEA, 2015). For example, policy can prescribe guidelines or establish educational programs (Osbaldeston and Schott, 2012). However, if political regulations now determine people's lives, the question arises to what extent these affect the framework for action and an individual's own subjective well-being (SWB).

Thus, it can be assumed that any ordinances that cost people money, time, or effort reduce individual's SWB (Schmitt et al., 2018). However, Schmitt et al. (2018) also provide evidence that ordinances regarding environmentally sustainable behaviors can lead to lifestyle changes that increase rather than decrease individual's SWB. Hence, it can be understood that people are responsible for their own SWB with their individual behaviors. Incentives such as sports and educational programs, clubs and other opportunities can exist, but everyone must initiate their own participation.

Since the beginning of the COVID-19 pandemic, people's lives have changed drastically. To contain the virus, open spaces, restaurants, and sport facilities were closed. People were asked to stay at home and practice social distancing, companies had to reduce working-time or dismiss staff. Questions arise considering the impact of these lifestyle changes on psychosocial factors such as SWB.

The purpose of this study is to examine the effects of sport activities and environmentally sustainable behaviors on individuals' SWB. Specifically, it investigates the effects of different types of sport activities, including nature-based, natural resource-using, and nature-neutral sport activities and different types of environmentally sustainable behaviors such as recycling, ecological consumption, energy-saving, and mobility on the SWB of working-age adults in Germany. It advances two main research questions: (1) how do different types of sport activities and environmentally sustainable behaviors affect SWB? And (2) how do changes in sport activities and environmentally sustainable behaviors between the pre- and during-COVID-19-period impact overall SWB and changes in SWB? These research questions will be analyzed using survey data from Germany.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Subjective Well-Being

There are mainly two ways to approach well-being. One the one hand, psychological well-being is a multidimensional construct measuring life aspects such as self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth (Ryff, 1989; Hernandez et al., 2018). On the other hand, SWB is defined as the cognitive and affective

evaluation of individual's own life (Diener et al., 2018). The latter approach to well-being has been chosen to identify the relationship between specific sport activities and environmentally sustainable behavior and a general self-assessed well-being. SWB also includes eudaimonic and hedonic elements. The eudaimonic element means that people strive for self-fulfillment, which motivates them to naturally behave in a way that fulfills their needs. However, Ryan and Deci (2001) point out that some actions are more influenced by norms and external demands, which would not contribute to individuals' SWB. The hedonic element defines SWB as a condition whereby people rather like their life and tend to approach joy and prevent pain (Kahneman et al., 1999).

According to set point theory, individuals' general life satisfaction is genetically anchored (Lykken and Tellegen, 1996) and will be restored eventually to its former level (Brickman and Campbell, 1971). Speaking from a behavioral economics perspective, people naturally behave in a way that would ensure joy and satisfaction which would ultimately contribute to their SWB (Kahneman et al., 1997). Thus, people are acting in a utility oriented and utility maximizing manner. The literature shows that current SWB is driven by individuals' subjective perception and depends on many factors. For example, SWB is related to specific employment factors such as income (Stevenson and Wolfers, 2008; Zhang and Churchill, 2020) or unemployment (Helliwell and Huang, 2014). In addition, associations of SWB with various psychological factors were found, such as depression (Fergusson et al., 2015), personality traits (DeNeve and Cooper, 1998; Steel et al., 2008), goals (Klug and Maier, 2015), prosocial behavior (Thoits and Hewitt, 2001; Dunn et al., 2008), and job satisfaction (Bowling et al., 2010). Specific life events such as weddings, breakups (Luhmann et al., 2012), or parenting characteristics (Nelson et al., 2014) also contribute to changes in SWB. Many different factors and areas of life influence SWB. However, it is not clear which factors stabilize individuals' SWB during life-changing times like the COVID-19 pandemic.

Sport Activities

Physical inactivity is one of the largest risk factors for global mortality (WHO, 2019). Although there are studies that cannot confirm the relationship between physical activity and health factors (Janssen and LeBlanc, 2010), the majority of studies have indeed shown a positive relationship (e.g., Humphreys et al., 2014; Rhodes et al., 2017; Warburton and Bredin, 2017). For example, cardiovascular diseases, diabetes, cancer, elevated blood pressure, elevated blood glucose levels, and obesity are all associated with physical inactivity. Therefore, strategies and implementation options were developed as early as 2004 in the 57th World Health Assembly Decision and 2008 in the 61st World Health Assembly Decision to provide guidelines and recommendations for physical activity for member countries (WHO, 2010). The German government also recommends a physically active life style for better health, SWB, and quality of life (German Parliament, 2010). For example, the national program "IN FORM - Germany's initiative for healthy nutrition and more exercise" was created (German Parliament, 2010),

whereby, among other things, sport activities are promoted in everyday life.

Thus, sport activity is considered a national and global goal for a healthy population, and it is useful to further investigate the relationship of sport with other aspects of life. Rasciute and Downward (2010) showed that people who are more frequently active in sports not only feel healthier, but also happier. Furthermore, sport activities were found to be a positive contributor to SWB (e.g., Pawlowski et al., 2011; Wicker and Frick, 2017; WHO, 2018).

Existing studies have measured (regular) sport activity with a dummy variable (yes or no) (Pawlowski et al., 2011; Huang and Humphreys, 2012; Ruseski et al., 2014) or captured the frequency (Lechner, 2009; Orlowski and Wicker, 2018; Wicker, 2020) or minutes of participation (e.g., Downward and Rasciute, 2011; Wicker and Frick, 2015; Downward and Dawson, 2016). Collectively, these studies found that active people have higher SWB than inactive people and that SWB increases with increasing frequency and minutes of sport activity. Further studies focused on the intensity of sport activities, with higher-intensity activities not significantly contributing to or even reducing SWB (Wicker and Frick, 2015, 2017). Only a few studies examined different types of sport activities. For example, Rasciute and Downward (2010) distinguished between sport activities for health, utilitarian, and competitive purposes.

Existing research has indicated that the context of sport activities matters and the extent to which these are related to nature or consume nature. Regarding nature sports, Bratman et al. (2015) contemplate on general proximity to nature being related to lower distress and higher positive affect. Hence, it is possible that performing sport activities while being connected to nature multiplies those positive effects. Indeed, Wolsko et al. (2019) found that nature-based sport contributes toward more sustainable behaviors and SWB. Nature-based sport includes activities such as walking, cycling, swimming, or snowboarding which do not consume, use, or harm nature in any form. Bratman et al. (2015) also showed that walking in nature reduces rumination, ultimately leading to higher satisfaction and less distress.

On the other hand resource-using sport in nature does not add to SWB (Wolsko et al., 2019). Those activities encompass hunting, fishing, or driving a motorboat which emit carbon dioxide or consume natural resources. It can be concluded that not primarily the connectedness to nature, but rather the cognitive and moral evaluation of the consequences of the respective sport activity is relevant for the influence on SWB. The first hypothesis reflects this relationship:

H1. The more often individuals engage in nature-based activities, the higher their SWB.

Environmentally Sustainable Behaviors

Environmental protection is becoming increasingly important in international politics and for many people. The European Union (EU) has created a package of measures in the context of the European Green Deal. According to this package, Europe attempts to reduce carbon dioxide emissions even further by

2030 and become a climate-neutral continent by 2050 (EU, 2020). Additionally, the European Climate Pact will also be initialized from the last quarter of 2020 to involve all citizens and areas of life in active climate protection. The EU has recognized that measures for the conservation of nature must be defined not only at a political level, but also at an individual level in people's daily lives (e.g., regarding mobility, energy-saving or ecological consumption). Consequently, individual environmentally sustainable behaviors are important. Moreover, studying interrelationships of these behaviors with other aspects of life in more detail is critical as individuals are more likely to perform behaviors which improve their situation and add to their SWB, respectively. Additionally, O'Brien (2008) has pointed out the importance of further investigating the intersection between environmental sustainability and happiness because both aspects can actually benefit from each other in the future.

From a theoretical perspective, a number of theoretical mechanisms explain the association between environmentally sustainable behaviors and SWB (e.g., Schmitt et al., 2018). On the one hand, many types of environmentally sustainable behavior are associated with costs for the individual in terms of, for example, time, money, effort, reduced convenience, or personal sacrifice. The level of these potential costs differs among individuals as every individual has different subjective perceptions in this regard. Depending on the level of these perceived costs, it can be assumed that these costs represent barriers to perform environmentally sustainable behaviors and they explain why performing such behaviors does not improve SWB (Schmitt et al., 2018).

On the other hand, environmentally sustainable behavior is also considered pro-social behavior (Schmitt et al., 2018), meaning that individuals' perceived costs in terms of e.g., time, money, and reduced convenience are accepted to do something good for, in this case, the environment. Accordingly, existing studies have shown that people who behave pro-socially experience positive emotions (Pruneau et al., 2006; Schmitt et al., 2018). This relationship between pro-social behavior and positive emotions can be explained by different psychological mechanisms. For example, people feel proud of themselves when they can help someone or something else through personal sacrifice or at their own expense. This feeling can also be referred to as the warm glow of giving (Andreoni, 1990). Likewise, people often behave altruistically because they want to contribute to the satisfaction of others (Batson and Weeks, 1996; Oliner, 2003). Or they behave less selfishly because they want to reduce their own experience of stress by reducing the suffering of others (Cialdini et al., 1987). Altogether, these mechanisms explain why performing environmentally sustainable behavior can improve individuals' SWB.

From an empirical perspective, many studies have examined the link between environmentally sustainable behaviors and SWB. For example, Wolsko et al. (2019) found that 39 sustainable behaviors positively contribute to individuals' SWB. They conclude that such behaviors facilitate climate protection, especially when nature is endangered due to climate change. This positive relationship between environmentally sustainable behaviors and SWB has also been shown in existing research in

the United States (Brown and Kasser, 2005), Mexico (Corral-Verdugo et al., 2011), Sweden (Kaida and Kaida, 2016), Spain (Suárez-Varela et al., 2016), and China (Xiao and Li, 2011). In Germany, Welsch and Kühling (2011) found that recycling, water conservation, and ecological consumption, such as the purchase of environmentally friendly products, were particularly related to individual's SWB. Collectively, these empirical findings support the notion of a positive relationship between environmentally sustainable behavior and SWB, suggesting that the above noted mechanisms of pride, altruism, warm glow, and generosity might be at work. These aspects lead to the second hypothesis:

H2. The more frequently people perform environmentally sustainable behaviors, the higher their SWB.

Behaviors and Subjective Well-Being Before and During COVID-19

Existing research has shown that both sport activities (e.g., Huang and Humphreys, 2012; Ruseski et al., 2014; Downward and Dawson, 2016; Wicker, 2020) and environmentally sustainable behaviors (Schmitt et al., 2018; Wolsko et al., 2019) are positively related to SWB. However, as a result of the COVID-19 pandemic and associated restrictions, these behaviors might have changed and these changes might affect individuals' level of SWB. For example, Evans et al. (2020) argue that the setting of sport activities will change due to the pandemic. So far, Cunningham (2021) found that higher levels of sport activities moderate the relationship between COVID-19 cases and deaths, supporting the importance of analyzing COVID-19 related changes in sport activities and their impact on mental health and SWB, respectively.

The COVID-19 pandemic has changed the private and public lives of everyone around the world. The sport sector was also affected in many ways. For example, sports competitions paused and both fitness clubs and community sport clubs had to close. Government health measures such as social isolation were implemented with the aim of encouraging (or reinforcing) people to stay at home more often. In this time of social isolation and reduced organized sport opportunities, it is possible that people increasingly use walks, runs, bike rides, or (online) home workouts and to what extent these changes in sport activities influence their SWB. For example, Brand et al. (2020) showed that individuals who exercised every day during the pandemic had the best mood, while individuals who decreased their sport activities during the pandemic had the worst mood. Other studies also found positive effects of sport activities on SWB during the pandemic (Lesser and Nienhuis, 2020; Ranasinghe et al., 2020). Again, the cognitive and moral evaluation of sport activities is also believed to influence individuals' SWB during the lockdown (Wolsko et al., 2019). Thus, the third hypothesis reads as follows:

H3. The greater the increase in nature-based sport, the higher the level of SWB.

Likewise, lifestyle changes are possible because of an increased number of days working from home or short-time work, allowing people to develop new environmentally sustainable

habits (Ramkissoon, 2020). Hence, in light of an increasing awareness of climate protection, the pandemic might have fostered environmentally sustainable behaviors, and an increase in these behaviors might contribute to individuals' SWB. This relationship leads to the fourth hypothesis of this study:

H4. The greater the increase in environmentally sustainable behaviors, the higher the level of SWB.

METHODS

Data Collection

To investigate the research questions, quantitative survey data were collected using a convenience sampling approach in Germany. The online questionnaire was programmed with the internet platform SoSci Survey. The data collection period was from June 1st to August 31st, 2020. The link to the survey was shared with interested participants via private social networks (Facebook, Instagram), professional networks (Xing, LinkedIn) and via e-mail. Additional participants were also recruited via the SurveyCircle and PollPool research platforms. On average, respondents needed about 7 min for the completion of the online questionnaire. The total sample consists of 476 respondents.

Of these 476 respondents, 59 individuals dropped out of the questionnaire early or were non-serious responses (e.g., always medium expression), so these observations were excluded from the dataset. An additional five subjects were removed from the data set because they did not meet the age-based target population. According to the WHO (2010) guidelines, the following age groups are distinctive for considering sport activities and health: 5–17, 18–64, and 65 years and older. The questionnaire was sent to adults between 18 and 64 years old to obtain a sufficiently large sample for the working-age population. Consequently, a total of 412 observations could be included in the empirical analysis.

Questionnaire and Variables

At the beginning of the survey, respondents were informed about the purpose of the survey, the anonymity of the data collection, and the voluntary nature of participation. The survey consisted of several sections, including sport activities, environmentally sustainable behaviors, SWB, and socio-demographics. All variables used in this study are summarized in **Table 1**.

Within the section assessing sport activities, questions related to the weekly number of hours spent with different forms of sport activities were asked for both the pre-COVID-19-period (i.e., 2019) and the during-COVID-19-period (i.e., 2020). The different types of sport activities were measured using an existing typology. According to Wolsko et al. (2019), sport activities can be classified into nature-dependent outdoor activities (e.g., canoeing, kayaking, skiing, snowboarding, stand-up paddling, swimming in an outdoor pool or the ocean), nature-independent outdoor activities (e.g., hiking, horseback riding, golf, running, cycling, or ball sports), consumptive nature-related sports (e.g., hunting or fishing), and motorized activities

TABLE 1 | Overview of variables.

Variable	Description
SWB (WHO-5; 0 = at no time; 5 = all the time)	
Good mood	... I was happy and in a good mood
Relaxation	... I felt calm and relaxed
Energy	... I felt energetic and active
Recovery	... I felt fresh and rested when I woke up
Curiosity	... my daily life was full of things that interest me
Environmentally sustainable behaviors (1 = never; 5 = always)	
Paper recycling	I recycle paper/newspaper
Glass recycling	I recycle glass
Plastic recycling	I recycle plastic
Organic recycling	I recycle organic material
Packaging in the store	I leave the packaging material in the shopping stores where I bought the products
Eco label	I buy products with an eco-label
Seasonal food	I buy seasonal and regional fruits and vegetables
Refillable bottles	I buy beverages in refillable or recyclable bottles
Turn off light	I turn off the lights when I walk out of a room in my home
Energy-saving bulb	I use energy-saving lamps in my household
Water-saving devices	I use appliances in my household that use less water (e.g., water-saving shower head)
Turn off water	When I shower or bathe, I turn off the water when I soap myself with shower gel/shampoo
Shopping	I go shopping without a car
Weekend trips	I plan my weekend trip so that I don't need a car
Traveling	I reach my destinations on vacation without a car, plane or cruise ship
Car usage in the household	I use a car in my household (reverse coded)
Sport activities (hours per week)	
Nature dependent sports	Canoeing, kayaking, skiing, snowboarding, stand-up paddling, swimming in an outdoor pool or the ocean
Nature independent sports	Hiking, horseback riding, golf, running, biking, ball sports
Consuming sports	Hunting or fishing
Motorized sports	Quad bike, motor boat
Nature-neutral sports	Gymnastics, basketball, handball, tennis, soccer, fitness training at home or in a gym, swimming in an indoor pool
Employment	
Working time	Number of weekly working hours
Working time ²	Working time*Working time
Home office	Number of weekly days in home office
Income	Personal net income per month (from 1 = €500 to 9 = >€4000)
Sociodemographic variables	
Woman	Respondent's gender (0 = man, 1 = woman)
Age	Respondent's age (in years)
Age ²	Age*Age
Low educational attainment	0 = no, 1 = yes
Higher education entry qualification	0 = no, 1 = yes
University degree	0 = no, 1 = yes
State	Dummies for the 16 German states

in nature (e.g., quad bikes, motorboats). The category nature-neutral sports (e.g., gymnastics, basketball, handball, tennis, soccer, fitness training at home or in a gym, and swimming in an indoor pool) was added as well as the option to indicate other activities. Nature-dependent and nature-independent outdoor activities neither pollute nor consume nature, so these two categories are combined as nature-based activities. Consuming nature-related sports and motorized activities in nature, on the other hand, pollute nature or cause noise and are thus summarized as resource-using activities. If respondents listed further activities in the category “other activities,” they were manually assigned to the appropriate main categories (if possible) or were excluded when they were not considered sport (e.g., gardening). No further sport activity category emerged from the category “other.” Overall, the sport activities variables reflect the number of weekly hours respondents spend on the respective sport activities.

Environmentally sustainable behaviors pre (2019) and during the COVID-19 pandemic (2020) were assessed with a set of items. Specifically, environmentally sustainable behaviors were classified into four categories, including recycling, ecological consumption, energy-saving, and mobility (Diekmann and Preisendörfer, 2003). For recycling, a distinction was made between paper/newspaper, glass, plastic, and organic/waste residues. Each category was captured by four items which were provided to respondents in randomized order. All items were measured on a five-point Likert scale. For reasons of comparability, the four-point Likert scale of Diekmann and Preisendörfer (2003) was not used here, but rather a five-point scale since the other constructs were also assessed using a five-point Likert scale.

The four latent factors recycling, ecological consumption, energy-saving, and mobility are not directly measurable, but were used as recommended by Diekmann and Preisendörfer (2003). To assess the dimensionality of the scale, a confirmatory factor analysis was run. The loadings vary between 0.28 and 0.88, with most of the variables being in the acceptable range. Even if a few single loadings are weak, the variables are not removed from the model because they still indicate the same direction of effect (Hair et al., 2010). With the comparative fit indexes (CFIs) > 0.89, the standardized root-mean square residuals (SRMR) < 0.10, and the root mean square errors of approximation (RMSEA) < 0.10, all criteria for a good model fit are met. Thus, it can be concluded that the variables meaningfully represent the four latent factors (Kearney, 2006). The factor analysis was only conducted for assessing the dimensionality of the scale. Both the *t*-test and the regression analysis are based on the four mean variables capturing the four types of environmentally sustainable behavior. The reliability of the scale was assessed using Cronbach's alpha. The corresponding values for the 2019 and 2020 data are $\alpha = 0.75$ and $\alpha = 0.77$, respectively. According to Taber (2018), values above 0.70 are considered satisfactory.

Respondents' SWB pre (2019) and during the COVID-19 pandemic (2020) was assessed using the WHO-5 scale which was developed by the World Health Organization (1998). This scale has already been translated into more than 30 languages and has

been validated many times (e.g., Topp et al., 2015; Zeike et al., 2019). The scale contains of five items. The items are positively worded and relate to mood, vitality, and general interest in individual's own life over the past 2 weeks. They are measured on a 6-point scale. A confirmatory factor analysis was calculated to evaluate the reliability and dimensionality of the five variables being summarized as a latent factor of SWB. Due to consistently high loadings of the variables (>0.70) on the SWB factor and very good fit indices ($CFI > 0.95$) for both models, unidimensionality can be assumed. The Cronbach's alphas are $\alpha = 0.87$ and $\alpha = 0.91$ for the 2019 and 2020 data, respectively, indicating strong internal consistency (Taber, 2018). The five items of the WHO-5 scale are added up to a sum score, which is further multiplied by four, analogous to the study of Topp et al. (2015). Hence, the SWB variable has a range from 0 to 100.

Dolan et al. (2008) summarized the effects of employment-related and sociodemographic factors on SWB. These factors are included as control variables in the present analysis. Employment in the form of average working time, the number of days working from home and income at the time before the pandemic in 2019 and after the first lockdown in 2020 was assessed to see whether a change in employment conditions influenced an individual's SWB. Working time was measured by the average number of working hours per week and is expected to have a u-shaped relationship with SWB. To capture these possible non-linear effects, squared working time was included in the analysis (Dolan et al., 2008). Home office was measured by the average number of days worked from home and is expected to be moderately related to SWB (Hayman, 2010). Concerning income, respondents could choose between nine categories with intervals of €500. Several studies so far showed that higher income also contributes to higher SWB (for a review see Dolan et al., 2008).

According to Babbie (2010), the inclusion of sociodemographic factors such as age, gender, and educational level as control variables in regression analyses enhances the generalizability and interpretability of findings. Previous research on the relationship between age and SWB found a u-shaped relationship (e.g., Dolan et al., 2008; Ruseski et al., 2014). Gender was coded as a dummy variable, with men being assigned a zero and women assigned a one. Two individuals assigned themselves to neither male nor female gender. These were not considered further due to the small number of cases. While some studies found that women reported higher SWB than men (DiTella et al., 2003; Huang and Humphreys, 2012), others did not find any gender differences in SWB (Louis and Zhao, 2002; Schmitt et al., 2018). Regarding educational level, it can be expected that educational attainment indirectly influences SWB by being related to a higher standard of living, more income, and health (DiTella et al., 2003; Dolan et al., 2008). Therefore, the educational level is also included in the regression as a dummy variable. Like in the study of Wicker (2020), educational attainment is recoded into three dummy variables reflecting low educational attainment (some form of secondary school; i.e., below A-levels), higher education entry qualification (i.e., technical college or university entry qualification), and university (i.e., university degree).

Additionally, the state where respondents live is also assessed in the survey and included in the regression as a dummy variable

to investigate whether respondents' place of residence has a significant influence on SWB. One study has detected differences in SWB between East and West Germany (Schimmack et al., 2008). The variable federal state was recoded from 16 to eleven categories, since fewer than ten respondents came from the federal states of Brandenburg, Bremen, Mecklenburg-Western Pomerania, Saarland, Saxony, and Saxony-Anhalt. These were collapsed into the category "other." The reference category is North Rhine-Westphalia.

Data Analysis

This study aimed to analyse, first, whether the sport activities, environmentally sustainable behaviors and SWB changed between 2019 and 2020 using *t*-tests and, second, the effect of sport activities and environmentally sustainable behaviors on SWB using regression analyses. Paired samples *t*-tests were employed to analyse differences in sport activities, environmentally sustainable behaviors, SWB, and employment conditions between the pre-COVID-19-period and the during-COVID-19-period. Altogether, four linear regression models were estimated. The first model is for the pre-COVID-19-period (2019 data), while the second model includes the during-COVID-19-period (2020 data). The third model examines how changes in sport activities and environmentally sustainable behaviors affect changes in SWB, implying that difference variables are included in this model. The last model also includes changes in sport activities and environmentally sustainable behaviors, but the dependent variable is SWB during the pandemic (i.e., in 2020).

For the regression analysis to be employed, certain prerequisites and conditions were met. The first condition was to thoroughly check the data set for outliers and influential data points to be able to exclude measurement errors of the predictors and the dependent variable (Eid et al., 2017). Overall, all measurement values that were impossible to obtain were removed. All other values that were within the realistic range were retained. The second requirement for multiple regression analysis was the exclusion of multicollinearity of predictors, which means that the independent variables must meaningfully and independently contribute to variance explanation in SWB and should not be highly correlated with each other, otherwise, the regression weights can only be estimated imprecisely (Eid et al., 2017). Multicollinearity was tested using correlation analysis. All correlation coefficients were below 0.8 and all variance inflation factors were <10 (except for age and squared age and work time and squared work time), suggesting that multicollinearity of predictors was not an issue in the present analysis (Hair et al., 2010).

The second pre-condition was normal distribution of residuals which was required to accurately estimate the standard errors (Eid et al., 2017). This assumption was tested using Q-Q-plots which showed that the assumption was not violated. The third pre-condition was the homoscedasticity of the residuals which was analyzed with scale-location plots. These plots gave relatively uniform standard deviations of the residuals over the range of the dependent variable (normalized between 0 and 100), meaning this condition was also not violated. Thus, the regression model made equally good predictions for all

TABLE 2 | Well-being in 2019 and 2020 ($n = 412$).

Item (0 = at no time; 5 = all the time)	2019		2020		Difference 2020–2019 (<i>t</i> -test)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>t</i>	<i>p</i>
Good mood	18.34	3.61	16.64	4.49			
Relaxation	17.39	4.20	15.62	5.15			
Energy	17.43	4.24	15.58	4.87			
Recovery	16.43	4.84	14.83	5.22			
Curiosity	17.17	4.32	15.80	4.90			
SWB	86.76	17.29	78.47	21.04	–8.282	–8.537	<0.001***

*** $p < 0.001$.**TABLE 3 |** Environmentally sustainable behaviors in 2019 and 2020 ($n = 412$).

Item (1 = never; 5 = always)	2019		2020		Difference 2020–2019 (<i>t</i> -test)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>t</i>	<i>p</i>
Paper recycling	3.83	1.29	4.06	1.16			
Glass recycling	4.03	1.18	4.12	1.19			
Plastic recycling	3.80	1.29	3.93	1.20			
Organic recycling	2.23	1.34	3.50	1.36			
Recycling (mean)	3.72	1.05	3.90	1.05	0.181	7.283	<0.001***
Packaging in store	2.07	1.08	2.15	1.15			
Eco-label	3.13	0.99	3.25	0.99			
Seasonal food	3.46	0.93	3.60	0.89			
Refillable bottles	3.60	1.20	3.70	1.24			
Ecological consumption (mean)	3.06	0.70	3.17	0.71	0.110	5.082	<0.001***
Switch off lights	4.43	0.81	4.44	0.79			
Energy saving light bulbs	3.81	1.15	3.85	1.19			
Water saving devices	2.45	1.22	2.55	1.28			
Turn off water	3.28	1.54	3.37	1.55			
Energy-saving (mean)	3.49	0.76	3.55	0.79	0.059	3.433	<0.001***
Shopping	3.34	1.35	3.31	1.36			
Weekend getaway	2.86	1.22	2.92	1.26			
Travel	2.26	1.23	2.53	1.32			
Car in the household (reverse coded)	3.14	1.38	3.18	1.43			
Mobility (mean)	2.90	0.58	2.99	0.64	0.065	2.054	<0.001***

*** $p < 0.001$.

values and respondents. Another pre-condition was linearity of relationships, which was tested and confirmed using scatterplots. Finally, for an unbiased multiple regression analysis, the residuals of the variables were also independent of each other (Eid et al., 2017). The Durbin-Watson coefficient was $DW = 2.01$ ($p = 0.970$) for the 2019 model and $DW = 2.11$ ($p = 0.318$) for the 2020 model. Also, the non-significant p -value showed that there was no autocorrelation of the residuals. The condition of independent residuals was hereby fulfilled. Hence, all pre-conditions for applying regression analysis were met.

RESULTS

At the time of the survey, respondents were 27 years old on average. The youngest respondent is 18 years and the oldest is 64

years old. Female respondents make up two thirds of the sample (66.75%). Overall, just under 60% of respondents have a degree from a university or technical college and just under 37% have a technical college or university entry qualification.

Table 2 shows the summary statistics of SWB for 2019 and 2020 as well as the results of the t -tests. Respondents' self-reported SWB reveals that, on average, they felt positive slightly more than half of the time in a typical week in 2019 ($M = 86.76$). On average, subjects feel less positive about their situation in 2020 than in 2019 ($M = 78.47$). The average reduction in SWB is highly significant ($p < 0.001$).

Table 3 summarizes the descriptive statistics for environmentally sustainable behaviors and the results of the t -tests. They reveal that respondents often behave in an environmentally sustainable manner. The mean value of

TABLE 4 | Sport activities in 2019 and 2020 ($n = 412$).

Sport activities (in hours per week)	2019		2020		Difference 2020–2019 (<i>t</i> -test)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>t</i>	<i>p</i>
Nature dependent sport	1.69	7.53	1.07	2.89			
Nature independent sport	4.56	5.62	4.54	5.16			
Nature-based sport	6.25	9.75	5.62	5.95	−0.619	−1.369	0.172
Consuming sport	0.41	5.98	0.55	7.54			
Motorized sport	0.28	1.65	0.25	1.64			
Natural resource-using sport	0.69	6.24	0.80	8.58	0.112	0.616	0.539
Nature-neutral sport	3.08	3.32	2.77	3.46	−0.312	−2.043	0.042*

*** $p < 0.001$.**TABLE 5 |** Employment situation in 2019 and 2020 ($n = 412$).

	2019		2020		Difference 2020–2019 (<i>t</i> -test)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>t</i>	<i>p</i>
Working time	19.97	17.73	19.58	18	−0.039	−0.557	0.578
Home office	1.58	2.24	2.96	2.81	1.355	10.520	<0.001***
Income	2.78	1.92	2.80	2.04	0.03	0.549	0.584

*** $p < 0.001$.

the recycling factor is $M = 3.72$ in 2019 and increases to $M = 3.90$ in 2020. For ecological consumption, the mean increases from $M = 3.06$ in 2019 to $M = 3.17$ in 2020. For mobility, the mean increases from $M = 2.90$ to $M = 2.99$ during the same period. A slight average increase in environmentally sustainable behaviors is also seen for energy conservation, with a mean of $M = 3.49$ in 2019 and of $M = 3.55$ in 2020. Altogether, in 2020, all environmentally sustainable behaviors were performed more frequently than in 2019. The pairwise tests show that these differences are statistically significant.

Table 4 shows the summary statistics for sport activities and the results of the *t*-tests. Nature-dependent sport activities outside were performed more frequently in 2019 ($M = 1.69$) than in 2020 ($M = 1.07$). In 2020, the frequency of nature-independent activities outside also decreased by 0.02 h per week compared to 2019. Thus, in 2020, respondents reported spending an average of 4.54 h per week of time hiking or similar activities. On average, nature-based sport was thus practiced more frequently in 2019 before COVID-19 ($M = 6.25$) than during the pandemic in 2020 ($M = 5.62$).

In 2020, respondents engaged more frequently in hunting or fishing ($M = 0.55$) than in 2019 ($M = 0.41$). Motorized activities outside decreased by an average of 0.03 h per week. Overall, resource-using sport activities increased by an average of 0.11 h per week compared to 2019. The second most common sport activity was nature-neutral sport. On average, respondents dedicated 0.31 more hours to indoor sport activities per week in 2019 ($M = 3.08$) than in 2020 ($M = 2.77$). Overall, the *t*-tests reveal that only nature-neutral sport activities have significantly changed between 2019 and 2020.

Table 5 displays the descriptive statistics and the results of the *t*-test for the employment variables. During the pandemic in 2020, respondents worked an average of 3 days per week in the home office. Before COVID-19, they were in home office only between 1 and 2 days per week. In total, respondents worked just under 20 h per week both before COVID-19 and in 2020, including work in home office and at the normal workplace. The high standard deviation of the working hour's variable can be explained by some extreme values that were not removed because respondents explained in the text box that these many overtime hours were operationally necessary and thus realistic. The mean personal net income is between €500 and €1,500 per month in both 2019 and 2020.

Table 6 presents the results of the multiple regression analysis. Starting with sport activities, the 2019 model shows that nature-based sport activities are significantly related to SWB, but resource-using sports do not. Nature-neutral sport activities are also significant. Nature-based sport activities are also a significant predictor of SWB for the period during the pandemic in 2020. Thus, SWB increases by slightly more than one unit when people perform more hours of nature-based sport (*ceteris paribus* [c.p.]). Resource-using sport continues to be non-significantly related to SWB. However, nature-neutral sport is again a significant predictor of SWB (c.p.). It was hypothesized that more frequent engagement in nature-based sport activities (hypothesis H1) would be related to higher SWB. Overall, the results show that nature-based sport activities are significantly and positively related to SWB, suggesting that the first hypothesis can be supported.

Turning to environmentally sustainable behaviors, the results of the 2019 model show that recycling, ecological consumer

TABLE 6 | Regression analyses for SWB ($n = 412$).

	SWB 2019	SWB 2020	SWB Diff 20-19 (IVs: Diff 20-19)	SWB 2020 (IVs: Diff 20-19)
Constant	57.940*** (16.680)	43.790* (20.300)	2.833 (18.887)	69.782*** (20.85)
Recycling	2.095* (0.922)	1.841 (1.112)	-4.317* (2.102)	-1.137 (2.321)
Ecological consumption	2.734* (1.384)	4.339* (1.806)	0.263 (2.477)	4.738 (2.735)
Energy-saving	2.257 (1.219)	2.090 (1.486)	5.674 (3.180)	5.018 (3.512)
Mobility	-1.274 (0.907)	0.495 (1.056)	0.012 (1.670)	0.813 (1.844)
Nature-based sport	0.218* (0.098)	0.519** (0.180)	0.356** (0.129)	0.197 (0.143)
Resource-using sport	-0.004 (0.133)	0.066 (0.122)	0.177 (0.352)	0.155 (0.388)
Nature-neutral sport	0.542 (0.282)	0.903** (0.315)	1.065** (0.370)	0.656 (0.408)
Age	-0.542 (0.969)	-1.119 (1.181)	-0.413 (1.111)	-0.563 (1.228)
Age ²	0.009 (0.013)	0.016 (0.016)	0.008 (0.016)	0.012 (0.017)
Woman	-0.642 (1.932)	-5.916* (2.349)	-5.631* (2.192)	-4.232 (2.421)
Working time	-0.038 (1.214)	-0.043 (0.154)	0.280 (0.178)	0.220 (1.251)
Working time ²	0.000 (0.002)	-0.001 (0.002)	-0.007* (0.003)	-0.005 (0.004)
Income	0.836 (0.671)	1.419 (0.728)	-0.836 (1.133)	0.211 (1.251)
Home office	-0.316 (0.412)	0.120 (0.441)	-0.284 (0.453)	-0.808 (0.500)
Low educational attainment	-10.550 (6.605)	-1.074 (7.442)	12.026 (7.658)	-0.949 (8.457)
Higher educational entry qualification	-3.269 (2.021)	-2.277 (2.539)	-0.195 (2.424)	-2.529 (2.677)
State	Yes	Yes	Yes	Yes
R ²	0.166	0.176	0.171	0.124
Adj. R ²	0.102	0.112	0.104	0.052

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; IVs = independent variables; displayed are the unstandardized regression coefficients; standard errors in parentheses; reference categories are male, university degree, and North-Rhine-Westphalia.

behaviors and energy-saving behaviors as well as nature-based sports are significant predictors of SWB. Overall, a one-unit increase in recycling behaviors *ceteris paribus* (c.p.) leads to a 2.095 unit increase in SWB. SWB also increases by 2.734 units when ecological consumption behaviors increase by one unit (c.p.). Energy-saving behaviors are a significant predictor

of SWB, while mobility behaviors are not. Hypothesis H2 can thus be partially confirmed, as individual environmentally sustainable behaviors are positively related to SWB. Some theory-conforming significant correlations can also be identified in the 2020 model. Ecological consumption behaviors show to be a suitable predictor (c.p.) for SWB in this model. Recycling behaviors are only marginally significant, while energy-saving and mobility behaviors are not significantly related to SWB in the 2020 model. It was hypothesized that more environmentally sustainable behaviors (hypothesis H2) would be related to higher SWB. The results show that individual environmentally sustainable behaviors (ecological consumption and recycling) are significantly and positively related to SWB, so the second hypothesis can be partially supported.

The next step was to analyse how behavioral changes affect SWB. The results of the multiple regression analysis with difference terms show that a change in recycling behaviors, nature-based sports, and nature-neutral sports are significantly related to a change in SWB. If the 2020-2019 difference in recycling behaviors increases by one unit, SWB decreases by 4.137 units. Energy conservation is marginally significant. If the difference in nature-based behaviors increases by one unit from 2020 and 2019, the difference in SWB increases by 0.712 units. The change in nature-neutral sports is also a significant predictor of the change in SWB. In this study, SWB during the pandemic in 2020 cannot significantly be predicted by a change in the independent variables.

Regarding behavioral changes, it was hypothesized for the comparison before COVID-19 and during COVID-19 that increases in nature-based sport activities (hypothesis H3) and environmentally sustainable behaviors (hypothesis H4) would also be positively related to SWB. Hypothesis H3 can be supported because the increase in nature-based sport activities is significantly and positively related to an increase in SWB. However, the results of the difference analysis show that SWB decreases significantly despite an increase in recycling behaviors and that an increase in environmentally sustainable behaviors does not yield increases in SWB. Therefore, hypothesis H4 must be rejected.

DISCUSSION

This study looked at the effects of different types of sport activities and environmentally sustainable behaviors on individuals' SWB. For this purpose, a quantitative survey was designed and data were collected in Germany. Due to the private and professional life changes because of the COVID-19 pandemic and the resulting lockdown, both the situation before COVID-19 (in 2019) and the situation during the pandemic (in 2020) were assessed in the survey. In summary, both in retrospect in 2019 and the evaluation of the current situation, individual environmentally sustainable behaviors and nature-based sports were found to be related to SWB.

Discussion of Findings

The first hypothesis was that sport activities that are nature-based positively contribute to SWB. The results of the regression analysis reflect that nature-based sport activities correlate more strongly with SWB than resource-using activities (e.g., hunting, fishing, motor boating, or quad biking). In both the 2019 and 2020 models, nature-based sport activities are a positive predictor of SWB, even when controlling for employment and sociodemographic variables. Hence, performing these activities contributes to individuals' SWB because the health and social benefits of sport activity do not occur at the expense of the natural environment. Nature-based sport activities such as cycling, running, swimming, or skiing do not consume any natural resources and do not cause any negative consequences such as noise or pollution. Beyond noise or pollution, the impact of skiing on nature can be seen controversially as skiing pistes and resorts can also damage the natural environment (Digel, 2013). Acknowledging this controversy, it was nevertheless included in the nature-based sport activity category as proposed by Wolsko et al. (2019). Moreover, nature-neutral sport activities were a significant determinant of SWB in 2020 and increasing the duration of these activities from 2019 to 2020 also yielded increases in SWB. Hence, also sport activities that do not consume or harm the natural environment help people to feel better. Only the feeling of consuming or harming environmental resources during sport activities do not impact SWB. The finding that duration of sport activities positively affects SWB is in line with existing research (e.g., Wicker and Frick, 2015; Downward and Dawson, 2016), which, however, did not distinguish between different types of sport activities. The contribution of the present work lies in a nuanced analysis of sport activities and a classification of these activities based on their relation to nature.

The second hypothesis stated that people with more pronounced environmentally sustainable behaviors also experience greater SWB. Schmitt et al. (2018) showed that almost all environmentally sustainable behaviors are related to individual's life satisfaction. The results of this study can partially confirm this relationship. Ecological consumption is a significant predictor of SWB in both models (2019 and 2020). Recycling was also a suitable behavior to improve individuals' SWB in 2019. Mobility and energy-saving behaviors, on the other hand, were not significantly related to SWB.

The third and fourth hypotheses were related to changes in sport activities and environmentally sustainable behaviors and how these changes affect SWB in 2020 or changes in SWB between 2019 and 2020. In particular, due to the COVID-19 pandemic, there were some restrictions, bans, and regulations that changed people's daily life as early as March 2020. The *t*-test supports the notion that the pandemic has changed various parts and activities of people's lives, including environmentally sustainable behaviors, nature-neutral sport activities, SWB, and work in home office. The significant decline in nature-neutral sport activities can be explained by the closure of many sport facilities, including especially indoor facilities, but also outdoor facilities to some extent depending on the respective lockdown regulations. On the contrary, participation in nature-based and natural-resource using sport activities

did not change significantly. It is possible that interested individuals did not have the opportunity to participate in these activities during the pandemic as organizations offering these sport activities were also closed and/or travel restrictions were in place.

The question is to what extent sport activities or environmentally sustainable behaviors can serve as resilience factors for alleviating the negative well-being impacts on a crisis such as the COVID-19 pandemic. The COVID-19 pandemic and everyday lifestyle restrictions are shaping people's lives and preferences for future sport activities (Teare and Taks, 2021). For example, because of COVID-19 related restrictions, people were found to spend less time in outdoor recreational settings (Landry et al., 2021). It is possible that the increased accessibility of digital sport offers, and the lack of offline sport opportunities are responsible for the positive effect of nature-neutral sport activities on SWB. Qin et al. (2020) have identified less physical activity and increased screen time to be related to poorer emotional state during the nationwide lockdown in China in spring 2019. Cindrich et al. (2021) have also found that during COVID-19 decreasing hours spent outside led to more negative stress and lower positive mental health levels. Both aspects, sport activities themselves and time in nature, were identified as important factors for SWB in the present work as well. While nature-neutral sport activities were not relevant to SWB before the pandemic, they gained in importance during the pandemic because of stay-home policies and were able to add to people's SWB. Nature-based sport activities also significantly added to SWB, while it was still important to not harm nature.

Binder and Blankenberg (2017) found that self-assessed sustainability of an individual's behaviors are strongly related to individual's life satisfaction, precisely because reflection on the positive impact on the environment generates satisfaction. Thus, the cognitive focus people have while assessing their SWB is critical. Loewenstein and Schkade (1999) call this phenomenon focusing illusion. It may be that the focus during the COVID-19 pandemic is not on sustainability, but on health and occupational safety. This may explain why SWB decreases in this data set, although environmentally sustainable behaviors increase. In accordance with set point theory, it can be assumed that individuals' average SWB will improve again, even if the pandemic continues for a longer time. This adjustment tends to happen because people adapt to this adverse situation and shift their cognitive focus to other aspects of their life. Still, being physically active was found to support individuals in bouncing back from adversity more quickly than without participating in sport and physical exercise (Wicker and Orlowski, 2020).

Sociodemographic factors such as age, gender, level of education and state, as well as employment factors such as working time, income, and home office were included to control for other factors that also affect individuals' SWB and, in doing so, isolate the effects of sport activities and environmentally sustainable behaviors. The self-assessment of the situation during the pandemic (2020) revealed that women reported lower SWB levels than men. This gender difference in favor of men echoes

existing research (e.g., Dolan et al., 2008) and suggests that the typical drivers of SWB are also evident in a crisis situation like the COVID-19 pandemic. In the present study, women also experienced significantly larger declines in SWB during the pandemic compared to before the pandemic. This finding differs from Lades et al. (2020) who found no gender differences in daily well-being outcomes during the COVID-19 pandemic. The other socio-demographic factors played no role in either model.

The increased number of days people worked from home indicate that the pandemic has significantly changed their working conditions. This finding echoes Brynjolfsson et al. (2020) who have reported that at least one third of the labor force in the United States have changed to remote work between February and May 2020. Such changes can be perceived as financially or organizationally inconvenient, hindering or endangering, and could reduce people's SWB because they are worried about their professional future or their finances. However, the present study supports the notion that these changes in the working environment did not affect their SWB, meaning that they could also be considered by employers in the period after the pandemic.

Limitations

The first limitation of the study is the generalizability of the data. Looking at the sample, it is noticeable that almost 85% of respondents are under 30 years old and around two thirds are women. This gender and age composition indicates that the sample is not representative of the German resident population and it might have skewed the results. This high proportion of younger people can be explained by the fact that the personal network and the people using platforms such as Survey Circle or PollPool are younger. The second limitation is that the different types of environmentally sustainable behaviors were not weighted depending on their (perceived) threat to the natural environment. According to Schmitt et al. (2018), this leads to more environmentally sustainable behaviors. It can be assumed that those individuals who perceive the environment to be threatened feel happier when they engage in environmentally sustainable behaviors that greatly reduce environmental impact. However, it is unclear whether the perception of environmental threat has decreased, increased, or remained the same during the COVID-19 pandemic compared to before the pandemic as this aspect was not included in the survey. The third limitation considers the retrospection of behaviors and SWB in 2019 and the potential of recall bias. Some participants might have had difficulties in accurately recalling their sport activities, environmentally sustainable behaviors, and SWB in the time period before the pandemic.

Future Research Directions

In this study, sport activities were classified based on the connectedness to nature, yielding a distinction between sports related to nature and sports neutral to nature. Schmitt et al. (2018) mention in their study that, in addition to pure nature-relatedness, social connection plays an important role in SWB. Another perspective for future studies would be to differentiate based on social connection within nature-neutral and nature-related sport activities. Social connection in sport activities that

are conducted within groups represents an opportunity for prosocial behavior and exchange of knowledge, which can also affect SWB. While organized recreational sports in group settings paused during the lockdown, people in a social space such as a digital training group might engage more with other participants.

The present study relied on quantitative survey data with a retrospective part. It is possible that respondents had difficulty recalling their level of sport activities and environmentally sustainable behaviors. Follow-up studies should examine the relationship between sport activities, environmentally sustainable behaviors, and psychosocial factors such as SWB using longitudinal research designs where individuals' behaviors and SWB levels are recorded over a longer period of time. Naturally, with longitudinal studies, the anonymity of participants is compromised.

This interdisciplinary study focused on the intersection of sports sciences, health/psychology, and environmental sustainability to examine the relationship between individual behaviors and SWB. A positive correlation of sport activities, environmentally sustainable behaviors and SWB is of high relevance for climate change and human health at the same time. In summary, people feel better overall when they include environmentally sustainable behaviors or nature-based outdoor sport activities in their life. With the backdrop of increasing "green politics" (State Center for Political Education, 2019), public interest in sustainability, resource conservation, and environmentally sustainable behaviors is on the rise. Accordingly, future research should continue to approach this topic from interdisciplinary perspectives. The present research design of studying nature-related activities and environmentally sustainable behaviors could also be applied to other contexts of daily life such as work, education, and leisure tourism.

DATA AVAILABILITY STATEMENT

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

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 for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

MW designed the survey, collected the data, and drafted the first version of the paper. PW oversaw the data collection process, revised and partially rewrote paragraphs in all chapters, and checked the overall manuscript for coherence, consistency, and format. Both authors contributed to conception and design of the work, drafted it, and revised it critically for important intellectual content, approved the final version of the manuscript, agree to be

accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All persons designated as authors qualify for authorship, and all those who qualify for authorship are listed.

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A Bird's-Eye View of Exercise Intervention in Treating Depression Among Teenagers in the Last 20 Years: A Bibliometric Study and Visualization Analysis

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Background: Exercise is medicine. Multiple studies on the effects and mechanisms of exercise in treating depression among teenagers and adolescents have been widely reported. However, literature involving scientometric analysis of this topic is sparse. Here, we endeavored to conduct a bibliometric study and visualization analysis to give a bird's-eye view of publications between 2000 and 2020 on exercise therapy treating depression.

Methods: Relevant original publications were obtained from the Science Citation Index Expanded in the Web of Science Core Collection (WoSCC) database between 2000 and 2020. CiteSpace (5.7.R 5) and VOSviewer (1.6.16) software were used to perform bibliometric analysis of countries, institutions, categories, journals, authors, references, and keywords involved in this topic.

Results: A total number of 975 articles on this field were retrieved from the WoSCC database and we identified an overall increase in the amount of publications over the past two decades, with the United States and Harvard University leading the field. Most related publications were published in the journals with a focus on sport, medicine, rehabilitation, psychology, and health, as represented by the dual-map overlay. A series of authors and co-cited authors were identified as main contributors in the exercise-depression-teenager domain. Three major clusters were explored based on the reference co-citation analysis: "exercise," "suicide," and "concussion".

Conclusions: Current concerns and hotspots of exercise intervention in depression treatments were summarized by "individual level," "social level," "role of exercise," and "research quality." We considered that the following four directions were potential future perspectives: "research on the effect of specific exercise intervention," "research on the essence of exercise and sports," "research on the combination mode of 'exercise + X'," and "research on the micro and molecular level," which should receive more attention.

Keywords: exercise intervention, depression, teenagers, bibliometric, visualization analysis

INTRODUCTION

Depression is one of the most common psychiatric conditions (1–5) and is becoming a leading cause of global health burden (6–8). According to the research results from the World Health Organization, over 300 million people, or 4.4% of the global population, suffer from depression (9). As a chronic medical illness that can affect both physical and psychological health (10, 11), depression is characterized by sadness, insomnia or hypersomnia, absence of enjoyment, loss of interest, lack of energy, and an inability to be optimistic and positive toward life. Depressive disorder in teenager groups is a non-negligible psychiatric disorder that remains to be solved. Studies also showed that the 1 year prevalence rate of adolescent depression was estimated to be 5.6 and 2.8% for girls and boys below the age of 13 (12, 13). Adolescence is a time of increasing vulnerability for poor mental health, and so-called “puberty blues” may disturb teenagers' social functioning, familial relationships, and personality cultivation. A previous research indicated that at least one-quarter of young populations might experience an episode of depressive disorder before 19 years of age (14). Given the considerable scope and influence of depression in youth groups, there is a pressing need to identify efficient and convenient strategies to deal with these issues caused by depressive disorders.

However, there are deficiencies in approved pharmacological therapy options in young populations partly due to unknown risks associated with lasting effects during their future life. Hence, interest in non-pharmacological methods is now gaining popularity with the development of complementary or integrated medicine strategies. Exercise is considered to be a potential strategy for the prevention, treatment, and rehabilitation of depression on a wide scale. Early-life training of appropriate exercise may present a distinctive “window of opportunity” (15) to induce long-term beneficial effects in young individuals, including but not limited to the treatment of depression. Generally, there is an increasing body of meta-analysis-based studies (16–20) suggesting that physical activity (PA) and exercise are useful methods for improving depressive symptoms, promoting health outcomes, and preventing other mood disorders.

Bibliometric analysis is an informational process which involves mathematics and statistics tools to identify publication entities, development tendencies, and focuses of research subjects or domains (21, 22). Based on multiple indexes like references, authors, journals, countries, and institutions, it can conduct an in-depth assessment of the topic trends and the focus of a certain field (23–25). The results of bibliometric analysis are accessible and convenient for calculating the productivity of authors and institutions, identifying geographic distributions, uncovering the knowledge map, and then providing advice for future research and decision making. Compared with the traditional systematic review and meta-analysis, bibliometric analysis can reveal the current situation and evolution of a research topic from a more systematic and intuitive level. The common difficulties in the existing meta-analyses of exercise intervention for adolescent depression are that the number of included publications are not enough and the outcome indicators are quite different. Therefore,

the high heterogeneity and risk bias make it difficult for readers to have a comprehensive grasp of this topic. However, by providing visual graphics, a bibliometric review can help investigators clearly understand the past, present, and future of this domain. Results from bibliometric analysis can also help researchers to identify the current concerns and hot spots, thereby suggesting ideas and perspectives to guide future research directions. In view of this, applying the bibliometric method has outstanding significance and extreme importance in the field of exercise intervention in treating adolescent depression.

A variety of software is available that can be used for bibliometric studies, such as, VOSviewer (26, 27) and CiteSpace (28, 29). VOSviewer is a freely available computer program that is often applied to construct visualization maps (30, 31), using the full details of indexes such as authors, journals, keywords, or any other network data. Besides, the visualization function of VOSviewer also allows scholars to excavate valuable information by data-mining technology and display it intuitively. CiteSpace is a Java-based scientific mapping software for scientometric and comparative analysis. By presenting numerous data in the form of knowledge maps, results including productivity of authors and institutions, geographic distribution of regions, and cooperative relations can be presented directly to reflect the development of a certain field (32, 33).

Although previous literature has provided an overview of several theoretical and empirical domains on the relationship between exercise and depression in adolescents, to the best of our knowledge, none of these publications made use of a quantitative and visualization approach to survey the longitudinal and transversal characteristics, developments, and multiple ramifications of this topic. It should be noted that this review does not illustrate exercise prescriptions for specific depressive symptoms in adolescents, but presents a visual analysis to evaluate research status and discover the potential mechanisms and applicable strategies of exercise intervention for depression. We would like to identify collaboration networks among authors, institutions, and countries, and explore crucial contributors in this field since the beginning of the new century. In addition, we aimed to investigate which topics of interests were recent hot spots and had potential to be prominent in the up-coming years. To this end, we constructed this organic image of exercise treatment of depression in teenagers to portray a bottom-up view in a historical and prospective standpoint, thereby shedding new light for scholars to help them draft and manage their scientific research.

MATERIALS AND METHODS

Data Acquisition and Search Strategy

A comprehensive search was conducted using the Science Citation Index Expanded in the Web of Science Core Collection (WoSCC) database on March 29, 2021, at Tsinghua University, Beijing, China. The reason for using the SCI-E of WoSCC was due to its coverage of numerous records and documents, especially in the domains of psychiatry and mental health. This database has been used as a data resource in some previous bibliometric studies (34, 35). To define the time interval of this

research, we set the time span from January 1, 2000 to December 31, 2020. To guarantee the representativeness of the internalized literature, the document types were limited to “article” or “review” and the language was limited to English. We used the “title,” “abstract,” and “author keywords” filters at the same time to ensure the relevance of the included literature. The search strategy was as follows: topic = (exercise OR fitness OR sports OR sport OR physical exercise OR exercise training OR physical activity OR physical fitness OR exercise therapy OR aerobic exercise OR non-aerobic exercise OR resistance exercise OR strength exercise OR breathing exercises OR muscle stretching exercises OR walking OR jogging OR running OR cycling OR swimming OR weight lifting OR tai chi OR qigong OR yoga) AND (depression OR depress OR dysthymia OR manic depress OR major depress OR clinical depress OR depressive disorder OR depressive symptom) AND (adolescents OR adolescent OR teens OR teen OR teenagers OR teenager OR youth OR youths OR female adolescents OR female adolescent OR male adolescent OR male adolescents). To avoid bias, all hits were retrieved as “full record and cited references” files from WoSCC on March 29, 2021 for further analysis.

Analysis Tools

CiteSpace (5.7.R 5 Version) was applied to conduct bibliometric analysis on the literature, including key features such as publication categories, countries/regions, organizations, journals, references, and keywords. Dual-map overlays of journals and burst strength analysis were also explored by CiteSpace. The parameters of CiteSpace were set as follows: link retaining factor = 2, look back years = -1, q for top $N = 2$, time span = 2000–2020, years per slice = 1, selection criteria = top 50. After a first visualization of the network, the pathfinder function was applied to use a link reduction algorithm (36), which can provide a more reasonable and precise network configuration (37). VOSviewer (1.6.16) was used to generate and analyze authors and keywords. The parameters of VOSviewer were set as follows: counting method (fractional counting) and “ignore documents with a large number of authors” (maximum number of authors per document is 25) (38).

Different nodes in a map represented indexes including a country, institution, or journal. The size of the nodes spoke on behalf of the centrality of publications or frequency, and a node with large size typically indicated high occurrence or citation frequency as a pivotal point (39, 40). The links between nodes showed the network of cooperation, collaboration, or co-citation, and the color of nodes and links indicated different clusters (41). The clustering function was used to find the major groups in which single nodes could be divided into. Occurrence burst expressed a term that occurred frequently during a given period of time which can be regarded as emerging foci or frontiers, and the burst of nodes was developed with a given network through Kleinberg's algorithm (42). Microsoft Excel 2016 software was applied to describe and predict the annual output of related publications. The function model was laid out as quadratic polynomial: $f(x) = ax^2 + bx + c$, in which x represented the year of publication and $f(x)$ demonstrated the number of publications. The reason for using quadratic polynomial

instead of linear, exponential, logarithmic, or other functions was that the polynomial can better reflect the relationship between publication number and time. Through the above approaches, we have a profound understanding of the historical trend, present situation, and future forecast of exercise intervention targeting depressive disorders among teenagers.

RESULTS

Annual Outputs and Growth Trend

In total, we retrieved 975 exercise-depression-teenager-related research published between 2000 and 2020, the average annual output was 46. The relationship between the amount of documents per year and the publication amount is showed in **Figure 1**. In 2000, only 11 works were published; however, two decades later in 2020, the annual output reached 119, almost 10 times the previous amount. The annual output showed an overall upward tendency although with some fluctuations during the time interval from 2000 to 2020.

Publications in the exercise-depression-teenager field can be divided into three stages: the initial stage (2000–2010), second stage (2011–2015), and third stage (2016–2020). Before the year 2010, no more than 40 papers were published annually. While after 2011, annual published research had increased sharply, and by 2015, the amount had reached more than 50 per year. After 2016, the number of publications rose exponentially, tripling in just 5 years to nearly 120 by the end of 2020. A growth trend model ($R^2 = 0.9657$) predicted that the amount of literature related to exercise treating depression in adolescents would be progressive and promising in the near future.

Countries and Institutions

Scholars from more than 70 regions and 430 institutions contributed to publications on the field of exercise-depression-teenager research. The details of the top 10 countries and institutions are listed in **Table 1**.

As shown in **Figure 2A**, the cooperation conditions were generated by CiteSpace software with 73 nodes and 336 links, and close relationships were observed among these countries. Nine of the top 10 prolific countries were developed countries, while China was the only developing country. This implied that developed regions may input more resources into anti-depression strategies and pay more attention to adolescent health. The United States ranked first and had the highest amount of literature, 406, also the highest centrality (0.65). Canada was the second most productive country with 117 publications, followed by England (114 publications), Australia (96 publications), and China (71 publications). The top five countries' contributions were all above 70 publications, which indicated that they contributed chiefly in research achievements.

As shown in **Figure 2B**, the collaborations between institutions were presented with 437 nodes and 757 links simultaneously. According to the definition of links and nodes, these organizations had close ties with each other and have a considerable academic impact. Harvard University participated in the most studies ($n = 32$), followed by the University of Toronto ($n = 24$), University of Montreal

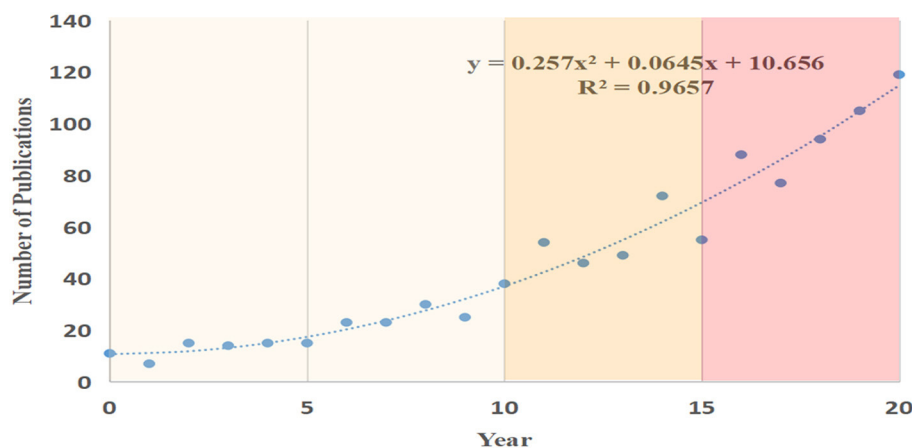


FIGURE 1 | The output of publications and growth trend in exercise-depression-teenager research.

TABLE 1 | Ranking of top 10 countries and institutions in the field of exercise-depression-teenager research from 2000 to 2020.

Rank	Country	Publications	Centrality	Institution	Publications	Centrality
1	United States	406	0.65	Harvard Univ	32	0.17
2	Canada	117	0.11	Univ Toronto	24	0.08
3	England	114	0.39	Univ Montreal	19	0.07
4	Australia	96	0.06	Univ Melbourne	19	0.05
5	China	71	0.03	Univ Penn	19	0.07
6	Netherlands	40	0.04	Kings Coll London	18	0.07
7	Sweden	38	0.09	Univ Washington	18	0.05
8	Germany	32	0.08	Univ Ottawa	16	0.01
9	Italy	26	0.01	UCL	15	0.04
10	Norway	24	0.02	Univ Calgary	13	0.03
10*				Karolinska Inst	13	0.04
10*				Columbia Univ	13	0.03

*Indicates a tie for 10th place.

($n = 19$), University of Melbourne ($n = 19$), and University of Pennsylvania ($n = 19$). Furthermore, all of the top 10 institutions belonged to Western nations, also indicating that Western institutions occupied the first-tier position in the field of exercise-depression-teenager research. The distribution of these countries is presented in **Figure 2C**. From this figure, we can also find that countries and institutions in North America, western Europe, Australia, and East Asia led the way in the field of exercise-depression-teenager research.

Categories and Journals

The most related categories in publishing studies concerned with exercise and depression in young groups are presented in **Figure 3A**. Categories including *Psychology*, *Psychiatry*, *Public Environmental and Occupational Health*, *Pediatrics*, and *Neurosciences and Neurology* seemed to be the most common. It was noteworthy that *Sport Sciences* also played a significant role in the formation of discipline composition. The merged network of nodes was 89, and links accounted for 341. Based on the analysis of the multidisciplinary composition of the categories involved in this field, we found that “cross-disciplinary communities” were

formed. The various research directions of different categories were gathered together, which represented the diversity and richness of the publication sources.

In all, 428 journals published articles on exercise-depression-teenager research. As shown in **Table 2**, the top 10 citing journals contributed a total of 206 publications, making up nearly 20% of all the 975 documents retrieved. The *JOURNAL OF ADOLESCENT HEALTH* (IF 2019 = 3.900) published the greatest amount of literature (44 publications, 4.51%), followed by *BMC PUBLIC HEALTH* (26 publications), *JOURNAL OF AFFECTIVE DISORDERS* (23 publications), and *PLOS ONE* (23 publications). In terms of impact factor (IF), all 10 journals were ranked from 1.673 to 7.890, only two journals' impact factor exceeded 3, whereas the average value of these 10 journals' impact factors was 3.771.

Figure 3B presents the relationships among cited journals. The merged network included 603 nodes and 5,827 links. *PEDIATRICS* took the lead with 370 co-citation counts, *ARCH GEN PSYCHIAT*, *J AM ACAD CHILD PSY*, and *J ADOLESCENT HEALTH* also contributed 344, 336, and 311, respectively. All these top 10 cited journals contributed more than 200 article

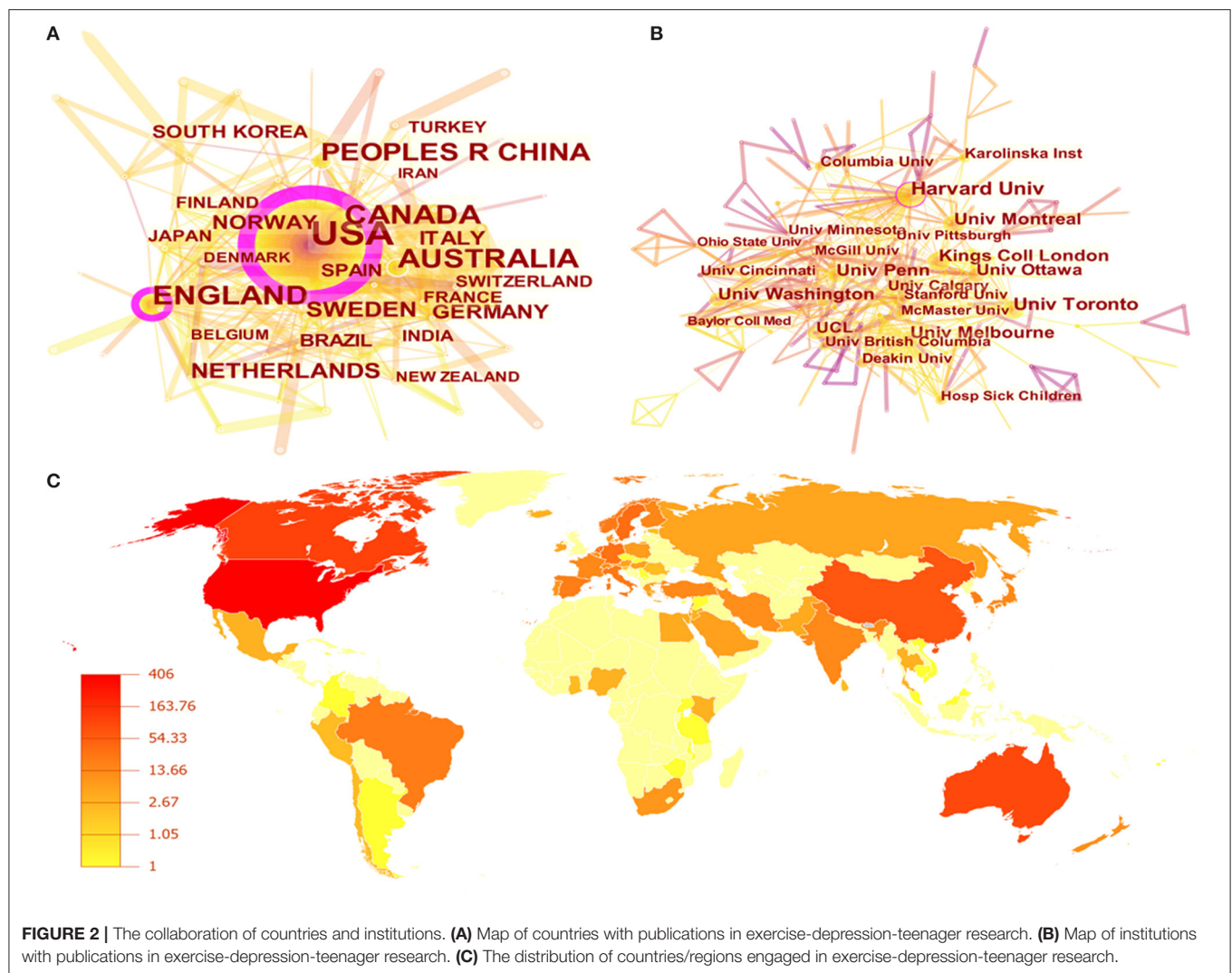


FIGURE 2 | The collaboration of countries and institutions. **(A)** Map of countries with publications in exercise-depression-teenager research. **(B)** Map of institutions with publications in exercise-depression-teenager research. **(C)** The distribution of countries/regions engaged in exercise-depression-teenager research.

co-citation counts, which represented that these journals were in the dominant position in citing exercise-depression-teenager-related works.

Figure 3C reveals a dual-map overlay of the research themes between citing journals and cited journals in the field of exercise-depression-teenager research. The citing journals are on the left side of the map while the cited journal are on the right. There are four citation paths in this picture. The grass green paths illustrate that studies published in “*medicine, medical, clinical*,” and “*neurology, sports, ophthalmology*” journals tended to cite journals primarily in the domains of “*health, nursing, medicine*” and “*sports, rehabilitation, sport*.” The paths colored with pale blue showcase that research published in “*psychology, education, health*” journals preferred to quote journals mostly in the domains of “*psychology, education, social*.”

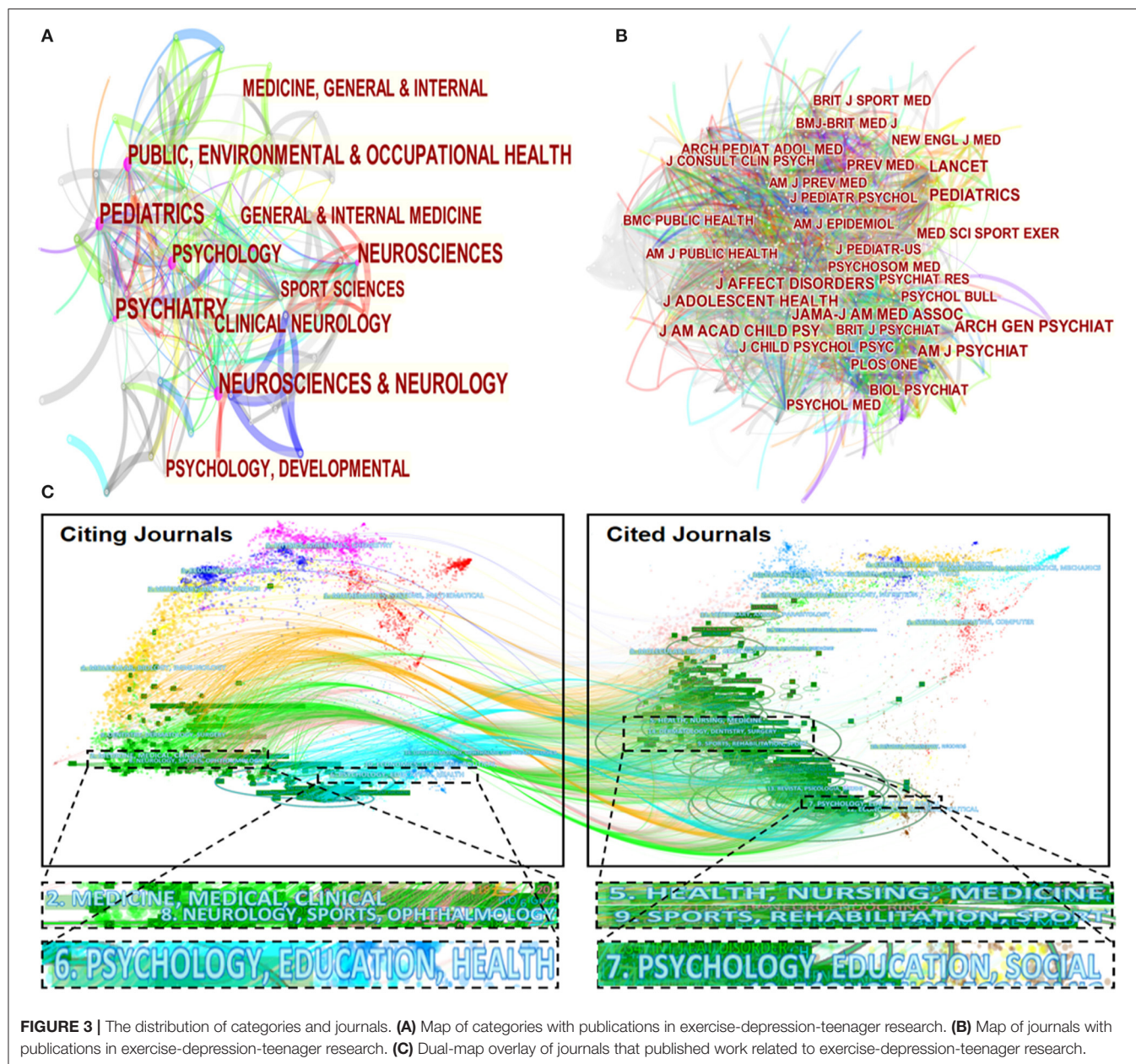
Authors and Co-Cited Authors

The top 10 authors, co-cited authors, and co-cited references of exercise-depression-teenager research are displayed in **Table 3**.

Discovery and exploration of remarkable authors and publications were carried out in this study. The tremendous

amount of works was contributed by 4,799 authors. Among the top 10 scholars, Ian Colman took the first place in publication output (eight publications), followed by Serge Brande with seven papers. The difference in the number of publications by these authors was generally small but all top 10 authors possessed five works at the minimum. We made the author's cooperation network diagram by setting the co-authorship minimum number of documents of an author at 3, and 136 authors met the threshold. Moreover, we used overlay visualization to reflect the time span of these authors' products. Particularly, we normalized scores by subtracting mean and dividing by standard deviation (time span from -1 to 1). Judging from the distribution of cooperation situation presented in **Figure 4A**, the relationships among these authors were rather fragmented. It seemed that the scale of cooperation among scholars was relatively small, and there was still a lack of connection in the whole.

Meanwhile, 28,478 co-cited authors were identified in the 975 articles. Among them, Kessler RC occupied the #1 ranking in 167 citation counts, followed by Kovacs, M, Radloef, LS, and Beck, AT with 122, 98, and 92 citations, respectively. These authors' quotation amounts all exceeded 90 which implied that they were



active and favorable authors in the field of exercise-depression-teenager research. Cooperation between co-cited authors were analyzed for the excavations of underlying partnerships. We set the minimum number of citations of an author at 20, and finally 136 authors were included. As shown in **Figure 4B**, a network visualization of co-cited authors was generated by nodes and links, and the larger node and thicker link represented closer cooperation. From the citation network, we saw that key authors were mostly in the position of crucial nodes and they pointed out the directions of research trends.

In detail, several scholars have played an important role in promoting research progress. In 2000, Sallis et al. (43) probed into the correlates of physical activity of young groups and

examined the efficacy of physical activity and exercise as a universal prevention for depression in youth groups. Half a decade later, Penedo and Dahn (44) reviewed the relationship between exercise and well-being, and implied that exercise and physical activity can lead to better quality of life and health outcomes, including reducing symptoms of both depression and anxiety. In 2009, Babiss and Gangwisch (45) proved that sports participation can be used as a protective factor against depression and suicidal ideation by activating self-esteem and increasing social support. One year later in 2010, Brand et al. (46) conducted a comparative study between athletes and controls to investigate whether chronic vigorous exercising was related to improved psychological functioning (depressive symptoms, stress, state,

TABLE 2 | Ranking of top 10 journals and co-cited journals in the field of exercise-depression-teenager research from 2000 to 2020.

Rank	Citing journal	Publications	Percentage (%)	IF (2019)	Cited journal	Co-citation counts
1	JOURNAL OF ADOLESCENT HEALTH	44	4.51%	3.900	PEDIATRICS	370
2	BMC PUBLIC HEALTH	26	2.67%	2.521	ARCH GEN PSYCHIAT	344
3	JOURNAL OF AFFECTIVE DISORDERS	23	2.36%	3.892	J AM ACAD CHILD PSY	336
4	PLOS ONE	23	2.36%	2.740	J ADOLESCENT HEALTH	311
5	BMJ OPEN	16	1.64%	3.892	JAMA-J AM MED ASSOC	293
6	PEDIATRICS	15	1.54%	5.359	LANCET	280
7	PREVENTIVE MEDICINE	13	1.33%	3.788	J AFFECT DISORDERS	259
8	INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH	12	1.23%	2.849	AM J PSYCHIAT	249
9	JOURNAL OF SCHOOL HEALTH	12	1.23%	1.673	PSYCHOL MED	225
10	BEHAVIORAL BRAIN RESEARCH	11	1.13%	2.977	PLOS ONE	215
10*	COCHRANE DATABASE OF SYSTEMATIC REVIEWS	11	1.13%	7.890		

*indicates a tie for 10th place.

TABLE 3 | Ranking of top 10 authors, co-cited authors, and co-cited references in the field of exercise-depression-teenager research from 2000 to 2020.

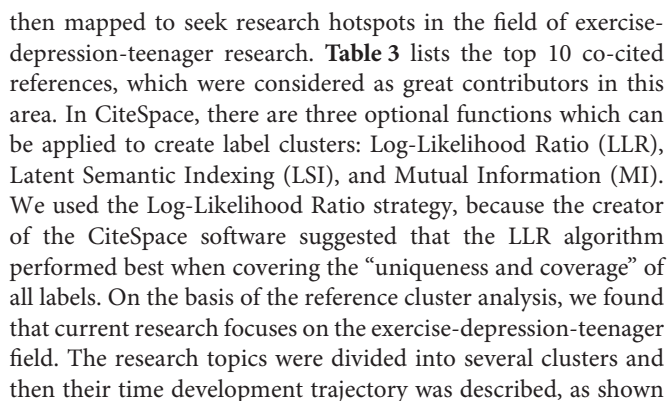
Rank	Author	Counts	Co-cited author	Counts	Co-cited reference	Counts
1	Ian Colman	8	Kessler, RC	167	Carter, T, 2016, J AM ACAD CHILD PSY, V55, P580, DOI 10.1016/j.jaac.2016.04.016	22
2	Serge Brand	7	Kovacs, M	122	Hoare, E, 2016, INT J BEHAV NUTR PHY, V13, P0, DOI 10.1186/s12966-016-0432-4	18
3	Gerber Markus	6	Radloef, LS	98	Bailey, AP, 2018, PSYCHOL MED, V48, P1068, DOI 10.1017/S0033291717002653	16
4	E. Holsboer-Trachsler	6	Beck, AT	92	McMahon, EM, 2017, EUR CHILD ADOLES PSY, V26, P111, DOI 10.1007/s00787-016-0875-9	16
5	Jennifer O'Loughlin	6	Lewinsohn, PM	87	Biddle, SJH, 2011, BRIT J SPORT MED, V45, P886, DOI 10.1136/bjsports-2011-090185	16
6	Anthony F Jorm	7	Vaeni, JW	84	Brown, HE, 2013, SPORTS MED, V43, P195, DOI 10.1007/s40279-012-0015-8	15
7	Brendon Stubbs	6	Birmaher, B	77	Jerstad, SJ, 2010, J CONSULT CLIN PSYCH, V78, P268, DOI 10.1037/a0018793	15
8	Jennifer Brunet	5	Costello, EG	77	Sund, AM, 2011, SOC PSYCH PSYCH EPID, V46, P431, DOI 10.1007/s00127-010-0208-0	13
9	Catherine M Sabiston	5	Sallis, JF	76	Maras, D, 2015, PREV MED, V73, P133, DOI 10.1016/j.ypmed.2015.01.029	13
10	Sergio D Iniguez	5	Biddle, SJH	76	Schuch, FB, 2016, J PSYCHIATR RES, V77, P42, DOI 10.1016/j.jpsychires.2016.02.023	11

and trait anxiety), and his results found that adolescents engaging in an enormous number of exercises positively related to favorable sleep patterns and psychological functioning. A 2013 survey from Kremer et al. (47) inquired into the relationship among physical activity, leisure-time screen use, and depression in youth groups, and reported that higher levels of exercise combined with lower levels of leisure-time screen use were relevant to lower depressive symptoms. In 2018, Bailey et al. (48) summarized the previous randomized controlled trials and did a meta-analysis-based review to establish the treatment efficiency

of physical activity for depressive disorders in adolescents, and suggested that although physical activity seemed to be a promising and acceptable method for young populations with depression, further clinical effectiveness trials were still required to verify these findings.

References Cluster Analysis

References and relevant co-citation data were retrieved to generate major clusters, and knowledge domains of clusters were



The “exercise” cluster went from nearly 2010 to the present. Exercise intervention is mainly based on the theory of kinematics,

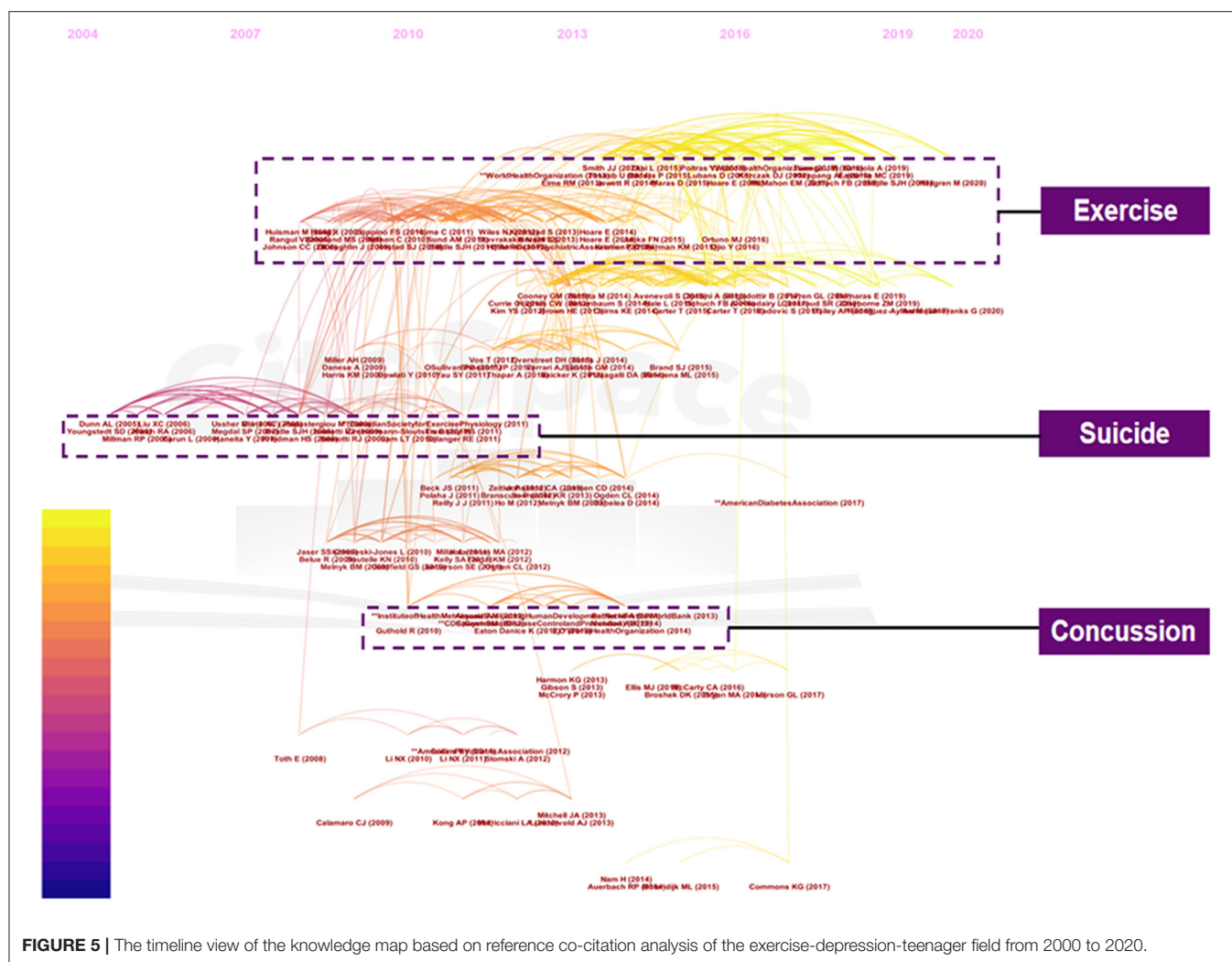


FIGURE 5 | The timeline view of the knowledge map based on reference co-citation analysis of the exercise-depression-teenager field from 2000 to 2020.

neuron-development, and sports psychology. As an emerging method of depression countermeasures, exercise intervention did not get enough attention in the early years, but with more and more patients with depressive symptoms benefitting from sports and exercise, clinicians began to pay attention to the effect of exercise therapies. Depression can cause mental and psychological trauma to adolescent groups, thereby leading to homeostasis imbalance and central nervous system disorder, which is an extremely terrible portent for teenagers who are in a critical period of growth and development. At the molecular level, relevant studies (49–54) have also suggested that the concentration of noradrenaline and 5-hydroxytryptamine (5-HT) in the cerebrospinal fluid of sufferers with depression were significantly lower than that of healthy groups. In line with these effects, exercise was associated with various neurological improvements which might contribute to prevent or improve depression (55–58). Besides, recent literature (59) showed that the cellular changes induced by exercise were long-lasting, regardless of whether muscles became atrophic or not, which stood up for the viewpoint that sports-related activities can exert positive long-term results.

“Suicide” was another topic worthy of concern, which appeared mainly in the first decade of the twenty first century. Suicide risks originating from depression are of increasing concern on school campuses nowadays (60–62). Early studies already detected that depression was one of the leading risk factors for suicide (63), accompanied by substance abuse, adverse life events, separate family conditions, troubled relationships, and other problems (64, 65). There were also concerns (66, 67) about the dubious effects of traditional anti-depression drugs on the long-term development of teenagers, since major depression medication might further aggravate the social isolation of these teenagers, and even lead to suicide. When it comes to exercise activities decreasing suicide risks caused by depression, in 2003, Tomson et al. (68) assessed the relationship of playing sports outside of school, and of meeting health-related fitness indexes, to symptoms of depression (including correlations with thoughts of suicide and attempted suicide), suggesting that daily physical activities would both prevent depressive disorders and help young people with symptoms of depression to establish excellent health habits. A survey (69) conducted in 2007 also showed that when comparing high school active students with sports



Research frontiers and future perspectives

1). Research on the effect of specific exercise intervention

2). Research on the essence of exercise and sports

3). Research on the combination mode of "Exercise + X"

4). Research on the micro and molecular level

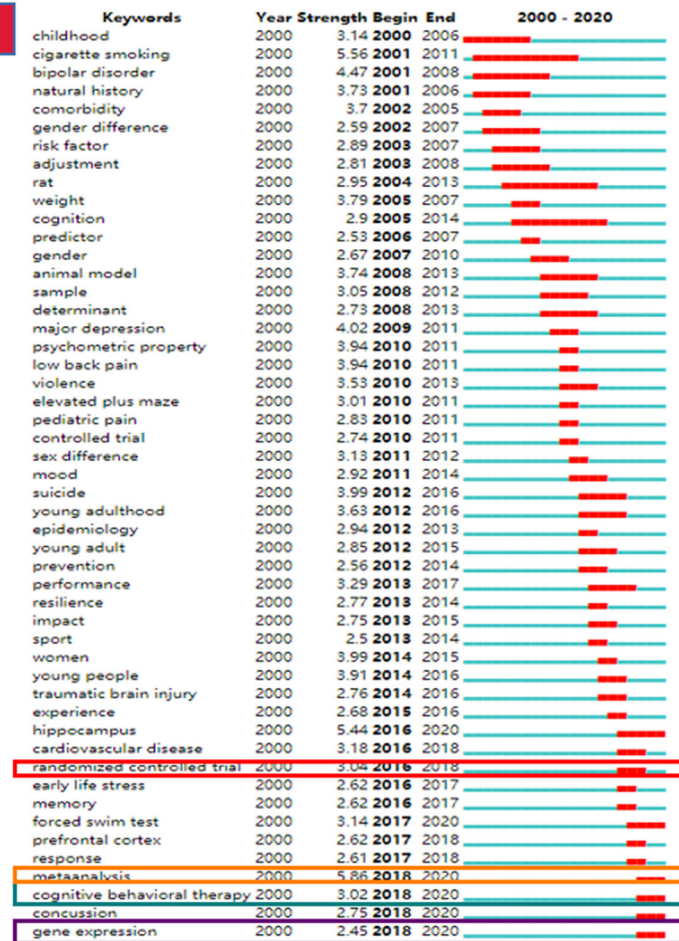


FIGURE 7 | Top 50 keywords with the strongest citation burst in exercise-depression-teenager research.

provided by VOSviewer. As a consequence, a total of 121 frequently referred keywords were incorporated and 922 links were built among them. Four clusters were then formed with different colors, and the bright red, sunset yellow, photo blue, and violet purple represent the following four clusters respectively: "individual level," "social level," "role of exercise," and "research quality." The top 50 keywords with strong burst strength in exercise-depression-teenager research are presented in Figure 7. The keywords with bursts lasting until 2020 included "hippocampus," "forced swim test," "meta-analysis," "cognitive behavioral therapy," "concussion," and "gene expression," which reflected the most recent research trends. The exploration of these keywords will be discussed in depth in the next section.

DISCUSSION

Here, we focused on the further detection of the co-occurrence and burst analysis of the major keywords. The generation of clustering was based on the information of the main keywords' co-occurrence. According to the classification of the causes of depression, we divided it into two categories: the individual

factors of teenagers and the external factors caused by society. On the basis of the whole process of depression management, it is necessary for us to discuss the essential roles of exercise. At the same time, most of the current studies on exercise intervention in depression have expressed concerns about the research objects and quality, so it is meaningful to make a general summary based on this. Based on the above discussion of the four clusters, we have a profound grasp of the present concerns and research hotspots in this field.

1) Individual level: Keywords including "sedentary behavior," "overweight," "type 2 diabetes" can be considered as the teenagers' endogenous factors of depression. Teenagers who are overweight, physical inactive, have an irregular diet, smoke, and other characteristics are more likely to suffer from depression. However, these teenagers could prevent and alleviate the symptoms of depression by adjusting schedules, trying a reasonable diet, and performing regular exercise. Current findings have suggested that exercise or physical activities might be protective against depression caused by these series of factors (89–91), while the exercise type, disorder category, sport intensity, and intervention period all

have influence on the effectiveness of exercise intervention. Thus, the different endogenous factors leading to depression still need to be further studied and should be personalized.

- 2) Social level: "Social support," "suicide," "violence," and other relevant keywords can represent the main mechanisms of social factors on adolescent depression. Social factors can be divided in two ways: direct and indirect effect. Direct effect emphasizes that social support has a positive impact on individuals whether they are in a stress state or not. Indirect effect focuses on reducing the negative impact of stress events on individuals and decreasing the probability of individual depression caused by stress events. Taking adolescent depression caused by concussion as an example, the occurrence of such factors is usually not determined by the individual's will. While the attitudes of society toward young concussed patients are likely to affect the trend of depression development. It is significant to reduce social discrimination, physical violence, and language aggression for the recovery of such depressive symptoms. A sound social support structure, health education system, and regular organization of sports activities cannot only buffer the impact of negative emotions on teenagers and reduce the tendency of suicide, but also enable them to have better interpersonal relationships, so as to promote their mental health development.
- 3) Role of exercise: Terms containing "self-esteem," "behavior," and "cognition" were associated with the role of exercise. We divided the role of sports into two aspects: the physiological and psychological part. The physiological promotion of exercise on adolescents with depressive symptoms is to shape their body, and the main psychological improvement is to cultivate mental toughness and self-confidence. Exercise participation plays a positive role in keeping teenagers at a healthy body mass index (BMI) and releasing their stress. Except for improving physical ability like aerobic capacity of adolescents, exercise can also help shape mental toughness, a keyword which has also occurred frequently lately. Mental toughness is regarded as a cognitive strength variable comprising a series of values, attitudes, and emotions that enable an individual to negotiate with challenges and adversities (92), which is also especially explored within sport contexts. A study performed in 2012 (93, 94) focusing on adolescent cricketers discovered that the mental toughness profiles in this group were associated with negative emotional conditions, and cricketers with high levels of mental toughness reported lower levels of negative emotional states such as depression, anxiety, and stress. In line with this, mental toughness not only belongs to the realm of elite sport, but can also be applied in normal adolescents. One research (94) conducted in 2017 invited 1,361 teenagers to participate in exploring the associations among physical activity, subjective sleep, mental toughness, and other indexes, showing that greater physical activity was associated with more favorable subjective sleep, higher mental toughness, and lower depression. To sum up, exercise activities have a positive mind-body impact on depressive teenagers.
- 4) Research quality: Keywords including "systematic review," "meta-analysis," and "longitudinal study" were related to

risk factors and research quality of studies focusing on exercise intervention in treating depression among teenagers. Several factors such as sample size, gender, age, family background, education level, countries, and regions may affect the accuracy of the results of exercise intervention on depression, especially gender difference, since a large number of studies have indicated that the effect of exercise treatment on depression was significantly different between boys and girls. Factors mentioned above are the main reasons for the different conclusions of studies with variations in designs, comparisons, and controls. Therefore, systematic reviews and meta-analyses have sprung up in recent periods to evaluate the effect size of exercise therapy on depression. Besides, there is still great demand for more high-quality, well-controlled reviews to provide suggestions for strategy exploration and clinical decision-making.

The bursts of the top keywords can be used to analyze evolution and future trends. In view of **Figure 7**, we can explore research perspectives and predict frontrunners. A total number of 50 prevalent keywords and cutting-edge fields of exercise-depression-teenager research were found and grouped into four categories:

- 1) Research on the effect of specific exercise intervention: Since numerous studies have clearly indicated a positive association between sports participation and psychological health, what kind of exercise is common and effective? At the beginning of the century, Larun et al. (95) suggested that sport might be an important instrument in improving the emotional health of children and adolescents, while there was little difference between high-intensity and low-intensity exercise. With the deepening and development of research, several articles and systematic reviews (48, 72, 96) reported that aerobic exercise might be considered as a promising strategy, and aerobic-based activity of moderate-to-vigorous intensity, engaged in multiple times per week over 8 or more weeks, could be recommended as best candidates for improving depression among teenagers (48). From a way to look good to an opportunity to feel good, aerobic exercise may help teenagers change their motivations for daily activity, which can improve their body satisfaction and self-esteem, and then reduce their depressive symptoms. Additionally, Chinese traditional exercise like Tai Chi might be an applicable strategy to alleviate the progression of depression in youth groups (97, 98). As a mindfulness-based exercise, Tai Chi can not only strengthen the body, but also help depressive teenagers build confidence and relieve anxiety. In addition, accumulating evidence has suggested that team sports are effective in diminishing risk and promoting rehabilitation for depressive symptoms (99–101). Besides, there is debate on whether high-intensity interval training (HIIT) is an appropriate type of exercise for adolescents with depression. One study showed that HIIT was able to enhance focus and reduce impulsive thoughts, which might improve adolescents' response to mental health treatment (102). However, some researchers argued that HIIT was too arduous and could evoke experiences of incompetence, failure, and lower self-esteem, thus reducing treatment effects (103). Furthermore,

we considered that combat or collision sports like boxing, full-contact martial arts, rugby, ice hockey, or lacrosse should not be recommended as interventions for depressive symptoms. To summarize, moderate-intensity aerobic exercise and physical activities involving group participation could be recommended as feasible options for depressive adolescents, while the detailed intervention dose and strategy need to be verified by more high-quality RCTs.

- 2) Research on the essence of exercise and sports: By classifying different types of exercise and discussing their outcome indicators, current meta-analysis-based studies have discussed the nature of sports intervention. For the influence of exercise as a treatment for depressive teenagers, some previous literature concluded exercise as an alternative intervention. However, if we only regard exercise as a complementary strategy, it seems that one important point has been ignored. From the perspective of evolution, human beings were born to exercise, and our ancestors established cooperative relationships and social networks in exercise and physical-related activities such as planting, hunting, migrating, etc. However, in modern society, with a sedentary lifestyle due to the popularization of electronic products, over-nutrition caused by unhealthy diets, self-centered value on account of excessive family pampering, and exhaustion derived from academic pressure, children and teenagers gradually lost the drive to build a connection with society and became lonely, anxious, even depressive. The most essential value of sports activities to prevent or treat depression may be rooted in making these young people understand how to live with dignity, value, and meaning, as well as regain their connection with society. Hence, in this study, we summarized that the essence of exercise and sport is to help depressive adolescents “pick back [up] lost things.” However, the exploration of the sociology of physical exercise and essence of sports are still in pressing need to detect clear lines of demarcation between exercise intervention and depression treatment.
- 3) Research on the combination mode of “exercise + X”: Obviously, the strategy to treat depression is not just exercise. What effect will be achieved if more than one intervention mode is applied? Regular exercise combined with healthy diet and peaceful sleep are considered as important parts of complementary and alternative medicine in treating depression. Converging epidemiological evidence suggests that a sedentary lifestyle and lack of physical activity may lead to numerous chronic diseases. As shown in the burst keywords list, cardiovascular disease was also highly mentioned in recent years and it is not realistic to rely on only exercise intervention to solve these problems. Therefore, the treatment mode of combining various methods with exercise as the main line may be the best way to treat adolescent depression and its complications. Studies focusing on exercise intervention accompanied with lifestyle cures and cognitive behavior therapy should be further investigated to identify which mode is available for most targeted groups, as well as which intervention should be the first choice.

- 4) Research on the micro and molecular level: In recent years, a growing body of scholars have used neuro-physiology, genes, and omics analysis to explore the key pathways and factors to improve depression from the perspective of animal models. Current literature has proved that exercise influences the association of physiological and biochemical variables (104, 105), including serum levels of copper (Cu), zinc (Zn), serotonin, and salivary cortisol, which can achieve similar effects with antidepressants. Studies also initially showed that exercise and physical activity plays an analogous role as medicine *via* increasing brain neurogenesis in the hippocampus (106, 107). During the recovery stage of depression, exercise can induce a series of physical and emotional changes, including the release of endorphins and neurotransmitters, improving brain hemodynamics, enhancing nerve cell growth and synaptic plasticity, and reducing inflammation (108–110). In addition, the latest evidence revealed that physical exercise in the adolescence period could also serve as a predictor of depressive symptoms (111, 112). However, the metabolic crosstalk and the molecular mechanism of exercise used to treat depression are still not completely clear, and more regulatory factors and circulatory pathways are needed to prove adaptations induced by exercise intervention.

There were some limitations in the present study. First, the database analyzed in our research was limited to the Science Citation Index Expanded of WoSCC, and we did not include data from other relevant search engines. However, the WoSCC SCI-E database has been recognized for the quality of its papers, and this database has been widely used for the retrieval of nature science publications. Second, this study generated a linguistic bias considering we only considered English publications, despite English remaining the most commonly applied language for publishing academic documents worldwide. Additionally, we only selected articles and reviews for analysis, the identified types of research may not fully represent all exercise-depression-teenager studies. Nonetheless, articles and reviews were the mainstream types of publications.

CONCLUSIONS

This study conducted a bibliometric and comparative analysis from 2000 to 2020 and provided a bird's-eye view of exercise intervention in treating depression among teenager groups. We highlighted the opportunities and developments of exercise therapy applied in the treatment of adolescents' depression in an objective and systematic manner, which can not only assist scholars in extracting hidden information for further research, but also provide them with valuable directions for topic selection activities. The first part of this study examined the document trends, active authors, journals, countries, and institutions. The latter part was applied to perform cluster and burst analysis of the major keywords to identify research hotspots and explore potential topics in this field. As a cost-effective, space-saving, and more enjoyable component in the prevention and treatment

of depression, exercise therapy was particularly promising in teenager groups, not only for its influence on physiological indexes, but also the shaping of personality and the return of social relations. More specifically, aerobic-based activities combined with team sports might be optimal exercise strategies for depressive youth. Finally, we considered the following four novel topics: “research on the effect of specific exercise intervention,” “research on the essence of exercise and sports,” “research on the combination mode of ‘exercise + X,’” and “research on the micro and molecular level,” which should receive further attention in the coming years.

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/s.

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AUTHOR CONTRIBUTIONS

YY helped to organize the study, prepared datasets, performed the statistical analysis, and drafted the manuscript. DW conducted study design and prepared datasets. YW helped to prepare the datasets. ZL contributed to study design. XM contributed to study organization and revision of the manuscript. All authors read and approved the final manuscript.

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Yoga Practice Is Beneficial for Maintaining Healthy Lifestyle and Endurance Under Restrictions and Stress Imposed by Lockdown During COVID-19 Pandemic

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Uncertainty about Coronavirus disease 2019 (COVID-19) and resulting lockdown caused widespread panic, stress, and anxiety. Yoga is a known practice that reduces stress and anxiety and may enhance immunity. This study aimed to (1) investigate that including Yoga in daily routine is beneficial for physical and mental health, and (2) to evaluate lifestyle of Yoga practitioners that may be instrumental in coping with stress associated with lockdown. This is a pan-India cross-sectional survey study, which was conducted during the lockdown. A self-rated scale, COVID Health Assessment Scale (CHAS), was designed by 11 experts in 3 Delphi rounds (Content valid ratio = 0.85) to evaluate the physical health, mental health, lifestyle, and coping skills of the individuals. The survey was made available digitally using Google forms and collected 23,760 CHAS responses. There were 23,290 valid responses (98%). After the study's inclusion and exclusion criteria of yogic practices, the respondents were categorized into the Yoga ($n = 9,840$) and Non-Yoga ($n = 3,377$) groups, who actively practiced Yoga during the lockdown in India. The statistical analyses were performed running logistic and multinomial regression and calculating odds ratio estimation using R software version 4.0.0. The non-Yoga group was more likely to use substances and unhealthy food and less likely to have good quality sleep. Yoga practitioners reported good physical ability and endurance. Yoga group also showed less anxiety, stress, fear, and having better coping strategies than the non-Yoga group. The Yoga group displayed striking and superior ability to cope with stress and anxiety associated with lockdown and COVID-19. In the Yoga group, participants performing meditation reportedly had relatively better mental health. Yoga may lead to risk reduction of COVID-19 by decreasing stress and improving immunity if specific yoga protocols are implemented through a global public health initiative.

Keywords: COVID-19, Yoga, global health, stress, coping strategies

INTRODUCTION

WHO declared Coronavirus disease 2019 (COVID-19), originating from Wuhan, China, caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS CoV-2), as a pandemic on March 11, 2020. To prevent spread and provide sufficient time for hospitals' readiness, the Governments worldwide had to impose "Lockdown" in their respective countries. Under lockdown, people were restricted from remaining outdoors with certain exceptions resulting from emergencies.

India imposed the world's most extensive lockdown on March 23, 2020 (1). Many people were either stranded in their homes or containment zones, disrupting small businesses' earnings, working of domestic maids, daily wagers, and laborers. In addition, the uncertainty of the disease's contagious nature among the public and healthcare workers led to fear, panic, anxiety, and stress. Stress also intensified among those with chronic illnesses, as susceptibility and severity of COVID-19 were associated with co-morbidities (2–4). Furthermore, global infodemic and fake news exasperated anxiety and stress among the general public (5, 6).

Previous studies have evidenced increased post-traumatic stress disorder (PTSD) after epidemic or natural calamities such as SARS, earthquake, or a tornado, including COVID-19 (7–10). Wang et al. conducted a comprehensive self-administered online survey in China to understand the prevalence of psychological stress in the COVID-19 pandemic. They reported increased panic, stress, anxiety, and depression similar to previous studies conducted during the 2003 SARS epidemic (7, 8, 11). A similar online survey by Liu et al. reported that 20% of people showed anxiety, 27% reported depression, 7.7% had psychological distress, and 10% suffered from phobias (12). Furthermore, there were changes in people's behavioral patterns due to lockdown, especially concerning their eating habits. Increased consumption of junk food, soft drinks, and alcohol resulted in obesity. Lockdown disrupted the daily routines, sleep hours, outdoor activities, and increased screen time and smoking, predisposing people to risks of COVID-19 (13, 14). Two small studies from India have shown similar trends (15, 16).

In the current study on the COVID-19 pandemic, it has been reported that the impact on psychological stress might be more pronounced due to persistent global media feeds and internet access. The present COVID Health Assessment Scale (CHAS) survey was designed to evaluate the physical and mental health and coping skills of participants who practiced yoga and those who did not. Several studies have shown that Yoga brings a positive change in physical and mental health by regulating the hypothalamic–pituitary–adrenal system, sympathetic nervous system, reducing the cortisol, and improving immunity indicated by an increase in CD4, heart rate, fasting blood glucose, cholesterol, and low-density lipoprotein levels (17–20). Thus, it appears that Yoga practitioners have healthy lifestyle among the

general population. This study investigated that including Yoga in daily routine is beneficial for physical and mental health. Also, Yoga practitioners have a healthier lifestyle, which improves their ability to cope with the restrictions and stress under lockdown.

MATERIALS AND METHODS

The current study received ethical approval from Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA) University, Karnataka, India. CHAS, a unique self-assessment scale, was designed for the survey in 10 different languages, English, Hindi, Assamese, Bengali, Kannada, Malayalam, Marathi, Odia, Tamil, and Telugu. A committee consisting of 11 experts was constituted who undertook three rounds of discussions as per Delphi protocol and agreed to the CHAS questionnaire that assessed the positive and negative aspects of physical and mental health, lifestyle, and associated coping methods during the lockdown period (Table 1). Among 11 experts, 6 had PhD in Yoga with more than 15 years of experience in yoga research, 3 were post-graduate in yoga with experience of more than 10 years in yoga, one is a professor of statistics, a mathematician with masters in psychology and PhD in yoga, and one is a psychologist with PhD in yoga. Content valid ratio (CVR) was 0.85 for CHAS as per Delphi method (21–23). CHAS also collected the demographic (questions 1–10) and lifestyle (questions 39–64) details of the participants.

Questions 11–15 accessed COVID-19 exposure of participants; these included self-reported symptoms, travel history, details of interaction with COVID-19-positive patient, and quarantine history. Physical health was accessed by rating physical strength and endurance (question 16) and disease history (question 17). In question 16, two extreme options were considered as a single option during analysis.

Twelve questions (questions 18–29) were included in CHAS to assess the mental health during the lockdown. The questions were designed to evaluate fear and anxiety during the lockdown and evaluate the individual's general personality or character. Standard neuropsychological questionnaires were not used to evaluate stress and anxiety.

The coping ability of participants was accessed by a direct question with four options, i.e., "Poor," "Average," "Very good," and "Excellent" (question 30). During analysis, "Poor" and "Average" were merged into a single attribute, i.e., "Poor." Similarly, "Very Good" and "Excellent" were merged to constitute "Good." Questions 31–38 enquired about different activities of participants during lockdown; these questions indicate coping strategy of participants during lockdown. Questions 39–42 in lifestyle domain also provide information on coping strategy.

Data Collection and Study Participants

The survey items for CHAS were prepared on Google forms and circulated in public through social media. Snowball method was used to acquire the data nationwide. Phone calls and special requests were sent to different sections of the society (~200 universities, Corporate companies, healthcare institutions, government organizations, wellness centers, and their networks) to acquire data within this short period. No inclusion and

Abbreviations: CHAS, COVID Health Assessment Scale; COVID-19, Coronavirus disease 2019; OR, Odds ratio; PTSD, Post-traumatic stress disorders; S-VYASA, Swami Vivekananda Yoga Anusandhana Samsthana.

TABLE 1 | CHAS questionnaire.

Parameters	Question number	Questions	Valid responses
Demographics	1	Gender	Female, male, other
	2	Age	<20 years, 20–30 years, 31–40 years, 41–50 years, 51–60 years, 61–70 years, 71–80 years, above 80 years
	3	Weight (kg)	Open-ended question
	4	Height (cm)	Open-ended question
	5	State	Not in India, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttarakhand, West Bengal, Andaman and Nicobar, Chandigarh, Delhi NCT, Dadra and Daman, Jammu and Kashmir, Ladakh, Lakshadweep, Puducherry
	6	Country	India, China, USA, Italy, UK, Spain, France, Other
	7	Occupation	Agriculture, business, employed, homemaker, retired, student, professional, other
	8	Education	Less than graduation, graduate, post-graduate
	9	During lock down staying with:	Family, friends, colleagues, alone, away from home
	10	During lock down are you:	Working from home, working from office, not working
COVID-19 exposure	11	Are you experiencing any of the following?	No symptoms, cough, fever, breathing difficulty, other
	12	Have you traveled anywhere internationally since January 2020?	Yes, no
	13	Which of the following apply to you?	Other, recent COVID-19 interacted, was quarantined, in quarantine, health worker, hospitalized
	14	Number of days passed since you interacted or lived with someone who has been tested positive for COVID-19	Open-ended question
	15	Number of days passed since you are in quarantine. Please ignore if you were not quarantined	Open-ended question
Physical health	16	How do you rate your physical strength and endurance?	Very good, good, average, bad, very bad
	17	History of chronic health problems	Healthy, BP, lung disease, heart disease, cancer, arthritis, diabetes, others
Mental health	18	Do you feel you are low in energy and downhearted during this lock-down period?	Not at all, somewhat, very much
	19	How anxious are you about the implications of COVID-19 in your life?	Not at all, somewhat, very much
	20	How much do the following issues worry you during this lock-down period? (Fear of getting infected and the associated physical suffering)	Not at all, somewhat, very much
	21	How much do the following issues worry you during this lock-down period? (Fear of death)	Not at all, somewhat, very much
	22	How much do the following issues worry you during this lock-down period? (Fear of a possible financial burden)	Not at all, somewhat, very much
	23	How much do the following issues worry you during this lock-down period? (Fear of unknown related to COVID-19)	Not at all, somewhat, very much
	24	How much do the following issues worry you during this lock-down period? (Fear of spreading infection to near and dear ones)	Not at all, somewhat, very much

(Continued)

TABLE 1 | Continued

Parameters	Question number	Questions	Valid responses
Coping strategy	25	How do you rate your personality? (Are you generally goal driven; perfectionist and persistent)	Disagree, maybe, agree
	26	How do you rate your personality? (Are you caring and ready to help others all the time)	Disagree, maybe, agree
	27	How do you rate your personality? (Do you always feel insecure; stressed and have mood swings)	Disagree, maybe, agree
	28	How do you rate your personality? (Are you always open to new ideas and suggestions and willing to try them)	Disagree, maybe, agree
	29	How do you rate your personality? (Do you always enjoy sharing your thoughts and ideas with others)	Disagree, maybe, agree
	30	How do you rate your coping abilities during this lock-down period?	Poor, average, very good, excellent
	31	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Watching TV/playing computer games)	Yes, no
	32	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Reading/writing)	Yes, no
	33	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Cooking)	Yes, no
	34	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Exercise)	Yes, no
	35	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (<i>Yogasana</i>)	Yes, no
	36	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Meditation)	Yes, no
	37	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Faith-based practices including prayer etc.)	Yes, no
	38	How do you prefer spending time (apart from your regular, work-related engagements) during this national lock-down period? (Social media and Internet)	Yes, no
Lifestyle	39	As a coping strategy do you use? (Tobacco)	Never, occasionally, regularly
	40	As a coping strategy do you use? (Drink Alcohol)	Never, occasionally, regularly
	41	As a coping strategy do you use? (or use any other substance)	Never, occasionally, regularly

(Continued)

TABLE 1 | Continued

Parameters	Question number	Questions	Valid responses
	42	Has the lock-down increased your dependency on use of tobacco, alcohol, or any other substances?	Yes, no, not applicable
	43	In general, how do you describe your eating habits as? (I am disciplined with respect to time and place of eating)	Yes, no
	44	In general, how do you describe your eating habits as? (I am a strict vegetarian/vegan)	Yes, no
	45	In general, how do you describe your eating habits as? (I like eating junk food)	Yes, no
	46	In general, how do you describe your eating habits as? (I like spicy and hot food)	Yes, no
	47	In general, how do you describe your eating habits as? (I like sweet and sour food)	Yes, no
	48	In general, how do you describe your eating habits as? (I like cold and refrigerated food)	Yes, no
	49	In general, how do you describe your eating habits as? (I tend to frequently snack)	Yes, no
	50	How would you describe your overnight sleep DURING this lock-down period?	Very good, good, OK, bad, very bad
	51	How would you describe your overnight sleep BEFORE this lock-down period?	Very good, good, OK, bad, very bad
	52	What activity were you engaged with BEFORE this lock-down period?	Did yoga, went fitness, went walking, did household, other
	53	What activity are you engaged with DURING this lock-down period?	Doing yoga, going fitness, going walk, doing household, other
	54	How much time do you spend for a structured physical activity as mentioned above during this lock-down period?	Never, <30 min, 30 min–1 h, >1 h
	55	Duration of practices per week during this lock-down period? (<i>Asana</i>)	Don't practice, <2 h, 2–4 h, 4–6 h, >6 h
	56	Duration of practices per week during this lock-down period? (<i>Pranayama</i>)	Don't practice, <2 h, 2–4 h, 4–6 h, >6 h
	57	Duration of practices per week during this lock-down period? (Meditation)	Don't practice, <2 h, 2–4 h, 4–6 h, >6 h
	58	Duration of practices per week during this lock-down period? (Religious practices)	Don't practice, <2 h, 2–4 h, 4–6 h, >6 h
	59	How motivated are/were you to start Yoga during this lock-down period?	Not at all, somewhat, very much so
	60	In general, how do you rate the happiness/peace you derive from the following? (Yoga and/ or religious practices)	Not at all, somewhat, very much
	61	In general, how do you rate the happiness/peace you derive from the following? (Money)	Not at all, somewhat, very much
	62	In general, how do you rate the happiness/peace you derive from the following? (Sensory pleasures)	Not at all, somewhat, very much
	63	In general, how do you rate the happiness/peace you derive from the following? (Name and fame)	Not at all, somewhat, very much
	64	In general, how do you rate the happiness/peace you derive from the following? (Service to society)	Not at all, somewhat, very much

exclusion criteria were defined during the circulation of CHAS. Hence, the received responses showed diversity in age, gender, occupation, education, and other demographics (Table 2). This study was sponsored and conducted by S-VYASA. The participation was voluntary, and the response sheets were downloaded daily.

The CHAS data were collected between May 9, 2020 and May 31, 2020, and 23,760 responses were received. Incomplete and unreliable responses, respondents from outside of India and respondents aged <18 years were excluded ($n = 470$). The remaining 23,290 responses were evaluated to assign participants in Yoga and non-Yoga groups. Inclusion criteria were age should be ≥ 18 years and all respondents should be residing in India. Yoga and non-Yoga group was defined according to the responses of question numbers 52, 53, 55, 56, and 57 of the CHAS questionnaire (Table 1).

Criteria for Defining Yoga Group

The Yoga group was defined as individuals who performed Yoga both before (question 52) and during (question 53) the lockdown, which included practicing one or more among *Asanas* (question 55) (Yoga postures), *Pranayama* (Yogic breathing exercises) (question 56), and meditation (question 57) for a few hours to more than 6 h per week during the lockdown. Participants, who replied “Did Yoga” for questions 52 and 53, but marked “Don’t practice” for questions 55–57 were excluded from the Yoga group. According to these criteria, 9,840 participants qualified for the Yoga group.

Furthermore, the Yoga group was divided into four sub-groups, i.e., Yoga practitioners who practiced *Asana*, *Pranayama*, and meditation (all three together; $n = 6,156$), practitioners who practiced only *Asana* ($n = 149$), only *Pranayama* ($n = 89$), and only meditation ($n = 1,485$). The combination of two practices among *Asana*, *Pranayama*, and meditation was not considered as a sub-group.

Criteria for Defining Non-Yoga Group

The non-Yoga group included respondents who did not perform Yoga before (question 52) or during (question 53) the lockdown and replied “Don’t Practice” for the questions on *Asana* (question 55), *Pranayama* (question 56), and meditation (question 57). Following the aforementioned inclusion criteria, 3,377 participants were accepted in the non-Yoga group.

Statistical Analysis

R Statistical software, version 4.0.0, was used for data cleaning, extraction, and analyses. The arsenal package in R was used to determine cross-tabulations and χ^2 test; logistic and multinomial regression was used. Age, gender, occupation, education, and working status during lockdown were used as covariates.

The dependent variables were the study groups. We used multiple predictors in each of the regression models. Sequential contrast was used for ordinal variables. The predictors were selected based on the domains presented in the survey. The domains were demographic details, physical health, mental health, coping strategy, and lifestyle.

RESULTS

Demographic Characterization

Table 2 summarizes the demographics of the non-Yoga group (25.6%), Yoga group (74.4%), and total participants. Participation of males in the survey was proportionally higher in both non-Yoga (67.5%) and Yoga (55.3%) groups. The young population in the age group of 20–30 years was higher in the non-Yoga (50.5%) group than in the Yoga group (22.8%). The participation from the age group > 50 years was higher in the Yoga group (26.8%) than in the non-Yoga group (6.0%). Our data also revealed that the percentage of employed and professional participants was higher in both groups, with 44.1% in non-Yoga and 40.4% in Yoga. The non-Yoga group had 37.0% participation from young students. Most of the participants had a good educational background as they were either graduates or post-graduates. We noted that 85.0% of the participants stayed with their family during the lockdown, apparently lending help to cope with stress. On further analysis, we found that the non-working participants were fewer in the non-Yoga group (36.5 vs. 43.9%). Furthermore, the proportion of participants going to the office during lockdown was more in the non-Yoga group (25.7 vs. 15.2%).

COVID-19 Exposure

Participants with no symptoms are less likely to be in the non-Yoga group than participants with cough, fever, breathing difficulty, and other symptoms (Table 2). The symptoms of COVID-19 were self-reported. Approximately 98.1% of non-Yoga and 97.8% of the Yoga group did not undertake any international travel since January 2020. Further, the non-Yoga group is more likely to have exposure to COVID-19 than the Yoga group.

Lifestyle

Although the proportion of participants using substances was lower in both groups, the non-Yoga group was more likely to depend on alcohol, tobacco, and other substances (Table 3). The non-Yoga group was less likely to have a good quality of sleep before and during the lockdown than the Yoga group, odds ratio (OR) < 1 (Table 3).

Participants of the non-Yoga group were less likely to have food in a disciplined manner [unadjusted OR = 0.58 (0.49–0.69), adjusted OR = 0.60 (0.51–0.52)] and were less likely to be vegetarian [unadjusted OR = 0.27 (0.23–0.31), adjusted OR = 0.31 (0.27–0.36)] (Table 3). The non-Yoga group was more likely to consume junk food [unadjusted OR = 1.69 (1.44–1.98), adjusted OR = 1.39 (1.18–1.64)] and spicy and hot food [unadjusted OR = 1.91 (1.65–2.21), adjusted OR = 1.77 (1.53–2.05)]. Interestingly, about 55.3% of the non-Yoga participants were motivated to start Yoga during the lockdown (Table 3).

Physical Health

The Yoga group reported very good physical strength and endurance, with only 7.5% of participants reporting an average or below average physical strength and endurance (Table 4). The non-Yoga practitioners were less likely to have good physical strength and endurance (OR < 1), suggesting physical endurance attributes might be superior in Yoga practitioners. Disease risk

TABLE 2 | Demographic characteristics and COVID-19 exposure in non-Yoga and Yoga groups.

Demographics	Non-Yoga (<i>N</i> = 3,377), No. (%)	Yoga (<i>N</i> = 9,840), No. (%)	Total <i>N</i> = 13,217, No. (%)	<i>P</i> -value
Gender				<0.001
Female	1,097 (32.5)	4,397 (44.7)	5,494 (41.6)	
Male	2,280 (67.5)	5,443 (55.3)	7,723 (58.4)	
Age				<0.001
<20 years	372 (11.0)	332 (3.4)	704 (5.3)	
20–30 years	1,704 (50.5)	2,240 (22.8)	3,944 (29.8)	
31–40 years	761 (22.5)	2,375 (24.1)	3,136 (23.7)	
41–50 years	341 (10.1)	2,243 (22.8)	2,584 (19.6)	
51–60 years	136 (4.0)	1,519 (15.4)	1,655 (12.5)	
61–70 years	49 (1.5)	880 (8.9)	929 (7.0)	
71–80 years	12 (0.4)	209 (2.1)	221 (1.7)	
Above 80 years	2 (0.1)	42 (0.4)	44 (0.3)	
Occupation				<0.001
Agriculture	104 (3.1)	245 (2.5)	349 (2.6)	
Business	99 (2.9)	708 (7.2)	807 (6.1)	
Employed	1,209 (35.8)	2,809 (28.5)	4,018 (30.4)	
Homemaker	123 (3.6)	1,504 (15.3)	1,627 (12.3)	
Retired	56 (1.7)	744 (7.6)	800 (6.1)	
Student	1,248 (37.0)	1,358 (13.8)	2,606 (19.7)	
Professional	280 (8.3)	1,171 (11.9)	1,451 (11.0)	
Other	258 (7.6)	1,301 (13.2)	1,559 (11.8)	
Education				<0.001
Less than graduation	992 (29.4)	2,459 (25.0)	3,451 (26.1)	
Graduate	1,398 (41.4)	3,748 (38.1)	5,146 (38.9)	
Post graduate	987 (29.2)	3,633 (36.9)	4,620 (35.0)	
Lockdown stay status				<0.001
Family	2,799 (82.9)	8,429 (85.7)	11,228 (85.0)	
Friends	64 (1.9)	113 (1.1)	177 (1.3)	
Colleagues	193 (5.7)	332 (3.4)	525 (4.0)	
Alone	169 (5.0)	588 (6.0)	757 (5.7)	
Missing data	152 (4.5)	378 (3.8)	530 (4.0)	
Working status during lockdown				<0.001
Working from home	1,276 (37.8)	4,027 (40.9)	5,303 (40.1)	
Working from office	867 (25.7)	1,494 (15.2)	2,361 (17.9)	
Not working	1,234 (36.5)	4,319 (43.9)	5,553 (42.0)	
COVID-19 symptoms				<0.001
No symptoms	2,943 (87.1)	9,037 (91.8)	11,980 (90.7)	
Cough	68 (2.0)	78 (0.8)	146 (1.1)	
Fever	5 (0.1)	2 (0.0)	7 (0.0)	
Breathing difficulty	8 (0.2)	20 (0.2)	28 (0.2)	
Other	353 (10.5)	703 (7.1)	1,056 (8.0)	
International travel since January 2020				0.383
Yes	65 (1.9)	214 (2.2)	279 (2.1)	
No	3,312 (98.1)	9,626 (97.8)	12,938 (97.9)	
Exposure to COVID-19				<0.001
No exposure	3,106 (92.0)	9,381 (95.3)	12,487 (94.5)	
Recent COVID-19 interaction	19 (0.6)	40 (0.4)	59 (0.4)	
Were in quarantine	90 (2.7)	166 (1.7)	256 (1.9)	
Still in quarantine	54 (1.6)	99 (1.0)	153 (1.2)	
Healthcare worker	104 (3.1)	143 (1.5)	247 (1.9)	
Hospitalized	4 (0.1)	11 (0.1)	15 (0.1)	

TABLE 3 | Lifestyle in non-Yoga and Yoga groups.

Lifestyle			Non-Yoga (N = 3,377) Reference	Yoga (N = 9,840)
Substance abuse No. (%) Adjusted <i>p</i> -value Adjusted OR (95% CI) Unadjusted OR (95% CI)	Tobacco	Never	2,961 (87.7)	9,586 (97.4)
		Occasionally	288 (8.5)	191 (1.9)
				0.001
				0.58 (0.42–0.80)
				0.64 (0.47–0.87)
		Regularly	128 (3.8)	63 (0.6)
	Alcohol			0.067
				0.57 (0.31–1.03)
				0.59 (0.32–1.05)
		Never	2,703 (80.0)	9,499 (96.5)
		Occasionally	636 (18.8)	317 (3.2)
				<0.001
	Other substances			0.56 (0.44–0.72)
				0.59 (0.46–0.75)
		Regularly	38 (1.1)	24 (0.2)
				0.010
				3.08 (1.29–7.14)
				3.33 (1.38–7.80)
Eating habits No. (%) Adjusted <i>p</i> -value Adjusted OR (95% CI) Unadjusted OR (95% CI)	Increased substance dependence	Never	3,261 (96.6)	9,688 (98.5)
		Occasionally	74 (2.2)	113 (1.1)
				0.090
				1.53 (0.94–2.51)
				1.41 (0.87–2.30)
		Regularly	42 (1.2)	39 (0.4)
	Disciplined to time			0.229
				0.58 (0.24–1.39)
				0.51 (0.21–1.23)
		Yes	63 (1.9)	55 (0.6)
		No	1,229 (36.4)	1,917 (19.5)
				<0.001
	Vegetarian/vegan			0.32 (0.18–0.58)
				0.30 (0.17–0.55)
		Not applicable	2,085 (61.7)	7,868 (80.0)
				<0.001
				0.27 (0.15–0.48)
				0.26 (0.14–0.47)
Eating habits No. (%) Adjusted <i>p</i> -value Adjusted OR (95% CI) Unadjusted OR (95% CI)	Junk food	Yes	2,414 (71.5)	8,915 (90.6)
		No	963 (28.5)	925 (9.4)
				<0.001
				0.60 (0.51–0.52)
				0.58 (0.49–0.69)
		Yes	1,373 (40.7)	8,713 (88.5)
	Spicy and hot food	No	2,004 (59.3)	1,127 (11.5)
				<0.001
				0.31 (0.27–0.36)
				0.27 (0.23–0.31)
		Yes	1,505 (44.6)	1,166 (11.8)
		No	1,872 (55.4)	8,674 (88.2)
				<0.001
				1.39 (1.18–1.64)
				1.69 (1.44–1.98)
	Unadjusted OR (95% CI)	Yes	2,322 (68.8)	2,992 (30.4)
		No	1,055 (31.2)	6,848 (69.6)
				<0.001
				1.77 (1.53–2.05)
				1.91 (1.65–2.21)

(Continued)

TABLE 3 | Continued

Lifestyle			Non-Yoga (N = 3,377) Reference	Yoga (N = 9,840)
Sleep No. (%) Adjusted <i>p</i> -value Adjusted OR (95% CI) Unadjusted OR (95% CI)	Sweet and sour food	Yes	2,225 (65.9)	5,234 (53.2)
		No	1,152 (34.1)	4,606 (46.8) 0.115 1.12 (0.97–1.30) 1.15 (1.00–1.33)
	Cold and refrigerated food	Yes	1,123 (33.3)	1,019 (10.4)
		No	2,254 (66.7)	8,821 (89.6) 0.993 (0.84–1.19) 1.09 (0.92–1.30)
	Frequent snacks	Yes	1,758 (52.1)	2,729 (27.7)
		No	1,619 (47.9)	7,111 (72.3) 0.235 0.92 (0.79–1.06) 0.98 (0.85–1.12)
	During lockdown period	Good	2,171 (64.3)	8,558 (87.0)
		Ok	856 (25.3)	1,107 (11.2) <0.001 0.67 (0.55–0.81) 0.67 (0.55–0.81)
		Bad	350 (10.4)	175 (1.8) 0.011 0.64 (0.45–0.9) 0.60 (0.43–0.85)
		Before lockdown period	2,427 (71.9)	8,744 (88.9)
		Ok	776 (23.0)	992 (10.1) 0.035 0.81 (0.66–0.99) 0.81 (0.67–0.98)
		Bad	174 (5.2)	104 (1.1) 0.387 0.81 (0.51–1.29) 0.76 (0.48–1.21)
Happiness/peace No. (%) Adjusted <i>p</i> -value Adjusted OR (95% CI) Unadjusted OR (95% CI)	By doing Yoga/religious practices	Not at all	1,358 (40.2)	184 (1.9)
		Somewhat	1,391 (41.2)	1,795 (18.2) <0.001 5.88 (4.63–7.52) 6.05 (4.78–7.70)
		Very much	628 (18.6)	7,861 (79.9) <0.001 2.42 (2.07–2.82) 2.54 (2.18–2.95)
	By earning money	Not at all	688 (20.4)	3,344 (34.0)
		Somewhat	1,760 (52.1)	5,456 (55.4) <0.001 0.68 (0.57–0.82) 0.70 (0.59–0.84)
		Very much	929 (27.5)	1,040 (10.6) <0.001 0.56 (0.46–0.68) 0.54 (0.45–0.66)
	By sensory pleasure	Not at all	764 (22.6)	3,727 (37.9)
		Somewhat	1,895 (56.1)	4,330 (44.0) <0.001 0.71 (0.59–0.85) 0.72 (0.60–0.86)

(Continued)

TABLE 3 | Continued

Lifestyle		Non-Yoga (N = 3,377) Reference	Yoga (N = 9,840)
	Very much	718 (21.3)	1,783 (18.1) 0.698 0.96 (0.79–1.17) 0.98 (0.81–1.19)
	By name and fame		
	Not at all	1,084 (32.1)	5,705 (58.0)
	Somewhat	1,540 (45.6)	3,033 (30.8) 0.020 0.81 (0.68–0.97) 0.73 (0.62–0.87)
	Very much	753 (22.3)	1,102 (11.2) 0.840 0.98 (0.79–1.21) 0.96 (0.78–1.19)
	By social service		
	Not at all	361 (10.7)	401 (4.1)
	Somewhat	1,460 (43.2)	3,157 (32.1) 0.292 1.17 (0.88–1.55) 1.22 (0.93–1.61)
	Very much	1,556 (46.1)	6,282 (63.8) 0.970 (0.86–1.16) 0.92 (0.80–1.07)
	Not at all	1,508 (44.7)	395 (4.0)
Motivation to start/practice more Yoga during lockdown			
No. (%)			
Adjusted <i>p</i> -value			
Adjusted OR (95% CI)			
Unadjusted OR (95% CI)			
	Somewhat	1,665 (49.3)	2,405 (24.4) <0.001 4.54 (3.79–5.46) 4.22 (3.54–5.03)
	Very much	204 (6.0)	7,040 (71.5) <0.001 11.39 (9.50–13.72) 11.33 (9.47–13.62)
	Never	2,002 (59.3)	3,155 (32.1)
	<4 h	1,331 (39.4)	5,658 (57.5) <0.001 1.79 (1.56–2.06) 1.82 (1.59–2.09)
	>4 h	44 (1.3)	1,027 (10.4) <0.001 3.09 (2.04–4.80) 3.13 (2.08–4.80)
Any religious practices other than Yoga			
No. (%)			
Adjusted <i>p</i> -value			
Adjusted OR (95% CI)			
Unadjusted OR (95% CI)			

Sequential contrast was used for ordinal variables and reference level is mentioned in the table for nominal variables.

TABLE 4 | Physical health in non-Yoga and Yoga groups.

Physical health parameters	Non-Yoga (N = 3,377), No. (%) (Reference)	Yoga (N = 9,840), No. (%)	Non-Yoga vs. Yoga, unadjusted odds ratio (95% CI)	Non-Yoga vs. Yoga, adjusted odds ratio (95% CI)	Adjusted <i>p</i> -value
Physical strength and endurance					
Good	2,688 (79.6)	9,106 (92.5)			
Average	630 (18.7)	697 (7.1)	0.31 (0.28–0.35)	0.32 (0.28–0.37)	<0.001
Bad	59 (1.7)	37 (0.4)	0.51 (0.32–0.79)	0.59 (0.35–0.98)	0.045
Disease history					
High risk	391 (11.6)	1,739 (17.7)	0.53 (0.46–0.60)	1.08 (0.94)	0.286
No risk	2,986 (88.4)	8,101 (82.3)			

Sequential contrast was used for ordinal variables and reference level is mentioned in the table for nominal variables.

for co-morbidities, including heart diseases, lung disease, blood pressure, and others, was lower in both the groups (Table 4).

Mental Health

The non-Yoga group reported higher anxiety and fear than the Yoga group when asked about “down-hearted” feeling, low energy (30.9%), anxiety due to COVID-19 (63.9%), fear of getting infected, related suffering (53.4%), fear of death (28.7%), fear of financial difficulties (63.0%), fear of the unknown (57.0%), and fear of spreading infection (65.9%) (Figure 1A).

Furthermore, the non-Yoga group was less goal-driven and oriented toward perfection in their activities (15.9%), less helpful and caring (5.2%), more insecure (50.2%), not open to new ideas (6.6%), and do not enjoy sharing their thoughts (9.7%) than the Yoga group (Figure 1B).

Strategies for Coping With COVID-19 and Lockdown-Related Stress

Most of the Yoga group members reported good coping ability (82.8%), while most of the non-Yoga (58.8%) group reported poor coping ability thereby highlighting a significant difference in two groups (Figure 1C).

Figure 1D shows that the non-Yoga group could cope using the Internet, watching TV, reading/writing, cooking, religious activity, and exercise (>50%). In contrast, the Yoga group was engaged in yoga *Asanas*, meditation, and religious/spiritual activities besides using the Internet, reading/writing, cooking, and exercise (>50%).

Meditation Is Highly Effective to Bring Mental Stability and Strength

We also examined whether practicing a combination of *Asanas*, *Pranayama*, and meditation has a different influence on outcome variables than practicing one of these three yogic practices, individually. Table 5 summarizes the different parameters of physical health, mental health, and coping strategies of four sub-groups. Meditation was frequently performed by the age group of 41–50 years (26.3%), while *Asana* (49.7%) and *Pranayama* (39.3%) were favored by young people between the ages of 20 and

30 years. The consolidated Yoga practice was preferred mainly by participants of 31–40 years (24.5%).

Physical health, predicted by strength and endurance, revealed that the *Asana* group might have lower physical health, whereas co-morbidities were higher in the meditation group (19.3%). Good mental ability was revealed by lower anxiety and stress in the meditation group, followed by the combined group, *Asana* and *Pranayama*, sequentially. In addition, the ability to cope with the stress of COVID-19 was highest and comparable in the meditation group (85.3%) and the combined yoga group (83.2%). The preference of watching TV during lockdown was least in the meditation group (30.2%); their preferences included reading/writing (90.0%) and meditation (96.5%). The combined group preferred a range of activities, including reading/writing (92.2%), cooking (75.7%), exercise (93.2%), *Yogasana* (96.9%), meditation (97.1%), and religious activity (86.2%). TV watching was preferred by the *Pranayama* group (66.3%) followed by the *Asana* group (62.4%), and the Internet was preferred by the *Asana* group (87.9%) followed by the *Pranayama* group (76.4%). The aforementioned observations suggest that meditation might be more effective in reducing stress and anxiety and improving coping abilities in lockdown situations.

DISCUSSION

Despite limited public health intervention strategies, Yoga has remained the mainstay for improving well-being, disease risk reduction, and improving mental and physical health (17–20, 24, 25). We had earlier reported significant barriers in access to Yoga resources even though the prevalence of Yoga in India and elsewhere was significantly noteworthy (26, 27). Regardless, several studies have reported over time better physical health, mental health, and quality of life both among healthy individuals and those with disease or disorder (17–20, 24, 25). Yoga has been known to improve physical and mental health compared with a physically active group or a physically inactive group, yet the reliance on its anticipated benefits has never been assessed in any nationwide study during a health crisis (28, 29).

Yoga represents a regulated lifestyle that involves *Asanas*, *Pranayamas*, and meditation. It makes an individual self-aware of his/her body, mind, thoughts, and soul. The Yogic

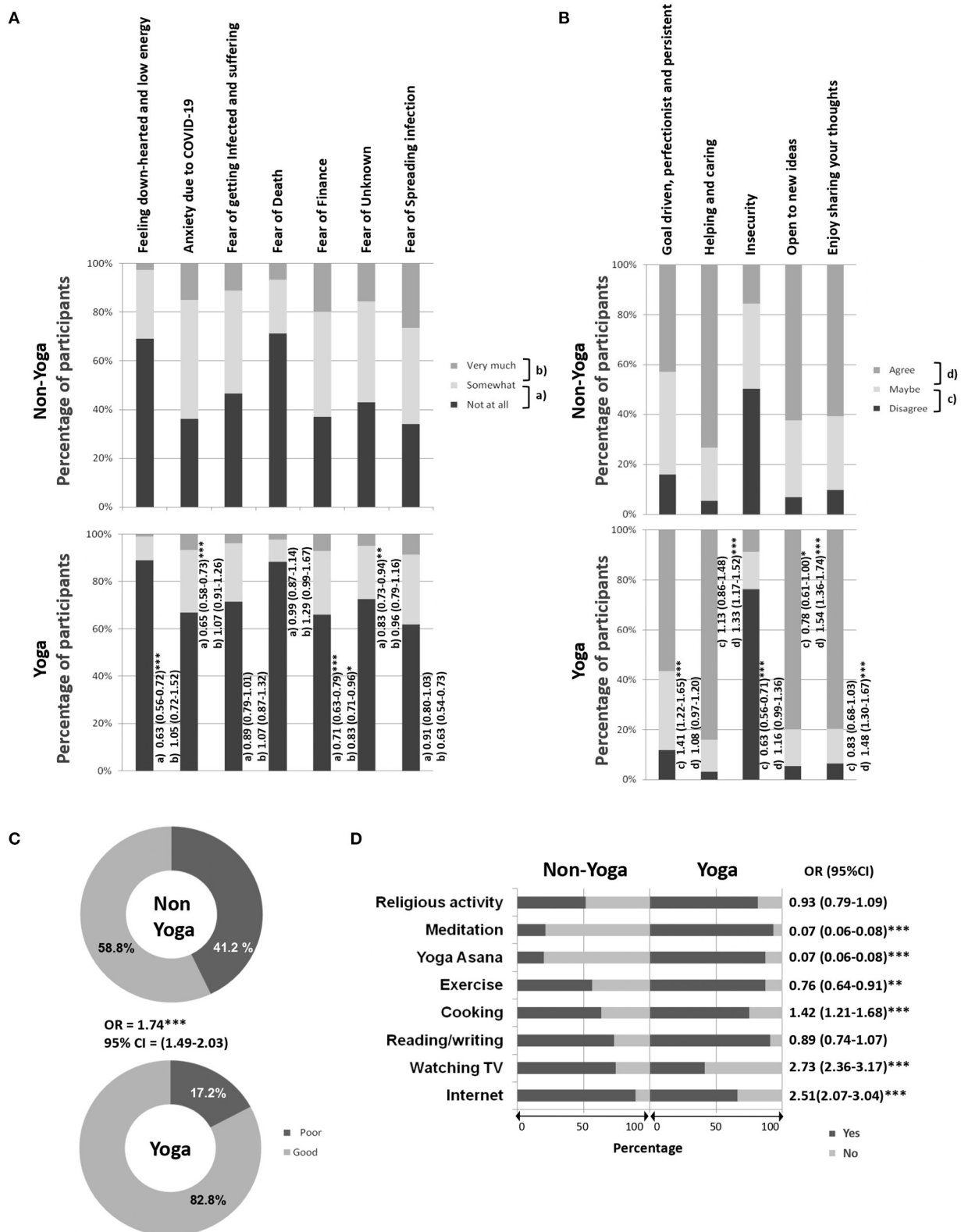


TABLE 5 | Physical health, mental health, and coping strategy among the different Yoga groups practicing all or a particular form of Yoga.

		Combined Yoga group (N = 6,156) (Reference)	Only Asana (N = 149)	Only meditation (N = 1,485)	Only Pranayama (N = 89)
Physical health	Physical strength and endurance				
No. (%)	Good	5,729 (93.1)	124 (83.2)	1,388 (93.5)	85 (95.5)
Adjusted <i>p</i> -value	Average	405 (6.6)	23 (15.4)	89 (6.0)	4 (4.5)
Adjusted OR (95% CI)			0.133	0.581	0.332
Unadjusted OR (95% CI)			2.28 (0.78–6.64)	0.85 (0.47–1.53)	0.76 (0.44–1.32)
			2.79 (0.96–8.07)	0.90 (0.50–1.62)	0.73 (0.00–2.34E06)
	Bad	22 (0.4)	2 (1.3)	8 (0.5)	0 (0.0)
			0.074	0.009	<0.001
			1.92 (0.94–3.91)	1.69 (1.14–2.49)	0.00 (0.00–0.00)
			1.91 (0.94–3.88)	2.03 (1.37–2.99)	0.05 (0.00–271.11)
	Disease history				
	High risk	1,076 (17.5)	20 (13.4)	287 (19.3)	15 (16.9)
	No risk	5,080 (82.5)	129 (86.6)	1,198 (80.7)	74 (83.1)
			0.588	0.892	0.287
			0.87 (0.52–1.45)	0.99 (0.84–1.16)	0.72 (0.40–1.31)
			1.71 (1.02–2.85)	0.86 (0.74–1.00)	1.10 (0.60–2.01)
Mental health	Down-hearted and low energy				
No. (%)	Not at all	5,485 (89.1)	109 (73.2)	1,385 (93.3)	72 (80.9)
Adjusted <i>p</i> -value	Somewhat	620 (10.1)	36 (24.2)	91 (6.1)	16 (18.0)
Adjusted OR (95% CI)			0.580	0.803	0.500
Unadjusted OR (95% CI)			1.25 (0.56–2.78)	1.07 (0.64–1.78)	1.76 (0.34–9.09)
			1.31 (0.59–2.91)	1.13 (0.67–1.90)	1.33 (0.31–5.69)
	Very much	51 (0.8)	4 (2.7)	9 (0.6)	1 (1.1)
			0.926	0.189	0.526
			1.03 (0.60–1.77)	1.27 (0.89–1.81)	0.71 (0.25–2.04)
			1.26 (0.73–2.16)	0.90 (0.63–1.29)	0.53 (0.21–1.35)
	Anxiety due to COVID-19				
	Not at all	4,001 (65.0)	62 (41.6)	1,197 (80.6)	45 (50.6)
	Somewhat	1,752 (28.5)	65 (43.6)	230 (15.5)	27 (30.3)
			0.430	0.003	0.347
			1.19 (0.77–1.84)	0.71 (0.57–0.89)	0.78 (0.47–1.31)
			1.26 (0.82–1.95)	0.70 (0.57–0.88)	0.84 (0.51–1.38)
	Very much	403 (6.5)	22 (14.8)	58 (3.9)	17 (19.1)
			0.218	0.081	<0.001
			1.24 (0.88–1.73)	1.17 (0.98–1.40)	2.48 (1.57–3.92)
			1.36 (0.98–1.89)	1.15 (0.97–1.37)	2.79 (1.80–4.33)
	Fear of getting infected				
	Not at all	4,260 (69.2)	67 (45.0)	1,254 (84.4)	51 (57.3)
	Somewhat	1,649 (26.8)	67 (45.0)	210 (14.1)	33 (37.1)
			0.153	0.423	0.415
			1.54 (0.85–2.77)	0.85 (0.56–1.27)	0.68 (0.27–1.73)
			1.57 (0.87–2.82)	0.80 (0.54–1.20)	0.79 (0.33–1.90)
	Very much	247 (4.0)	15 (10.1)	21 (1.4)	5 (5.6)
			0.453	0.566	<0.001
			1.15 (0.79–1.68)	0.93 (0.72–1.20)	0.20 (0.12–0.36)
			1.03 (0.71–1.50)	0.96 (0.74–1.23)	0.27 (0.16–0.47)
	Fear of death				
	Not at all	5,393 (87.6)	120 (80.5)	1,411 (95.0)	61 (68.5)
	Somewhat	614 (10.0)	23 (15.4)	62 (4.2)	18 (20.2)

(Continued)

TABLE 5 | Continued

		Combined Yoga group (N = 6,156) (Reference)	Only Asana (N = 149)	Only meditation (N = 1,485)	Only Pranayama (N = 89)
			0.143	0.546	0.282
			0.58 (0.29–1.20)	0.85 (0.50–1.44)	1.48 (0.72–3.03)
			0.56 (0.28–1.15)	0.86 (0.52–1.43)	1.98 (0.98–4.01)
Very much	149 (2.4)	6 (4.0)	12 (0.8)	10 (11.2)	
			0.061	0.833	<0.001
			0.61 (0.37–1.02)	1.04 (0.73–1.49)	4.38 (2.45–7.81)
			0.62 (0.37–1.03)	1.13 (0.80–1.61)	3.17 (1.85–5.46)
Fear of finance					
Not at all	3,931 (63.9)	59 (39.6)	1,182 (79.6)	46 (51.7)	
Somewhat	1,777 (28.9)	62 (41.6)	261 (17.6)	32 (36.0)	
			0.068	0.043	0.952
			1.49 (0.97–2.28)	0.76 (0.58–0.99)	1.02 (0.53–1.95)
			1.48 (0.98–2.24)	0.74 (0.57–0.96)	1.00 (0.54–1.87)
Very much	448 (7.3)	28 (18.8)	42 (2.8)	11 (12.4)	
			0.226	0.007	0.117
			1.21 (0.89–1.65)	0.78 (0.65–0.93)	0.69 (0.44–1.10)
			1.26 (0.93–1.71)	0.81 (0.68–0.97)	0.80 (0.51–1.24)
Fear of unknown					
Not at all	4,366 (70.9)	69 (46.3)	1,275 (85.9)	44 (49.4)	
Somewhat	1,486 (24.1)	57 (38.3)	184 (12.4)	34 (38.2)	
			0.532	0.326	0.169
			1.19 (0.70–2.02)	0.83 (0.56–1.21)	1.70 (0.80–3.63)
			1.41 (0.83–2.40)	0.80 (0.55–1.17)	2.00 (0.95–4.23)
Very much	304 (4.9)	23 (15.4)	26 (1.8)	11 (12.4)	
			0.015	0.764	0.121
			1.56 (1.09–2.23)	0.96 (0.75–1.23)	1.48 (0.90–2.41)
			1.63 (1.14–2.31)	1.07 (0.84–1.36)	1.30 (0.80–2.10)
Fear of spread					
Not at all	3,665 (59.5)	65 (43.6)	1,127 (75.9)	42 (47.2)	
Somewhat	1,933 (31.4)	56 (37.6)	309 (20.8)	32 (36.0)	
			0.634	0.300	0.908
			0.89 (0.56–1.42)	0.87 (0.66–1.14)	1.04 (0.54–2.01)
			0.75 (0.47–1.20)	0.83 (0.63–1.08)	0.99 (0.52–1.87)
Very much	558 (9.1)	28 (18.8)	49 (3.3)	15 (16.9)	
			0.545	0.010	0.347
			0.90 (0.65–1.26)	0.79 (0.66–0.94)	0.80 (0.51–1.27)
			1.02 (0.73–1.42)	0.75 (0.63–0.90)	0.80 (0.51–1.24)
Goal driven, perfectionist, and persistent					
Disagree	715 (11.6)	20 (13.4)	181 (12.2)	15 (16.9)	
Maybe	1,963 (31.9)	59 (39.6)	422 (28.4)	31 (34.8)	
			0.541	0.260	0.738
			0.88 (0.59–1.31)	1.08 (0.94–1.25)	0.91 (0.54–1.55)
			0.80 (0.55–1.19)	1.04 (0.91–1.20)	0.73 (0.45–1.17)
Agree	3,478 (56.5)	70 (47.0)	882 (59.4)	43 (48.3)	
			0.387	0.124	0.572
			0.87 (0.63–1.19)	1.10 (0.97–1.24)	1.13 (0.74–1.73)
			0.88 (0.64–1.21)	1.03 (0.91–1.16)	0.92 (0.61–1.38)
Helping and caring					
Disagree	199 (3.2)	6 (4.0)	41 (2.8)	6 (6.7)	
Maybe	751 (12.2)	24 (16.1)	169 (11.4)	23 (25.8)	

(Continued)

TABLE 5 | Continued

		Combined Yoga group (N = 6,156) (Reference)	Only Asana (N = 149)	Only meditation (N = 1,485)	Only Pranayama (N = 89)
			0.840	0.053	0.760
			0.93 (0.46–1.87)	1.32 (1.00–1.75)	1.12 (0.53–2.38)
			0.96 (0.49–1.88)	1.55 (1.17–2.05)	1.18 (0.56–2.51)
	Agree	5,206 (84.6)	119 (79.9)	1,275 (85.9)	60 (67.4)
			0.481	0.863	<0.001
			1.22 (0.71–2.10)	0.98 (0.79–1.22)	0.32 (0.18–0.56)
			1.10 (0.66–1.84)	0.93 (0.75–1.15)	0.38 (0.22–0.66)
	Insecurity				
	Disagree	4,651 (75.6)	73 (49.0)	1,261 (84.9)	59 (66.3)
	Maybe	977 (15.9)	50 (33.6)	114 (7.7)	21 (23.6)
			0.001	<0.001	0.326
			1.85 (1.29–2.67)	0.60 (0.51–0.70)	1.30 (0.77–2.22)
			2.06 (1.45–2.94)	0.61 (0.52–0.72)	1.17 (0.69–1.99)
	Agree	528 (8.6)	26 (17.4)	110 (7.4)	9 (10.1)
			0.886	<0.001	0.184
			1.02 (0.74–1.41)	1.52 (1.25–1.84)	0.71 (0.43–1.18)
			1.04 (0.76–1.43)	1.53 (1.27–1.85)	0.82 (0.50–1.34)
	Open to new ideas				
	Disagree	319 (5.2)	8 (5.4)	91 (6.1)	6 (6.7)
	Maybe	893 (14.5)	38 (25.5)	196 (13.2)	13 (14.6)
			0.067	0.879	0.081
			1.87 (0.96–3.66)	0.98 (0.78–1.24)	2.05 (0.92–4.59)
			2.07 (1.09–3.91)	0.90 (0.72–1.13)	1.86 (0.84–4.13)
	Agree	4,944 (80.3)	103 (69.1)	1,198 (80.7)	70 (78.7)
			0.237	0.183	0.147
			0.75 (0.47–1.21)	0.88 (0.73–1.06)	1.63 (0.84–3.17)
			0.75 (0.47–1.18)	0.88 (0.73–1.06)	1.90 (0.99–3.65)
	Enjoy sharing your thoughts				
	Disagree	361 (5.9)	17 (11.4)	96 (6.5)	15 (16.9)
	Maybe	854 (13.9)	33 (22.1)	164 (11.0)	12 (13.5)
			0.002	0.158	<0.001
			0.48 (0.30–0.76)	0.86 (0.69–1.06)	0.21 (0.12–0.35)
			0.54 (0.35–0.85)	0.86 (0.70–1.07)	0.20 (0.12–0.34)
	Agree	4,941 (80.3)	99 (66.4)	1,225 (82.5)	62 (69.7)
			0.386	0.632	0.253
			0.83 (0.55–1.26)	1.05 (0.86–1.27)	1.45 (0.77–2.74)
			0.71 (0.48–1.07)	1.12 (0.93–1.35)	1.23 (0.67–2.24)
	Coping ability				
Coping strategy					
No. (%)	Poor	1,037 (16.8)	50 (33.6)	219 (14.7)	18 (20.2)
Adjusted <i>p</i> -value	Good	5,119 (83.2)	99 (66.4)	1,266 (85.3)	71 (79.8)
Adjusted OR (95% CI)			0.163	0.006	0.472
Unadjusted OR (95% CI)			0.80 (0.59–1.10)	1.23 (1.06–1.42)	0.86 (0.58–1.29)
			0.64 (0.48–0.86)	1.23 (1.07–1.42)	1.09 (0.74–1.61)
	Do you prefer watching TV				
	Yes	2,698 (43.8)	93 (62.4)	449 (30.2)	59 (66.3)
	No	3,458 (56.2)	56 (37.6)	1,036 (69.8)	30 (33.7)
			0.037	<0.001	0.001
			0.64 (0.42–0.97)	1.38 (1.18–1.62)	0.43 (0.26–0.71)
			0.68 (0.46–1.01)	1.38 (1.18–1.61)	0.41 (0.26–0.67)

(Continued)

TABLE 5 | Continued

	Combined Yoga group (N = 6,156) (Reference)	Only Asana (N = 149)	Only meditation (N = 1,485)	Only Pranayama (N = 89)
Do you prefer reading/writing				
Yes	5,677 (92.2)	116 (77.9)	1,337 (90.0)	71 (79.8)
No	479 (7.8)	33 (22.1)	148 (10.0)	18 (20.2)
		0.051	<0.001	0.959
		1.72 (1.00–2.95)	0.52 (0.39–0.70)	1.02 (0.52–2.01)
		1.63 72 (1.00–2.95)	0.57 (0.43–0.76)	1.24 (0.66–2.30)
Do you prefer cooking				
Yes	4,662 (75.7)	110 (73.8)	1,094 (73.7)	57 (64.0)
No	1,494 (24.3)	39 (26.2)	391 (26.3)	32 (36.0)
		0.496	0.061	0.988
		0.84 (0.52–1.38)	0.84 (0.69–1.01)	1.00 (0.59–1.68)
		0.73 (0.47–1.13)	0.80 (0.68–0.95)	1.15 (0.71–1.86)
Do you prefer exercise				
Yes	5,739 (93.2)	134 (89.9)	919 (61.9)	74 (83.1)
No	417 (6.8)	15 (10.1)	566 (38.1)	15 (16.9)
		0.008	<0.001	0.942
		0.40 (0.21–0.79)	3.96 (3.27–4.79)	1.03 (0.51–2.07)
		0.41 (0.22–0.79)	4.18 (3.46–5.04)	0.92 (0.47–1.80)
Do you prefer Yoga Asana				
Yes	5,965 (96.9)	135 (90.6)	744 (50.1)	74 (83.1)
No	191 (3.1)	14 (9.4)	741 (49.9)	15 (16.9)
		0.242	<0.001	0.121
		0.64 (0.31–1.35)	24.31 (19.85–29.78)	1.84 (0.85–3.98)
		0.79 (0.39–1.61)	24.78 (20.29–30.27)	1.92 (0.93–3.95)
Do you prefer meditation				
Yes	5,984 (97.2)	50 (33.6)	1,433 (96.5)	51 (57.3)
No	172 (2.8)	99 (66.4)	52 (3.5)	38 (42.7)
		<0.001	<0.001	<0.001
		58.60 (37.77–90.90)	0.23 (0.14–0.36)	19.01 (11.05–32.70)
		62.43 (41.25–94.49)	0.21 (0.13–0.32)	19.15 (11.42–32.11)
Do you prefer religious activity				
Yes	5,305 (86.2)	89 (59.7)	1,121 (75.5)	62 (69.7)
No	851 (13.8)	60 (40.3)	364 (24.5)	27 (30.3)
		0.026	0.009	0.057
		1.66 (1.06–2.59)	1.28 (1.06–1.54)	1.69 (0.99–2.91)
		1.74 (1.14–2.65)	1.25 (1.04–1.51)	1.39 (0.83–2.33)
Do you prefer Internet				
Yes	4,247 (69.0)	131 (87.9)	806 (54.3)	68 (76.4)
No	1,909 (31.0)	18 (12.1)	679 (45.7)	21 (23.6)
		0.039	0.022	0.994
		0.54 (0.31–0.97)	1.20 (1.03–1.41)	1.00 (0.56–1.78)
		0.41 (0.24–0.71)	1.34 (1.15–1.56)	0.84 (0.49–1.45)

Sequential contrast was used for ordinal variables and reference level is mentioned in the table for nominal variables.

teaching is based on the fundamentals of *Yama* (restraints) and *Niyama* (observances) (30). *Yama* includes teachings of non-violence, truthfulness, non-stealing, moderation, and non-hoarding, whereas *Niyama* includes teachings of cleanliness, contentment, self-discipline, self-study, and wellness. Yoga practitioners routinely isolate themselves from the general population to achieve higher spiritual goals (31). Thus, one who follows the Yoga and Yogic lifestyle can easily maintain cleanliness and social distancing without an agitated mind. Therefore, Yoga practitioners can be hypothesized to quickly adapt to lockdown rules without experiencing chronic anxiety and stress.

The present study extends the above hypothesis operationalized as an investigation carried out when the world is gripped with fear and uncertainty due to an impending pandemic. In this context, the present study has evaluated the outcomes of physical and mental health, including lifestyle and coping strategies of Yoga and non-Yoga groups, during the lockdown imposed by COVID-19 pandemic. A CHAS questionnaire was generated following the Delphi protocol and was circulated among the Indian mass by snowball method as Google Forms. Phone calls and special requests were sent to different sections of the society including ~200 universities, Corporate companies, healthcare institutions, government organizations, wellness centers, and their networks to acquire data. The data were collected between May 9, 2020 and May 31, 2020; data were downloaded daily.

In the present survey, among the total respondents of 23,290, 42.2% ($n = 9,840$) were Yoga practitioners, which is much higher than the previous report of 11.8% of a nationwide randomized structured survey in 2017 (27). This may not indicate a true rise in the number of yoga practitioners in the country as this was not a randomly selected population.

The current study reports proportionately higher response from males than females. Non-Yoga group has a higher percentage of young participants than the Yoga group, which is a limitation of the study. In both Yoga and non-Yoga groups, most of the participants were employed or well-educated professionals. Furthermore, the analysis of the data collected during this survey revealed that both groups represented a similar proportion of participants living with family; however, a small proportion of participants were also reported to be living alone in both groups. Thus, loneliness cannot be a leading attribute of anxiety, stress, and fear in this study. Another feature of the participants who responded to the survey was that a greater proportion of the working and office going population was represented in the non-Yoga. Working and attending office during the lockdown may be considered as a reason for not practicing Yoga.

Emerging data have shown differences in the susceptibility to COVID-19 symptoms based on age and co-morbidities (4). Studies have shown the benefits of Yoga intervention in reducing the risk and severity of diabetes and other co-morbidities (24, 25). Such interventions may, therefore, be helpful for the risk reduction of COVID-19. Our data show increased non-Yoga group susceptibility to COVID-19 compared with those belonging to the Yoga group; however, RT-PCR for COVID-19 was not carried out to confirm this. Regardless, this calls for

new public health and cost-effective intervention strategies based on a digital Yoga interface, compliant to Tele-Yoga regulations. Recently, a breathing technique known as *Liuzijue* has been reported to improve pulmonary function and quality of life in discharged COVID-19 patients (32). However, it cannot be neglected that the Yoga group is mainly constituted by participants who are “not working” or “working from home,” because of which they have a lower COVID-19 risk and are less fearful about COVID-19.

Sleeping and eating habits in the Yoga group were more health promotive. Furthermore, it also revealed that the dependence on substances use, as resources to cope with anxiety and stress, was lower in the Yoga group. Moreover, good physical strength and endurance coupled with the absence of chronic disease were also proportionately higher in the Yoga group, suggesting better health outcomes corresponding to COVID-19. Our study, however, did not estimate the non-Yoga exercise groups consisting of sportsmen or other physical activities.

We observed that the non-Yoga group was coping with COVID-19 lockdown by relying on the Internet, TV, reading/writing, cooking, and exercise, while the Yoga group was more engaged in *Asana*, meditation, and religious/spiritual activities besides using the Internet, reading/writing, cooking, and exercise. The Yoga group maintained their routine consistently, while the non-Yoga group could not sustain their regular practices.

The comparisons between the two groups unanimously showed that the non-Yoga group faced mental challenges. They reported higher anxiety and fear associated with COVID-19, including fear of getting infected with COVID-19, death, finance-related stress, and spreading COVID-19 in addition to other unknown causes. Instead, compared with the non-Yoga group, the Yoga group was reportedly more goal-driven and methodical, eliciting responses that showed a helping and caring attitude. The latter group displayed more openness to new ideas and enjoyed sharing their thoughts, being less insecure. Reports from China also show similar psychological distress (8, 17, 33).

COVID-19-related stress creates panic and reduces quality of life in patients as well as in healthcare workers (HCWs). Hence, introducing Yoga in the healthcare system would be beneficial for the patients, HCWs, and other service providers: they may successfully cope with psychological stress (34–37). Stress, anxiety, and depression among HCWs in COVID-19 pandemic was reduced by practicing *Sudarshan kriya* (38). Perceived stress in COVID-19 patients was also reduced by multimedia psychoeducational intervention, which included relaxation and mindfulness techniques (39). Not limited to COVID-19, integrative medicine including modern medicine, Yoga, mindfulness techniques, Ayurveda, and many more can be helpful for managing health and quality of life, and have the ability to reduce severity of disease. However, randomized trials are required to develop integrative healthcare.

It has been shown that meditation can potentially decrease the risk of acquiring cold and flu by improving physiological function and quality of life (40). Yogic breathing techniques improve respiratory and cardiac function, rendering it an effective tool to combat COVID-19 (41). Yoga will help calm down the

mind and enhance immunity (17–20). PTSD due to natural disasters, epidemics, and wars has been shown to regress after practicing Yoga (42). Its application in the current pandemic using the digital module of Yoga and mindfulness may be helpful. If administered to COVID-19 patients under supervision, it may even reduce psychological stress (43). A few randomized controlled trials are taken up in the present pandemic that are investigating the efficacy of various breathing techniques including Yogic breathing in COVID-19 (44–46).

It is pertinent to note that we had stratified the Yoga group into a consolidated Yoga group, only *Asana*, only *Pranayama*, and only meditation groups. Meditation seemed to evoke beneficial outcomes than those practicing all, i.e., *Asana*, *Pranayamas*, and meditation. However, a longitudinal randomized trial is imperative to establish evidence. Our observation that the younger population preferred *Asanas* and *Pranayama*, while meditation was mainly preferred by the elderly, can help deliver innovative yoga protocols that make meditation more attractive to the young population and, consequently, useful for mental hygiene if presented as integrated yoga protocols (available at www.svyasa.edu.in). Our report highlights that a large number of subjects practiced consolidated Yoga (including *Asanas*, *Pranayama*, and meditation), proving the acceptability of an integrated module for school and college teachers. This could partly be due to the widespread popularity of both the Common Yoga Protocol released by the Ministry of AYUSH on the eve of International Day of Yoga, celebrated on June 21, as well as the widely published efficacy of Diabetic Yoga Protocol and COVID-19 Yoga Protocols released by the S-VYASA University (47, 48). These protocols include *Asana*, *Pranayama*, and meditation.

LIMITATIONS OF THE STUDY

The study is limited by the fact that the sampling does not generate a study group that represents the general population as it was collected through social media. Second, the duration and regularity of Yoga practice before the lockdown was not assessed in the Yoga group, which would have given details of practice before lockdown. The same was assessed for lockdown period. Third, a proportionately higher number of younger subjects were found represented in the non-Yoga group; this might have influenced the outcome in a few components of the scales like the use of the Internet, physical strength, and others. Fourth, the self-reported COVID-19 symptoms could not be verified and RT-PCR for COVID-19 was not performed to establish increased susceptibility of non-Yoga group because of the lockdown restrictions. Fifth, a non-standard questionnaire was used. Mental health was not evaluated by any neuropsychological

questionnaire such as the Perceived Stress Scale, but was based on the responses of CHAS.

We also could not rule out the role of physical exercises in improving mental and physical health; however, outdoor activities were restricted due to the lockdown. Furthermore, whether the restrictions mentioned earlier provided the environment conducive for the practice of *Asanas*, *Pranayamas*, and meditation, available through digital media, cannot be ascertained unless another validation study is carried out. In addition, we did not explore means to rule out repetitive form filling by the same individual due to error or intention; however, there were no rewards or benefits attached to completing the survey. Because the survey was administered online, the possibility of cognitive bias in the study was minimal; however, we entirely relied on the answers provided online without verifying the IP address, consistent with similar reports published elsewhere.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, upon eligible request.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Swami Vivekananda Yoga Anusandhana Samsthana. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

RN conceptualized the study, supervised data collection, and involved in discussions during article preparation. AA conceptualized the article. MR and MSS wrote and edited the article and contributed in data presentation. MNKS conceptualized the study. RK and JI performed the statistical analyses. AS created the scale and administered it nationally. HN envisioned the study, and inspired and guided the study to its completion imparting quality assurance. RN, AA, and VS critically reviewed and edited the article. All authors contributed to the article and approved the submitted version.

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U.S. Paralympic Hopeful's Athletic Identity and How It Has Been Affected by the Sport Disruption of COVID-19

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The purpose of this study was to explore the status of Paralympic hopefuls' athletic identity and how this identity was impacted by the training and competition cessation resulting from the COVID-19 pandemic. Researchers conducted in-depth semi-structured interviews that explored the experiences of 29 Paralympic hopefuls who compete in thirteen different Paralympic sports. A thematic analysis yielded two superordinate themes: a) Prominent athletic identity, multiplicity over exclusivity; b) Various Impact on AI: Mental adaptation helps overcome the lack of sport participation. Participants in this study possessed prominent strong athletic identities from the benefits of sport participation. Their prioritized athletic role still remains despite setbacks due to the pandemic. However, athletes identified with multiple roles rather than an exclusive athletic identity during COVID-19. As for the impacts on identity, the severity of challenges are determined by the mindset of the athletes. All of the athletes experienced a decreased amount of time and physical participation in their sport. Paralympians whose sole focus was on the loss of physical participation were impacted the most. Athletes who felt unchallenged did so because of their mental adaptation. Through a positive outlook and mentality, athletes were able to effectively cope and not dwell on the negative aspects brought on by the pandemic. In conclusion, having a strong AI did not necessarily coincide with a negative impact on identity from COVID-19, and those who do not possess a strong AI felt their AI was unchallenged by the pandemic. More importantly, Paralympians' mindset of how they view and interpret their AI is crucial to how the individual's AI is affected by the sport disruption of COVID-19.

Keywords: athletic identity, paralympian, sport disruption, COVID-19 pandemic, disability sport, Tokyo 2020 olympic and paralympic games, sport psychology, paralympics

INTRODUCTION

The ongoing coronavirus disease (COVID-19) caused a worldwide pandemic, most strongly recognized during its surge in 2020, when all communities and societies were forced to adopt drastic changes to curb its spread. In the sport realm, an announcement made Mar. 24th, 2020 declared that the Tokyo 2020 Olympic and Paralympic Games would be postponed for 1 year, causing great disruption among athletes who had trained long and hard for years to participate. Suddenly, athletes experienced lockdown, travel bans, tournament cancellations, facility shutdowns, social distancing, as well as other governmental guidelines and safety protocols—botching the athletes' competitive

calendars and routines. This undoubtedly presented challenges as they had limited to no access to effective training environments, partners and teammates (Schinke et al., 2020).

Several researchers have investigated the impact that such inactivity conditions may have on physiological systems, as well as on athletic performance (Jukic et al., 2020). However, the effects of the global pandemic on athletes' Athletic Identity, an important component of athlete's self-concept and health and performance outcomes, is still to be explored. Athletic identity (AI) was examined based on sport-related benefits (i.e., physical self-efficacy, enhanced body image), and with the premise that it would be manifested most strongly in athletes whose self-concepts were significantly tied into the athlete role (Martin, 1999). Although developing a strong athletic identity can be salient and beneficial for active athletes, athletes with too exclusive of an AI may have emotional difficulty adjusting to non-sport participation (Werthner and Orlick, 1986).

Scant research has only begun to track AI changes among non-disabled athletes during the COVID-19 pandemic, which forced a decline in sport participation. The recent knowledge reveals that during the lockdown period, elite athletes, and team sports athletes showed higher AI compared to other level and individual sport athletes; however, athletes with higher AI tend to ruminate and catastrophize more (Costa et al., 2020). Student-athletes did not uniformly experience identity loss following school closures; some of them even reported stronger AI at a certain time mainly due to maintaining social interaction and team support (Graupensperger et al., 2020).

Currently, there is no identified research exploring the status of the athletes with disabilities' AI and how it is impacted by COVID-19. We will argue that Paralympic-level athletes who were training for the pinnacle sporting event of their careers were uniquely situated, in that their AI may be influenced by the new challenges brought on by the pandemic. Paralympic-level athletes already face challenges including overtraining and injury, normalized pain, and health hazards (Fagher et al., 2016). Moreover, they continue to struggle with external barriers such as lack of sufficient adaptive sport facilities, as well as logistical hurdles in travel to competition sites (Swartz et al., 2019).

With the uncertainty of when it will be safe to return to athletic participation, Paralympians are now up against new straining circumstances due to COVID-19's impact on their physical, social, and even financial state. They rely very heavily on the Games, as it represents the greatest chance for single-source income for most Paralympians in the U.S. For those who have side jobs to support their livelihoods, the pandemic may still cause financial hardships resulting from job or sponsorship loss (Taku and Arai, 2020). Based on the aforementioned considerations, the aim of the current study was to examine the status of Paralympic hopefuls' athletic identity and how this identity was impacted by the training and competition cessation resulting from the COVID-19 pandemic.

LITERATURE REVIEW

Athletic Identity

Athletic identity (AI) is based in social role theory and refers to the degree with which an individual identifies with the athletic

role (Brewer et al., 1993). It is considered both a cognitive structure (schema) and a social role. AI is known to be a pervasive and important factor for health and fitness outcomes, global self-esteem, social relationships, and commitment to sport and physical activity (Horton and Mack, 2000). Furthermore, it effectively creates positive impressions regardless of sex, age, or activity level, as well as able-bodiedness (Hutzler and Bar-Eli, 1993; Manns and Chad, 1999).

People with strong AI have self-schema grounded in being an athlete. Possessing a strong AI can have both positive and negative effects. Athletes who possessed a stronger AI were more committed to their sport and had better athletic performances (Horton and Mack, 2000); however, they were more likely to neglect other parts of their lives to fulfill their athletic role (Cornelius, 1995; Murphy et al., 1996) and were at greater risk of emotional and psychological distress while adjusting upon injury and retirement (Brewer, 1993; Grove et al., 1997; Webb et al., 1998).

Strength of athletic identity is thought to vary with past and current athletic experience and the relative success or failure in this domain (Horton and Mack, 2000); it may be assessed through the 3-factor structure (social identity, exclusivity, and negative affectivity) Athletic Identity Measurement Scale (AIMS) (Brewer et al., 1993). While we have a good understanding on the conceptualization of AI, very few studies examined how AI was maintained, managed, and changed. Through Poucher and Tamminen (2017), we know elite athletes appeared to maintain AI through personal actions and behaviors (e.g., compartmentalization, justified commitment) as well as environmental factors (e.g., attention from others, daily routines).

Disability Sport Athletic Identity

Regarding disability sport AI, the present body of literature follow two distinct research lines: Quantitative research examining potential antecedents, correlates, and outcomes of the AI, and qualitative research learning how athletes feel about being an athlete while having a disability (Guerrero and Martin, 2018). By using in-depth interviews and focusing on personal narratives, qualitative studies capture the broad and complex dynamics of identity construction, development, and negotiation process (Martin, 2013).

How AI is constructed within populations of athletes with disabilities is still relatively unknown. The only identified research on athletes with intellectual disabilities shows that participants generally do not identify themselves with the role of a sportsman (Wilinski et al., 2014). Correspondingly, research investigating the influence of sport on athletes with physical disabilities' sense of self and identity development is also considered limited (Pack et al., 2017). What is known, is that sport as a domain has been identified as a venue that produces favorable self-perceptions among individuals with disabilities (Arbour et al., 2007; Giacobbi et al., 2008; Ginis et al., 2010), while also facilitating AI development (Anderson, 2009) and AI strengthening (Ioannis et al., 2018). Disability sport participation both predicts and results in AI development (Groff and Zabriskie, 2006; Tasiemski and Brewer, 2011; Perrier et al., 2012), meaning that the relationship between sport participation and AI is likely

bidirectional and thus verifies the value of sport participation for people with disabilities.

Indeed, involvement in sports and AI development could potentially help people with disabilities to repair and redefine themselves, combating social marginalization. In doing so, they are recognized as “real” athletes by themselves and by society, are able to cope efficiently with the disability state (Wheeler et al., 1999; Swartz et al., 2018); they transform their disability identity to that of an elite athlete (Le Clair, 2011) and enhance their well-being (Nagata, 2014). These athletes who possess an affirmative athlete identity are proud to be disabled and experience benefits of living with a disability. This so-called affirmative model (Swain and French, 2000), which focuses on positive experiences and social identities for people with disabilities. It explains athletes with disabilities who embrace a disability sport AI during the identity negotiation process, compare to those reject it, and those who will not likely develop an AI (Sparkes and Smith, 2002). Thus, a strong AI is correlative with aspects of personal and social identities.

A strong disability sport AI is also related to various psychological factors, such as perceived competence (Shapiro, 2003), quality of life (Groff et al., 2009), self-esteem (Marin-Urquiza et al., 2018), and physical self-confidence (Van de Vliet et al., 2008). Several other factors have been linked to disability sport AI formation: athletes with disabilities' profile factors like family status, level of education, disability, athletic experience, and type of games (Ioannis et al., 2018), nationality differences (Groff and Zabriskie, 2006), and the athletes' role during competition and their type of sport (Tasiemski and Brewer, 2011). Further, Anderson (2009) found that factors like confidence in sporting abilities, a strong commitment to sport goals, a sense of community, and significant others' support are important elements that facilitated the development of disability sport AI.

There is a divergence of the findings in previous research regarding relationship between AI and negative affectivity, life satisfaction, and sport performance (Tasiemski et al., 2004, 2013; Wiśniewska et al., 2012). However, to date, research has demonstrated equally strong AI between athletes with disabilities when compared to those without a disability (Groff and Zabriskie, 2006). Researchers confirmed that athletes with disabilities strongly considered themselves as athletes (Ioannis et al., 2018), and have many sport-related goals as well as a strong desire to achieve these goals (Martin et al., 1995).

In contrast with non-disabled AI, there is conflicting evidence that the 3-factor structure is maintained when the AIMS is used among athletes with disabilities (Martin et al., 1997; Groff and Zabriskie, 2006; Ioannis et al., 2018). Despite ongoing controversy in regards to the best use of the measurement scale, we know disability sport AI tends to be stronger among men (Brewer and Cornelius, 2001), older athletes (Brewer et al., 1993), and elite athletes (Tasiemski et al., 2004). Strength of AI also increases with the number of hours devoted to practice (Tasiemski and Brewer, 2011), experience, accomplishments, and competence (Le Clair, 2011).

A disability sport AI does not end when sport ends. Given that athletes with disabilities' career has been cited as a

central part of an athlete's identity (Wheeler et al., 1999), the sport career transition (e.g., retirement) received comparable attention. Research showed that athletes with disabilities who were retired and considering retiring had lower AI and poorer performance compared with those who did not plan to retire, and no relationship was found between perceived stress and AI (Martin and Ridler, 2014). Likewise, athletes with disabilities experience the same negative psychological outcomes of AI, such as post-injury depression (Buman et al., 2008) and difficulties transitioning to retirement (Grove et al., 1997; Marin-Urquiza et al., 2018).

With the aforementioned heavy attention in disability sport AI, it is worth noting that the self-schemas of many athletes with disabilities are not limited solely to their AI and an athlete may describe oneself through multiple identities (Martin, 1999; Huang and Brittain, 2006). It is in line with the concept of multiplicity in personality psychology research, which refers to people who identify as if they have at least two distinct selves (Spanos, 1994). To further understand AI in the disability sport context, an important yet rarely investigated group, Paralympic athletes, were chosen as representatives for this study.

Athletic Identity of Paralymians

The Paralympic Games is a quadrennial global multi-sport competition for individuals with certain impairments. This elite sport event has become increasingly competitive and larger over the years, which consequently resulted in heightened expectations of participating para-athletes with regards to time spent training and the achievement of podium performances (Hammond and Jeanes, 2018). The anticipated highest level of competition and considerable sporting achievement leads to the recognition of “being an athlete” and is associated with Paralympian's AI.

Few researchers have examined Paralymians' AI. Quantitative research has focused on relationships between Paralymians' AI score, sport performance, self-perception, and retirement status. Paralympic athletes report strong AI, self-esteem and physical self-perceptions compared to non-disabled sportive individuals. Paralymians' AI levels were relatively stable compared with the non-Paralymians over time. However, no relationship was found between AI and (physical) self-perceptions (Van de Vliet et al., 2008). Further, active Paralymians have a stronger AI and better performance compared to those who are retired or are considering retirement. Athletes who have a higher scores of AI, exclusivity and negative affectivity would likely to experience a higher degree of depressive symptoms upon retirement. Also, no correlation has been found between AI, retirement status (active, retired), sport performance with self-esteem (Tasiemski et al., 2013; Martin and Ridler, 2014; Marin-Urquiza et al., 2018).

Qualitative research focuses on Paralymians' identity development through learning how Paralympic athletes described their identities and how they meshed perceptions of sport, impairment, disability, and life. Research has shown that sport participation enhanced self and social acceptance, identity development, and quality of life. Paralymians did not view themselves as having lost something, as being disabled, nor as

supercrises, which support the Affirmation Model of Disability (Pack et al., 2017; Swartz et al., 2019). In contrast, Huang and Brittain (2006) reported that most Paralympians assigned their impairment as their “master identity status” instead of AI, which follows the medical model. This study also briefly commented on culture and identity as broader influences on identity development. Moreover, it highlights how being a Paralympian uniquely contributed to the transformation process of identity development by experiencing success through international disability sport.

Meanwhile, Le Clair (2011) also highlighted that the elite athlete status of being a Paralympian contributes to an identity transformation from a disability identity to an AI. This AI development results from the experience of accomplishment and competence in professional sport. Moreover, the study emphasized the unique platform of the international Paralympic Games and its institutional transformation from a disability rehabilitation-based organization to an elite sport-based organization. This shift contributes to the transformation of the Paralympians' identity.

We understand that identities are constantly in the process of change and transformation, and Paralympians have multiple identities outside of their AI, and these identities shift over time as athletes go through life changes (Huang and Brittain, 2006). Significant life events relating to sport disruption (e.g., retirement, parenthood) are often catalysts for identity changes and challenges. Paralympians—who possibly possess the strongest disability sport AI—face unique identity challenges related to sport disruption.

Sport Disruptions and Athletic Identity

To better understand the possible effects of COVID-19 on athlete identity, we examined sport disruptions, the closest identified analog. Career transitions brought on by athletic disturbances can result in a negative impact on AI (Park et al., 2012). These athletic disturbances typically lead to a partial or complete stop of sport participation and include, injury, retirement, and parenthood (Kerr and Dacyshyn, 2000; Tekavc et al., 2020; Caron et al., 2021). While the latter has a contrasting effect, sport disruptions such as injury and retirement can be detrimental to elite athletes' psychology which ultimately impairs their AI. This is a result of the sometimes-lengthy hiatus interfering with their normal sport participation. Because sport so deeply influences an elite athletes' way of living and manner of socialization, injury affects athletes' physical health as well as mental health (Caron et al., 2017). The mental health impacts that often arise accompanying these life-altering events, ranging from feeling neglected by their support systems, to struggling to figure out self-identity (Caron et al., 2021). Some elite athletes describe their AI struggles from sport disruption as being in “Nowhere Land”—feeling an overwhelming sense of identity confusion and life uncertainty (Kerr and Dacyshyn, 2000). They may even lose characteristics of their personality (Blinde and Stratta, 1992; Muscat, 2010). Experiencing severe depression and a loss of status and self-confidence, athletes' feel inferior to their previous self and former teammates. In addition to the psychological stressors, sport disruptions can have physical

impacts on the athlete including sleep disorders, appetite loss, and alcohol abuse (Blinde and Stratta, 1992; Sinclair and Orlick, 1993).

It is important to note that though these negative effects from sport disruption are significant and well-studied, it has also been found that they can be precluded if athletes proactively retract themselves from sport and take initiative to develop identity in other areas. Research has concluded that the application of identity multiplicity is a significant factor in preventing AI difficulty for these athletes (Lally, 2007; Muscat, 2010). In addition, a particular sport disruption, motherhood, has been shown to self-enlighten athletes. Athlete mothers are able to discover different self-dimensions which ultimately decrease sport competitive pressure (Appleby and Fisher, 2009). This is beneficial for athlete's mentality when they return to sport, as they described having a stronger motivation to train, a stronger wish to compete in tournaments, and the desire to make their performance at the Olympic Games a family experience (Tekavc et al., 2020).

Throughout this body of literature, it is apparent that there are negative effects on identity from sport disruption when elite athletes do not make an effort to identify in other life domains. Further, it is acknowledged that a need for counseling exists to assist elite athletes in adjusting to life without sport. The discussed information correlates with the experiences of non-disabled elite athletes, as many studies have focused on this population when studying sport disruption. In contrast, however, studies on elite disability sport and populations of Paralympic athletes is lacking.

Limited studies in the disability sport context have only briefly touched on how the disruptions of injury and retirement can be a psychological stressor, resulting in negative feelings such as depression and anxiety for Paralympians (Fagher et al., 2016; Marin-Urquiza et al., 2018). Further, there are experiences from sport disruptions that are unique to elite athletes with disabilities that need to be explored more in depth. These experiences include retirement from declassification. Declassification in para-sports involves a system of segmenting, and in some cases excluding, athletes based on the type of impairment and whether they meet the “Minimum Impairment Criteria”—regardless of their performance level. For this reason, there is no able-body equivalent (Bundon et al., 2018). Yet, while it has been found that Paralympians' AI is negatively affected by retirement, the area of sport disruption in general on AI of Paralympians is greatly lacking. Research in this field can help explain the causes and solutions to athlete's psychological traumas, financial struggles, and illness' that coincide with AI difficulties.

A unique and collective sport disruption that all, if not most, Paralympians have experienced starting in 2020 is the ongoing COVID-19 pandemic. By investigating how COVID-19 has affected the AI of Paralympians, we hope to add to this body of literature, as well as discuss the unique challenges para-athletes specifically face. Studying this will aid in understanding Paralympians' AI and how it is affected by sport disruptions. The purpose of our study is to examine the status of Paralympic hopefuls' athletic identity and if that identity has been impacted

from the training and competition cessation caused by the COVID-19 pandemic.

METHODS

Design of Study

Researchers had increasingly called for a qualitative manner to better understand the unique yet complex process of athletes with disabilities' identity development. Moreover, with limited previous research regarding Paralympian's AI and no equivalent sport disruption event like COVID-19, we deem it is important to track changes of Paralympian's AI based on acknowledging their AI status. Thus, as the first attempt seeking to understand how participating in sport and Paralympic Games would result in developing a disability sport AI and how it would be impacted by COVID-19, we employed an exploratory qualitative methodology. To achieve the research goal, two research questions were addressed through this study:

RQ1: What is Paralympic hopeful's athletic identity?

RQ2: Have Paralympic Hopefuls' athletic identity been impacted by COVID-19; if so, how?

Procedures

All research assistants that collected data worked in an established disability sport lab and had been exposed to disability sports for at least 6 months to a year. These individuals took part in leadership roles running disability sport programming. Following, the individuals transitioned into conducting research where they were trained in qualitative research and data collection. The project was led by a tenured senior faculty member who has conducted qualitative research and has a number of peer-reviewed publications. The training process included multiple observations of interviews, practice interviews, partnering in observing and listening to practice interviews, gaining feedback through the practice interview process, and being trained in asking follow-up questions.

All individuals were trained in qualitative data collection and engaged in bracketing in order to address issues of reliability (Tufford and Newman, 2012). Bracketing was used to mitigate biases and preconceptions of personal experience, interest, values, and emotions. This is significant in being aware of one's preconceptions, as it influences the research assistants' perceptions toward a subject or their interpretation of a subject's response (Darawsheh, 2014). The specific process of bracketing was to individually self-reflect and list out every bias or influence that could have impacted data collection or interpretation of the findings. Following this, every individual was instructed to share their form of bracketing to a close family member or friend to challenge validity of the biases and to further reflect on the influences that can cause predetermined disposition.

A reflection of roles in the context of what it means to work with a person with a disability was discussed prior with the senior faculty member of this study. While the senior faculty member on this study does have a physical disability, none of the other individuals presented a disability. However, it should be acknowledged that world views and experiences

will be different from the participants who did have physical disabilities. Researchers were also trained to ethically engage with the athletes throughout interviews, as they are freely and voluntarily participating in the research (Seidman, 2006).

A total of five research assistants participated in data collection, consisting of two males and three females, ages ranging from 20 to 25 years old, with ethnicities including Hispanic, Middle Eastern, Asian, and African American. Out of the five research assistants, two individuals that were involved in data collection furthered the data analysis and continued to be authors. An additional author was added for data analysis and to further the study for publication.

Data was managed in a way that protected confidentiality by providing pseudonyms for all subjects. The engagement in practice interviews provided research assistants the experience to effectively probe for responses while still respecting the participants' privacy and desire to discuss or not discuss certain topics, especially questions that might be sensitive to them.

Participants and Participant Selection

Purposeful sampling was used for selection of participants. Paralympic Hopefuls who were qualified or attempting to qualify for the 2020 Paralympics were recruited for the study. Athletes meeting the criteria were invited by the research assistants to participate in the study. Coaches and administrators were contacted via email, posting on social media, and using snowball sampling. Athletes who wanted to participate in the study contacted the lab via email. Following, a consent form was emailed to the athletes. After the athletes reviewed the consent form, they were instructed to give a verbal or digital confirmation that they accept and agree to the study. Once approved, a date and time was scheduled between the athlete and two research assistants for an interview. Every athlete that participated in the interview process received a \$25 gift card that was provided by the Lab of (name redacted until article accepted). Twenty-nine Paralympic hopefuls, ages ranging from 18 to 62 participated in this study. **Table 1** provides a detailed description of our sample, including pseudonym, gender, specific sport participation, and nature of disability. The results section gives a broader picture of who the athletes are and how sport has influenced their current identity as a Paralympic Hopeful who self identifies as an athlete.

Out of 29 participants, 18 were female and 11 were male. The nature of disabilities included physical, congenital, and acquired. Thirteen sports, both team and individual, were represented. The majority of the subjects had competed in the Paralympics prior and have qualified to compete in Tokyo 2020. While the majority had qualified, some were waiting on qualification and have not been given the chance to do so due to the disruption of COVID-19. Examples of sports represented included taekwondo, swimming, sitting volleyball, and goalball.

Data Collection

Before data collection, an electronic confirmation was requested from the athletes upon review of the provided consent form. Twenty-nine in-depth, semi-structured interviews were completed with the duration of interviews lasting from 19 min to 1 h and 20 min. Data collection was conducted

TABLE 1 | Demographic information of athletes.

Pseudonyms	Gender	Sport	Nature of disability
Cooper	Male	Boccia	Cerebral Palsy
Neal	Male	Cycling	Cerebral Palsy
Stephanie	Female	Equestrian	Wyburn Mason Syndrome
Katherine	Female	Equestrian	Brain Stem Cerebellar Injury
Marge	Female	Equestrian	Multiple Sclerosis
Trisha	Female	Fencing	Primary Cerebellar Degeneration
Valerie	Female	Fencing	Ehlers-Danlos Syndrome
Connor	Male	Goalball	Retinitis Pigmentosa
Abbie	Female	Goalball	Visual Impairment
Maranda	Female	Goalball	Visual Impairment
Leslie	Female	Goalball	Visual Impairment
Allie	Female	Goalball	Congenital Glaucoma
Kendall	Female	Paracanoeing	Spinal Cord Injury
Cara	Female	Paracanoeing	Spinal Cord Injury
Campbell	Male	Powerlifting	Spina Bifida
John	Male	Powerlifting	Amputee
Jacob	Male	Rugby	Spinal Cord Injury
Natalie	Female	Sitting Volleyball	Umbilical Band Syndrome
Brittney	Female	Sitting Volleyball	Fibular Hemimelia
Lilly	Female	Sitting Volleyball	Amputee
Michelle	Female	Swimming	Visual Impairment
Stewart	Male	Swimming	Neuroblastoma
Brandy	Female	Taekwondo	Cerebral Palsy
Erwin	Male	Taekwondo	Brachial Plexus
Sandra	Female	Wheelchair Racer	Spinal Cord Injury
Jerry	Male	Wheelchair Tennis	Spinal Cord Injury
Nathan	Male	Wheelchair Tennis	Arthrogryposis
Frank	Male	Wheelchair Tennis	Spinal Cord Injury
Denise	Female	Wheelchair Tennis	Transverse Myelitis

through virtual video calls under the university account to maintain confidentiality of participants. Twelve questions were sub-categorized into introduction/background, COVID-19 specific, and reflection-based questions (Table 2 provides sample interview questions).

All five research assistants were trained for the interview process by observing the tenured senior faculty member conduct two interviews; following, each researcher participated in a practice interview. Two researchers were present during data collection: a primary and secondary interviewer. The primary interviewer's role was to facilitate the flow of the interview and ensure all questions were addressed. The secondary interviewer primarily observed and provided follow-up questions when appropriate. A brief reflection by both researchers followed after data was collected. All interviews were recorded and transcribed.

Data Analysis

Data analysis was conducted simultaneously with data collection and was employed using an inductive and comparative analysis strategy. Data was analyzed by the researchers using thematic analysis (Merriam, 2002) and a constant comparative method

to maintain reliability and consistency. Organization of the analyzed data was inputted into an excel spreadsheet. First, three researchers individually analyzed one transcribed interview, then compared findings and determined a process for analyses. Each researcher was to be presented with 2/3rd of the data. This resulted in all transcripts being analyzed by two scholars, where they jointly discussed their analyses in a critical and constructive manner in order to refine the subthemes. By having two researchers analyze every interview, a level of accountability was shown throughout this process. Finally, all three researchers regrouped and agreed upon the final interpretation of the themes and categorized units.

FINDINGS AND DISCUSSION

Prominent Strong AI, Multiplicity Over Exclusivity

The vast majority of the participants indicated that they strongly identified themselves as athletes at the time we interviewed them during COVID-19. Their strong AI originated from long-term commitment in sports, as well as benefits from involving and excelling in disability sport, including financial support, social opportunity, self-empowerment, and other life opportunities. By prioritizing the key athletic role and emphasizing the importance of sport while holding concerns of losing it, eight Paralympians stated they had exclusive AI. By contrast to exclusivity, the rest claimed that multiple roles in school, work and family accounted for their identities besides being an athlete. Interestingly, two athletes who underlined the multiplicity of their identities outside of sport, suggested that being an athlete was not a significant portion of their identities.

Overall Strong AI

When asked how much of their self-identity was rooted in being an athlete, 27 of the participants positively expressed a shared significant AI. This lends support to previous research (Groff and Zabriskie, 2006), which indicates that athletes with disabilities have equally strong AI compared to non-disabled athletes. Paralympians stressed its weight with different measurements by frequently quoting “a lot” “very strong” “almost all of it” “really big.” To support their statements, they automatically explained how much sports means to them and their lives through different lenses.

One crucial aspect of AI is the physical devotion to sport. Some of the athletes expressed enthusiasm and accumulated athletic experience in general sport participation. For instance, John emphasized that everything he “has ever done was sports-wise” while Campbell said he had an almost fixed athletic identity because “ever since I was little, I always tried to get into as many sports as I possibly could, and it's been like that ever since pretty much.”

With the maximized desire to improve and win, our participants focused on their goal-setting and devoted extensive efforts in training and competing, aside their fondness of sport. As Allie said, her strong AI was from committing to sport and then working as hard as needed. In addition, participants constantly mentioned the longevity of sport participation. As

TABLE 2 | Sample interview Questions.

1. How did you get involved in the sport you are wanting to compete in?
2. How have the regulations affected your health regimen, such as your nutrition, training, and sleep?
3. Has your self-identity as an athlete been challenged during this pandemic?

Erwin explained, “I spend the majority of my life training, working out, hanging out with my teammates and so yeah, I would say that’s a good chunk, like probably, a large part of my identity.”

By prioritizing the athlete role, Paralympians planned life around sport and achieving sporting goals, but at the cost of the majority of their time and commitment. Maranda described her AI through the sacrifice of other activities or roles:

So that being an athlete is kind of my identity at the current moment because I have put so much time into it. And right now, it’s where all my resources are going. It’s planning around it. So, I’ve had to make a lot of sacrifices in the past 2 years to be able to make this dream a reality.

The confidence in their ability and their sense of self was unconditional, as Jerry indicated “before my injury and after my injury, tennis has always been a part of my life.”

Surprisingly, some of the athletes illustrated their strong AI by highlighting the situations when they were unable to compete. By going through injuries and similar experiences, Brittney related her AI to her strong determination to pursue excellence in volleyball. She claimed she would only quit until she couldn’t play it “a hundred percent.” For John, He emphasized that even if he “was not competing in the Paralympics,” being an athlete will remain a huge part of his character. These experiences and reflections show that the athletes possess strong AI and have confidence in the stability of their AI, even throughout the COVID-19 pandemic.

Besides the impacts of long-term sport involvement to strong AI, athletes also underlined their appreciation for the physical and mental self-empowerment gained from disability sport. Sport not only provided them the opportunity to be active and healthy, but also offered other benefits that shaped who they are and changed their lives. The financial, psychological, and social benefits athletes received from sport, helped them easily identify their strong athletic persona.

Directly, some participants defined their strong AI regarding being an athlete as their occupation and livelihood, where sport provided them partial or full financial support. As Natalie pointed out, besides setting her goal to be the “greatest athlete that [she] can be,” having an athletic career was “also allowing [her] to financially be stable.” Moreover, while lack of social interaction and inclusion was a problem for many people with disability, our participants highlighted the independence and social opportunities they gained from the platform of sport and tournament participation. Participants were able to travel, meet people, interact with others and make friends. As Dennis recalled, being a Paralympian or just an adaptive athlete “has afforded

me the opportunities to travel the world and to meet the friends I have.”

On the psychological side, through equal involvement and competition, sport allowed athletes to be competitive; build something concrete and be a better version of themselves, as Marge expressed:

The sport gave me an identity and I loved sports where things were really fair like jumping horses like the poles stay up or they come down, you know you go fast or you go faster, you know something concrete. I’ve always believed that you can try to be better at something and I think that identified me as an athlete.

Based on a concrete foundation, sport gave Paralympians identities outside of their disability, allowing them to self-identify as athletes, and be recognized as such by others. Having a master identity status was essential to them, as Brittney described:

That body image is huge, and it’s been huge maybe like my whole life with my leg was always wanting to fit in or identify with something. It was very easy for me to identify with being an athlete. I look like an athlete, I act like athlete. I’m an athlete.

The self-definition from Brittney and other athletes illustrated that being an elite athlete provided a base to define and redefine themselves, think and behave beyond their disability. Moreover, the master role drawn from self-definition helped them to gain external recognition as athletes and resist stereotypes. Brittney further indicated when she was at school, “I’m the athlete like everyone knows that.” Being recognized and validated as athletes were important for them to reassure their identities. To Stewart, participating in sport or being a Paralympian could prove “that I’m deeper than just someone with a disability.” In Lily’s experience as a Paralympian, she further identified as both an athlete and an advocate for disability sport and its benefits, and thus, “it’s a gigantic part of” who she was.

More importantly, having a master identity as an athlete, along with strengthened competitiveness and confidence from winning and other achievements, the participants gained positive self-perceptions, which they have applied to other areas of life. Allie said, to “be on an equal playing field gave me a lot of confidence, and strengthened other areas of my life.” The positivity and achievements in sport also allowed Paralympians to pursue opportunities and lives outside of being an athlete, with enhanced self-esteem and other developed identities around sport (e.g., coach, advocate) or beyond sport (e.g., student, accountant). Thus, the multi-layer benefits of participation in adaptive sport were unanimously affirmed by Paralympians who commented: “there’s so many layers” (Brittney); “it’s so much more because it’s just like ticks off all these boxes” (Natalie). Leslie elaborated on how sport shaped who she was and changed her life by offering so many opportunities:

Being an athlete has opened so many doors to opportunities, have influenced my life in such a positive way, through teaching opportunities through adaptive sports, and my life would be totally different without it.

In summary, Paralympians asserted that sport meant a lot to them because it influenced their lives in a greatly positive way, and they were grateful and proud of the outcome. As Stephanie stated, "I wouldn't have it any other way, you know, like it's made me into someone that I really proud." The identity they brought into life and the experience learned from other events facilitated and reinforced their AI, as Leslie indicated: "I've learned like a lot of life lessons from being an elite level athlete and a lot of great qualities that I've carried into other experiences and vice versa." The achievements in other roles constantly reminded them of the important roles derived from their athletic identities: "It's just like everything, like every little avenue that I've taken kind of steers back into my identity" (Natalie). We can see that being an elite athlete educated athletes in various ways, leading to progressions that would remind them of and reinforce their strong AI.

Indeed, through participation in disability sport and aspirations to win Paralympic medals, Paralympians developed self-acceptance and personal growth, along with the experiences of traveling and connecting with people around the world, leading to a purposeful life. These experiences were closely consistent with Taiwanese and British Paralympian participants' experience in previous research (Huang and Brittain, 2006), who suggested that sport participation and excellence gave participants a key identity as well as the ability to explore beyond their disability. However, in our study, instead of focusing on the impact of their disability status and transformative process, Paralympians were more positively focused on their strong athletic identity and multiplicity.

This study also confirmed contributors to stronger AI, such as devoting more hours to practice (Tasiemski and Brewer, 2011) and experiencing accomplishment and competence (Le Clair, 2011). It also supported the benefits associated with sports involvement and AI development, including perceived competence (Shapiro, 2003) and the ability to combat social marginalization and redefined as athletes by themselves and by society (Wheeler et al., 1999). Through this study, we further the discussion that strong AI allowed Paralympians to explore beyond athleticism to develop multiple identities through deeper interaction and engagement in society.

Exclusivity and Multiplicity

Based on the prominent strong AI, some of the athletes stressed their identities as being exclusively athletic, while more of the others stated alternative social roles and characteristics that complete the multiplicity of their identity.

Those who identified exclusively as athletes pronounced sport as a dominant anchor in life. Frank claimed: "Sports is my life, everything inside of me revolves around it. Sports is my world." Athletes also highlighted the peak status of being a Paralympian, as Brandy states, "I'm at the height of my career right now. I mean, I qualified for the Paralympics, so you don't get any higher." Due to age, Cara's first shot at the Paralympics would also be her last, so she felt her AI peaked at the moment as well. It seems like the exclusivity stemmed more from personal experience; nevertheless, these athletes shared the same appreciation of disability sport participation, on par with others expressing strong AI.

They had also described their participation in disability sport as a life-changing experience: "Man, without wheelchair sports I wouldn't be who I am today. It totally changed my life" (Kendall). Athletes were able to recognize the sole identity they were experiencing and the concern of losing that identity in the future:

It was so hard to stop and I've never really thought about that before because you know, I've always played sports and always played goalball. And so just to think about not playing anymore, I was like man, I... don't necessarily have an identity outside of goalball. (Connor)

While those who exclusively defined themselves as athletes struggled with finding identity outside of sport, there were comparatively more athletes in the study that claimed to intentionally plan for multiplicity or already have multiple identities. Yet for most of them, being an athlete was still their key identity. Jerry explained, "it doesn't take up my entire character." It supports Martin (1999) found that many athletes' self-schemas are not limited solely to their AI. This is understandable because Paralympians, benefiting from confidence gained on court, often transition successfully to positions such as coaches, advocates, sport committee members, and other societal roles. Many of these identities came from sport and tie back to being an athlete. As Nathan reflected, "it's all connected back to playing the sport, but solely as an athlete probably 70% would be where I put my identity at and then you know, I definitely identify as a coach."

Additionally, athletes described alternative social roles they held while engaging in society, whether familial, religious, or other roles. For instance, Maranda said, "I do have a career and I still find that as my identity as a working young professional also, as a family member." Leslie detailed how she enjoyed her family role while concurrently an athlete: "I love being a parent. I love being a mom. I love being a wife."

Both athletes who developed exclusive AI and multiple AI mentioned how sport as a foundation helped develop their identity. However, those with multiplicity consciously found other interests to balance and enjoy their lives, and purposefully planned out the post-athlete future to avoid exclusivity and its negative consequences. For instance, learning from stories of athletes experiencing deep loss with sport disruption, Jacob firmly believed that wheelchair rugby was a huge part of his life, but not the only part. He had to leave the sport for a time when injured, and this highlighted the need to learn life without sport, ensuring that upon retirement, he could say, "then I have a great life outside of sport." In contrast, Michelle noticed her exclusivity while considering retirement, as she was constantly questioning herself: "Who am I without swimming? Who am I without a medal? What can I do and accomplish without swimming and a medal?" Not knowing their values without sport had forced some athletes to intentionally develop other identities, as Stewart added:

I'm more than just a swimmer. You know, I'm a good swimmer, but you know, I think it's important not to be all in on one thing. You need to have multiple outlets to pour your energy into, so to make yourself, you know, to not drive yourself crazy.

Paralympians realized that having identities outside of being an athlete is important for a well-balanced and diverse life. By their competitive nature and tendency to focus on a single activity, having multiple identities helps them maintain more balanced lives. As John shared:

So, training is my Yin to my Yang on balancing all the time that goes into work. It gives me something to keep my mind off work because I tend to get all consumed with whatever I'm going to do.

To further combat the pitfalls of exclusivity, we found that our participants actively planned for a future career, pursued higher education, and sought part-time employment even through retirement (in part due to financial concerns). There has been criticism for inequities in funding between Paralympic vs. Olympic athletes; the U.S. governing body provides smaller training stipends and pays smaller financial awards for medals won at a Paralympic Games. Among all the Paralympians in our study, only Stephanie identified herself as “a full time Paralympian right now” while the rest introduced themselves as athletes along with other roles. Leslie responded to her occupation as “a part time elite level athlete in the sport of goalball” and “also a part-time accounting assistant,” as she worked to support herself financially. It was worth noting that based on the strong AI, most of the athletes' priorities still remained in sport. However, other roles and identities could fulfill their lives when needed, as Katherine described:

“Being an athlete is something that I've always wanted to do and always strive for. But when it doesn't happen, then I have other things that I enjoy.”

However, with acknowledging that sports were critical to them, two Paralympians prioritized their multiplicity over their athletic identities and did not possess strong AI. It is necessary to discuss these two individuals' cases, because it potentially resonates with the aforementioned discussions on the considerable time Paralympians devoted in major activities (e.g., education), the moment they reviewed their AI, and their plans for the future. For Valerie, even though “at this point, I feel like it's just eating up so much of my life fencing as an athlete,” she only identified a quarter of her identity as an athlete. We tend to believe that compared to her long-time work as a farmer, the short time she competed internationally and the time-consuming efforts she was making for graduate school during this time could be part of the explanation. Meanwhile, for Sandra, due to financial concerns, she chose to pursue graduate school. She stated that less than 50% of her identity was rooted in being an athlete because she stepped out of her exclusive athletic role years ago for a more certain future:

I'm starting to think about what's coming after my athletic career. Yeah, and so I think in 2017 just because of grad school and realizing that it's not very sustainable to be relying on like U.S. Paralympics for my health care and like my health insurance just because like you have to almost get a world record every year to keep your health insurance. And so, it just became more and more apparent that I'm like, okay. Logically, I can't do that forever.

We conclude that Paralympians were having prominent strong AI during COVID-19. The overall strong AI and partially exclusive AI in Paralympians supported that elite athletes have stronger AI (Tasiemski et al., 2004). As we explored the paths of Paralympic hopefuls, we found that their strong identities were consistent with what they described as good experiences of participating in disability sport and all the benefits accompanying it. These factors work as facilitators to help with strong AI development and maintenance. One prominent facilitator observed is how Paralympians justify the importance of the Paralympics to the athletes.

In our study, AI development facilitated athletes' positive personal and social identities which supported the affirmative mode. Consistent with previous studies, Paralympians use sport participation as a means to repair and redefine self-identity, increase sense of pride, normalize physical appearances to the greater society, and catalyze personal empowerment in non-sport contexts (Swartz et al., 2019). Yet our athletes fully embraced their disability status along with their athlete status. Thus, throughout the current study, the notion of multiple identities was not narrowly based on the discussion of the negotiation process between a disability identity and athletic identity, but more emphasized on the meaningful identities developed beyond it.

We understand individuals can draw their self-identity from a variety of sources. In the current study, most of the Paralympians established their identity by their primary time-consuming activity (e.g., sport, occupation). However, we should also notice that even with the same level of commitment, efforts, and achievements, there were athletes that did not express a strong AI. According to previous research, we would assume that our participants, who have devoted intensive efforts and have great achievements through professional mega disability sporting events, would tend to have more exclusive AI. Yet, through a qualitative manner and under each participant's individualized experience, we are able to identify that more Paralympic Hopefuls express identity multiplicity over exclusivity. When participants identified themselves through other roles other than their athletic role, they did not possess a strong AI. It is a unique phenomenon compared to their non-disabled counterparts (e.g., Olympian), who tend to have a one-dimensional athletic identity.

We clearly observed the multiplicity and fluidity aspects of identity construction through our participants. It seems that athletes realized sport “is not everything” or should not be the only defining identity due to the impact of exclusivity, funding issues, and career considerations. These critical factors compelled them to make conscious decisions to commit to other activities and develop identity multiplicity, and were not identified by previous research. According to Wheeler et al. (1999), active elite athletes with disabilities seemed not to consider or think about their future life outside of sports, which might cause future transitional problems. With acknowledging their considerations, the governing body should accordingly provide career consultation, more funding opportunities, and other environmental support to help athletes develop and maintain their strong AI.

Also noting that by the time the worldwide COVID-19 pandemic took place, their identities were shifting due to their life situations. This supports Huang and Brittain's (2006) study observing that identities shift over time as people change, and we will illustrate this theme more thoroughly through the following section.

Various Impacts on AI, Mental Adaptation Helps Overcome the Lack of Sport Participation

Given the status of Paralympian's AI, we investigated the effects of the pandemic sport disruption and whether the athlete's AI were challenged. Three major subthemes emerged from our data, with athlete's AI being: (a) Challenged, (b) Unchanged, and (c) Strengthened. We hope this section sheds light and gives a voice to not just elite athletes, but the unique population of Paralympians. Given that there can be such harmful repercussions from sport disruptions on athlete's AI, the lived experiences discussed from this study are beneficial to sport personnel and governing bodies in assisting elite athlete's more adequately with their struggles.

Challenged AI

When athletes were asked about the COVID-19-related impacts on their AI, a slight majority of our Paralympians described their AI as being challenged and negatively impacted. The pandemic caused these athletes to feel as if their AI had been completely lost, and they struggled psychologically, feeling that they could no longer define themselves as "athletes." The most prominent reason for these AI challenges was the strong tie between AI and the physical aspect of sport. With facility closures, cancellations of competitions, and overall decrease of sport participation due to COVID-19, the athletes' AI faltered along with their lack of athletic activity. It was difficult for them to identify as athletes without the continuous training and high-level competition they practiced prior to the pandemic. This relationship is explained by Abbie, who experienced a decrease in training that resulted in her AI being challenged:

You know, it's kind of been a little more challenging, I guess. Because then you know, if you can't train then you don't necessarily represent being an athlete, you know. It's like, 'oh I worked out like three times in the past month' and that's not really being an athlete. It's actually really sad. So, I've kind of been a little stir-crazy not being able to train.

Allie also describes how she struggles to have an athletic identity without participating in her sport. The long period unable to play causes her to question her athlete status.

We honestly haven't competed since January. That is insane for us, like that's 6 months. So, it's like I know I need to be back out there and compete and I know, you know being an athlete is a big part of my identity, but I kind of just feel lost right now.

The identity loss experience by Allie is shared by among all of our athletes in this subtheme. For these athletes sport was

not just activity they took part in, but it is how they defined themselves. Defined by the title "Paralympian," they felt the need to prove themselves in training and competing on the high-stage of Paralympics. With the event's postponement athlete's no longer had this title to identify with, and questioned themselves as Maranda did:

It has definitely been challenged because I haven't been able to get on the court. I haven't been able to prove myself as an athlete and like I said before it was kind of like well the Paralympics don't happen then who am I now?

Coupling this loss of identity, our findings revealed that "Challenged AI" athlete's experienced negative impacts on their mental health. The decision to postpone the Paralympics a year was hard to cope with for these athletes, as many of them prepared intensely in the 4 years leading up to the event. Reflecting on their current lifestyle revealed how different it was prior to the pandemic. Natalie goes on to describe how the lack for sport has affected her mental health:

I think the only thing that it did mess with was my mental because you know, you're so used to a lifestyle. I'm so used to always being on the go, training and traveling and I used to fly at least once a month and now it's nothing, like I don't go anywhere.

This loss of identity and identity confusion due to sports disruption are consistent with what was observed by Caron et al. and Kerr and Dacyshyn (2017; 2000) when studying identity effects from injury and retirement. Because injury and retirement lead to a complete or partial stop of sport participation, the athletes' mental health suffered severely. These challenges are not only caused by loss of identity and of sport, but from the disruptions in other areas of their lives. It alters their life purpose, social network, and overall lifestyles in a negative way, resulting in symptoms of depression and anxiety. With these factors and much of their AI revolving around their sport, the sudden halt forced athletes into an uncomfortable and stressful situation. Similarly, Muscat's (2010) findings revealed that elite athletes struggled to adapt to a life without sport, one that is not structured by training, coaching, and competition. Further, the abrupt nature of the lockdown and facility closure intensified the reaction by athletes, as there was little anticipation- not allowing time for athletes to cope and adjust. Wippert and Wippert (2010) discuss how the involuntary exiting of sport has a significant impact on psychopathological symptoms, with a higher prevalence for depression, anger, and hostility.

Unchanged AI

An almost equal portion of athletes did not feel their AI had been challenged. In contrast with the participants who experienced a challenged AI, these athletes' AI consisted of more than the physical aspect of sport. Athletes describe how they have internalized the sport and maintain the self-image of an athlete, so much so that their AI is unwavering despite decreased activity:

I have so much confidence in myself. It doesn't matter if I haven't practiced in 10 years. I'm still going to go out there and beat everybody, that's just the self-confidence... I just go to strive to be the best at what I can do. It doesn't matter if I'll practice or not. At the end of all this (the pandemic), I'm going to go out there and play. I'm giving my whole heart, mind, body, and soul to whatever the outcome is. That's what's going to happen here. That's what I have to do. (Frank)

For Frank the relationship with sport is much more than being physically active, it carries an existential tie and meaning for him. Frank describes how sport is at the center of everything he does, and even with the delay of playing he feels obligated to continue his purpose to be the greatest athlete he can be.

This kind of confidence and athletic manifestation is further expressed by Valerie. For her, being an athlete is not simply an activity she participates in, but it is how she identifies regardless of the situation she is in. The pandemic seems to be a period where she is needing to change the way she completes tasks, but does not alter her self-perception:

So, like I'm pretty secure in who I am as a person. So, like if I can't figure it out, like how to be active at home that's on me... I stay active where I can and even if I'm not being active and being lazy for a while, I know I'm still an athlete. I can still do sports. Just because I'm not doing it now doesn't mean I'm not an athlete.

These athletes were very firm in their idea of self and were able to separate their emotional distress and their AI. Brandy, explains how her mental health suffered without her standard training structure. She states that although she went through a period of depression, her AI remains unchanged:

I would definitely say I went through a minor like depression phase I think just because I'm so used to routine and not having a routine like definitely stressed me out. I wouldn't say I question myself as an athlete. At the end of the day, I'm still an athlete, quarantine, no quarantine, Corona no Corona, like I'm still an athlete. I'm confident in that aspect, but it was just like I thrown off of my routine and stuff like that.

These athlete's perspectives speak to this groups' confidence and positive mentality maintained throughout the pandemic. Their self-concept as an athlete remains intact as they focused on the pandemic as a temporary event rather than changing their commitment to their sport and the Paralympics. Describing these athletes as focused, emotionally intelligent, and adaptable, they are in line with the Paralympians' "mental toughness" characteristics discussed by Powell and Myers (2017). Paralympian's mental toughness is conceptualized from specific cognitive strategies (rational thinking and goal setting), cognitions (connection and non-acceptance of constraints), and specific characteristics including optimism, pragmatism, resilience, and self-belief (Powell and Myers, 2017). The observation of AI being unaffected by sport disruption is one that is not expounded on much in the related body of literature. In previous research, much of the discussion on sport disruptions and AI revolves around the struggles athletes face,

many times resulting in negative impacts on their identity. With these participants, however, we recognize and discuss how Paralympians' AI remains fixed and salient, in spite of a pandemic.

An interesting perspective shared by a few of the athletes across challenged and unchanged AI, was that they viewed the pandemic as a way to break from their strict AI, giving them an opportunity to explore other activities. Instead of feeling anxious and uncertain about not being able to participate in their sport, the break was a period to figure out how to navigate life without sport. A test for retirement is how athletes described it. For Nathan, sport was a significant part of his life from an early age. He explains how thoughts of life without sport worried him and made him question whether his mental health would be sound once he retired. Anticipating this internal conflict, he decided to take advantage of this time off to prepare himself mentally.

Here's the one interesting thing with COVID. It was somewhat of a preview of what my life is going to be after I retire, because all of a sudden, I'm not traveling and not going to compete or play tennis tournaments. To be honest, I mean, it's been my life since I was 14, so I was scared. I don't know how much you guys have read about athletes who have been athletes their whole life and all of a sudden when they stop it's scary. They don't know what they could do themselves, and I knew that I was going to be that way. So, this has kind of been a test run for that... So, I think that mentally it shed light on what it's going to be like and I think it's given me some good ideas of things to do when I quit so I don't, you know, go into some mental dark place and stuff like that.

Lally (2007) has observed that loss of sport can preclude AI challenges, if approached the correct way. This can be achieved by in-depth thought and consideration for what life is like after sport, and this anticipation can be beneficial in coping when departing from sport, much like in Nathan's discussion. Anxiety over exclusive athletic identity in the face of retirement or sport disruption is common in the elite athlete world. Athletes often realize that without other meaningful identities outside of sport, feelings of emptiness may result when sport is lost. The importance of developing identity in other avenues has been expressed by prior research (Kerr and Dacyshyn, 2000; Muscat, 2010), stating that competing at an elite level of sport can be detrimental if there is no effort to maintain a balance in other life activities. Loss of identity can result from athletes lacking the confidence to explore new areas (Muscat, 2010). That being said, for the athletes seeking more identifiers beyond their AI, they consciously acknowledged the importance of identity multiplicity.

Strengthened AI

Three athletes with both "challenged" and "unchallenged" AI explicitly state that they feel their AI has been ultimately strengthened. As athletes learned to develop other fulfilling roles during the pandemic, the hiatus from sport interestingly

strengthened their AI. Kendall explains that after 16 years of a sport-dominated lifestyle, she embraced other interests:

I'm not training at a Paralympic level right now that I would normally be leading up to the games. I think it's (AI) strengthened because I found acceptance. I found peace in myself doing other things that make me happy and being active like I've really gotten into hiking a lot and biking like I know that like I can do other activities and they still make me feel good inside and maybe I don't need to be at that like super high level or on that stage all the time. I think I've never had that because I've always been training for a "games" or something. So, in this, I really think it has strengthened my identity as an athlete because I'm okay that I don't have to be amazing at something. I can suck at something and I'm okay with it now, whereas before it was a lot harder to accept.

In contrast to what "Challenged AI" athletes stated about their identity loss from being away from sport, it seems that "Strengthened AI" athletes express that they had found identity within the break. Without the pressures from their sport-training routine, coaching, and competition they gain confidence within themselves and their identity as a whole. Marge, an equestrian athlete, states how she felt a sense of freedom from her athletic lifestyle, even though she enjoys being an athlete. This allowed her to gain confidence in her identity without external pressures. When asked if she felt her AI has strengthened, she states:

Yes. Yes, I do because it builds resourcefulness and a lot of times especially with our sport. There's a lot of coaches involved and honestly, for lack of a better phrase, a lot of egos and power trips and control. Right now, the only person that can really control me is myself, and so that's reinstalled confidence.

She further describes her AI in relation to her sense of liberation:

Yeah I still have value as an athlete. I still am motivating myself to do the best I can and now it's not like I have somebody sitting there telling me what to do every 2 s. I have a certain freedom and can make choices for myself and for my horse as well. He's never seemed happier, you know, so sometimes it's kind of good to go back to your roots, connecting with what you love about the sport and you still have your hopes and goals and dreams, you know, it's just a different way of doing it.

For Brittney, she developed a new sense of AI. She speaks as if before the pandemic she had been taking for granted the ability to connect with her teammates, and practice. Because of the halt in her sport participation, she feels a sense of loss, however it seems she subconsciously knows that this break is short-term, thus making her want to participate in her sport more than before. She gains appreciation and a newfound admiration for the sport she no longer could participate in. Until the pandemic, she had not taken the time to think on why she continues in her sport. Brittney questions:

I also feel like it makes me enjoy playing volleyball even more. Is that weird? I appreciate when I go out and play even though it's not like I can play with anyone. Like there's a reason why I

started playing volleyball like I love it. So like these things that I've not necessarily embraced before have given me this platform and showed me this is what sent me on this path to really identifying as an athlete again.

For Brittney and Marge, the cessation from sport allowed them to reflect on the state of their AI before the pandemic, and realize it was not the same after years within their athletic career. Without their focus on competition, training, and coaching they re-centered their AI, and ultimately felt more enjoyment and confidence in their identity. Kendall, however, feels more comfortable in her AI by adding more aspects to her identity wholistically. She also spoke on her dedication to training and how it is, in some ways, detrimental to her mental health- with the constant desire to perform at a high level. Further describing her growth in finding acceptance when she cannot meet such high standards.

The observation of AI strengthening from developing identity outside of sport, is a relationship that is not common in the body of literature involving sport disruption. Even so, sport disruption resulting in AI strengthen is most similar to that of the sport disruption of motherhood. Because our 'Strengthened AI' athletes emphasize the development in their AI, similarities can be drawn from their growth and the enlightenment to that observed in mother-athletes. Prior to motherhood, pregnant elite athletes maintained their strong AI with much of their whole identity constructed around sport (Tekavc et al., 2020). Following childbirth, these athletes developed a dual identity, and were observed to experience a stronger motivation to pursue their athletic goals and an overall stronger desire to continue engagement in their sport (Tekavc et al., 2020). This reaction to sport disruption is similar to what was discussed by Brittney and Marge, as their motivation and passion grew for their sport. Further on motherhood, elite athletes' self-identity has also been seen to benefit from identity multiplicity by reducing the competitive pressure of sport (Appleby and Fisher, 2009). This relationship of AI benefitting from sport disruption is described by our participants Kendall and Marge, as they thrived without the strict structure of their athletic lifestyle. As for the reduced sport pressures strengthening AI, this perspective is inconsistent with other studies where athletes have been shown to feel uncertainty about their future lives without the structure and routine sport gives them (Kerr and Dacyshyn, 2000; Menke and Germany, 2019).

In summary, athletes who experienced AI challenges in COVID-19 did so as a result of not being able to participate in sport; focusing on the temporary loss of their sport. This progressed to identity loss and ultimately symptoms of depression and anxiety. Speaking to the "unchanged" and "strengthened" AI athletes perspective, though experiencing a similar situation and lifestyle change as the challenge athletes, they seemed to develop a mental adaptation and create a positive outlook as a way to cope with the sport disruption. Instead of dwelling on the negative emotion felt by the postponement and the decreased sport participation, they chose to use the situation as an opportunity to

self-explore. In addition, in documenting these athletes' perspectives and the reasoning for them, we hope sport management organizations heed them to create a more supportive system- accommodating to AI difficulties through sport disruptions.

CONCLUSION

Participants in this study possessed prominent strong athletic identities. Rather than identifying with just their athletic role, athletes self-identities were comprised of multiple responsibilities and activities during COVID-19. We found there were about equal numbers of participants who claimed that their AI has been predominantly challenged, unchallenged, and who felt their identity was both unchanged, strengthened and challenged. Findings indicated that having strong AI did not necessarily result in negative identity impacted by the sport disruption of COVID-19. In addition, COVID-19 did not challenge those who do not possess a strong AI.

Paralympians who developed multiple roles in life mostly felt that their AI has been negatively challenged. This is likely because of their singular focus on the loss of physical participation in sport during COVID-19. These Paralympians strongly structured their identity in their physical devotion to being an athlete. In contrast, athletes who have exclusive AI tended to report the mixed feeling of identity change due to the sport disruption of COVID-19. The reduced sport participation definite impacted their AI, yet they reported having the confidence and security in their AI. For participants who were able to adapt to the situation and maintain a stable AI (e.g., AI was unchallenged or even strengthened) during COVID-19, the mental preparation and adaptation was consistent.

Some of these athletes treated the situation resulting from COVID-19 as a test run for retirement and an opportunity to pursue other interests. Other Paralympians developed appreciation for their sport by keeping their athletic mindset, continuing with their previous training commitment. These athletes shared a positive outlook on the COVID-19 pandemic in relation to their AI. In conclusion, Paralympians' mindset of how to view and interpret their AI is crucial to how the individual's AI is affected by COVID-19.

We believe this study is the first of its kind, detailing how Paralympic athletes' identities have been impacted by the unique sport disruption cause by COVID-19 pandemic. In terms of theoretical implication, our study adds to the body of knowledge regarding social identity, athletes with disability in general, and Paralympians- a group that literature has not focused on. The findings of the study prepared for further discussion of disability sport AI through a quantitative lens. In addition, this study provides a clearer picture as to how and why athletic identities are impacted by career transitions. We believe that this research will provide sport governing bodies, coaches, athletes, and other sport personnel with a better understanding of the impacts of major athletic disruptions and how to provide more effective support for these identity-challenging events. Sport managers should work on creating environmental support to provide athletes more time for quality training to maintain their strong AI. Consultation service

and funding opportunities needs to be provided by sport managers to help Paralympians avoid exclusivity and develop multiple identity for post-athlete life transition. Specifically, administrators could assist athletes transfer sport skills to daily life situations and career planning. Thus, to help Paralympians decrease their AI by investing in other roles for their post-athletic lives.

Limitations and Future Research

The present study is not without limitations, but also presents important opportunities for future research. This study represents disability sports only in the United States. Funding and recognition differ in other countries and organizations (Hums et al., 2003). Cottingham et al. (2015) note that the vast majority of research in disability sport focuses on western contexts.

Based on this limitation, we would encourage future researchers to examine National Governing Bodies (NGBs) in differing geographical areas and their response to the effects of COVID-19, particularly 6 months after the 2020 Paralympic Games, as the impacts and implications of COVID-19 seem to go well-beyond the games. Implementation of new regulations made by governing bodies can be tested to see if they are beneficial, sustainable in time, and advantageous regardless of the pandemic. Responses made by NGBs that addressed the training of the athletes and their sport participation can play a part in the formation or break down of an athlete's self-identity. Furthermore, these new regulations may be considered as a sport disruptor to the way these individuals train. Athletes already fight for more representation and view the Paralympics and being a Paralympian as a career. Guidelines like no spectators, that can lead to less promotion, which then leads to less sponsorship—should be examined to see if a correlation between these factors can further affect an athlete's identity.

Another limitation of the study is the duration of time the interviews took place. Interviews were conducted during the months of July and August 2020, only capturing a narrow window of time during the pandemic. The ongoing pandemic can further influence training and the mental and physical state of athletes for months or years to come.

This study focuses on the identity of athletes where disruptors from the pandemic subsequently caused a shift in their self-perceptions of identity. It is possible for athletes' identity and experiences to change after the interviews. Future research could focus on quantifying the self-identity change with Athletic Identity Measurement Scale to generalize the sample and examine a subject's AI using a quantitative method. The construct of an individual's identity needs to be better represented, because the measurement of identity is never identical. The exploration of identity formation and experiences in athletes are few, resulting in many questions remaining on this topic (Muscat, 2010). Various factors lead to identity formation and continue to develop new roles in an individual. As identities are constantly in the process of change and transformation (Hall and Du Gay, 1996), follow up research is needed to explore how athlete identities evolve.

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 human participants were reviewed and approved by Institutional Review Board of the University of Houston. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

TH contributions to this study involved reviewing and analyzing the literature body of athletic identity (AI) and its significance to Paralymptians, and also wrote about the prominence of

AI in Paralymptians in the results section. In addition, TH contributed to the abstract, introduction, and conclusion parts of the paper. MM contributions included reviewing and analyzing the literature body surrounding sport disruptions and wrote about the impacts (challenged, unchallenged, and strengthened) on AI. JC contribution included writing about the methods incorporated in this study, as well as the future research suggested to expand the literature body on AI. MC contributions involved providing guidance and overlooking research assistants work throughout the study. All authors contributed to the article and approved the submitted version.

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Anxiety Level During the Second Localized COVID-19 Pandemic Among Quarantined Infertile Women: A Cross-Sectional Survey in China

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Infertility usually causes mental health problems for patients and unfavorable emotions such as anxiety and depression can have an adverse effect on women's normal pregnancy. We aimed to compare the anxiety level between infertile female patients in quarantined and non-quarantined areas during the second wave of COVID-19 epidemic. A total of 759 infertile women were included in this cross-sectional study conducted through an online survey. Anxiety was measured by the State-Trait Anxiety Inventory (STAI) tool. Participants were divided into the quarantined group (QG) and non-quarantined group (Non-QG). Independent sample *T*-test and chi-square test were performed to examine the difference between the two groups. There was no significant difference in the average STAI score of the two groups of infertile women, but responses to the emotional state showed that women in the QG had a higher tendency to be anxious. Participants in QG spent more time paying attention to the dynamics of the epidemic every day, and their sleep ($p < 0.01$) and mood conditions were worse ($p < 0.01$) than in the Non-QG. The family relationship of QG is more tense than non-QG. Through the research on the infertility treatment information of the overall research population, it is found the average STAI-State (STAI-S) ($p = 0.031$) score and STAI-Trait (STAI-T) ($p = 0.005$) score of women who were infertile for more than 3 years were significantly higher than those of women with <2 years. The STAI-T score of infertile women who underwent *in vitro* fertilization (IVF) was higher than that of non-IVF women ($p = 0.007$), but no significant difference was observed with the STAI-S score. To conclude, although the second wave of quarantine during COVID-19 epidemic did not significantly increase anxiety in infertile women, it did lead to an increase in other negative emotions and worse family relationships. Patients with long-term infertility treatment and those who have had IVF are more anxious subgroups.

Keywords: anxiety, COVID-19, mental health, quarantine, infertility

INTRODUCTION

The COVID-19 pandemic was first announced by the World Health Organization (WHO) in December, 2019 and is now spreading worldwide at an alarming rate. The pandemic has had a wide-ranging impact on people's lives and psychology (1, 2). In China, with the effective control of the COVID-19 epidemic, the first wave of the epidemic has been brought under control, however, it is still facing the impact of the second or third wave of some regional small-scale outbreaks. Beijing, Xinjiang, Qingdao, Guangzhou, and other important cities have all experienced second wave of the epidemic. The first wave of the epidemic made people realize the hazards of the novel coronavirus in terms of infectivity and pathogenicity, and the sudden arrival of the second wave accentuated people's fear (3).

Quarantine measures are adopted by many countries to combat the spread of COVID-19. Its side effects have gradually started attracting people's attention. Psychological distress such as anxiety and depression have shown widespread occurrence in the global pandemic of COVID-19 (1, 4). Our previous research has proved that in the second wave of the epidemic, quarantine can increase the anxiety levels of the population (3). Risk of getting infected by COVID-19 accompanied by quarantine and the national lockdown may lead to acute panic, anxiety, compulsive behavior, and other mental health problems (5). Among mental distress factors (anxiety, stress, and fear of COVID19), depressive symptoms play a vital role (6). Meta-analysis studies indicated that the quarantine does not have a uniformly adverse effect on mental health of population at risk, and the mental state of medical staff, patients with non-communicable chronic diseases, COVID-19 patients, and quarantined people are more likely to be affected (7, 8). Relationship between couples and the quality of sexual life are also affected by quarantine during COVID-19 epidemic (9, 10). Scholars began to notice these problems and called for effective preventive measures (11, 12).

The blockade due to the epidemic will inevitably affect the number of medical visits for some chronic diseases or clinical populations with regular follow-ups. During the delayed phase of the COVID-19 pandemic, pregnant women experience high levels of anxiety, and post-traumatic stress disorder (PTSD) symptoms (13). However, there are not many research reports on the psychological state of infertile female women during the pandemic (14, 15). The pressure of infertility is still high and higher than the pressure caused by the pandemic (16). For people with assisted reproductive treatments (ART), they need to go to the hospital for review on a regular basis to determine the next treatment plan. The sudden outbreak disrupted the normal medical treatment plan of infertility patients. Suspension of fertility treatment during the pandemic was taxing and as a result, negative emotional reactions were triggered (17, 18). For infertile patients, repeated treatment failures and long-term treatments can bring about psychological problems such as anxiety, especially for patients who have been identified as the infertility caused by female causes, they will experience more serious anxiety levels (19, 20). Previous research suggests going beyond psychiatric evaluation of infertile patients and focusing research efforts on the analysis of impaired quality of

life in order to clinically address aspects related to infertility that can affect couples' well-being (21, 22). Relatively, bad mental states such as anxiety and depression will adversely affect the pregnancy outcome of infertile females (23–25). Infertility affects the relationship of both members of the couple, and women usually report worse adjustments to infertility and higher infertility related stress to man (26). Therefore, current study was conducted with the aim to explore whether quarantine will cause changes in the psychological state of infertile females.

Since July 15, 2020, Urumqi, Xinjiang has experienced the second wave of COVID-19 pandemic. Subsequently, the government adopted emergency isolation and blockade measures. The current study explores the anxiety levels among infertile women during the COVID-19-related quarantine. The aim of the current study is to compare the anxiety level between the quarantined and non-quarantined infertile women during the second wave of COVID-19.

METHODS

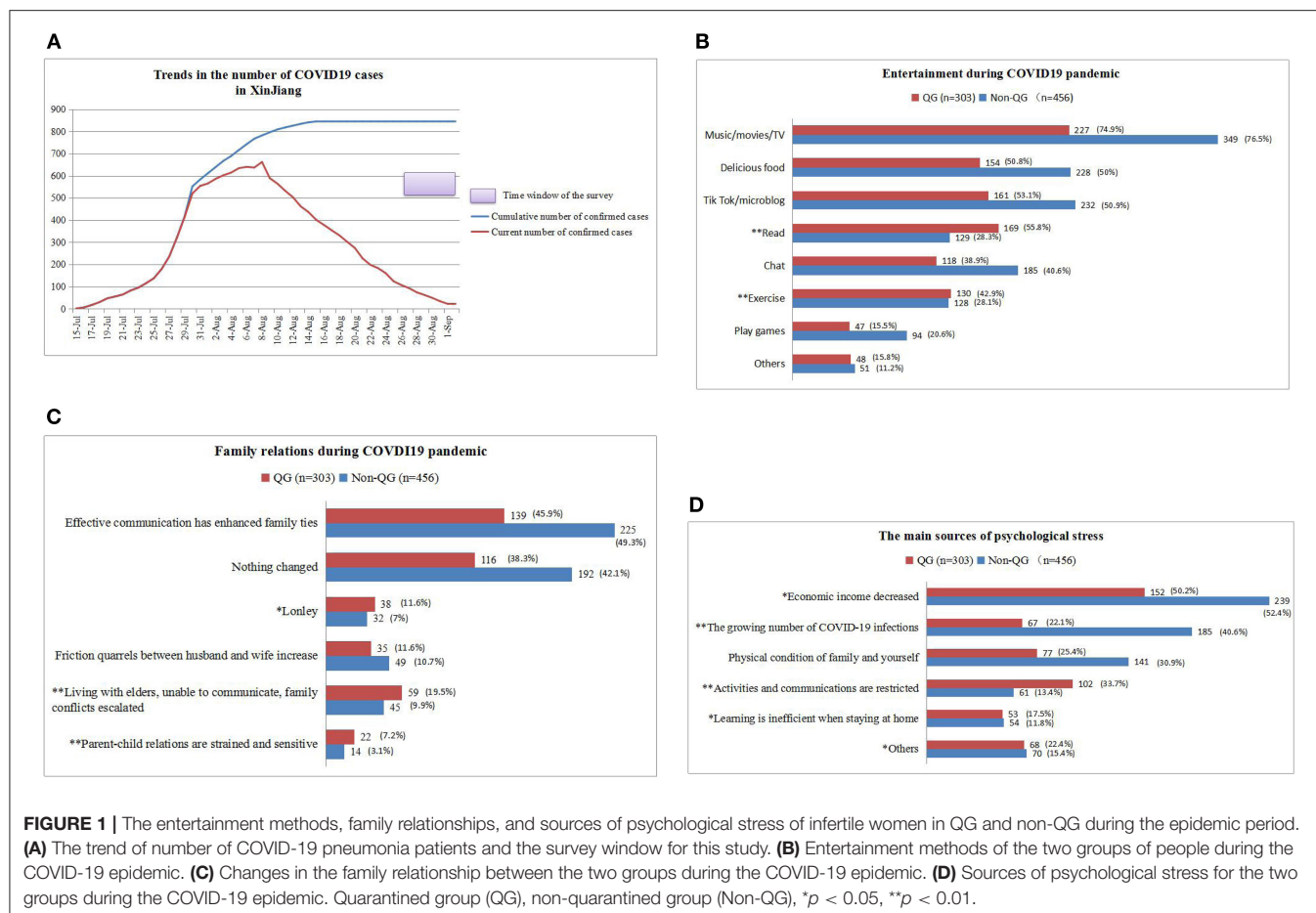
Study Design

The cross-sectional study was conducted from August 20 to September 1, 2020 in the form of the "Questionnaire STAI" electronic questionnaire system (China Changsha Haoxing Information Technology Co., Ltd.). The research protocol was approved by the Ethics Committee of the Eighth People's Hospital of Xinjiang Uygur Autonomous Region. The informed consent form is displayed on the front page of the questionnaire and was accepted by the participants. All investigations are voluntary and anonymous.

Some items (such as age, marriage, pregnant, or not) are also used for invalid response and to ensure data quality. The inclusion criteria are: ① Chinese female citizens who live in mainland China and answer the set questions accurately; ② diagnosed of infertility; ③ information feedback can be provided through WeChat electronic questionnaire system. The exclusion criteria are: ① invalid responses; ② suffering from known mental illness; ③ already pregnant after treatment; ④ important data missing. According to the answers to the question about quarantine situation, the participants were divided into two groups: Quarantine Group (QG) and Non-Quarantine Group (Non-QG), which was also described in our previous paper (3).

Questionnaire Design

The questionnaire includes aim, informed consent, general information, infertility information, and State-Trait Anxiety Inventory (STAI) component. The answers are expressed in ordered or unordered categorical variables. The content of the COVID-19 impact questionnaire has been introduced in detail in our previous research (3). The State-Trait Anxiety Scale has two subscales: State (STAI-S) and Trait (STAI-T) (27). STAI-S includes 20 items, which determine how an individual feels at a specific moment and under specific conditions. STAI-T has 20 items and usually determines how the participants feel, regardless of the situation. We defined STAI-S score higher than 53 or STAI-T score higher than 55 as suffering from severe anxiety disorder, which have been validated in the Chinese population before



(28). The infertility information survey includes information as follows: ① History of pregnancy and child birth; ② Number of years of marriage; ③ Frequency of sex; ④ Have ever used assisted reproductive technology; ⑤ Current treatment methods; ⑥ Number of years of treatment.

Statistical Analysis

The data were analyzed using SPSS 20 program (IBM Corporation, Illinois, USA). Independent samples *T*-test or one-way analysis of variance were used to compare the average of independent groups with a normal distribution. Bonferroni correction was performed when multiple independent statistical tests were being performed simultaneously. Chi-square test or Fisher's exact test was used to compare categorical variables. $P < 0.05$ is used for statistical significance. Quantitative variables are expressed as mean \pm standard deviation (*SD*). Qualitative variables were expressed as numbers and percentages.

RESULTS

Comparison of Anxiety Levels Between the Non-QG and QG

A total of 1,943 participants from 27 provinces of China completed the questionnaire. 874 of the participants had been

diagnosed with infertility. Among them, 115 patients were excluded based on exclusion criteria and 759 patients were finally included in the analysis, including 456 patients in non-QG and 303 patients in QG. In the non-QG group, 381 patients were diagnosed as primary infertility, with 229 patients with primary infertility in the QG groups ($P = 0.339$). The proportion of participants who had been infertile for more than 5 years did not differ statistically between the QG and non-QG groups except for the lack of related information in some patients (145/376 vs. 93/296, $P = 0.055$). **Figure 1A** showed the curve of number of COVID-19 pneumonia patients and the survey window. The questionnaire was delivered in the late stage of the second wave.

Table 1 showed the anxiety scores of the participants according to being quarantined or not. The mean STAI-S of all participants in the QG did not differ significantly compared to those in the Non-QG (40.7 ± 9.4 vs. 40.2 ± 9.1 , $P = 0.415$), STAI-T score also had no significant difference (41.0 ± 9.2 vs. 41.6 ± 9.2 , $P = 0.421$). There were also no statistical differences in the STAI-S and STAI-T scores of participants having different age, income levels, education levels, or health status.

In order to further compare the severity of anxiety between the two groups, we analyzed its presence according to different factors (**Table 2**). Similarly, between the QG group and the non-QG group, there was no significant difference in the proportion

TABLE 1 | Comparison of STAI scores between the quarantined and non-quarantined groups.

Characteristics	Sample size Non-QG	Sample size QG	STAI-S Non QG (Mean \pm SD)	STAI-S QG (Mean \pm SD)	<i>F</i>	<i>df</i>	<i>P</i>	STAI-T Non-QG (Mean \pm SD)	STAI-T QG (Mean \pm SD)	<i>F</i>	<i>df</i>	<i>P</i>
Total	456	303	40.2 \pm 9.1	40.7 \pm 9.4	0.028	757	0.415	41.6 \pm 9.2	41.0 \pm 9.2	0.177	757	0.421
Age(Y)												
18–25	15	9	38.9 \pm 7.5	43.6 \pm 9.2	0.552	22	0.194	42.4 \pm 7.9	43 \pm 11.6	1.980	22	0.881
26–39	359	190	40.4 \pm 9.3	41.3 \pm 10.3	0.974	547	0.303	41.7 \pm 9.4	41.6 \pm 9.6	0.001	547	0.891
40–59	82	104	39.7 \pm 8.6	39.6 \pm 7.6	1.079	184	0.945	40.9 \pm 8.6	39.8 \pm 8.0	0.421	184	0.390
Income												
Low	221	126	41.6 \pm 9.6	42.3 \pm 9.9	0.008	345	0.279	42.3 \pm 9.9	42.6 \pm 8.9	0.539	345	0.518
Middle	122	134	39.8 \pm 8.4	40.2 \pm 9.7	0.623	254	0.763	41.2 \pm 8.5	40.9 \pm 9.6	0.436	254	0.791
High	113	43	39.8 \pm 8.8	39.7 \pm 8.9	0.158	154	0.925	40.5 \pm 8.6	39.7 \pm 8.6	0.313	154	0.578
Education												
High school or below	187	73	40.5 \pm 9.5	42.0 \pm 8.1	2.364	258	0.233	42.0 \pm 9.7	42.0 \pm 8.0	1.434	258	0.977
College or Bachelor	224	212	40.2 \pm 9.2	40.3 \pm 9.8	0.398	434	0.908	41.6 \pm 9.1	40.8 \pm 9.4	0.005	434	0.365
Master or Doctor	45	18	38.8 \pm 7.3	40.9 \pm 10.0	0.962	61	0.343	39.8 \pm 7.6	39.7 \pm 10.9	1.996	61	0.974
Occupation												
Employees of institutions or government	137	170	40.0 \pm 8.0	40.6 \pm 10.0	3.249	305	0.566	41.7 \pm 8.5	40.8 \pm 9.9	0.609	305	0.419
Other employees or retired or students	319	133	40.3 \pm 9.6	40.9 \pm 8.8	1.340	450	0.487	41.5 \pm 9.6	41.3 \pm 8.2	1.652	450	0.808
Health status												
Very healthy	169	49	37.9 \pm 8.9	39.4 \pm 8.7	0.030	216	0.299	39.4 \pm 9.0	37.3 \pm 7.8	0.781	216	0.125
Relatively good	200	187	40.9 \pm 8.3	39.9 \pm 9.1	0.461	385	0.237	41.9 \pm 8.7	40.9 \pm 9.0	0.074	385	0.283
Moderate or bad	87	67	42.9 \pm 10.4	44.1 \pm 10.2	0.003	152	0.457	44.9 \pm 9.9	44.0 \pm 9.5	0.002	152	0.558

STAI-S, State-Trait Anxiety Inventory-State; STAI-T, State-Trait Anxiety Inventory-Trait; QG, quarantined group; Non-QG, non-quarantined group; Y, year. *P*-values < 0.05 are in bold typeface.

of severe anxiety measured by STAI-S (7.9 vs. 7.0%, $P = 0.641$), and the STAI-T measurement results also showed no significant difference (7.6 vs. 7.9%, $P = 0.878$). A detailed analysis of the subgroups also showed that the remaining comparisons were not significantly different.

The analysis of the overall research population found that there is no significant difference in the STAI scores of different age, income, education, and occupation subgroups (**Supplementary Table 1**). The STAI scores of different health status subgroups (moderate or bad, relatively good, and very healthy) were significantly different, and the anxiety degree of normal health status was significantly less than that of poor health status ($p < 0.001$, **Figure 2A**). Besides, we also found that the average STAI-S (41.8 \pm 9.4 vs. 40.0 \pm 9.1, $p = 0.031$) score and STAI-T (43.3 \pm 9.9 vs. 40.9 \pm 8.8, $p = 0.005$) score of women with time to treatment of more than 3 years were significantly higher than those for patients with time of treatment for <2 years. Compared to patients with non-IVF, the STAI-T score of IVF patients was significant higher (42.7 \pm 9.4 vs. 40.4 \pm 8.5, $p = 0.007$), but the STAI-S score was not significantly different (41.0 \pm 9.2 vs. 39.6 \pm 9.0, $p = 0.096$) (**Figures 2B,C**).

Other Psychological Effects of the Second COVID-19 Confinement

Table 3 summarizes other psychological findings of study participants related to the COVID-19 pandemic. The percentage of responses between the two groups also showed a similar trend. There was no significant difference between the two groups in their attitudes toward the COVID-19 pandemic and the feeling of relaxation after the pandemic was reduced. However, QG participants spent more time paying attention to the news about COVID-19 ($P < 0.001$), were more afraid or confused about the news about COVID-19 ($P < 0.001$), and also mood became worse and irritable ($P < 0.001$). The quality of sleep in the QG group was significantly worse ($P < 0.001$). The proportion of participants who felt lonely and depressed in QG was significantly higher from that in non-QG ($P < 0.001$). Our questionnaire also showed that the proportion of female patients in quarantine areas who need psychological counseling is higher than that in non-quarantine areas (16.8 vs. 10.1%, $P = 0.006$).

Compared with non-QG, women in QG prefer to read books (28.3 vs. 55.8%, $p < 0.01$) and exercise (28.1 vs. 42.9%, $p < 0.01$) for entertainment (**Figure 1B**). The family relationship of QG is more tense than non-QG: the proportion of women

TABLE 2 | Comparison of rates of severe anxiety between the quarantined and non-quarantined groups.

Characteristics	Rate in Non-QG (STAI-S, %)	Rate in QG (STAI-S, %)	χ^2	<i>P</i>	OR(95%CI)	Rate in Non-QG (STAI-T, %)	Rate in QG (STAI-T, %)	χ^2	<i>P</i>	OR (95%CI)
Total	(32/456)	(24/303)	0.217	0.641	0.877(0.506–1.521)	(36/456)	(23/303)	0.023	0.878	1.043 (0.605–1.799)
Sum	7.4 (56/759) [†]					7.8 (59/759) [†]				
Age (Y)										
18–25	6.7 (1/15)	11.1 (1/9)	0.145	1.000	0.571 (0.031–10.435)	13.4 (2/15)	11.1 (1/9)	0.025	1.000	1.231 (0.095–15.872)
26–39	7.2 (26/359)	10.5 (20/190)	1.745	0.186	0.664 (0.360–1.223)	8.1 (29/359)	9.5 (18/190)	0.309	0.578	0.840 (0.453–1.555)
40–59	6.1 (5/82)	2.9 (3/104)	1.150	0.304	2.186 (0.507–9.430)	6.1 (5/82)	3.8 (4/104)	0.505	0.511	1.632 (0.422–6.249)
Income										
Low	8.1 (18/221)	10.3 (13/126)	0.466	0.495	0.771 (0.364–1.631)	10.0 (22/221)	7.1 (9/126)	0.780	0.377	1.437 (0.640–3.226)
Middle	6.6 (8/122)	6.0 (8/134)	0.038	0.846	1.105 (0.402–3.041)	6.6 (8/122)	8.2 (11/134)	0.254	0.615	0.785 (0.305–2.020)
High	5.3 (6/113)	7.0 (3/43)	0.159	0.707	0.748 (0.178–3.133)	5.3 (6/113)	7.0 (3/43)	0.159	0.707	0.748 (0.178–3.133)
Education										
High school or below	6.4 (12/187)	8.2 (6/73)	0.265	0.607	0.766 (0.276–2.123)	9.1 (17/187)	4.1 (3/73)	1.835	0.176	2.333 (0.663–8.214)
College or Bachelor	(19/224)	(17/212)	0.031	0.861	1.063 (0.537–2.105)	(18/224)	(18/212)	0.030	0.863	0.942 (0.476–1.863)
Master or Doctor	2.2 (1/45)	5.6 (1/18)	0.465	0.493	0.386 (0.023–6.532)	2.2 (1/45)	11.1 (2/18)	2.240	0.194	0.182 (0.015–2.145)
Occupation										
Employees of institutions or government	5.1 (7/137)	7.6 (13/170)	0.802	0.370	0.650 (0.252–1.678)	8.0 (11/137)	8.8 (15/170)	0.062	0.804	0.902 (0.400–2.033)
Other employees or retired or students	7.8 (25/319)	8.3 (11/133)	0.024	0.877	0.943 (0.450–1.976)	7.8 (25/319)	6.0 (8/133)	0.460	0.497	1.329 (0.583–3.026)
Health status										
Very healthy	4.7 (8/169)	4.1 (2/49)	0.037	1.000	1.168 (0.240–5.687)	6.5 (11/169)	2.0 (1/49)	1.458	0.307	3.342 (0.421–26.548)
Relatively good	6.5 (13/200)	6.4 (12/187)	0.001	0.974	1.014 (0.450–2.282)	6.5 (13/200)	7.0 (13/187)	0.031	0.859	0.930 (0.420–2.063)
Moderate or bad	12.6 (11/87)	14.9 (10/67)	0.167	0.683	0.825 (0.328–2.076)	13.8 (12/87)	13.4 (9/67)	0.004	0.949	1.031 (0.407–2.613)

STAI-S, State-Trait Anxiety Inventory-State; STAI-T, State-Trait Anxiety Inventory-Trait; QG, quarantined group; Non-QG, non-quarantined group; Y, year; NA, not applicable; CI, confidence interval; OR, odds ratio. *P*-values < 0.05 are in bold typeface.

[†] Sum of the two groups.

who feel lonely in the family was higher in the QG group (11.6 vs. 7%, $p < 0.05$); the proportion of women who have escalated family conflicts was higher in the QG group (19.5 vs. 9.9%, $p < 0.01$); the relationship between parents and children was more strained and sensitive (7.2 vs. 3.1%, $p < 0.01$) (**Figure 1C**). The top three sources of psychological stress among non-QG: ① Economic income decreased; ② the growing number of COVID-19 infections; ③ Physical condition of family and yourself. The top three sources of psychological stress among QG: ① Economic income decreased; ② Activities and communications are restricted; ③ Physical condition of family and the patient (**Figure 1D**).

DISCUSSION

This study focused on the impact of quarantine on the anxiety level of infertile female during the second wave of COVID-19 outbreak in Xinjiang. Result from our study indicated that, quarantine measures did not significantly affect the anxiety level of the two groups (QG vs. non-QG). But we also found that infertile women in quarantine group pay more attention to the dynamics of the epidemic than infertile women in non-quarantine group, and their mood, tension, and sleep were

all affected to varying degrees. It indicated that the quarantine may increase the psychological pressure of infertile women. There is growing evidence that most infertile women postpone examination and treatment during the pandemic, which may have a negative impact on their lives (17, 29). It has previously been reported that among infertile women whose ART cycle has been postponed due to the pandemic, women older than 35 years have higher levels of anxiety (30). Despite the COVID-19 pandemic, infertility is still among the top stressors, which can be comparable to the pressure caused by the epidemic itself (16). In April 2020, Ben-Kimhy et al. found in a study in Israel that despite the possible risk of infection and influence to embryos, most of infertile patients still expect to resume infertility treatment (31). Indeed, most infertile women are relatively young and healthy, and COVID-19 itself may not be as stressful as infertility. Regardless of whether it is a quarantine area or a non-quarantine area, economic pressure ranks first among infertile women. Interestingly, compared with COVID-19 itself, infertile women in the QG were more concerned about the restrictions on activities brought by quarantine.

Fertility is an important life decision for women, and the excessive moratorium caused by infertility will undoubtedly bring psychological pressure to women (32). The mental state

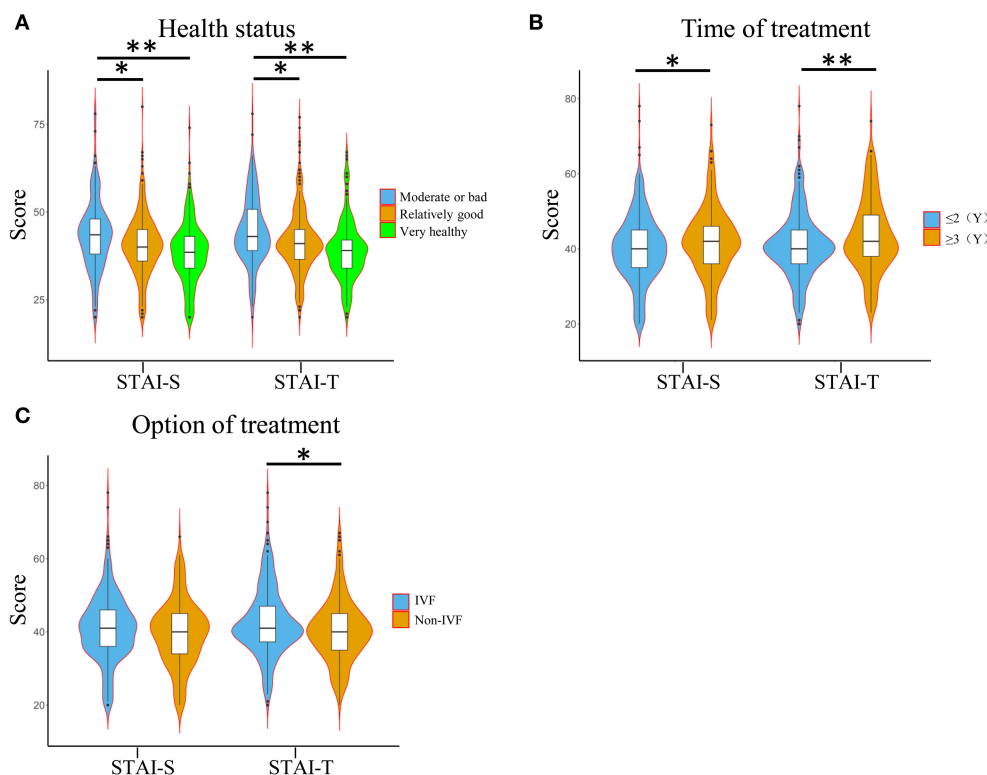


FIGURE 2 | Anxiety score of subgroup level in the included population ($n = 759$). **(A)** The STAI-S and STAI-T score levels in subgroups of different health status. **(B)** The score levels of STAI-S and STAI-T in the subgroups of different treatment methods. **(C)** The score levels of STAI-S and STAI-T in the subgroups of different treatment time. STAI-S, State-Trait Anxiety Inventory-State; STAI-T, State-Trait Anxiety Inventory-Trait; IVF, *in vitro* fertilization. * $P < 0.05$. ** $P < 0.01$.

TABLE 3 | Summary of the responses on the emotional and somatic state.

Questions about feelings on COVID19 pandemic (showed in percentage and grayscale)	Non-QG (n %) Total = 456				QG (n %) Total = 303	
	Strong		Strong		Strong	
	Low		Low		Low	
Attitude toward COVID19 pandemic	3.7	71.3	25	3	72.6	24.4
Time for concerning news COVID19**	26.5	32.5	41	11.9	21.1	67
Scared or confused about COVID19 news**	65.8	32.5	1.8	59	35.3	5.7
Quality of sleep becomes poor**	88.1	11.2	0.7	60.4	31.7	7.9
Mood getting worse and irascible**	81.8	15.8	2.4	61	31.4	7.6
Feel lonely and depressed because lack of social activities**	82.5	15.4	2.2	64.4	28.1	7.6
Still not relaxed after the pandemic alleviated*	11	74.1	14.9	11.9	66	22.1

QG, quarantined group; Non-QG, non-quarantined group.

* $P < 0.05$. ** $P < 0.01$.

The shade of the color represents the proportion of it. The darker the blue, the higher the proportion.

of infertile patients has been reported by many researchers (33, 34). Studies have shown that coping with infertility is related to the periodic increase in psychological symptoms of distress, depression, and anxiety (35, 36). Women bear greater anxiety during treatment than their partners (32). Our study shows that a longer period of infertility did cause a higher level of anxiety than shorter period of infertility in women. Previous study indicated

that women who have suffered from infertility for 2–3 years have the highest level of depression (37). Although IVF has brought new hope for infertile couples, the low success rate of IVF also brought a heavy burden (38). Compared with non-IVF patients, IVF patients had higher anxiety score and this may be as a result of IVF being the last resort for fertility treatment and can be more expensive than non-IVF. Women who received IVF treatment

experienced increased levels of anxiety and depression on the day of oocytes retrieval, during embryo transfer and during the 2 weeks waiting for the embryo (39–41). People who failed to conceive a child through IVF have significantly higher levels of anxiety than those who attempt successfully (42). Although whether the increase or decrease in anxiety level will affect the results of IVF is still ambiguous (43). We still hope that the mental health of infertile women can receive attention, especially during the epidemic.

The psychological state of the quarantined people has also been reported by researchers from different countries (44–46). Fear of COVID-19 and mandatory quarantine measures have had a great impact on people's psychological state (45, 47). We found higher proportion of infertile women in the quarantine group for psychological counseling than that in the non-quarantine group. In Italy, the COVID-19 pandemic itself and the recommendation to stop the ART program have been shown to create higher levels of distress among infertile couples (14). The situation of infertile patients feeling helpless after discontinuation of treatment is related to higher distress, which is also reported by Israeli scholars (31).

The impact of the second wave of the epidemic on people is different from that of the first wave. The quarantine experience in the first wave of epidemic has eased people's anxiety to a certain level. We found that there are more conflicts in women's family relationships in the quarantine group during the second wave. Quarantine measures have brought many factors (isolation, incurable, infection) that may increase anxiety, however, the companionship and communication of family members, and a variety of entertainment methods may help relieve anxiety. Intimacy, increased communication, and commitment can effectively alleviate the tension between husband and wife (26). From another perspective, the performance of the Chinese government in the first wave of the epidemic produced a certain degree of confidence among the people for the government's response to the emergency situation. Compared with the lack of understanding of the unknown new virus during the first wave of epidemic, in the face of the second wave of the epidemic, people's psychological state also underwent a process of adaptation. When infertile patients cannot visit hospitals for treatment, it is recommended that clinicians provide patients with psychological and lifestyle guidance through online forms. The role of social assistance cannot be ignored. The mutual communication between family and friends, and a good relationship between husband and wife are all conducive to the mental health of infertile women (31).

There are several limitations in our study; first, of which lies in the cross-sectional nature of data, without a baseline assessment of anxiety before the pandemic, or at least during the first months of the pandemic. Second, we used the mobile WeChat questionnaire to conduct surveys, so the women who felt good may have a higher response rate. Third, the number of confirmed infections in Xinjiang during the window period of our investigation had shown a clear downward trend, and people's anxiety at that time might have been relieved. Fourth, there are some disadvantages based on the cross-sectional study

itself. For example, it may include data on confounding factors and other variables that affect the assumed causality. Fifth, we have no information about the cause of infertility and the number of attempts. In addition, the self-reported diagnosis may also have some deviations in data collection.

In the future, research across different regions of China and research including the mental state of male infertile patients will help to further expand our understanding of the impact that quarantine measures on the mental state of infertile patients.

CONCLUSION

Our research found that there was no significant difference in the anxiety level of infertile females in Xinjiang quarantine area under the second wave of epidemics compared with patients in non-quarantine areas. However, quarantine could still lead to an increase in negative emotions and deterioration of family relationships; infertile patients of quarantine are people who need more psychological counseling and care. Patients with long-term infertility treatment and those who need to do IVF are more anxious.

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 human participants were reviewed and approved by Ethics Committee of the Eighth People's Hospital of Xinjiang Uygur Autonomous Region. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

L-BC: original draft preparation. QH, YL, QS, and BW: data collection. L-BC: writing—reviewing and editing. LY: study design, statistical analysis, and revise draft articles. All authors contributed, reviewed, and approved the final manuscript.

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A Tale of Two Cities: COVID-19 and the Emotional Well-Being of Student-Athletes Using Natural Language Processing

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Student-athletes at the Division I institutions face a slew of challenges and stressors that can have negative impacts in eliciting different emotional responses during the COVID-19 pandemic. We employed machine-learning-based natural language processing techniques to analyze the user-generated content posted on Twitter of Atlantic Coast Conference (ACC) student-athletes to study changes in their sentiment as it relates to the COVID-19 crisis, major societal events, and policy decisions. Our analysis found that positive sentiment slightly outweighed negative sentiment overall, but that there was a noticeable uptick in negative sentiment in May and June 2020 in conjunction with the Black Lives Matter protests. The most commonly expressed emotions by these athletes were joy, trust, anticipation, and fear, suggesting that they used social media as an outlet to share primarily optimistic sentiments, while still publicly expressing strong negative sentiments like fear and trepidation about the pandemic and other important contemporary events. Athletic administrators, ACC coaches, support staff, and other professionals can use findings like these to guide sound, evidence-based decision-making and to better track and promote the emotional wellness of student-athletes.

Keywords: machine learning, natural language processing, student-athletes, emotional well-being, sentiment analysis, COVID-19

INTRODUCTION

Over the year of 2020, a number of challenges and stressors, such as the public health crisis of COVID-19, nationwide racial justice protests in response to acts of police violence and brutality, and psychosocial isolation imposed by mandatory public health restrictions have emerged that could have a severe negative impact on the psychological well-being of collegiate student-athletes. These challenges and stressors can lead to heightened feelings of anger, anxiety, or fear (McGuine et al., 2021; Shepherd et al., 2021).

According to Facer-Childs et al. (2021), 54.3% of athletes have indicated that they experienced disrupted mental health due to the COVID-19 pandemic, whereas 63.6% indicated disrupted mood or sentiment. A recent narrative review also indicated that athletes are at a heightened risk of adverse mental health symptoms relative to the general population (Reardon et al., 2021). Due to these mental health risks, it is crucial that athletic administrators be able to efficiently diagnose indicators of heightened distress, fear, or anxiety. The current work provides a valuable

methodological foundation for day-to-day evaluations of emotional disposition on a broad scale, with thousands of athletes posting publicly on social media every day using natural language processing techniques (NLP). By implementing data scraping and machine-learning-based NLP, athletic administrators can quantify the sentiment of the social media posts of the student-athletes. By mapping changes in these sentiment values over time while comparing the trends against important or impactful events, it is possible to extrapolate a timeline of sentiment affectation. That is, we can pinpoint specific time periods and specific events that occurred during these time periods that might have caused a heightened emotional reaction in student-athletes. Athletic administrators, ACC coaches, support staff, and other professionals can use findings to guide sound, evidence-based decision-making and to better track and promote the emotional wellness of student-athletes.

As a subfield of natural language processing, sentiment analysis, and related text mining techniques automatically categorize the sentiment expressed in a text presented in various forms (e.g., textual information, emojis) posted on social media platforms and online retailing channels. Sentiment analysis techniques have been adopted in various academic disciplines, including public health and medicine. By employing these techniques, researchers have found a close relationship between the sentiment and the mental health and emotional well-being of an individual. For instance, Zunic et al. (2020) found that narratives within online communities formed around the health conditions, such as mental health problems or eating disorders, of an individual have been studied frequently using sentimental analysis to notice any mental health-related symptoms such as suicidal symptoms of the patients.

Furthermore, by applying an emotional decomposition matrix to data scraped from user-generated content on the social media profiles of the student-athletes, we decomposed the attitudes and feelings expressed within social media posts into a set of eight different emotions, which are as follows: anger, anticipation, disgust, fear, joy, sadness, surprise, and trust. This decomposition matrix can determine if user-generated content expresses more than one of these emotions simultaneously. Anecdotally, a student-athlete might express both fear and anticipation before a major change to conference or school athletic policy is announced.

There are numerous practical applications of a real-time analytical tool for sentiment evaluation. They could be used to tailor or guide organizational policy-making (Kowalski et al., 2020) to target specific athletes or groups of athletes (e.g., athletes of a particular sex or in a particular sport who are exhibiting heightened negative sentiment) for aid, or to anticipate and project future changes in sentiment. More specifically, collegiate athletic organizations like the Atlantic Coast Conference (ACC) can use the sentiment analysis techniques, proposed herein, to monitor expressions of the athletes regarding the feelings of being socially and emotionally supported, by firstly monitoring the overall sentiment trends and then implementing outreach intervention programs to mitigate the lingering impact of adverse mental health outcomes and promoting the optimal functioning under the paradigm of positive psychology (Seligman, 2012).

Athletes who express a lack of support have demonstrated heightened academic anxiety (Li et al., 2021) and degradation of athletic identity, or the “strength with which people identify with and embrace their role as an athlete” (Graupensperger et al., 2020). Additionally, research has found links between heightened feelings of anxiety and decreased athletic performance (Khan et al., 2017); so it is vital from both an ethical and a business standpoint that collegiate athletic organizations be able to fully understand the sentiments of their constituent athletes.

Although the current body of research has adeptly determined the connection between feelings of social support and academic and athletic outcomes for student-athletes, thus far no researchers have proposed a methodological approach that can assess such feelings for thousands of student-athletes in real time. This work, while limited in scope, offers a methodological foundation that could be expanded to assess fluctuations and trends in the sentiment of the athlete.

In sum, we apply two machine-learning-based NLP techniques, tripartite sentiment analysis through a logit regression classifier and an emotional decomposition-based machine learning algorithm, to the data generated by ACC student-athletes from March 2020 through February 2021 to evaluate the composition of and changes in student-athlete sentiments during the COVID-19 pandemic.

METHODS

Data Collection

The data were scraped from the Twitter accounts of ACC student-athletes from four different sports—football, women's volleyball, and men's and women's basketball—across four different ACC member institutions. These sports were selected to ensure a balanced sample in terms of both athlete gender and the season of play (i.e., fall, winter, and spring), as well as based on their financial and reputational significance to the ACC. Considering the fact that the sport leagues and NCAA suspended play due to the spike of COVID-19 cases across the United States (NCAA, 2020), the timeframe for the data collection was from March 2020 until February 2021 to examine the change of sentiments and emotions during the pandemic times.

We scraped and retrieved a total of 2,649 tweets from twitter.com by utilizing both the Twitter streaming API with Tweepy and Octoparse 8.1. The extracted tweets consisted of raw text data from the official Twitter accounts of student-athletes. With each line of raw tweets, we extracted and retained the original textual contents, time posted, user handle, number of views, retweets, and likes published on the official Twitter accounts of the athletes.

Text Mining

We incorporated a data preprocessing workflow used by sport management scholars to remove unusable or irrelevant information prior to the main analyses (Davidson et al., 2020). In this process, we eliminated extra white spaces, transformed textual contents to lower cases, removed numbers and special symbols (e.g., hyperlinks), deleted punctuations, and removed some common English stop words. These stop words refer to a

list of words that convey little value and meaning to analyze the sentiments of the people, and are intended primarily for syntax construction and flow. Examples include personal pronouns and their variants, as well as major prepositions. Further, a corpus was created for the data by using the TM (Feinerer et al., 2008) and SnowballC packages (Bouchet-Valat, 2020). Also, the procedure of stemming and lemmatization was incorporated to group the transformed forms of a word so that they can be analyzed as a single item, identified by the dictionary form of the word. Once a clear corpus was created, we developed a document-term matrix to facilitate the subsequent sentiment and analyses (Nave et al., 2018).

Sentiment Analysis

The sentiment analysis was conducted using two different algorithms. First, we conducted a machine-learning-based tripartite sentiment analysis through a logit regression classifier to produce a score that represented the sentiment of the Twitter text string in Python. Specifically, we capitalized on artificial intelligence to analyze the textual data. VADER is adopted as a sound machine-learning-based natural language processing tool that is precisely tuned to analyzing Twitter data. It constructed a valence-aware sentiment lexicon by combining existing sentiment word banks and a proprietary list of emojis (e.g., “:-”), sentiment-implied acronyms (e.g., “LOL”), and slangs with sentiment value (e.g., “giggly”) (Hutto and Gilbert, 2014). The package returns a decimal between -5 and 5 , decoding overall sentiment for each specific string of tweets. To breakdown, -5 indicates extremely negative sentiment and 5 implies extremely positive sentiment, whereas 0 denotes neutrality for the analyzed textual content. To justify the external validity, we used a 70:30 random split to form a twin-sample to validate the results of the clustering derived from the training set on the testing set. The formation of separate training and testing datasets adopts a firewall principle that searches for an optimized loss function from the training dataset as an input. Particularly, the loss function was minimized using data from the training dataset. The function is then applied to the previously-unseen testing data (from the identical distribution as the training set) to evaluate the model performance. The textual data were converted into numerical data before being partitioned into training and testing datasets using the vectorization function of Python. The data were labeled based on the polarity of the sentiment score values generated from the sentiment analysis algorithm for each tweet. The predictive accuracy of the machine-learning model was evaluated by the “confusion matrix” function from the Scikit-learn library.

Next, the work incorporated a decomposition-based machine learning approach to identify the most salient emotions from the data. As a lexicon-based approach, we used the frequency of lexicon words that appeared in a tweet to measure the strength of a specific emotion breakdown with eight emotional themes (i.e., anger, anticipation, disgust, fear, joy, sadness, surprise, and trust). This method has the benefit of relying on the lexicon of the text to evaluate the frequency of commonly used words based on the NRC emotion lexicon algorithm (Rose et al., 2018). We then calculated a compound score to create a data visualization

TABLE 1 | Examples of positive, negative, and neutral sentiments and the related sentiment scores generated by the tripartite sentiment analysis.

Types of sentiment	Sentiment score	Example
Negative	-3	Michelle Cusseau was shot and killed by Phoenix police during a mental wellness check. Say her name. https://t.co/JMW2Pid0o9
Positive	3	Today's Mantra: I AM love. You are love. We are love. May all beings awaken to love.
Neutral	0	#DeacsDecide: 99 percent of @WakeForest's 400-plus student-athletes are now registered to vote in either North Carolina or their home state. Are you?

of how the eight emotional sentiments changed each month in relation to the progression of the COVID-19 pandemic and the occurrence of other major societal events over the examined period of time frame.

RESULTS

The results indicated that more than half (54.92%) of the tweets of the athletes communicated informational messages with a neutral sentiment. Further, 31.1% of the tweets communicated a positive sentiment, whereas only 13.98% of the tweets communicated a negative sentiment. **Table 1** provides examples of tweets that were categorized as either neutral, positive, or negative. The results of the confusion matrix for the tripartite sentiment analysis indicated that overall the natural language processing model was able to correctly predict 89.38% of the total cases. Specifically, the model was able to correctly predict 90.47% of negative sentiments and 88.29% of positive sentiments, suggesting an adequate level of predictive accuracy, consistent with the previous empirical work using machine learning (Casanova et al., 2020).

Figure 1 displays the results of the emotional decomposition analysis depicting the extent to which the eight emotional themes were embedded in the scrapped Twitter data. **Table 2** illustrates examples of the emotions elicited with the associated tweets. It should be noted that the emotions of “trust,” “anticipation” accompanied by “joy,” and “fear” were recognized as top emotions conveyed by the student-athletes during the outbreak. During the global pandemic, student-athletes faced unpredictable uncertainty in terms of their future opportunities in athletics. The postponement and suspension of the games, in particular, heightened the sense of anxiety and distress of student-athletes about the existing situation. Besides, the widespread hope that the college athletics season will begin and end on the schedule had given way to trepidation as teams continued to witness athletes with COVID-19 infections during voluntary practices, and several states had either slowed or reversed

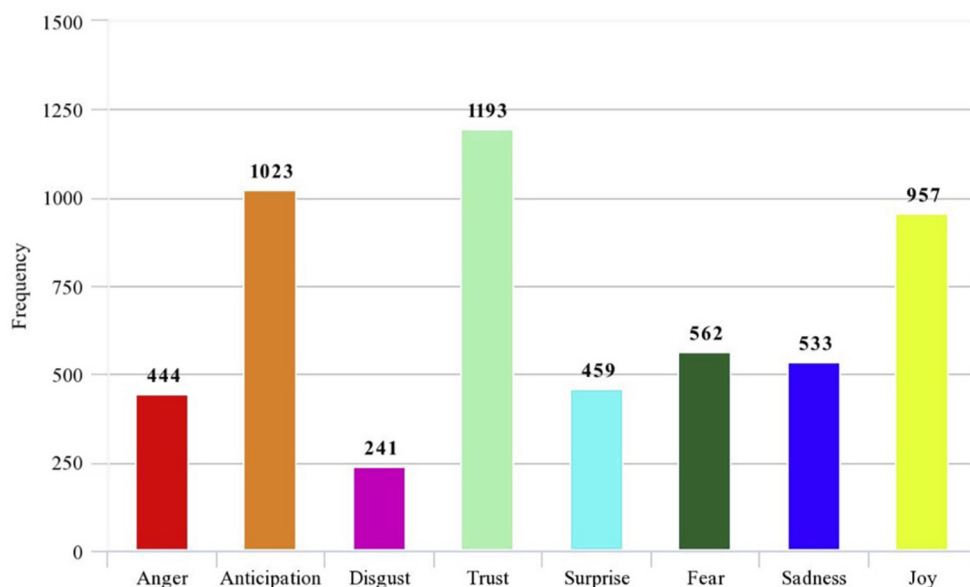


FIGURE 1 | Results of machine-learning-based sentiment decomposition analysis.

TABLE 2 | Examples of emotions elicited corresponding to respective tweets.

Tweet	Emotions elicited
Focused improvement on your #CLIMB #EverythingIsConnected	Joy, trust
Proud of these guys for their continued growth in the classroom! #KeepCLIMBing #WORK	Anticipation, joy, trust
We live in a crazy world BE SMART BE SAFE?	Anger, fear, joy, sadness, trust

certain facets of their reopening plans in response to the rising case numbers.

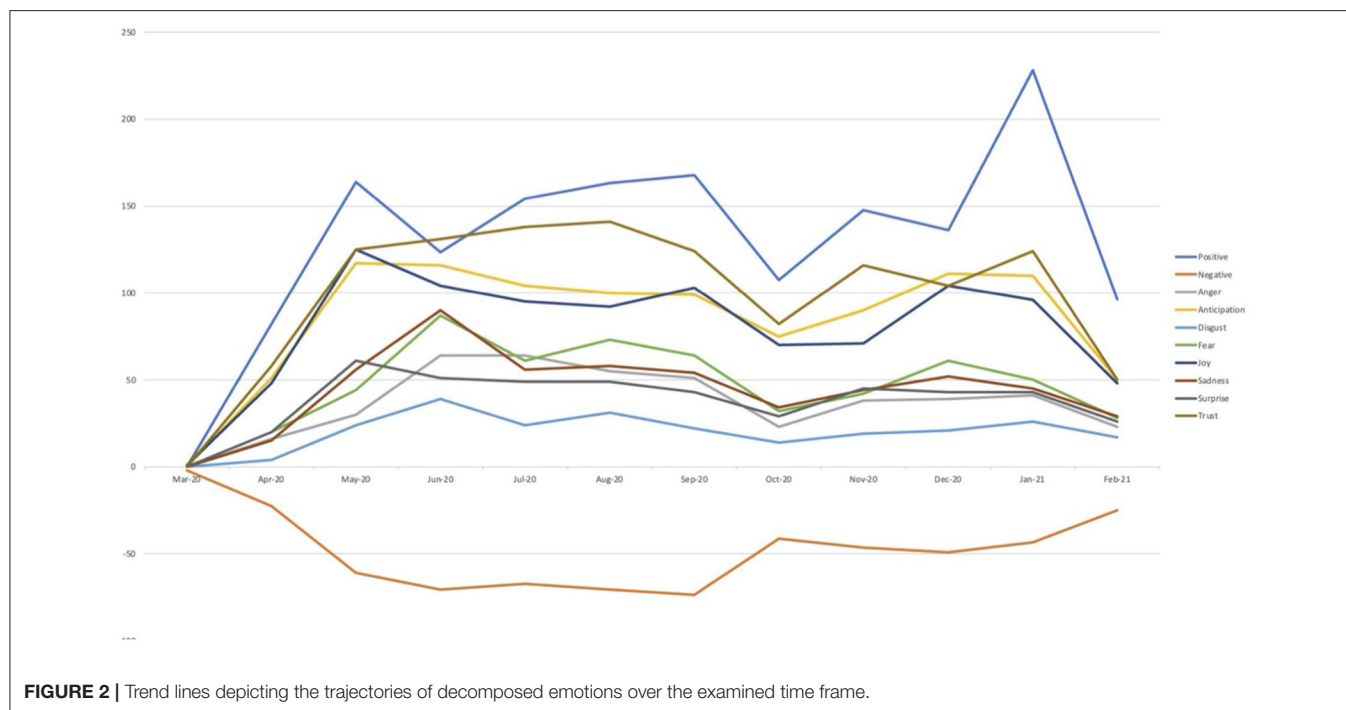
Figure 2 represents the trendline of the sentiments that were elicited throughout the year. The trendline depicts the frequency with which the positive and negative sentiments as well as the eight emotional themes were elicited throughout the year. The figure shows that the positive sentiments peaked in the month of January 2021, which corresponds with the commencement of the vaccination program throughout the country. Also, the positive sentiments were elicited to a greater degree in September 2020, which corresponds to the commencement of the college football season. During this time period, even the emotions of anticipation, trust, and joy were elicited to a greater extent. This indicates that the student-athletes were excited for the start of the college football season and anticipated that the season would unfold positively. Further, the negative sentiments were elicited to a greater extent from June 2020 to September 2020. The murder of George Floyd occurred in the month of May,

prompting nationwide “Black Lives Matter” protests. Due to these incidents, negative sentiments were elicited to a greater extent and the emotions of sadness, fear, disgust, and anger also peaked during this time period.

DISCUSSION

Despite the numerous physiological and psychosocial challenges that these student-athletes were presented with in 2020, big data sentiment analysis found that their social media posts displayed a nearly even mix of positive and negative sentiments, with the four most commonly expressed emotions on Twitter being joy, trust, anticipation, and fear (see **Figure 1**). Three of these four emotions have positive connotations, suggesting that, at least publicly on social media, these athletes tried to maintain an optimistic attitude. Furthermore, the players showed appreciation for the contributions of both conference administrators and individual colleges in attempting to maintain a semblance of normalcy in their lives. Having a sense of belonging with your peers and having a connection with the university is beneficial for ensuring a sense of psychological well-being (Wann, 2006).

At the same time, the scars of 2020 were evident in both the tripartite sentiment model and the emotional decomposition matrix. As expected, May and June, **Figure 2**, showed negative sentiments overtaking positive sentiments, a trend that coincides with the resurgence of racial justice protests in response to the newest series of police killings throughout the country. This trend is mirrored with the emotional decomposition matrix, where positive emotions like joy and anticipation became less frequent in May and June, whereas emotions like anger, fear, disgust, and sadness spiked significantly. Negative emotions remained



prevalent throughout the summer, coinciding with ongoing protests throughout the country, but began to subside around the end of summer leading into September and October.

Analyzing these sentiment trends against a timeline of major events for the sample of student-athletes, we determined that the decreasing intensity of negative emotions might be connected with the resumption of normally scheduled athletic activity (the ACC announced a comprehensive COVID-19 testing plan on August 18 and the conference football season began on September 3). It could also relate to the increased focus of ACC on speaking out against racial injustice and expanding structural and social support resources for its Black athletes during the 2020–2021 athletic calendar year (Atlantic Coast Conference, 2020). While the conference did not employ the sentiment analysis methods utilized in this work to craft its racial justice initiatives, the changes were made in response to public outcry from the student-athlete population; conceptually, this process was very similar to the sentiment-driven policy-making model we proposed, with the exception that using big data to craft policy would allow an organization to tune its policy decisions more accurately and expediently to the needs of its constituents.

Using text mining and NLP techniques to analyze sentiments allows us not only to extrapolate sentiment trendlines, but to analyze the contents (text) of the tweets themselves to determine popular topics. For example, we conducted a word frequency distribution of the sampled tweets (after removing prepositions, connecting phrases, and other stop words from the dataset) and found that words like “game,” “season,” and “work” were all among those most frequently used by the athletes, suggesting that athletic activity was important to the athletes. Organizations like the ACC could use this data as a way of evaluating the potential

shortcomings of their relationship with their constituents. In this case, the trendlines (**Figure 2**) indicate that conference officials need to do a better job of fostering positive sentiments within their student-athlete population during the summer months, while a content analysis shows specific topics that are important to the athletes.

While acknowledging the merits of the paper, there are several drawbacks associated with it. First, our emotional analysis was based on the individual words that comprised each tweet, but this method does not consider the semantic meaning of the whole tweet, which is much more difficult to quantify given the complexity of lingual expression. We acknowledge that this sentiment lexicon cannot cover the complete domain of knowledge and cannot extract the exact meaning of each word in context. NLP is unable to imply the meaning of textual contents, analyze underlying tone and connotation, and interpret statements accurately without a specific context. For example, in “if I had a dollar for every time my name was pronounced wrongly,” “wrongly” here does not express either the emotion of anger or sadness. Thus, the algorithm does not account for the context specific tweets such as sarcasm or misapplied words. Future studies should investigate beyond the conventional transcript content and capitalize on other forms of social media (e.g., short video sharing via TikTok, Su et al., 2020) through employing recent developments in multimodal sentiment analysis to analyze the complexity of complementary information sources including texts, audios, images, and videos (Soleymani et al., 2017).

Second, our research focused on the tweets from specific student-athletes. We did not analyze tweets from student-athletes competing in Division II or III collegiate athletics. Future

research may want to extend our projects to analyze sentiments that are elicited in student-athletes competing in various levels of collegiate athletics, as their priorities could differ significantly from Division I athletes. Third, it remains to be seen if this discrepancy in sentiment between the fall athletic season and the summer offseason is a persistent trend or if it was a one-time occurrence resulting from the unique circumstances of the COVID-19 pandemic (e.g., cancelation of all spring and summer sports, unpredictable schedule alterations, social isolation, the health risks of a once-in-a-lifetime respiratory virus, and a nationwide civil rights movement).

Fourth, it is possible that student-athletes, either voluntarily or at the direction of coaches and administrators at their school, self-censor their thoughts and opinions on social media to avoid institutional or public backlash. The dynamics of public expression of student-athletes through social media are not universal, different programs have different policies (Hopkins et al., 2013, p. 36–41), and these policies are typically established and enforced internally (i.e., coaches and schools do not announce publicly that their athletes are prohibited from discussing certain topics on social media). Additionally, even if athletes are not explicitly prohibited from sharing certain content on social media, fear of negatively impacting intrateam dynamics might lead them to self-censor or refrain from sharing certain ideas.

It should also be noted that the total number of tweets decreased noticeably during the Fall athletic season. As all NCAA sports were canceled over the summer, fall represented the first opportunity for many teams to participate in organized team activities. Additionally, fall marks the beginning of the academic year for these student-athletes as well, and so the decrease in the total tweets could be attributable to the full athletic and academic schedules for the athletes. However, this seasonal decrease in total tweets also raises questions about the ability of athletes to express their genuine emotions in a public forum like Twitter. Some college coaches have instituted team-wide social media bans in the past as a way of avoiding controversy and minimizing the chances of an athlete posting something that a majority of fans might not agree with.

Finally, we wanted to acknowledge that NLP might be prone to human errors and subjective biases in the development of dictionaries and classifiers, although the task of analyzing large-scale textual data would have been labor-intensive to perform using traditional manual approaches. It is straightforward to

depict a change in sentiment as an abstract concept with NLP, but it is also important to remember that the trendlines presented in **Figure 2** represent genuine emotions expressed by real people. This quantitative, data-driven approach to analyzing sentiments is an effective tool to create a “snapshot” of the emotional consensus of the constituents of an organization, but it can never fully capture the felt emotions and lived experiences of these constituents, which is why even organizations that employ these big data-driven approaches to measuring constituent sentiment should still prioritize facilitating candid, productive discussions (i.e., qualitative research) with those constituents to determine how to address various mutual challenges. In other words, it is still incumbent upon organizing bodies like the ACC to be proactive in diagnosing and addressing problems before they manifest in more extreme or destructive ways, rather than being reactive and waiting until their constituents demonstrate significant negative sentiment to begin troubleshooting and exploring solutions.

DATA AVAILABILITY STATEMENT

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

AUTHOR CONTRIBUTIONS

CF conducted the literature review and data interpretation and drafted the first version of the paper. SG collected and analyzed the data and created data visualizations. JD oversaw the idea generation and manuscript development, guided data scrapping and analysis process, revised and partially rewrote paragraphs in the article, and checked the overall manuscript for coherence, consistency, and format. AK and JP involved in the conceptualization of the manuscript, provided feedback, and helped revise the paper during the manuscript development process. All authors contributed to the article and approved the submitted version.

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Psychological Status Associated With Low Quality of Life in School-Age Children With Neurodevelopmental Disorders During COVID-19 Stay-At-Home Period

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Background: This study seeks to ascertain how the COVID-19 stay-at-home period has affected the quality of life (QOL) of children with neurodevelopmental disorders (NDDs) who had experienced sleep schedules alteration and clarify what psychological status predicted low QOL in children with and without altered sleep patterns.

Materials and Methods: Study participants were 86 children between 8 and 17 years of age (mean age, 11.7 years; 70 boys, 16 girls; mean intellectual quotient, 83.6). QOL was evaluated using the self-assessment KINDL^R. Participants answered questions regarding depression and anxiety on a visual analog scale (VAS) for temporary mood. Their parents answered questionnaires regarding their maladaptive behaviors and differences in sleep patterns before and during the COVID-19 pandemic. The student's *t*-test was performed to examine the presence or absence of sleep changes in the children, which affected QOL, temporary mood, and maladaptive behaviors. Multiple or simple linear regression analyses were also performed to identify the psychogenic factors that significantly affected decreased QOL for each group with and without changes in sleep schedule.

Results: During the COVID-19 stay-at-home period, 46.5% of participants experienced changes in sleep patterns. These changes were associated with decreased QOL as well as internalized symptoms. The decreased QOL of children with sleep patterns changed was predicted by a high level of depression. In addition, low QOL in children with unchanged sleep patterns was predicted by a high level of depression and low current mood status.

Conclusions: Almost half of the participants experienced a poor sleep schedule during the stay-at-home period. These alterations in sleep patterns were associated with a low QOL. The QOL of children with a stable life schedule was affected not only by depressive tendencies but also temporary moods. Therefore, they need to live a fulfilling life to maintain their QOL. However, the QOL of children with poor sleep patterns was affected only by depressive tendencies. Hence, clinicians need to ensure that children with NDDs are well-diagnosed with depression and treated for sleep problems.

Keywords: COVID-19, children, neurodevelopmental disorders, quality of life, depression

INTRODUCTION

The 2019 coronavirus disease (COVID-19) pandemic has profoundly altered the way people live and work worldwide. In particular, the suspension of in-person education, extracurriculars, social activities, and routine healthcare for children severely threatens their physical and mental well-being.

In Japan, an emergency declaration was issued by the Prime Minister on April 7, 2020. Citizens were mandated to stay at home and refrain from outdoor activities until May 25, 2020. School-age children had been sent home even earlier, on March 2, 2020. Similar to caregivers around the world, Japanese parents too faced questions about how to best support their children under these conditions (1, 2).

Neurodevelopmental disorders (NDDs) are a group of conditions that produce developmental impairment in personal, social, and academic functioning from the developmental period, including genetic syndromes, metabolic diseases, cerebral palsy, psychomotor delay, etc. (3). It has been warned since the beginning of the COVID-19 pandemic that children with NDDs are more likely to experience mental and physical difficulties during a disaster in comparison with typically developing children (TDC) because of their inability to adapt to unpredictable changes around them and alterations to their routines (1, 4, 5). In the Australian study, the lifestyle habits of children with NDDs worsened, especially in terms of spending more time watching TV and digital media, getting less exercise, and having a poor diet (6). Furthermore, it was revealed in several studies that both internalizing and externalizing symptoms in children with NDDs and their comorbid mental health symptoms were worse than before the COVID-19 outbreak (1, 6). In addition, one of the severe problems for caregivers was the increased psychological and social burden of parenting children (7–10). The suspension of daily rehabilitation services and the lack of alternative recreational opportunities leave these caregivers alone caring for their children, with increased childcare burden and stressors, such as lack of access to needed therapies, medical supplies, and nursing care (7–10). The concerns for their child were significantly associated with the caregivers' stress, depressive and anxious symptoms (9). Namely, in recent years, the correlation between the social status of children with NDDs and the psychological status of their parents as well as the worsening of children's psychological behaviors during the COVID-19

pandemic has been revealed, emphasizing the importance of appropriate assessment and alternative intervention for children with NDDs as one of the global public health priorities (1, 6–9, 11).

Among the many problems of children with NDDs during the COVID-19 pandemic, deterioration of sleep schedules was one of the most significant problems. Children with NDDs are prone to sleep problems, even under normal circumstances. Sleep dysfunction for children with NDDs was a common and underlying problem associated with multiple factors, including biological and genetic abnormalities (12–14). Previous studies have shown that sleep problems affect the mental problems of children with the attention-deficit hyperactive disorder (ADHD) and autism spectrum disorder (ASD) (15–17). Some neurological and psychological experts predicted sleep problems in children with NDDs, especially during the COVID-19 pandemic (4). Therefore, it is significant to identify changes in sleep patterns during the COVID-19 stay-at-home period and related factors.

Furthermore, improving the subjective indicator of children's well-being is one of the most important goals in terms of supporting children. Quality of life (QOL) describes an individual's subjective perception of their position in life, as evidenced by their physical, psychological, and social functioning (18).

In a previous study, we asked parents to respond to the questionnaire survey on changes in children's QOL and lifestyle during the COVID-19 stay-at-home period. We found that changes in children's sleep schedules were associated with reduced QOL, and decreased maladaptive behavior with a maintained QOL (19). Thus, our former study indicated the importance of adjusting the sleep schedule to maintain the QOL of children. However, many previous studies have shown that the results of parental proxy- and children's self-reports do not always match (20–23). Therefore, it is prudent to analyze the results of the children's assessment of their mental state and QOL and to clarify their detailed characteristics.

The purpose of this study was to determine, using self-assessments, how the QOL of school-age children with NDDs during the COVID-19 pandemic has been affected by changes in the sleep schedules and the psychological status that predicted low QOL in children with and without altered sleep patterns. Clarifying the relationship between children's sleep problems and QOL can help reveal focus areas for child care and its support.

MATERIALS AND METHODS

Participant Characteristics

We recruited 86 children who were patients at the Shimada Ryoiku Center Hachioji in May 2020. The center is a regional core outpatient clinic where children receive medical examinations, rehabilitation, and psychotherapy. Hachioji is located in the western suburbs of Tokyo. It is a commuter town with a population of 580,000 (population density 3,093/km²). Nineteen persons were infected with COVID-19 in Hachioji City (a 6.8% positivity rate in polymerase chain reaction examination for COVID-19) in May 2020.

The inclusion criteria for participants were children with NDDs, including ADHD, ASD, specific learning disorders (SLD), tic disorders, or neurodevelopmental disorders classified by DSM-5. All diagnoses were reviewed by two board-certified pediatricians, including at least one board-certified pediatric neurologist. The children were between 8 and 17 years of age, referencing the target age of the questionnaires. The exclusion criterion was children with moderate or profound intellectual disabilities through prior testing full scale intellectual quotient (FSIQ) score from the Wechsler Intelligence Scale for Children, 3rd edition or 4th edition.

In addition, the center's dedicated staff explained the study to all participants who met the above criteria while maintaining social distance in a well-ventilated large room. All parents agreed to the participation and provided written informed consent, as did the children. We collected the questionnaire from all the children who provided their informed consent.

No one refused to participate. The studies involving human participants were reviewed and approved by the Institutional Review Board of the Shimada Ryoiku Center Hachioji (Shimahachi-2001). The participants and their parents provided their written informed consent to participate in this study.

Measures

The children were asked to self-administer the following questionnaires to assess their clinical status: Kidd-KINDL^R (8–13 years) or Kiddo-KINDL^R (14–17 years) (24, 25), the Depression Self-Rating Scale for Children (DSRS-C) (26), the Spence Children's Anxiety Scale (SCAS) (26, 27), and a visual analog scale (VAS) for temporary mood status in terms of percentages of the best imaginable state (28, 29). The parents assessed the maladaptive behaviors of their children using the Child Behavior Checklist (CBCL) (30). They also answered whether their children were going to bed or waking up later during the COVID-19 stay-at-home period than before.

The KINDL^R items were rated on a five-point Likert scale, and the mean scores for each subscale and total items were calculated and converted to a 0–100 scale. The average values in the Kiddo-KINDL^R of four subscales (physical well-being, emotional well-being, self-esteem, and family), excluding social contact and school sub-scales, were calculated to evaluate the children's QOL. Higher KINDL^R scores indicate a better QOL.

Furthermore, VAS includes a graph scale on a horizontal line with endpoint 0 (the worst mood status imaginable, the picture

TABLE 1 | Clinical background of children ($n = 86$).

	Total
Male: Female	70:16
Age $M \pm SD$	11.7 (2.2)
WISC/WAIS FSIQ $M \pm SD$	83.6 (16.2)
ADHD N , (%)	50 (58.1)
ASD N , (%)	43 (50.0)
SLD N , (%)	5 (5.8)
Alteration of sleep schedules N , (%)	40 (46.5)
Bedtime later than before N , (%)	26 (30.2)
Arise time later than before N , (%)	1 (1.2)
Both bedtime and arise time later than before N , (%)	13 (15.1)

(%) data indicate the proportion of each characteristic in every group.

N , number; M , mean; SD , standard deviation; FSIQ, full-scale intellectual quotient; ADHD, attention-deficit hyperactivity disorder; ASD, autism spectrum disorder; SLD, specific learning disorder.

of a crying face), mid-point 50 (intermediate mood status, the picture of a neutral face), and opposite endpoint 100 (the best mood status imaginable, the picture of a smiling face). The face scale was added to VAS to increase non-verbal explanations for children with different verbal abilities (31). After being instructed on VAS by a pediatrician, participants were asked to mark across the line on a point from (inclusive) 0 to 100, which best describes their current mood state. Higher VAS scores were associated with better mood scores and vice versa, while scores of the other questionnaires showed better symptoms at lower scores.

Statistical Analysis

Statistical analysis was conducted using the JMP software, version 9.0.3 (SAS Institute Inc., Cary, NC, USA). Students t -test was performed to examine the presence or absence of sleep changes in the children, thereby affecting their QOL (KINDL^R), VAS, FSIQ, externalized index, and internalized index of the CBCL. Pearson's χ^2 -test was used to investigate the proportional differences of the children with sleep changes between presence or absence of ADHD, ASD, and SLD, respectively. We applied a stepwise multiple or simple linear regression analysis to QOL with selective pairs to identify the psychogenic factors for each group, with and without a sleep schedule change. We began with a model that included all of the psychogenic available explanatory variables: SCAS score, DSCR-C score, externalized index and internalized index of the CBCL, and VAS score; we subsequently dropped insignificant variables based on the Akaike information criterion and the Bayesian information criterion. Significance was set at $P < 0.05$.

RESULTS

Participants' Background

Table 1 shows the demographic parameters of the study participants. We surveyed their background and sleep schedules and assessed their QOL and mental health. There were 46 (53.5%) children with unchanged sleep schedules and 40 (46.5%) with changed sleep schedules (26 children with later bedtimes, 13

children with later bedtimes and later waking times, and one child with a later waking time than before the COVID-19 pandemic) (Table 1). None of the children took hypnotics and/or were newly diagnosed with a sleep disorder during the COVID-19 stay-at-home period.

Table 2 shows the results of the questionnaires. Among participants, 36 children (41.9%) scored above the CBCL internalized index cut-off of ≥ 70 points for the clinical range, and 26 children (30.2%) scored above the CBCL externalizing score cut-off of ≥ 70 points for the clinical range. Of the participants, 19 (22.1%) scored above the DSCR-C cut-off of ≥ 16 points, and another 19 (22.1%) scored above the SCAS cut-off of ≥ 42 points (27). The median QOL score for children was 71.2 (out of 100.0) on the KINDL^R questionnaire. The median score of temporary mood for children was 55.8 out of 100.0 points on the VAS scale.

Sleep Schedules Alteration of Children During COVID-19 Stay-At-Home

Table 3 shows the relationship between changes in sleep schedules and QOL in children during the COVID-19 stay-at-home period (deterioration = 40; unchanged = 46). Changes in

sleep schedules were associated with decreased QOL and were also associated with the internalized index of CBCL. Changed sleep schedules were not associated with the externalized index and FSIQ. There was no relationship between sleep schedules and NDDs (ADHD, ASD, and SLD).

Psychogenic Factors Predicting Lower QOL

Table 4 shows the psychological factors that significantly predicted the QOL of children. Stepwise multiple regression analysis for children with changed sleep schedules showed that higher DSCR-C scores were associated with lower KINDL^R scores. In children with unchanged sleep schedules, higher DSCR-C scores, and lower VAS scores were associated with lower KINDL^R scores.

DISCUSSION

To our knowledge, this was the first study to reveal the relationship between changed sleep patterns in children with NDDs and their QOL during the COVID-19 stay-at-home period, based on the results of self-assessment by children. Changed sleep patterns were associated with decreased QOL and internalized symptoms of children with NDDs. The decreased QOL of children with changed sleep patterns was predicted by high levels of depression. In addition, low QOL in children with unchanged sleep patterns was predicted by high levels of depression and low current mood status.

Factors Related to Changed Sleep Patterns

Results indicate that changed sleep patterns were associated with decreased QOL in our previous study. In previous studies, children with ADHD and ASD were prone to sleep problems, affecting their QOL, even when they were not facing a crisis (15–17). A Turkish study during the COVID-19 pandemic indicated that severe sleep disorders led to highly increased ASD symptoms (32). In our previous study, QOL of children in parent proxy-reports also decreased with changes in sleep during the

TABLE 2 | Results of questionnaires.

Questionnaire: children	Median, range	N (\geq cut-off) (%)	Cut-off
Total scores of KINDL ^R	71.3, 22.5–97.5		—
Physical health	80, 20–100		—
Emotional well-being	80, 25–100		—
Self-esteem	60, 20–100		—
Family	75, 25–100		—
CBCL, internalized index	66, 41–93	36 (41.9)	≥ 70
CBCL, externalized index	67, 39–91	26 (30.2)	≥ 70
DSRS-C	11, 0–26	19 (22.1)	≥ 16
SCAS	27.5, 0–71	19 (22.1)	≥ 42
VAS for mood	55.8, 0–100		—

N, number; CBCL, Child Behavior Checklist; DSRS-C, Depression Self-Rating Scale for Children; SCAS, Spence Children's Anxiety Scale; VAS, visual analog scale.

TABLE 3 | Relationship between changes in sleep schedules and QOL changes in children during the COVID-19 stay-at-home period.

	Deterioration of sleep schedules	Unchanged sleep schedules	t-value/ χ^2 -value	p-value
Kiddo-KINDL M; SD	66.8 (14.4)	75.9 (11.9)	3.220 ^a	0.002*
VAS score M; SD	57.4 (25.4)	64.3 (22.9)	1.342 ^a	0.183
CBCL; internal M; SD	69.4 (11.8)	63.5 (9.9)	2.547 ^a	0.013*
CBCL; external M; SD	68.1 (10.7)	64.2 (10.9)	1.683 ^a	0.096
FSIQ M; SD	86.6 (12.6)	81.0 (18.5)	1.603 ^a	0.113
ADHD (%)	26 (52.0)	24 (48.0)	1.446 ^b	0.229
ASD (%)	22 (51.2)	21 (48.8)	0.748 ^b	0.387
LD (%)	2 (40)	3 (60)	0.388 ^b	0.533

(%) data indicate the proportion of each characteristic in every group.

* $p < 0.05$.

QOL, quality of life; N, number; M, mean; SD, standard deviation; FSIQ, full scale intellectual quotient; ADHD, attention-deficit hyperactivity disorder; ASD, autism spectrum disorder; SLD, specific learning disorder; VAS, visual analog scale.

^at-value.

^b χ^2 -value are depicted.

TABLE 4 | Results of multiple or simple regression analysis for KINDL^R score predicting lower QOL.

Parameter	Unchanged sleep schedules (n = 46)		Changed sleep schedules (n = 40)	
	t-value	β coefficient	t-value	β coefficient
Intercept	20.51***	—	36.17***	
DSRS-C	7.99***	−0.697	10.98***	−0.872
VAS for mood	3.75***	0.327	N/A	N/A
F-value		47.1***		120.6***
R ²		0.69***		0.76***

QOL, quality of life; DSRS-C, Depression Self-Rating Scale for Children; VAS, visual analog scale.

*** $p < 0.001$.

COVID-19 stay-at-home period (19). Despite a weak correlation of the same domain in both reports in a previous study (20), the similarity of the results in self-report and proxy-report was clarified in this study. Conversely, there was no relationship between VAS scores and changes in sleep patterns in this study. Since the sleep schedule is not related to temporary mood status during daytime (VAS), it is recommended that parents and clinical practitioners monitor children's sleep conditions.

In addition, changed sleep patterns were associated with maladaptive behavior in children during the COVID-19 pandemic. In previous studies, internalizing symptoms were associated with problematic sleep behaviors in children with comorbid ASD or ADHD, even in non-emergency situations (33, 34). During the COVID-19 stay-at-home period in Italy, it was revealed that ASD children had more intense and frequent disruptive behavior, although there was no mention of the relationship between sleep problems and maladaptive behavior (1). A similar relationship was also clarified during the stay-at-home periods in the present study.

In summary, the relationship between sleep schedule change and low QOL, and between sleep schedule change and internalized symptoms in children with NDDs, during the COVID-19 stay-at-home period tended to be the same as before the COVID-19 pandemic.

Relationship Between QOL and Psychogenic Status

The decreased QOL of children with changed sleep patterns was predicted by high levels of depression. Furthermore, low QOL in children with unchanged sleep patterns was predicted by high levels of depression and low current mood status. As in previous studies, the prediction of low QOL was associated with increased depressive symptoms, regardless of sleep problems (35–37). Furthermore, in children with unchanged sleep patterns, worse temporary mood status was also a predictor of lower QOL. A positive relationship between temporary mood status and QOL in children having unchanged sleep patterns is affected by sleep invoked sufficient emotional adjustment (38).

In summary, the QOL of children with a stable life schedule was affected not only by depressive tendencies but also temporary

moods. Therefore, they need to live a fulfilling life to maintain their QOL. However, the QOL of children with poor sleep patterns was affected only by depressive tendencies. Hence, it is important for clinicians that children with NDDs are correctly diagnosed with depression and treated for sleep problems.

In addition, the telerehabilitation (online rehabilitation) and online medical service for children with NDDs were constructed in several countries during the prolonged COVID-19 pandemic to continue care and adequate support to children and their families (39–41) and to ensure that the human rights of children with NDDs are protected, even during the emergency (42). It has been paying attention because of its ability to at least partially reduce the risk of hopelessness and loneliness, including anxious and depressive feelings related to the COVID-19 emergency. Since telecommunication in the medical field can be expected to improve the depression and well-being of children with NDDs, it is essential to build and improve the system in Japan.

Limitations

The first of the study's limitations relates to the sample size of patients analyzed, which was small, even though the questionnaire collection rate was 100%. It was because there were a limited number of participants due to the single-center study. The second is that it is unclear whether the QOL of children was lower during the COVID-19 pandemic than before because the QOL of children with NDDs is usually significantly lower than that of the general child population (18, 36, 43). Third, the clinical characteristics of the children who participated in this study might differ from those throughout Japan because there were regional differences in infectious disease pandemics based on population density. Fourth, it was impossible to accurately diagnose sleep disorders, as there were no interviews by doctors regarding children's sleep patterns and no sleep diaries from which to glean information. In the future, longitudinal studies analyzing sleep diaries of children with NDDs gain a clearer understanding of sleep disorders.

CONCLUSION

Among the study sample, 46.5% of children with NDDs had changed sleep patterns during the COVID-19 stay-at-home period. Of these, 19 children (22.1%) also showed a high tendency for depression and anxiety, respectively. Changed sleep patterns were associated with decreased QOL and internalized symptoms. The decreased QOL of children with changed sleep patterns was predicted by high depression. In addition, low QOL in children with unchanged sleep patterns was predicted by high levels of depression and low current mood status.

Since the adjustment of sleep schedule was associated with depressive states improvement and also their QOL, it is recommended that clinicians focus on children's regular sleep schedule as manifested during the COVID-19 stay-at-home period. The QOL and psychiatric status had to be evaluated by self-report as much as possible. Furthermore, it is necessary for children's keeping regular sleep schedules to maintain a system

for linkage of education, welfare services, and medical care even in critical situations.

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 human participants were reviewed and approved by the Institutional Review Board of the Shimada Ryoiku Center Hachioji (Shimahachi-2001). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

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AUTHOR CONTRIBUTIONS

RU, TO, and HO decided on the conception and design of the study. YO, HI, MS, YKo, CKo, YN, KA, AI, NS, YM, CKa, MK, and HO jointly carried out the acquisition of data (participant collection and data curation). RU and YKi performed the data analysis. RU wrote the manuscript. TO supervised this work and assisted with the writing of the manuscript. All the authors have approved the final article.

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Psychosocial Health and Physical Activity in People With Major Depression in the Context of COVID-19

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Introduction: Major depression is a psychiatric disease associated with physical inactivity, which in turn affects mental and physical health. A randomized controlled trial is being implemented to facilitate physical activity in people with major depression. In March 2020, Swiss state authorities temporarily legislated a lockdown to contain the Coronavirus disease-19 (COVID-19), which influenced health, behavior and research. The aim of this study was to find out whether data gathered before and during/after the lockdown among in-patients with major depression differ with regard to psychosocial health, physical activity and related attitudes and to establish whether baseline data have been affected by the lockdown.

Methods: This is a cross-sectional analysis within a randomized controlled trial. Physically inactive, adult in-patients diagnosed with major depression were recruited from four Swiss psychiatric clinics between January 2019 and December 2020. Psychosocial health was measured with questionnaires pertaining to stress, sleep and health-related quality of life. Physical activity was measured with the Simple Physical Activity Questionnaire. Explicit attitudes were measured with seven questionnaires pertaining to physical activity-related motivation and volition. Implicit attitudes toward physical activity were captured with a single target implicit association test.

Results: The sample consisted of 165 participants ($n = 119$ before lockdown, $n = 46$ during/after lockdown). No statistically significant differences were found between in-patients with major depression assessed before and during/after the COVID-19 lockdown with regard to psychosocial health (stress, $p = 0.51$; sleep, $p = 0.70$; physical component of health-related quality of life, $p = 0.55$; mental component of health-related quality of life, $p = 0.64$), self-reported physical activity ($p = 0.16$) and explicit as well as implicit attitudes toward physical activity ($p = 0.94$). Hence, the COVID-19-induced lockdown seems not to have led to group differences.

Conclusion: Baseline data gathered in in-patients suffering from major depression who are physically inactive upon admission to in-patient treatment in Switzerland seem to be unaffected by the COVID-19-induced lockdown. To assess changes in said population regarding psychosocial health and physical activity patterns over time, longitudinal data are needed.

Keywords: psychosocial health, COVID-19, depression, physical activity, attitudes, lockdown

INTRODUCTION

Major depressive disorder (MDD) is a psychiatric disease that affects 10–15% of people worldwide at least once in their lifetime (Lépine and Briley, 2011). Twenty to thirty percent of cases are chronic, lasting 2 years or longer (Riso et al., 2002) engendering suffering for the afflicted person and their social network from a psychological, medical, economical as well as social point of view (Pincus and Pettit, 2001). Population studies have found that depression symptoms as well as major depression are associated with double the risk of premature mortality (SMR = 1.9 in men; SMR = 2.1 in women); significantly higher risk of all-cause mortality (HR = 1.05; 95% CI = 1.02–1.10); and double the risk of cardiovascular, specifically stroke, mortality (OR = 2.24; 95% CI = 1.37–3.60) compared to general populations (Lépine and Briley, 2011). The relationship between MDD and physical activity seems to be bi-directional (De Moor et al., 2006; Lindwall et al., 2014). Longitudinal data show that people suffering from MDD tend more toward sedentary behavior (Firth et al., 2016; Stubbs et al., 2018). Thus, physical activity recommendations according to the World Health Organization stating a minimum of 150 min of moderate-to-vigorous physical activity per week (WHO, 2010) may not be adhered to. According to a meta-analytic analysis including data from North America, Europe and Australia, people with MDD spend 126 min (95% CI = 91.90–160.10) and 8.5 hours (95% CI = 7.51–9.62) per day engaging in all types of physical activity and sedentary behavior, respectively. Compared to healthy people, they spend a mean difference of –11.6 min (95% CI = –25.70–2.60) less being physically active and a mean difference of –0.2 h (95% CI = –19.7–0.8) more in sedentary behavior. These differences are deemed statistically significant ($p < 0.05$; Schuch et al., 2017). On the other hand, low levels of physical activity may perpetuate symptoms and even increase the risk for MDD (Mammen and Faulkner, 2013). This is also supported by meta-analytic data, which states that compared to people engaging in low levels of physical activity, those engaging in high levels have lower odds to develop MDD (OR = 0.83; 95% CI = 0.79–0.88), and that physical activity can have a protective effect across ages and geographic regions (Schuch et al., 2018). Inactivity leads to negative outcomes such as obesity, diabetes, more severe negative mental health symptoms and poor socio-occupational functioning (Firth et al., 2016).

Reasons for inactivity among people suffering from psychiatric illnesses can be physical co-morbidities such as obesity and diabetes as well as demographic influences such as sex (female), age (inverse) and lower educational level (Gerber et al., 2016a; Schuch et al., 2017). Additionally, psychological

determinants correlated with engaging in health behaviors such as motivation, self-efficacy and volition may be impacted in people with MDD (Bauman et al., 2012; Vancampfort et al., 2015; Cortis et al., 2017). In recent years, increasing evidence points toward behavior being a result of two different information processing systems; one deliberate system requiring reflection, the other automatic requiring minimal cognitive resources (Chaiken and Trope, 1999; Kahneman and Frederick, 2002; Strack and Deutsch, 2004). Hence, behavior can be considered deliberative and rational decision-making enhanced by automatic, subconscious processes (Calitri et al., 2009; Conroy et al., 2010; Hyde et al., 2010). Decision-making is a slow process running on self-regulatory resources such as planning and goal setting. These are explicit motivational processes regulating intentional physical activity (Deutsch and Strack, 2006; Vohs, 2006). Additionally, intrinsic motivation may increase positive attitudes toward physical activity, thus leading to greater participation in and adherence to a physically active lifestyle (Haase et al., 2010). Attitudes are not only regulated by explicit motivational processes but also by automatic evaluative processes (Strack and Deutsch, 2004). Implicit attitudes have been shown to explain behavior beyond explicit attitudes (Greenwald and Banaji, 1995; Calitri et al., 2009; Rebar et al., 2016). They can be described as mental associations between a concept (e.g., physical activity) and its positive or negative evaluation (Chen and Bargh, 1999; Calitri et al., 2009). Automatic evaluative processes may influence immediate decisions regarding the target behavior (Brand and Schweizer, 2015); however, changes within the system are slow and gradual (Deutsch and Strack, 2006). Non-conscious processes explain the repetitious nature of physical activity, aspects unaccounted for in intention and maintenance when self-control resources are depleted (Aarts et al., 1997; Dimmock and Banting, 2009; Friese et al., 2011; Marteau et al., 2012; Rebar et al., 2016). Thus, pre-existing positive automatic evaluation of exercise may act as a buffer for potentially negative experiences (Antoniewicz and Brand, 2016a). Furthermore, implicit attitudes have been shown to be associated with previous self-reported physical activity, attentional biases to physical activity cues (Calitri et al., 2009), and may predict automatic / unplanned physical activity (e.g., taking the stairs instead of the lift) as well as objectively measured physical activity (Conroy et al., 2010).

In December 2019, first cases of Coronavirus disease-19 (COVID-19) were reported in China (WHO, 2021). By February 2020, the first cases were confirmed in Switzerland and a state legislated lockdown commenced in March until the end of April 2020. During the months between April and October, many

restrictions were lifted; shops and restaurants re-opened, school recommenced as usual and sport facilities were accessible again. However, with increasing number of cases, protective measures were implemented again in October 2020. This included wearing masks in all public areas, restrictions of gatherings and recommendations for working from home (BAG, 2020). This ongoing pandemic is impacting lives as well as research in a multitude of ways. People may be experiencing mental health issues and decreases in well-being and mood, which in turn may be associated with negative impacts on lifestyle behaviors (Ammar et al., 2020). In an Australian nation-wide online survey, Stanton et al. (2020) found that people reporting negative changes in physical activity behavior had higher depression, anxiety and stress symptoms [see also Lindwall et al. (2014), Gerber et al. (2020), Meyer et al. (2020)]. These negative changes may have occurred because of the inaccessibility of gyms and outdoor spaces. When comparing online questionnaires before and during lockdown completed by healthy individuals in France and Switzerland, an increase of moderate physical activity and walking of about 10 min per day was found, whereas a decrease in vigorous physical activity became evident. Additionally, an increase in sedentary behavior of about 75 min per day was observed. Increased physical activity showed positive effects on physical health, whereas increased sedentary behavior had a negative influence on physical and mental health (Cheval et al., 2020). In line with findings from Stanton et al. (2020), changes in health behaviors are attributed to practical reasons, such as fewer opportunities to be physically active (Cheval et al., 2020). In addition, affective factors such as anxiety and stress are highlighted since they negatively influence mood and interest in activity (Cheval et al., 2020). Bi-directional effects of decreased mental health and physical activity have also been observed. According to an online survey conducted in the United Kingdom, a lockdown-induced reduction in physical activity may lead to increased symptoms of loneliness and depression, hence negatively impacting mental health (Creese et al., 2020). Not only do decreased physical activity levels influence mental health, self-isolation measures as experienced during quarantine may evoke feelings of anxiety and depression. These have been linked to long quarantine durations, fear of infection, frustration, boredom, inadequate supplies and information, financial loss and stigma (Brooks et al., 2020). For ongoing clinical trials, the COVID-19 pandemic has led to trials being stopped or paused. Issues such as missing data, incomplete follow-up, reduced on-site data monitoring with implications for data quality and integrity, missed treatments, changes in usual care and heterogeneity of patients included in trials are becoming prevalent in trial work (Kunz et al., 2020; Sathian et al., 2020). An analysis of data gathered before the pandemic can be helpful for deciding how to proceed (Kunz et al., 2020). Potential confounding caused by COVID-19 may also be detected by examining outcome rates before and during the pandemic (Tuttle, 2020). Trials, which have continued have been subject to decreased recruitment rates because of the need to reduce face-to-face interactions, and alternatives such as video conferences to obtain informed consent as well as collect data are being explored. Communication with clinic staff and sponsors has increased to develop individual

solutions regarding COVID-19 implications for access to patients and funding matters. Additionally, some interventions have been interrupted or adapted to adhere to social and physical distancing standards (Mitchell et al., 2020). This gap can be filled with tools developed in recent years such as telehealth and home-based testing or monitoring technologies. There have also been cases in which recruitment rates have recovered, where attention must be paid to the potential effect COVID-19 may have on the study outcomes. For example, pre-existing conditions may have changed and lifestyle changes may have been made to adhere to safety guidelines (Tuttle, 2020).

Given the fact that changes in physical activity, as well as psychosocial health, have been detected in COVID-19 associated research so far, a closer look at data collected during this time is warranted. Hence, the aim of this study was to assess any potential differences in psychosocial health (stress, sleep, health related quality of life), self-reported physical activity and explicit as well as implicit attitudes toward physical activity in in-patients suffering from MDD recruited and assessed before COVID-19 in Switzerland and those recruited and assessed during/after the COVID-19-induced lockdown. It is of interest to see if trends that have been recognized in the afore-mentioned cohort studies are also visible in this sample. Additionally, it is of importance for the conduct of this trial to assess whether the COVID-19-induced lockdown in March and April 2020 has impacted the integrity of the baseline data in light of the planned longitudinal analyses.

MATERIALS AND METHODS

Study Design

This is a cross-sectional analysis conducted within the PACINPAT randomized controlled trial (Physical Activity Counseling in In-Patients with Major Depression) taking place in four centers in three Swiss cantons (Basel, Solothurn, and Bern) (Gerber et al., 2019). Recruitment started in January 2019, paused from March to April 2020 because of a COVID-19-induced lockdown and was taken up again in May 2020 at half the rate (January 2019–February 2020, $N = 143$, $M = 10$ participants per month vs. March 2020–December 2020, $N = 52$, $M = 5$ participants per month). Participants were screened by clinic personnel and included in the trial upon providing written informed consent to a member of the study team. An individual, in person baseline assessment was completed during the first weeks of in-patient treatment conducted by a member of the study team. This consisted of a 90 min session in which demographic data, information regarding past and current depressive episodes, medication, secondary diagnoses, self-reported physical activity, and self-perceived fitness were collected via interview. Additionally, self-perceived fitness was assessed with a 1-item question: “Overall, how would you rate your physical fitness?” This question was answered on a scale ranging from 1 (very poor fitness) to 10 (excellent fitness). Psychosocial health (psychosocial stress, sleep and health-related quality of life) and explicit attitudes (physical activity-related intention, self-concordance, self-efficacy, action and planning coping, outcome expectancies, perceived barriers, and social support) toward physical activity were assessed with

corresponding questionnaires (see below for more details). Implicit attitudes toward physical activity were assessed with a computer-based single target implicit association test. At this time, the participants did not receive any instructions regarding physical activity from the study team.

Participants and Procedures

The current study sample consists of in-patients who were being treated for unipolar major depressive disorder at the time of recruitment and data collection. The inclusion criteria were as follows: women and men between 18 and 65 years, ICD-10 diagnosed depressive episode (single episode or recurrent), Beck Depression Inventory score (BDI) of at least 17 representing clinical depression, physical inactivity as defined by <150 min of moderate-to-vigorous physical activity per week prior to in-patient treatment, and adequate German language skills. The eligible patients, who provided written informed consent were included in the study. The patients were recruited at varying durations of clinic stay, and were receiving various pharmacological and complementary treatments. Physical activity 1 week prior to admission to in-patient treatment was measured with the International Physical Activity Questionnaire (IPAQ) in which days per week and minutes per day spent in physical activity are used to calculate a total amount of minutes per week spent in moderate-to-vigorous physical activity. According to a validation and reliability study, this measure is sufficiently representative of physical activity behavior (Craig et al., 2003). Depression severity was measured with the BDI, a 21-item self-report instrument used to assess the symptoms and attitudes referring to depression. Items are rated from 0 to 3 in terms of intensity, individual item scores are added to reach a total score. Scores below 10 indicate no or minimal depression, scores between 10 and 18 mild-to-moderate depression, scores between 19 and 29 moderate-to-severe depression and scores between 30 and 63 severe depression (Beck et al., 1988). According to meta-analytic analysis, the BDI has high internal consistency, content validity, sensitivity to change, and validity in differentiating between subjects. Thus, its psychometric properties are acceptable and recognized worldwide (Richter et al., 1998). Six patients were recruited despite a BDI score < 17 based on the lead physician's estimation of sufficient depression severity. In addition, depression severity was assessed using the Hamilton Depression (HAMD) scale, which is a structured clinical interview. Scores range from 0 to 52 with higher scores representing more severe depression symptoms. This is a valid instrument with high discriminatory sensitivity (Fava et al., 1982). In addition, comparative reliability and validity have been established (Endicott et al., 1981).

All procedures received ethical approval from the "Ethikkommission Nordwest- und Zentralschweiz" and the "Ethikkommission Bern" (approval number: 2018-00976). Additionally the PACINPAT trial is registered in the ISRCTN registry (ISRCTN10469580) and the study protocol is published for more details (Gerber et al., 2019). All procedures are in line with the guidelines for Good Clinical Practice (ICH GCP) and with the ethical standards defined in the Declaration of Helsinki.

Measures

Internal consistency of the questionnaires for the current study was measured by calculating the Cronbach's alpha (including 95% CIs) for each questionnaire individually. Values of ≥ 0.70 were deemed as satisfactory (Bland and Altman, 1997).

Psychosocial Health

Psychological Stress

The Perceived Stress Scale (PSS) was used to assess the degree to which, in the past month, life was appraised as unpredictable, uncontrollable and overloaded (Cohen et al., 1983). The ten questions were answered on a scale from 1 (never) to 5 (very often) (e.g., "In the last month, how often have you been upset because of something that happened unexpectedly?"). To obtain the score, positive items (questions 4, 5, 7, and 8) were reversed, then the total sum over all items was calculated, hence the score ranges from 0 to 40, with higher scores reflecting higher perceived stress levels. A review on the psychometric properties revealed Cronbach's alpha ranging from 0.78 to 0.91 across cultures (Lee, 2012). A German translation of the tool was validated in a representative German sample with satisfactory internal consistency and construct validity (Klein et al., 2016). The internal consistency in the present sample was satisfactory (Cronbach's alpha: $\alpha = 0.80$, 95% CI = 0.74–0.84). The mean score across both groups was $M = 37.14$ (95% CI = 36.28 to 37.99).

Sleep

To measure symptoms and consequences of insomnia, which can be a common complaint in MDD (WHO, 2004), the seven-item Insomnia Severity Index (ISI) covering sleep complaints over the last 10 weeks was used. Three items relate to onset and maintenance (during the night and in the morning) of sleep on a scale from 0 (no difficulties) to 4 (very difficult). One item addresses satisfaction with sleep pattern, also ranging from 0 (very satisfied) to 4 (very dissatisfied). The next item refers to the extent to which the sleep problem interferes with daily functioning ranging from 0 (not at all) to 4 (very much). A further item relates to the perceived noticeability of others regarding the link between sleep problems and impaired quality of life of the person in question also ranging from 0 (not at all) to 4 (very much). The last item captures the degree to which the sleep problem causes distress on a scale from 0 (not at all) to 4 (very much). The final score is computed by the sum of all items which ranges from 0 to 28 with higher scores indicating higher levels of insomnia (0–7 = no clinical insomnia, 8–14 = subthreshold insomnia, 15–21 = moderate clinical insomnia, 22–28 = severe clinical insomnia). This is a self-reported measure which can be completed in 5 min (Bastien et al., 2001). Reliability as well as concurrent and content validity were deemed satisfactory for the original English questionnaire (Bastien et al., 2001) as well as the German translation (Gerber et al., 2016b) used in this study. The internal consistency in the present sample was satisfactory ($\alpha = 0.77$, 95% CI = 0.71–0.82). The mean score across both groups was $M = 12.11$ (95% CI = 11.24–12.98).

Health-Related Quality of Life

The Medical Outcomes Study Short Form 12 (SF-12) was used to assess health-related quality of life. This questionnaire originated in a longer form, SF-36 including eight domains: general health, physical functioning, social functioning, role limitations caused by physical problems, role limitations caused by emotional problems, mental health, vitality and bodily pain. The reliability of this questionnaire has been tested in both general and psychiatric populations, and has been proven to be internally consistent and valid in people with depression (McHorney et al., 1994; Leidy et al., 1998). It was found that two factors, the Physical Component Summary (PCS) and Mental Component Summary (MCS) account for >80% of the variance of individual scales with reliability estimates usually exceeding 0.90 (Ware et al., 1994). Additionally, these factors require fewer items and are easy to interpret. In the shorter form (SF-12) the PCS and MCS have been found to correlate highly with those of the SF-36 (Ware et al., 1996). Sound psychometric properties of the SF-12 in people with severe mental illness have been proven (Salyers et al., 2000). Both PCS and MCS scores range from 0 to 100 with higher scores indicating higher health-related quality of life correspondingly. In the present sample, the internal consistency was satisfactory for both the PCS and MCS ($\alpha = 0.76$, 95% CI = 0.70–0.82 and 0.70, 95% CI = 0.62–0.77, respectively). The mean scores across both groups were $M = 49.21$ (95% CI = 47.83–50.60) for the Physical Component Summary and $M = 26.60$ (95% CI = 25.61 to 28.19) for the Mental Component Summary.

Self-Reported Physical Activity

The Simple Physical Activity Questionnaire (SIMPAQ), a questionnaire conducted as a personal interview consisting of five categories (time spent in bed, in sedentary behavior, walking, in structured exercise and in incidental physical activity), was used (SIMPAQ, 2020). It was developed for populations at high risk of increased levels of sedentary behavior, such as people suffering from psychiatric illness. The sum of all categories should equal 24 h, representing an average day in the previous week. There is no minimum time requirement set in any category. Intensities are not included except in the category of structured exercise, in which the number of sessions per week and time as well as intensity spent in each session is recorded. The intensity is elicited via a visual analog scale ranging from zero to ten. A large-scale validation study is being conducted to compare SIMPAQ results with accelerometer-based data (Rosenbaum and Ward, 2016). However, an exploratory study in a sample of healthy young adults was conducted. Significant correlations ($p < 0.001$) were found for moderate-to-vigorous physical activity between self-reported and accelerometer-based data ($\rho = 0.49$). This study also includes the validation of the German language translation (Schilling et al., 2018).

Explicit Attitudes Toward Physical Activity

Physical Activity-Related Intention

The following one item was used to assess participants' intention to engage in physical activity: "How strong is your intention to be physically active in the next weeks and months?" Answer options

range from 0 (no intention) to 5 (very strong intention). This measure is reliable and valid according to previous studies (Seelig and Fuchs, 2006; Gerber et al., 2011).

Physical Activity-Related Self-Concordance

Four subscales of motivation: intrinsic ("I would exercise because it is just fun"), identified ("I would exercise because I have good reasons to be physically active"), introjected ("I would exercise because otherwise I would have a guilty conscience") and extrinsic ("I would exercise because others tell me to") were assessed with the 12-item self-concordance scale (Seelig and Fuchs, 2006). All items are answered on a 6-point Likert scale ranging from 1 (not at all true) to 6 (completely true). The scores of the three questions pertaining to intrinsic motivation were added, and the mean derived to obtain a score for intrinsic motivation. The same was done for all subscales. This instrument has proven to be psychometrically sound (Seelig and Fuchs, 2006; Fuchs et al., 2012). In the present sample, the internal consistencies for all subscales was as follows: intrinsic: $\alpha = 0.71$ (95% CI = 0.62–0.78), identified: $\alpha = 0.54$ (95% CI = 0.40–0.65), introjected: $\alpha = 0.69$ (95% CI = 0.60–0.77) and extrinsic: $\alpha = 0.72$ (95% CI = 0.63–0.79). Cronbach's alpha for the overall scale was $\alpha = 0.69$ (95% CI = 0.62–0.76). Despite the Cronbach's alpha for the subscale of identified motivation being below the acceptable threshold, this was accepted given the sample size and the acceptability of the overall scale value of Cronbach's alpha. The mean score across both groups was $M = 3.59$ (95% CI = 3.51–3.67).

Physical Activity-Related Self-Efficacy

Physical activity related self-efficacy was assessed with a 3-item score, with answers ranging from 0 (not at all confident) to 5 (100% confident in myself). The contents include self-efficacy beliefs regarding the initiation, maintenance and resumption of physical activity (e.g., "I feel confident to start with a new exercise activity"). The mean score is calculated from the three items, with higher scores representing higher self-efficacy levels. This questionnaire has been validated in a previous study (Fuchs, 2008). The internal consistency in the present sample was satisfactory ($\alpha = 0.82$, 95% CI = 0.77–0.87). The mean score across both groups was $M = 3.61$ (95% CI = 3.45 to 3.76).

Physical Activity-Related Action Planning

A 5-item questionnaire was used to measure action planning (Sniehotta et al., 2005). Questions pertain to when, where, how, how often and with whom participants are usually physically active. Answers range from 1 (not at all true) to 4 (completely true). The mean represents the final score with higher values indicating higher levels of pre-planned physical activity. Reliability and validity have been established in previous studies (Sniehotta et al., 2005; Gerber et al., 2011). The internal consistency in the present sample was satisfactory ($\alpha = 0.81$, 95% CI = 0.77–0.86). The mean score across both groups was $M = 2.64$ (95% CI = 2.54–2.75).

Physical Activity-Related Coping Planning

A 5-item questionnaire was used to evaluate coping planning (Sniehotta et al., 2005). On a 4-point Likert scale, participants

give information pertaining to the extent to which they implement self-regulatory strategies to overcome barriers. One such question is “I have made a detailed plan regarding what to do in difficult situations in order to act in accordance to my intentions.” Answers range from 1 (not at all true) to 4 (completely true). The final score consists of the mean of all items. Psychometric properties have been evaluated resulting in acceptable reliability and validity of the scale (Sniehotta et al., 2005; Gerber et al., 2011). The internal consistency in the present sample was satisfactory ($\alpha = 0.84$, 95% CI = 0.79–0.88). The mean score across both groups was $M = 2.11$ (95% CI = 1.99–2.22).

Physical Activity-Related Outcome Expectancies

Nine positive (e.g., “If I exercise or am physically active, I become more flexible”) and seven negative formulations (e.g., “If I exercise or am physically active, I could injure myself”) are provided to assess outcome expectancies (Fuchs, 1997). Answers range from 1 (not true) to 4 (completely true). The mean is calculated for positive as well as negative outcome expectancies, with higher scores indicative of higher positive or negative outcome expectancies correspondingly. This instrument has been proven to be reliable and valid (Fuchs, 1997; Fuchs et al., 2012). The internal consistency in the present sample was satisfactory for both positive ($\alpha = 0.77$, 95% CI = 0.71–0.82) and negative outcome expectancies ($\alpha = 0.74$, 95% CI = 0.67–0.80). The mean scores across both groups were $M = 3.23$ (95% CI = 3.16–3.30) for positive outcome expectancies and $M = 2.00$ (95% CI = 1.92–2.09) for negative outcome expectancies.

Physical Activity-Related Perceived Barriers

A 19-item tool was used to assess perceived barriers to physical activity (Krämer and Fuchs, 2010). Items take on the following nature: “I have too much work to do.” Answers range from 1 (almost never) to 4 (almost always). The mean is computed representing the overall score. Satisfactory psychometric properties have been proven in previous studies (Krämer and Fuchs, 2010; Kramer et al., 2014). The internal consistency in the present sample was satisfactory ($\alpha = 0.84$, 95% CI = 0.80–0.88). The mean score across both groups was $M = 2.13$ (95% CI = 2.06–2.21).

Physical Activity-Related Social Support

A 7-item index, which has proven reliability and validity, was used to measure social support (Gerber et al., 2010). Questions addressed the extent to which the participant experiences support from their social network (e.g., “Close family or friends help me plan my exercise”). Answers range from 1 (almost never) to 4 (almost always). The overall score is represented by the mean with higher values indicating more social support compared to low values. The internal consistency in the present sample was satisfactory ($\alpha = 0.88$, 95% CI = 0.84–0.90). The mean score across both groups was $M = 2.43$ (95% CI = 2.32–2.54).

Implicit Attitudes Toward Physical Activity

The computer-based Single Target-Implicit Association Test (ST-IAT) was used to assess implicit attitudes toward physical activity (Greenwald et al., 1998). It is a response-time based test using a

target concept, in this case physical activity, and target categories, in this case good and bad. The visual stimuli were people exercising displaying no obvious affect as well as emoticons (smileys and frownies) (Greenwald et al., 2003). First, the participants were instructed to accurately categorize the stimuli by pressing a button corresponding to the respective target category. The test was initiated with a practice block containing 16 trials, in which only the emoticons had to be categorized as good (smileys) or bad (frownies). Following a fixation period of 250 ms, stimuli were presented until a response was collected. After the initial block, participants were instructed to assign emoticons and target images to one of the response categories, which presented sport either along with the good or bad category. The order of the categorization was counterbalanced across participants. Participants completed two blocks with 32 trials each, which were preceded by 16 practice trials to reduce learning effects. Upon incorrect response, a repetition took place at the end of the block. For statistical analysis, the D-score was calculated by dividing the ST-IAT raw scores (reaction time difference between the two block types) by the within-subject standard deviation of reaction times. The D-score can take on values between -2 and $+2$ and the interpretation goes as follows: 0.15 = slight, 0.35 = moderate, 0.64 = strong preference/aversion (Blanton et al., 2015). This version has been developed specifically for inactive in-patients suffering from depression using E-prime 2.0 (PST, USA) software and images obtained from Adobe Stock and has been pilot tested. General reliability and discriminant validity of the ST-IAT has been well-established (Greenwald et al., 2003; Bluemke and Friese, 2008; Blanton et al., 2015; Antoniewicz and Brand, 2016b).

Given that sustained attention may affect ST-IAT scores (Wright and Meade, 2012) this cognitive domain was assessed using a computerized Oddball Paradigm (Calitri et al., 2009) administered with E-Prime 2.0 (PST, USA). Task instructions were presented on the screen. Speed and accuracy were equally emphasized across both tests. The Oddball Paradigm required participants to press one button to frequent stimuli (75%) and another button to infrequent stimuli (25%). Visual stimuli were the letters “X” and “O” and the stimulus-response mapping was counterbalanced across participants. Following an inter-stimulus interval varying randomly between 800 and 1,500 ms, visual stimuli were presented over 250 ms and responses were allowed within 1,000 ms. The task encompassed a practice block of 10 trials and two test blocks with 40 trials each. Reaction time (on response-correct trials) accuracy were extracted for analyses. Reliability for the oddball paradigm has been proven in a previous study (Williams et al., 2005).

Statistical Analyses

Descriptive statistics (M , SD , n , and %) were calculated for the total sample ($N = 165$) as well as both groups: pre-lockdown ($N = 119$) and post-lockdown ($N = 46$). Kolmogorov-Smirnov and Shapiro Wilk tests revealed that the assumptions of normality of the populations and homogeneity of population variance were violated in part. Hence, differences in potential confounders were measured with Brown Forsythe (BF) one-way Analyses of Variance (ANOVAs) to additionally adjust for unequal sample

TABLE 1 | Descriptive statistics and differences in potential confounders.

	Total sample (<i>N</i> = 165) M (SD)	Pre-lockdown (<i>N</i> = 119) M (SD)	Post-lockdown (<i>N</i> = 46) M (SD)	Brown Forsythe		ANOVA		
				<i>F</i>	<i>p</i>	<i>F</i>	<i>p</i>	η^2
Metric variables								
Age (years)	41.88 (12.48)	41.94 (12.29)	41.74 (13.09)	0.01	0.93	0.01	0.93	<0.001
Education (years)	14.10 (3.41)	14.02 (3.58)	14.29 (2.94)	0.24	0.62	0.20	0.65	<0.001
BDI score at screening	28.72 (8.78)	28.14 (9.08)	30.32 (7.73)	2.01	0.16	1.72	0.19	0.01
BDI score at baseline	21.36 (9.83)	21.71 (9.95)	20.55 (9.62)	0.45	0.51	0.43	0.51	<0.001
HAMD at baseline	13.44 (5.25)	14.03 (5.09)	11.89 (5.39)	5.39	0.02	5.67	0.02	0.03
Prior episodes (number of)	2.90 (6.13)	3.24 (7.16)	2.13 (2.51)	1.95	0.16	1.05	0.31	0.01
Age (years) at 1st episode	32.03 (14.20)	31.77 (14.11)	32.62 (14.55)	0.11	0.74	0.11	0.74	<0.001
Pre-clinic PA (min/week)	33.29 (49.33)	28.85 (47.04)	41.55 (52.90)	1.70	0.20	1.82	0.18	0.01
Perceived fitness (1–10)	3.77 (1.56)	3.82 (1.56)	3.65 (1.56)	0.39	0.53	0.39	0.53	<0.001
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	χ^2	phi			
Categorical variables								
Sex				0.70	−0.06			
Women	84 (51)	63 (53)	21 (46)					
Men	81 (49)	56 (47)	25 (54)					
Primary diagnosis				2.96	0.13			
F32.1	39 (24)	30 (25)	9 (19)					
F32.2	22 (13)	18 (15)	4 (9)					
F32.3	2 (1)	1 (1)	1 (2)					
F33.1	71 (43)	50 (42)	21 (46)					
F33.2	31 (19)	20 (17)	11 (24)					
Civil status				2.82	−0.13			
Single	113 (68)	77 (65)	36 (78)					
Married	52 (32)	42 (35)	10 (22)					
Employment (pre-clinic)				0.03	−0.01			
Yes	124 (75)	89 (75)	35 (76)					
No	41 (25)	30 (25)	11 (24)					
Yearly income				1.18	0.09			
<50,000 CHF	55 (42)	38 (43)	17 (39)					
50,000–100,000 CHF	51 (38)	35 (40)	16 (36)					
>100,000 CHF	26 (20)	15 (17)	11 (25)					

BDI, Beck Depression Inventory; HAMD, Hamilton Depression Score; PA, physical activity; Perceived fitness scale ranging from 1 = not fit to 10 = very fit. F32.1, major depressive disorder, single episode, moderate; F32.2, major depressive disorder, single episode, severe; F32.3, major depressive disorder, single episode, severe, with psychotic features; F33.1, major depressive disorder, recurrent, moderate; F33.2, major depressive disorder, recurrent, severe; CHF, Swiss Francs.

sizes. Differences in categorical variables were measured with χ^2 -tests. The BF procedure is robust, thus known to control Type 1 errors given heterogeneity of variance (Lix et al., 1996). To further analyze group differences in psychosocial health, physical activity and explicit as well as implicit attitudes toward physical activity, Analyses of Covariance (ANCOVAs) using age, sex and number of previous episodes as covariates as defined in the study protocol were conducted. Additionally, for implicit attitudes, sustained attention was controlled for by including reaction time on infrequent targets as a covariate. To test whether sex had a moderating effect, a two-factorial ANCOVA was carried out with the factors group (pre- vs. post), sex (female vs. male) and group by sex interactions. Effect sizes and partial eta-squared (η^2) were computed to determine the relative degree

of variance associated with each of the main effects. Statistical significance was set at $p < 0.05$ across all analyses. All analyses were conducted in SPSS software for Windows (version 26, IBM Corp., Armonk, NY, USA).

RESULTS

Descriptive Statistics

As shown in Table 1, the sample consisted of approximately equal amounts of women and men who were on average middle-aged, single, employed before in-patient treatment and most of whom, were diagnosed with moderate recurrent depression. As reflected in BDI-scores at screening compared to baseline, depression scores reduced in line with being in in-patient treatment. HAMD

TABLE 2 | Between-group differences in psychosocial health.

	Pre-lockdown		Post-lockdown		Brown Forsythe		ANCOVA		
	M	SD	M	SD	F	p	F	p	η^2
Psychosocial health									
Stress	36.88	5.84	37.55	4.57	0.43	0.51	3.76	0.05	0.03
Sleep	12.23	5.17	11.82	6.31	0.15	0.70	0.26	0.61	<0.001
PCS	48.95	8.75	49.87	8.45	0.36	0.55	0.01	0.91	<0.001
MCS	26.71	8.22	27.36	7.69	0.21	0.64	0.41	0.52	<0.001

PCS, physical component scale of the SF-12; MCS, mental component scale of the SF-12.
Brown Forsythe without co-variables.

scores differed statistically significantly between pre-lockdown ($M = 14.03$, $SD = 5.10$) and post-lockdown [$M = 11.89$, $SD = 5.40$, Brown Forsythe: $F_{(1, 77.8)} = 5.39$, $p = 0.02$, ANOVA: $F_{(1, 163)} = 5.67$, $p = 0.02$, $\eta^2 = 0.03$], and were thus taken into account as co-variables in further analyses. Furthermore, the sample did not reach the weekly recommended 150 min of moderate-to-vigorous physical activity and perceived their fitness below average. Information about medication, specific antidepressants and secondary diagnoses is provided as supplementary material (see **Supplementary Tables 1–3**).

Between-Group Differences in Psychosocial Health and Stress

Table 2 shows that there were no statistically significant between-group differences with regard to psychosocial health (stress, sleep, physical and mental quality of life). Perceived stress scores in both groups were high (scores ranging from 0 to 40). The sample exhibited subthreshold insomnia (scores between 8 and 14). Both groups revealed relatively low scores in perceived physical and mental health with perceived mental health rated lower than physical health in both groups. Participants with a secondary diagnosis relating to physical health had lower scores for physical health ($M = 46.93$, $SD = 8.58$) than in the participants with no secondary diagnosis relating to physical health ($M = 51.11$, $SD = 8.28$).

Between-Group Differences in Self-Reported Physical Activity and Explicit and Implicit Attitudes Toward Physical Activity

Table 3 shows that there were no statistically significant differences in self-reported physical activity levels. However, the post-lockdown group did achieve the recommended 150 min of moderate-to-vigorous physical activity per week ($M = 170.10$, $SD = 149.74$ min/week) whereas the pre-lockdown group did not ($M = 137.42$, $SD = 144.70$ min/week). Additionally, there were no statistically significant differences in explicit (intention, motivation, self-efficacy, planning, coping, positive and negative expectancies barrier and social support) or implicit attitudes toward physical activity. Results show that the sample had the intent to be physically active and they were most driven by intrinsic and identified motivation. Scores for planning physical

activity, coping with physical activity related barriers, perceived barriers and social support were low in both groups (scores ranging from 1 to 6). Yet negative outcome expectancies were low and positive ones were high, indicating that the participants may have had more positive attitudes toward the expected outcomes they may gain from physical activity. These results, which may be interpreted as a leaning toward positive explicit attitudes, seem in accordance with the ST-IAT scores, which indicated slight implicit preference for physical activity in both groups.

Table 4 shows a small yet statistically significant difference between women and men [$F_{(1, 131)} = 4.88$, $p = 0.03$, $\eta^2 = 0.04$], regarding positive outcome expectancies of physical activity with women reporting higher rates of positive outcome expectancies compared to men.

DISCUSSION

The main finding from this analysis is that there are no statistically significant differences between in-patients with MDD recruited and assessed before and during/after the COVID-19-induced lockdown with regard to psychosocial health (stress, sleep, health-related quality of life), self-reported physical activity and explicit as well as implicit attitudes toward physical activity.

Hence, the COVID-19-induced lockdown is not likely to have impacted the baseline data collected during this ongoing trial. This is an important finding because the COVID-19 pandemic has had a negative impact on the conduct of clinical trials especially in vulnerable samples (van Dorn, 2020). The successful reuptake of recruitment and data collection in this trial was largely because the systems in place were linked to care as usual. Additionally, these activities took place on site with a maximum of two individuals in a room, wearing masks and practicing physical distancing. The continuation of quality research is needed especially in this time to overcome existing as well as COVID-19 related conditions. For example, research on physical activity behavior may be particularly important as it may have protective effects. It is known that regular moderate exercise contributes to a well-functioning immune system through reductions in inflammation, alterations in the composition of immune cells and relief of psychological stress (Simpson et al., 2015). The effects of physical activity on the immune system can be particularly meaningful with regard to viral diseases, hence, it is suggested that physical activity could

TABLE 3 | Between-group differences in self-reported physical activity and explicit and implicit attitudes toward physical activity.

	Pre-lockdown		Post-lockdown		Brown forsythe		ANCOVA		
	M	SD	M	SD	F	p	F	p	η^2
Self-reported physical activity									
Minutes per week	137.42	144.70	170.10	149.74	2.05	0.16	0.82	0.37	0.01
Explicit attitudes toward physical activity									
Intention	3.82	1.05	3.88	1.03	0.34	0.56	0.09	0.76	<0.001
Intrinsic motivation	3.88	1.06	3.88	0.96	0.09	0.77	0.02	0.89	<0.001
Identified motivation	4.85	0.71	4.84	0.64	0.02	0.89	0.01	0.91	<0.001
Introjected motivation	3.57	1.05	3.53	0.92	<0.001	0.98	<0.001	1.00	<0.001
Extrinsic motivation	2.19	1.03	2.18	0.93	0.01	0.92	0.03	0.86	<0.001
Self-efficacy	3.62	0.99	3.52	1.01	0.53	0.47	1.67	0.20	0.01
Planning	2.62	0.68	2.74	0.61	1.51	0.22	0.32	0.57	<0.001
Coping	2.12	0.68	2.14	0.61	0.18	0.67	<0.001	0.95	<0.001
Positive expectancies	3.23	0.38	3.19	0.52	0.45	0.50	0.18	0.67	<0.001
Negative expectancies	2.06	0.57	1.86	0.46	5.62	0.02	2.69	0.10	0.02
Barriers	2.17	0.49	2.05	0.38	2.34	0.13	0.50	0.48	<0.001
Social support	2.33	0.71	2.58	0.72	2.88	0.09	2.96	0.09	0.02
Implicit attitudes toward physical activity									
D-Score	0.16	0.44	0.19	0.44	<0.001	0.94	0.42	0.52	<0.001

Brown Forsythe without co-variables.

TABLE 4 | Between-group differences in psychosocial health, self-reported physical activity and explicit/implicit attitudes toward physical activity, with group by sex interactions.

	Group 1: Pre-lockdown (N = 119)		Group 2: Post-lockdown (N = 46)		Group		Sex		Group x sex	
	Women	Men	Women	Men	F	η^2	F	η^2	F	η^2
	M (SD)	M (SD)	M (SD)	M (SD)						
Psychosocial health										
Stress	37.89 (6.17)	35.87 (5.38)	37.35 (4.50)	37.71 (4.72)	3.47	0.03	0.06	<0.001	1.79	0.01
Sleep	12.90 (5.09)	11.48 (5.38)	11.65 (7.00)	11.96 (5.83)	0.22	<0.001	0.03	<0.001	0.48	<0.001
PCS	47.53 (9.56)	50.46 (7.23)	50.89 (8.08)	48.93 (8.85)	0.02	<0.001	0.16	<0.001	2.03	0.02
MCS	26.30 (8.94)	27.61 (7.81)	27.08 (7.40)	27.62 (8.10)	0.40	<0.001	0.12	<0.001	0.02	<0.001
Self-reported physical activity										
Minutes per week	130.63 (138.64)	144.16 (151.64)	161.20 (137.08)	177.58 (162.03)	0.80	0.01	0.21	<0.001	0.01	<0.001
Explicit attitudes										
Intention	3.84 (1.07)	3.80 (1.04)	3.63 (1.01)	4.08 (1.02)	0.16	<0.001	0.91	0.01	0.15	0.01
Intrinsic motivation	3.94 (1.05)	3.83 (1.08)	3.89 (0.97)	3.89 (0.97)	0.02	<0.001	0.30	<0.001	0.09	<0.001
Identified motivation	4.89 (0.74)	4.81 (0.70)	4.81 (0.81)	4.87 (0.46)	0.02	<0.001	0.03	<0.001	0.39	<0.001
Introjected motivation	3.49 (1.10)	3.66 (1.00)	3.62 (0.90)	3.46 (0.95)	<0.001	<0.001	<0.001	<0.001	1.08	0.01
Extrinsic motivation	2.14 (1.16)	2.24 (0.88)	1.94 (0.85)	2.38 (0.96)	0.02	<0.001	2.49	0.02	0.76	0.01
Self-efficacy	3.64 (0.96)	3.60 (1.03)	3.43 (1.02)	3.60 (1.01)	1.74	0.01	0.01	<0.001	0.45	<0.001
Implementation	2.72 (0.61)	2.52 (0.75)	2.74 (0.55)	2.75 (0.67)	0.26	<0.001	1.31	0.01	1.11	0.01
Coping	2.23 (0.65)	2.00 (0.70)	2.04 (0.70)	2.23 (0.52)	0.02	<0.001	0.38	<0.001	3.73	0.03
Positive expectancies	3.31 (0.37)	3.16 (0.37)	3.29 (0.61)	3.10 (0.42)	0.17	<0.001	4.88*	0.04	0.08	<0.001
Negative expectancies	2.00 (0.56)	2.12 (0.58)	1.77 (0.49)	1.93 (0.44)	2.72	0.02	3.87	0.03	0.10	<0.001
Barriers	2.16 (0.46)	2.18 (0.53)	2.08 (0.35)	2.03 (0.41)	0.47	<0.001	0.19	<0.001	0.14	<0.001
Social support	2.28 (0.72)	2.38 (0.70)	2.56 (0.68)	2.61 (0.77)	2.93	0.02	0.39	<0.001	0.02	<0.001
Implicit attitudes										
D-Score	0.13 (0.46)	0.19 (0.43)	0.20 (0.50)	0.15 (0.40)	0.24	<0.001	0.04	<0.001	0.92	0.01

*p < 0.05. PCS, physical component scale of the SF-12; MCS, mental component scale of the SF-12.

be an important complement to preparing the immune system to fight COVID-19 infections (da Silveira et al., 2020). Additionally, being physically active has been shown to be associated with a lower prevalence of COVID-19 related hospitalizations (de Souza et al., 2020). When regarding the effect of physical activity on mortality caused by respiratory diseases in general, such as influenza, a study found that those adults performing low, moderate or frequent exercise were less at risk of mortality compared to those never or rarely engaging in exercise (Wong et al., 2008). Furthermore, a study conducted in elderly men examining different training patterns in relation to vaccine response found that both moderate and intense training patterns are associated with high antibody responses, which also last longer (de Araújo et al., 2015). In addition, regular physical activity during the pandemic may lead to fewer self-reported symptoms of depression and anxiety. This is especially true when comparing physical activity to no physical activity, or activity performed with lower volume and frequency. According to a rapid systematic review, there is no consensus regarding the exact volume and frequency of physical activity, however, in the included studies vigorous physical activity done regularly as opposed to irregularly was significantly associated with fewer depression symptoms (Wolf et al., 2020). This is of particular relevance for this sample population, which shows low levels of self-reported physical activity and may be at risk of decreased immune response.

One characteristic of the current pandemic contributing to psychological stress is social isolation, which has resulted from protective measures put in place (Clemente-Suárez et al., 2020). Isolation and the accompanying loneliness are associated with depression (Matthews et al., 2016) while depression is also associated with a small social network (Domènech-Abella et al., 2017). In combination this delineates the distinction between emotional and social loneliness and that both are present in symptoms of depression (Domènech-Abella et al., 2017). Hence, a hypothesis could be that people already suffering from depression may not notice the decline in social contact brought on by COVID-19 as much compared to healthy populations. Additionally, in the current sample, the participants were not in their everyday environment, but in in-patient treatment where social interactions are provided and encouraged (Holsboer-Trachsler et al., 2016). Another noteworthy point regarding psychosocial stress levels is that the current population had high levels of perceived stress in both groups. Hence, it could be hypothesized that the stress levels in the current sample of in-patients with MDD were at a level at which the addition of the pandemic may not have had a further impact. With regard to the lack of difference in sleep patterns, complaints may have been addressed by the structured nature of in-patient treatment and medication regimes. On the topic of health-related quality of life, it is known that people reporting increased symptoms of depression also generally report poorer health-related quality of life (lower scores in the chosen measuring instrument) involving physical, psychological and social domains which in turn may negatively affect functioning. The implications thereof are that dysfunctions can be targeted in tailored therapy settings (Daly et al., 2010). The association between poor

health-related quality of life and increased depression symptoms has also been confirmed in people with major depression (Sivertsen et al., 2015). A lack of difference in psychosocial health may be explained by the population at hand. Previous evidence shows that there are negative influences of COVID-19 on psychosocial health, however particularly in children, older people and their care-givers. When considering people with psychiatric conditions it is especially those suffering from obsessive-compulsive disorder (OCD) and those at risk of relapse or discontinuation of therapy who are at risk (Dubey et al., 2020). In this population all participants were in in-patient care and receiving therapy, thus the possibility of relapse was very low. When looking at other research being done in the area of psychosocial distress in the context of COVID-19, studies can be found on university students (Villani et al., 2021), health care workers (Shayganfard et al., 2021) and the general population (Wang et al., 2020). Further indicating that a change in people already diagnosed with major depression has not been investigated and may, for the afore-mentioned reasons, not be particularly likely.

A lack of difference in physical activity in the context of COVID-19 has also been found in Swiss office workers. According to IPAQ assessments, 75% of the participants reached physical activity recommendations and there was no significant evidence of decreased physical activity comparing measures in January to April 2020. Seventeen per cent reported less activity, while 29% even reported more activity (Aegerter et al., 2021). Similar results are found in Iranian adults engaging in team sports. Here physical activity intensity did decrease, however, frequency increased and physical activity patterns were unrelated to mood (Aghababa et al., 2021). Increases in physical activity from screening to baseline in this study may be attributable to different patterns of behavior when living at home vs. being in in-patient treatment. The large standard deviations may be explained by the range of physical activity (0–150 min per week) permitted according to the inclusion criteria. Corresponding to the level of physical activity, the related explicit attitudes elicited from the questionnaires indicate a positive inclination. This can be explained by the fact that they all enrolled in a trial to facilitate a more physically active lifestyle. Hence, a certain interest in becoming more active could be expected as can also be confirmed when taking into consideration that intrinsic motivation levels were high, indicating that physical activity goals were concordant with other interests and values and less induced by external forces (Fuchs, 2008). Arguably, these results could be influenced by social desirability, which is a weakness of the assessment of explicit attitudes (Axt, 2017) and a selection bias occurring during the recruitment process. However, there is a positive tendency in explicit as well as implicit attitudes. Concordant explicit and implicit attitudes, especially with regard to physical activity, have proven to be advantageous for performing the behavior in future (Muschalik et al., 2019). Attitudes generally do not change quickly, building motivational self-regulation takes time, and deep seated automatic evaluations change slowly (Deutsch and Strack, 2006). Hence, no group differences in attitudes is in line with the current state of knowledge. It could be hypothesized that if attitudes toward physical activity

actually would differ, they might differ both in a positive and negative direction. The COVID-19-induced lockdown has led to more leisure time and thus people may spend more of it being physically active (Cheval et al., 2020). Additionally, the protective benefits of physical activity may become even more tangible. On the other hand, anxiety regarding safe locations and types of physical activity during COVID-19 may contribute to more negative attitudes.

The relevance of the present study for research is that the ongoing trial can be continued with the assumption that baseline data may not have been contaminated. In addition, it may provide trials with similar designs, contents and population the basis for checking data quality and integrity and supporting findings. Furthermore, it is of clinical relevance to note the levels of self-reported physical activity. Thus, in-patient treatment may have the potential to be the platform from which to influence health behaviors such as physical activity. Along these lines, in-patients may be given the possibility to engage in physical activity and receive encouraged and positive feedback in continuing and increasing physical activity during in-patient care irrespective of when they were admitted.

The strengths of the current analysis are that potential COVID-19-induced interference with baseline data in this study have been monitored, thus contributing to data integrity. Meaningful co-variables for the variables of interest were collected and included in the analyses, hence, allowing for an optimized explanation of variance. The appropriate instruments were used for the measures, especially noteworthy is the population-specific ST-IAT. To investigate the accuracy of measures of depression severity, the HAMD score was checked for the influence of different researchers who performed the interviews and no differences were found. Additionally, the HAMD and BDI scores correlated positively, thus the assumption may be safe that the measuring method was accurate. The decrease in BDI score from screening to baseline is most likely because of the onset of treatment upon clinic admission.

Despite these strengths, there are limitations to be considered. This is a small sample of Swiss in-patients who were assessed at varying duration of stay and receiving a variety of treatments. Hence, the results cannot be generalized to all people with depression or indeed any other population. Given the cross-sectional nature of the data, the effect of the COVID-19-induced lockdown on psychosocial health and physical activity in people with major depression remains unknown and no causation can be inferred. There is a potential for selection bias, which may be visible in the group differences in HAMD scores. With this in mind, the possibility of systemic differences between the two groups does exist. Furthermore, the lack of difference between the two groups may also be explained by the smaller sample recruited and measured after the COVID-19-induced lockdown, which may have lead to decreased statistical power. Additionally, to investigate whether psychosocial stress, physical activity and attitudes toward physical activity in people suffering from MDD change over time in relation to the COVID-19 pandemic, longitudinal data are needed.

CONCLUSION

In the present study, it can be said that the COVID-19-induced lockdown did not lead to differences in the current groups recruited and assessed before and during/after the lockdown. However, to assess changes in people with MDD with regard to psychosocial health, physical activity and attitudes toward physical activity longitudinal data are needed. For the ongoing trial, this means that baseline data gathered in in-patients suffering from depression who are physically inactive upon admission to in-patient treatment seem not to be impacted by the COVID-19-induced lockdown in March 2020 in Switzerland. For the future, an analysis of longitudinal data would be of importance in light of changes in psychosocial health and physical activity behavior brought on by COVID-19 discovered in healthy populations given that these aspects are also of particular importance for people with MDD. For other clinical trials continuing during this pandemic, it will be necessary to assess potential effects of COVID-19 on data and intervention delivery.

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 human participants were reviewed and approved by Ethikkommission Nordwest- und Zentralschweiz and Ethikkommission Bern. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

MG, JB, LD, AE, CI, MH, EH-T, UL, SL, TM, AO, NS, LZ, and OF have contributed to the design of the study. MG serves as principal investigator of the study. UL and NS (Basel), JB, AO, and AR (Riehen), CI and SM (Münchenbuchsee), and MH and TM (Solothurn) are responsible for the coordination and the recruitment of patients of the study in the four partner clinics. SL is responsible for the selection, programming and processing of data of the computer-based tests. EH-T, LZ, OF, and SB served as project advisors. RC and J-NK implement the recruitment and data assessment at the four partner clinics and were also responsible for the data entry, cleaning, and processing. RC and MG are responsible for the data analysis strategy applied in this paper. RC performed all statistical analyses and wrote the first draft of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fspor.2021.685117/full#supplementary-material>

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An Empirical Exploration of Volunteer Management Theory and Practice: Considerations for Sport Events in a “Post-COVID-19” World

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The existing literature highlights some universal principles that are widely accepted as a good volunteer management practice, e. g., volunteer appreciation and recognition, provision of meaningful roles, effective communication, and the importance of relational connection, just to name a few. Yet, it can be argued that a gap exists in the relationship between volunteer management theory and practice in the context of large sport events. For example, published evidence shows that volunteer programs often lack effective planning and management to achieve successful program results. On one hand, this can be attributable to limited knowledge about volunteers’ characteristics and motivations, their lived experiences, the processes of volunteering, and the actual volunteer management practices. On the other hand, a lack of the right mechanisms (e.g., political will, financial, and managerial resources) in place before and throughout the event lifespan intensifies this disconnect. The aim of this research, therefore, was to critically examine the reasons behind this theory-practice divide in volunteer–volunteer management relationship and its potential impact on volunteer experiences and volunteer program outcomes, particularly in the context of the COVID-19 pandemic and its implications for sport event organizers and volunteer managers in the UK. A mixed methods approach was adopted for this study: a survey conducted with volunteers ($n = 101$) combined with a series of interviews with volunteers ($n = 8$) and volunteer managers ($n = 6$). The study identified some potential challenges facing volunteer programs associated with large sport events post-pandemic, particularly in relation to volunteer recruitment, volunteer management, and safety concerns affecting volunteer confidence to re-engage in volunteering. These challenges carry with them certain resource implications that event organizers need to consider to effectively run volunteer programs and support volunteers in engagement and re-engagement following the pandemic, as well as to harness opportunities the pandemic has potentially created to successfully re-emerge from the shadow of COVID-19. The study provides specific recommendations to inform event planning and delivery to enhance volunteer experiences and, ultimately, outcomes of volunteer programs associated with large sport events.

Keywords: volunteering, events, management, sport, COVID-19, pandemic, volunteer management, large sport events

INTRODUCTION

With an estimated equivalent value of £22 billion, volunteering contributes significantly to society in the UK (Office of National Statistics, 2017). Furthermore, within the UK sport sector volunteers contribute an annual equivalent value of more than £1.5 billion (Coleman, 2002). The volunteer workforce is arguably the most valuable asset possessed by the sector and is acknowledged as the indispensable resource for the operational and economic success of sport events (Catano et al., 2001; Surujlal and Dhurup, 2008; Nichols, 2014). Miles and Shipway (2020) acknowledged that the impact of the COVID-19 pandemic on the sport sector remains largely unknown. However, any impact upon the sector's volunteer workforce should be considered within the context of decline among those who volunteer in formal environments in the UK (Cuskelly et al., 2006a; Sport Recreation Alliance, 2018; Department of Media Culture Sport, 2019). These decreasing levels of engagement in formal volunteerism, along with the potential impact of COVID-19 present serious challenges to a sector already under a financial strain, and a threat to the successful delivery of sport events (Hiltrop, 1999; Cuskelly et al., 2006a; Studer and von Shnurbein, 2013; Sheptak and Menaker, 2020).

Effective volunteer management, therefore, has a crucial role to play in the successful re-emergence of the sport events industry from the pandemic. It is widely acknowledged that effective management of volunteers can influence positively volunteer experiences, performance, and likelihood of continued engagement (Allen and Bartle, 2013; Nedvetskaya and Girginov, 2017). This, in turn, can enhance the quality of sport events through the maintenance of a consistent workforce, increased efficiency, and enhanced spectator/participant experience (Taylor et al., 2008; Hallmann et al., 2018). Hence, a better understanding of volunteer attraction and management “on the ground”, and the resources required to do so effectively would benefit volunteers, event organizers, and the sector alike. Existing research broadly agrees on key themes that influence volunteer motivation and retention and the effective implementation of good volunteer management practices, i.e., meaningful volunteering roles, quality of experiences, levels of appreciation, effective relational connection, and clear communication (Allen and Bartle, 2013; Dunn et al., 2016; Nedvetskaya and Girginov, 2017). Yet, it appears that in practice volunteer recruitment and drop-off remain among the main concerns for sport event organizers with unsatisfactory volunteer management highlighted as a key contributor to volunteer dissatisfaction (Studer and von Shnurbein, 2013; Nedvetskaya and Girginov, 2017; Nichols et al., 2019). This seems to be exacerbated by the COVID-19 pandemic which put a halt to many sport events and volunteer activity, with the immediate and longer-term impact on the sport sector and its workforce currently unknown (Sheptak and Menaker, 2020).

This study aimed to address research questions related to (a) the theory-practice divide in volunteer–volunteer management relationship in the UK context of large sport events, and (b) the implications of the COVID-19 pandemic for volunteer programs related to recruitment, training, supervision, and recognition of volunteers. Firstly, the focus was on the broader organizational

context of volunteer management and the exploration of barriers to the effective implementation of known good practices. The intention was to identify the extent to which a disconnect exists between theory and practice of volunteer management, the reasons behind it, and provide recommendations to inform event planning and delivery to enhance volunteer experiences and volunteer program outcomes. Secondly, close consideration was given to the impact of the COVID-19 pandemic on sport event volunteers, their likelihood to engage or re-engage in event volunteering post-pandemic, and the implications for volunteer managers and event organizers as the industry continues to re-emerge from this crisis.

LITERATURE REVIEW

Sport Event Volunteering

Volunteering in the context of sport events has been the subject of extensive research literature (Hallmann and Harms, 2012; Gallarza et al., 2013). Much of this research revolves around the types of people who volunteer and their motivations (Kirstiansen et al., 2015; Schlesinger and Nagel, 2018). Despite this strong focus on the socio-psychological dimension of volunteering, there have also been numerous studies identifying the theory of good practice from a volunteer management perspective (Musick and Wilson, 2008). Kim et al. (2018) asserted that a substantial amount of this research can be categorized into two broad areas—volunteer characteristics and volunteer management.

Volunteer Characteristics

It is widely agreed that the volunteer demographic is diverse, comprised of people from different socio-economic backgrounds, cultures, nationalities, genders, ages, ethnicities, and personalities (Alexander et al., 2015). As such, volunteers present a diversity of motives, expectations, behaviors, and needs (Alexander et al., 2015). According to Cuskelly et al. (2006a), volunteer motivations are multifaceted in nature and can be located on a continuum, positioning altruistic and egoistic motivations at opposing ends. Indeed, Yeung (2004) highlighted a variety of differing volunteer motivations including altruistic reasons, the desire for social contact, the pursuit of personal interests, and fulfillment of emotional needs. Additionally, other influences such as family tradition, group identification, and the desire to utilize personal skills to contribute positively to society are also key factors affecting volunteer motivation (Bang and Ross, 2009). Kirstiansen et al. (2015) pointed to the challenge this presents to sport volunteer managers as they attempt to balance various needs and motivations of different volunteers. The more effectively this is achieved, the better the outcome for both the volunteers and the sport event organization (Taylor et al., 2006; Allen and Bartle, 2013; Nedvetskaya et al., 2015).

Cuskelly et al. (2006b) suggested that the adoption of a traditional Human Resource Management (HRM) approach when dealing with volunteers in the sport and recreation sector has its limitations as the effectiveness is dependent on varying factors, including volunteer motivations. As a result, an alternative approach is endorsed that considers volunteer motivation and the situational context of the volunteer

environment. This contrasts with a paid workforce motivated by extrinsic factors and contractual obligations (Cuskelly et al., 2006b). This argument adds to the findings of Shin and Kleiner (2003) who proposed that, unlike paid employees, volunteers are more motivated by intrinsic reward and, therefore, any HRM approach should be reflective of this. As a result, a volunteer-centered approach focusing on volunteer motivations could positively impact volunteer satisfaction and, ultimately, retention. This underlines the importance of effective management of volunteer programs associated with sport events, particularly where long-term volunteering is concerned (Cuskelly et al., 2006b; Kirstiansen et al., 2015).

Volunteer Management

Event managers with responsibility for volunteers play a key role in influencing the experience, expectations, and motivation of volunteers (Allen and Bartle, 2013). Volunteer management roles are concerned with the recruitment, orientation, deployment, and retention of volunteers (Studer and von Shnurbein, 2013). The volunteer recruitment process, along with the volunteer management before, during, and post-events are key factors in successful event delivery and the creation of positive volunteer experiences (Taylor et al., 2006). Volunteer orientation and training are particularly considered key components of volunteer programs (Taylor et al., 2008) that can help reduce stress, make volunteers feel welcome, and enhance their retention (Australian Sports Commission, 2000, cited in Taylor et al., 2008).

According to Hoye et al. (2018), good communication, respect, clear expectations, and flexibility are valued elements of effective leadership. This can increase engagement and commitment from a workforce (Hoye et al., 2018). As a result, the demonstration of such leadership principles should be evident in the practice of volunteer managers to effectively engage volunteers. Additionally, the recognition of volunteers is acknowledged as an important way to maintain their engagement (Cox, 2002). Perks such as volunteer uniforms, certificates, and awards evenings are identified as good practices (Cox, 2002; Phillips and Phillips, 2010). Moreover, one of the most valuable things volunteer managers can do is take time to express gratitude and show interest in volunteers on a personal level (Phillips and Phillips, 2010). This investment may have no financial bearing but does require sufficient human capacity to invest in volunteers in this way, which may only reinforce a positive volunteer-manager relationship claimed to be a key component of strong volunteer engagement (Kim et al., 2018). Importantly, according to Taylor et al. (2006), this depends on how well volunteer management processes are designed and implemented, as they require the corresponding human resources to be effective (Cuskelly et al., 2006a). Further research is endorsed to enhance understanding of the relationship between volunteer motivation, behavior and volunteer management practices (Cuskelly et al., 2006b; Allen and Shaw, 2009; Allen and Bartle, 2013).

COVID-19 Pandemic, Sport Sector, and Volunteering

While the long-term impact of the COVID-19 pandemic on the sport sector is currently unknown, it is evident that it significantly

disrupted the global society and the sport industry alike (Sheptak and Menaker, 2020). The World Health Organization, national and local Governments, sport governing bodies across the globe all responded to COVID-19 with various measures and restrictions, including a suspension of mass gatherings (e.g., to limit the spread of the virus and allow for more rapid vaccination programs to take place), which resulted in either cancellation or postponement of many sport events, including UEFA EURO 2020 and the Tokyo 2020 Olympics (Olympic Games, 2012; Miles and Shipway, 2020; Tokyo, 2020; Wackerhage et al., 2020). These decisions have not only negatively affected sport fans and elite athletes, but also the workforce that helps make these events happen, especially considering the positive role of sport events in providing identity, connection, and satisfaction (Sheptak and Menaker, 2020).

Indeed, work, whether through employment or volunteering, is known to increase a person's self-esteem, sense of fulfillment, and feeling of belonging. It is widely acknowledged that volunteering brings benefits that transcend tangible, extrinsic rewards (Cuskelly et al., 2006b; Allen and Bartle, 2013). The suspension of many sport events has presumably impacted volunteers' wellbeing, which may have implications for event managers as the sector re-emerges from the pandemic. This highlights the need for closer consideration of the connection between the pandemic and socio-psychosocial implications for volunteers, their wellbeing, and, ultimately, the quality and effectiveness of the work they perform—key components of successful volunteer programs associated with sport events. This is in line with the call for further studies into the response and resilience of sport events to unexpected challenges to solidify the research base and help the sector navigate its way out of this crisis (Miles and Shipway, 2020; Sheptak and Menaker, 2020).

Research Focus

Despite considerable studies published on event volunteering, it remains an emerging field of research (Hallmann and Harms, 2012). The present study aimed at adding to the limited literature on the relationship between theory and practice of volunteer management and the contextual factors that influence it. While many studies focus on the motives, dispositions, and characteristics of volunteers (Studer and von Shnurbein, 2013), there is an insufficient focus on wider organizational characteristics and contexts within which volunteers function (Cuskelly et al., 2006a; Musick and Wilson, 2008; Roza et al., 2017; Schlesinger and Nagel, 2018). While existing research is concerned with individual sport events (Hallmann et al., 2018), the current study considered multiple event contexts, gleaning from a broader range of experiences and environments to provide an alternative angle of research. Despite volunteers being acknowledged as a crucial element of the workforce to help deliver large sport events (Cuskelly et al., 2006a; Nichols, 2014), increasing concerns exist about volunteer capacity for sport events, and especially so in the context of the COVID-19 pandemic (Miles and Shipway, 2020; Sheptak and Menaker, 2020), which is an unprecedented phenomenon that provides a unique situation in its own right. Thus, close examination of the volunteer–volunteer management relationship helps identify

critical factors affecting the disconnect between theory and practice and what this means for sport events and their volunteer programs that are challenged by the COVID-19 pandemic yet strive to re-emerge from the crisis.

METHODS AND SAMPLING

A case-study research approach was adopted for this research to allow for an empirical examination of volunteer experiences and management within a sport event context. The goal was to gather valuable insights based on personal views, opinions, and experiences to help understand the behavior of volunteers and volunteer managers and the environmental and contextual factors that affect them. Due to the social dimensions and the organizational context involved in this study, an empirical, mixed methods approach was adopted consisting of predominantly qualitative data (Skinner et al., 2015) yet complemented by a quantitative approach to have a richer and stronger array of evidence.

Quantitative data was captured *via* a standardized Qualtrics-based online survey consisting of two sections. The first section focused on volunteer motivations, experiences, and individual perceptions of volunteer management. The second section focused on the impact of the COVID-19 pandemic on volunteer activity, health and wellbeing, and the factors affecting volunteers' likelihood of re-engaging in event volunteering post-pandemic. The survey comprised mostly closed questions, with some selected open-ended questions used to gather wider insights about volunteer experiences of management practices (e.g., communication, volunteer training, supervision, and recognition). A draft survey was compiled, peer-reviewed, and validated allowing for modification before circulation to help ensure effective data collection. The survey was circulated to 962 volunteers registered with Cardiff Council's "Volunteer Sports Bureau". This bureau is used to promote sport-related volunteer opportunities in Cardiff (UK), including major sport events.

The survey data was captured between the 16th–30th of December 2020, when the UK was under high levels of social restrictions due to COVID-19. The survey received 127 responses, yielding 101 usable results (13.2% response rate). Importantly, while 100% of survey respondents had first-hand experience of event volunteering, a proportion of the volunteers registered with the "Volunteer Sports Bureau" would not have been "event volunteers" but rather volunteers in non-event environments (e.g., local sports clubs). These volunteers were therefore ineligible to take part in the survey. It was not feasible to differentiate between the "type" of volunteer the survey was circulated to using the Bureau, which would have contributed to the relatively low response rate, combined with the survey overlapping the December holiday period in the UK. Yet, the survey design allowed for attracting only sport event sector volunteers, and therefore, all survey respondents had previously volunteered at least once at a sport event with 49.5% of them having volunteered at five events or more. A further 5.9% had volunteered at four events, 14.9% at three events, and 12.9% at two events. As a result, a range of volunteer

experience levels was incorporated into the study, helping reduce the risk of response bias among the respondents. The survey participants consisted of 60 females (59.40%), 40 males (39.60%), and one non-disclosure (0.99%). Respondents were all aged 18+. Further volunteer demographics are shown in **Table A1**. 43.6% of survey respondents were in full-time employment, with the next largest demographic being people who were retired (22.8%). Students made up 7.9% of the population sample. Given the relatively small sample size and low-level complexity of the survey, the quantitative analysis for this study was conducted using descriptive analysis performed *via* MS Excel spreadsheet software.

Semi-structured interviews with volunteers and volunteer managers ($n = 14$) enabled capturing deeper insights by digging "beneath the surface" of the more generalized survey responses to understand various perspectives as well as contextual and organizational challenges. This helped better understand the practice of volunteer management and how it was perceived by volunteers, the impact of COVID-19 on both volunteers and managers, particularly around new management practices that had to be created and implemented to respond to this threat yet help the sector survive. All interviews were conducted between the 13th of January and 3rd of February 2021 during the height of the COVID-19 pandemic in the UK. To minimize the risk of the virus transmission, all interviews were conducted *via* a video link using Microsoft Teams. Interview questions were divided into two sections, with the first section exploring volunteer motivations, their volunteering experiences, and perceptions related to volunteer management during sport events. The second section focused on how the pandemic was affecting volunteers in terms of their levels of volunteer activity, health, and wellbeing. This section also considered factors affecting the confidence and motivation of volunteers to return to event volunteering post-pandemic and explored practical considerations for volunteer managers that may influence future volunteer recruitment and management approaches. All volunteer and volunteer manager interviews followed similar themes and structures to enable comparisons among various perspectives. The key difference was in volunteer interview questions being focused on the impact of the pandemic on volunteers' health and wellbeing, whereas volunteer manager questions being focused on the operational challenges and the organizational context within which managers operated. Interview questions were peer-reviewed and validated accordingly before the start of the interview process. The use of scripts to introduce the subject helped provide consistency across different interviews, ensuring important points were covered and that assurance of confidentiality was provided to encourage openness and honesty in participant answers (Gratton and Jones, 2010).

A purposive approach was adopted in selecting the interview sample to help answer the proposed research questions. Using the Volunteer Sports Bureau, eight volunteers ($n = 8$) were identified based on their range of experiences and the appropriateness of the opportunities they had been involved in. All volunteer interview participants were aged 25+ with an average age of 51. Six female and two male volunteers were interviewed.

Volunteer experiences included a range of different opportunities provided by the city of Cardiff that attracts internationally and nationally recognized sport events, e.g., London 2012 Olympic and Paralympic Games, UEFA Champions League Final 2017, Rugby World Cup 2015, Velothon Wales, Gemau Cymru, Cardiff Half Marathon, Volvo Ocean Race 2017, Homeless World Cup 2019, European Hockey Championships, Super League Netball, and Ashes Cricket. Additionally, the network of contacts possessed by the authors within the industry allowed for accessing six professionals ($n = 6$) from the sport sector. These individuals (four females and two males) were selected based on their rich volunteer management experience and the specialist knowledge they possess within the context of national and international sport events. These events were predominantly Cardiff-based, although volunteer managers also had experienced events across the UK and Europe. Interviews in total equated to 11:08 hours of recorded conversations that were transcribed verbatim, resulting in 162 pages (91,901 transcribed words) of rich data for analysis, which produced enough corroborating evidence to suggest that saturation was reached within this number of participants. NVIVO 12 software assisted in qualitative data management and analysis. Data was coded into key themes including “volunteer experience,” “what volunteers value,” “motivators,” “de-motivators,” “factors affecting volunteer management practice,” “return to volunteering,” “health and wellbeing,” “COVID-19 impact,” “pandemic considerations,” and “management implications.” Thematic analysis was utilized to generate codes, review, and cluster themes, and translate them into a narrative account (Braun and Clarke, 2012). Both deductive and inductive approaches were in constant interplay to produce this research. The overarching themes and the analysis itself were theory-driven whereas coding originated from the raw material and was based on participants’ personal stories, reflecting their language (DeWalt and DeWalt, 2011). This formed an initial (albeit evolving) conceptual framework to support the research process and help make sense of the data. This approach enabled the drawing of initial conclusions that were verified throughout the remaining research process (Braun and Clarke, 2012).

This study was reviewed and approved by the Ethics Committee, in line with the Cardiff Metropolitan University Ethics Framework. All survey participants received written information concerning the study before providing consent, and subsequent completion of the survey. Survey responses were all anonymous. Interview participants received both written and verbal information concerning the study and provided written consent before their participation. All participants were informed of their right to withdraw from the study at any time.

RESULTS AND DISCUSSION

This section is split into two parts to address posed research questions related to the volunteer–volunteer management relationship associated with large sport events and implications of the COVID-19 pandemic.

Volunteer–Volunteer Management Relationship

The results of this study showed that most survey respondents (80.2%) were generally satisfied with their volunteer experience at large sport events in the past, reporting on their experience being “very positive”. The overall rating on event experiences had a mean score of 4.17 out of 5, with a standard deviation (SD) of 0.94. These trends correlated with results from the volunteer interviews, with respondents reporting generally positive experiences yet with occasional negative comments. The extent to which this experience was either positive or negative depended on several key factors that had to do with personal interaction and communication, overall event organization and the management approach pre, during and post-event—the factors that find support in the literature (Cuskelly et al., 2006a; Kirstiansen et al., 2015).

This study evidenced that a volunteer’s interaction with other people had the most significant effect on surveyed volunteers and their experience with a mean of 4.57 out of 5 (SD = 0.67)—whether that was interaction with the public, participants, volunteer managers, or fellow volunteers. This finding was reinforced by the volunteer interviews with one volunteer stating “...one of the biggest things for me is the connection with the people you’re helping, and the connection with the team around you” (Volunteer D). In support of Taylor et al. (2006) assertions, it also appeared that the recruitment phase of volunteer programs along with pre-event communication were key factors in shaping volunteer experiences. Where these elements were deemed poor, volunteer experience was negatively impacted: “[The organisation] were very slow ... the roles weren’t allocated until really close to the [event]. People didn’t want to book [travel] until they knew what their role was ... [my friend] decided not to go because she didn’t think the organisation was very good” (Volunteer H). This finding reinforces the need for maintaining close communication with volunteers at the key stages of the volunteer program. Equally, while post-event follow-up seemed to have a little direct bearing on volunteer experiences, this did form part of volunteer expectations with one volunteer remarking: “You always get an email or something to say thank you for participating, sometimes you get a gift... and maybe a follow-up email to say if there are other similar volunteer roles in the future” (Volunteer H). Given that lack of recognition and volunteer inconvenience are limiting factors to volunteer retention (Doherty, 2009), it can be inferred that post-event communication would be an advisable practice for volunteer managers showing appreciation of volunteer work and signposting volunteers to future opportunities, thereby maintaining their loyalty and continued commitment.

This study results further suggested that a proper match between volunteer motivations, experiences and role allocation is critical in both volunteer satisfaction and performance which, ultimately, has implications for volunteer management and program outcomes. Interview participants, for example, generally agreed that being involved and supporting an event was more important than the role given, which was echoed by survey respondents. Yet, further probing revealed that the ability to feel

they make a useful contribution to the event was important: “[The reason I loved the volunteer experience was that] I felt I was doing something worthwhile, I felt it was something I was doing to support people” (Volunteer E). These findings align with existing research, suggesting a general willingness among volunteers to fulfill whatever role is necessary. But the provision of stimulating roles can increase volunteer engagement, motivation, and satisfaction (Allen and Shaw, 2009; Allen and Bartle, 2013), whereas the absence of such fulfillment was connected to more negative volunteer experiences. Interestingly, role allocation was generally considered by volunteer managers as one of the key factors in the successful delivery of effective volunteer programs: “When [role allocation] is done well, the execution of the event runs smoothly, and the volunteer experience is higher quality. When it’s done poorly, it can lead to a poor experience and the needs of the event aren’t always met” (Volunteer Manager B). This was attributed to the perception that volunteers would be more motivated in fulfilling roles, and that the event delivery would run smoother where volunteer skills, abilities, and personalities were effectively aligned to the jobs assigned. This thinking was supported in the literature, where role allocation related to volunteer characteristics, skills and motives is endorsed for the mutual benefit of both a volunteer and an event (Khoo and Engelhorn, 2011; Allen and Bartle, 2013). However, it is equally acknowledged that there are challenges associated with achieving this aspiration, including time and human resource factors (Allen and Bartle, 2013; Nedvetskaya et al., 2015).

In connection to having appropriate lines of communication and being properly “matched”, this study revealed the importance of “feeling valued” for most respondents, with 93.8% of surveyed volunteers supporting this affirmation. This finding was backed by the volunteer interviewees expressing similar positive feelings: “I didn’t feel like I was somebody who’s just there to make up the numbers” (Volunteer C); and: “[Volunteer managers] are always really thankful for you being there and you always feel wanted” (Volunteer H). In support of the findings by Phillips and Phillips (2010), it was the people-management approach taken by volunteer managers that had the biggest impact on positive volunteer experiences, along with the allocation of meaningful roles (see **Figure A1**). Tangible rewards such as the provision of a quality uniform and mementoes were generally less of a determinant for feeling valued. However, these elements were more highly acknowledged by the younger volunteer demographic, whereas older volunteers appeared to have a greater appreciation of being able to make a positive contribution to events. Elements of volunteer reward identified by Cox (2002) and Phillips and Phillips (2010), such as the provision of uniforms, certificates, and “thank you” events, appeared to be common practice. This was identified by both volunteers and volunteer managers, although post-event recognition initiatives were more common among larger-scale events. This was attributed to the additional resources and planning required to host such functions.

On the other hand, volunteers expressed strong sentiments against feeling un-needed, under-appreciated or under-utilized, with one volunteer describing not being effectively employed as “a complete waste of time” (Volunteer G), with another stating:

“It’s like... I’ve done a lot of volunteering over the years, and this isn’t the best use of my skills ... you think why did I bother” (Volunteer E). The positive impact that intrinsic satisfaction can have on volunteer motivation is well documented in the literature (Cuskelly et al., 2006a; Allen and Bartle, 2013), and an awareness of this connection was evident among interviewed volunteer managers. However, the divergent priorities and organizational expectations they faced appeared to result in event delivery objectives becoming their primary concern, which is in line with the core purpose of event volunteer programs to aid in the successful delivery of an event. Yet, volunteer managers are seriously challenged with the need to balance the delivery of events and the interests of volunteers and their greater autonomy (Costa et al., 2006; Fairley et al., 2007; Nedvetskaya and Girginov, 2017). This would appear to be a downside of a more traditional HRM approach. Cuskelly et al. (2006b) warned of the dangers posed by regarding volunteers as a replaceable resource when preoccupation with delivering “outcomes” is legitimized at the expense of the fulfillment of volunteer needs and expectations. This in turn could have a detrimental effect on the event’s success, as failure to sufficiently manage volunteer expectations can negatively impact volunteer performance and retention (Allen and Shaw, 2009; Allen and Bartle, 2013; Nichols et al., 2019).

One such example was the desire of volunteer managers to mitigate against volunteer attrition and ensure sufficient volunteer numbers to meet event requirements through deliberate over-recruitment: “There is always a dropout, so you always have to oversubscribe your volunteer base to allow for those dropouts” (Volunteer Manager A). While this may seem a logical practice to combat a recognized challenge of sport event volunteer attrition (Allen and Bartle, 2013), it can negatively impact volunteer experiences. As mentioned, feeling useful is a contributing factor to positive volunteer experiences. Conversely, the absence of such feelings of worth would, therefore, be a demotivator. As one volunteer articulated: “Sometimes there are too many of you, and you think do I really need to be here?” (Volunteer H), with another adding: “They always ask for too many volunteers ... standing around not doing anything, that’s a complete waste of time—then you lose people” (Volunteer G). Based on this research evidence, it could be suggested that a careful balance should be found by volunteer managers in trying to manage volunteer attrition rates, where event needs are met while a surplus of volunteers lacking meaningful roles is avoided. Otherwise, the imbalance could negatively affect the satisfaction and associated continued engagement of volunteers motivated by a desire to contribute meaningfully, thereby adding to the volunteer drop-off problem that over-recruitment was intended to mitigate (Finkelstein, 2008; Bang and Ross, 2009; Allen and Bartle, 2013). It is regarded as a misconception that volunteers contribute to events by simply being there (Millette and Gagné, 2008). Furthermore, occupying a surplus of volunteers was identified as a drain on the time and resources of volunteer managers: “In some instances, we probably had too many [volunteers] and making sure that they felt valued and had enough to do was one of the biggest challenges” (Volunteer Manager F). Such observations find support in the literature where Farmer and Fedor (1999) highlight the potential for volunteers to become

burdens to event organizers. This further points to the need for event organizers to re-think their approaches to volunteer recruitment and the practice of volunteer over-recruitment and its management. Indeed, volunteer recruitment, communication, and the role allocation process are acknowledged among the biggest challenges in volunteer management (Studer and von Shnurbein, 2013; Nichols et al., 2019).

To appropriately address the identified challenges, this study argues that volunteer programs should be sufficiently resourced both financially and staff wise, meaning having enough volunteer managers working with volunteers daily throughout the even life cycle—from planning to delivery and beyond. Albeit there was general agreement that volunteer programs were sufficiently resourced, 35.6% of survey respondents felt that provision of expenses or support with travel was lacking, pointing toward the importance of providing financial help to cover basic costs associated with volunteering. Albeit in demand, this practice is not widely adopted by event organizers, which highly depends on the event status and context. High costs along with insufficient communication and lack of effective management are acknowledged among the main factors that lead to volunteer dissatisfaction and dropouts (Nedvetskaya and Girginov, 2017).

Additionally, an issue with staff availability on shifts was raised as another important element contributing to the level of satisfaction/dissatisfaction. When asked what could improve their experiences, volunteers identified enhanced supervision through lower volunteer-supervisor ratios as an area to be further developed, with one volunteer stating they would “perform better with more interaction with a team leader” (Volunteer F). This finding is linked to the need for personal connection identified earlier. Importantly, the desire for greater supervision did not negate the need for volunteers to maintain a degree of autonomy, with one volunteer objecting to being treated as “someone who didn’t have a mind”, saying: “you need to have the acknowledgment that you are a person with a brain, that you have something to offer” (Volunteer C). This further highlights the importance for volunteer managers to have the capacity to invest in getting to know and understand volunteers and developing a two-way relationship with them. Furthermore, volunteer managers accepted that staffing resources were not always adequate, with one describing this as “definitely an area that could be worked ...having a bit more resource at that level would really help” (Volunteer Manager A). This seemed to become particularly evident when something unexpected occurred during an event requiring additional staff attention, as expressed by one interviewee: “Events are typically resourced well enough from the human resource perspective until something changes or goes wrong! ... you only really know [it] when something goes wrong” (Volunteer Manager B). These findings suggest that there is limited additional capacity built into staffing resources for volunteer supervision to deal with unexpected occurrences.

Similarly, the pre-event phase of volunteer programs should be adequately supported in terms of human resources (Kim et al., 2018). However, four out of the six interviewed volunteer managers reported holding other competing organizational responsibilities outside of the volunteer program during the build-up to events. This appeared to heighten the pressures

experienced by volunteer managers and inhibit their ability to effectively administer the volunteer programs, with one volunteer manager stating “[I had experienced] challenges around lack of support from my organisation in terms of realising how much work I was actually doing—it was not necessarily difficult work responding to hundreds of volunteer emails, but it is time-consuming! I had other responsibilities as well and I think the day-to-day support when it comes close to the events is very important for volunteer managers” (Volunteer Manager A). This feeling was echoed by another volunteer manager charged with divergent responsibilities that impaired their ability to deliver the level of volunteer management practice they would have liked due to performing a volunteer management role on top of their main role: “[This was] additional responsibility which was a challenge to devote the right level of time and energy to...it was very difficult to try and effectively manage the responsibilities attached to the management of volunteers and my main role” (Volunteer Manager F). These findings could account for a potential disconnect between volunteer managers’ knowledge about best practice and their behavior in practice, suggesting that investment in additional human resources may be required by event organizers at every stage of volunteer programs to be effective. Cuskelly et al. (2006b) posited that effective HRM practices improve volunteer retention subject to appropriate resources required to effectively implement these practices. The financial investment to increase resource allocation in support of volunteer managers could, therefore, better enable them to invest in pre-event communication, role allocation, orientation, training, management, and post-event communication. This in turn could result in enhanced volunteer experience before, during and after events, thus having a positive impact on volunteer satisfaction, performance, and retention (Taylor et al., 2006; Allen and Bartle, 2013).

Post-pandemic Implications of COVID-19

The emergence of the sport event industry from the pandemic is expected to present new challenges that will need to be navigated carefully to ensure both the welfare of volunteers and the successful delivery of sport events (Sheptak and Menaker, 2020; Wackerhage et al., 2020). None of the volunteers taking part in the study reported doing any event volunteering during the pandemic. While this was largely due to a lack of opportunity and awareness, it was also down to the fear of contracting the COVID-19 virus and the risk this may pose for others—an area that appeared to be people’s primary concern about engaging in volunteer activity.

The COVID-19 pandemic has had a substantial impact on the overall wellbeing of volunteers. Almost half of the survey respondents (48.5%) reported a decrease in physical activity levels. This may be unsurprising considering how the pandemic has restricted the use of recreational facilities (e.g., gyms), swimming pools, and play areas, along with increasing numbers working from home and shopping online (Shahidi et al., 2020). Conversely, almost a quarter of volunteers (24.7%) reported doing more physical activity. This could be due to the rise in exercise taking place in homes and outdoor spaces (Smith, 2020). There were similar results concerning the general health of

volunteers during the pandemic, where over half of respondents (55.4%) reported poorer health during this period. Such a correlation between decreased physical activity and health is well known and would certainly be supported by the literature (Dwyer et al., 2020). It has already been widely acknowledged that the pandemic has had a negative impact on global mental health (Torales et al., 2020). This study specifically considered the impact of having the opportunity to volunteer at sport events taken away. Almost half of the respondents (47.4%) reported some form of negative mental impact. Of these, 6.7% reported a severe impact, all of whom were male. None of the interviewed volunteers explicitly admitted that being unable to volunteer had negatively impacted their mental health. This outcome could have been influenced by the stigma associated with the subject of mental health and a potential reluctance among interviewees to discuss openly in the context of a recorded interview (Jones, 2015; MIND., 2017; UK Government, 2019), which may explain the discrepancy between the survey and interview data.

A sense of loss of the social element associated with the event volunteering experience was captured across both the survey and interview data. Interviewees, in particular, acknowledged missing social interaction and anticipation that involvement in events provided: *"I do miss the excitement of doing the events, I look forward to doing them"* (Volunteer C), and *"I definitely haven't got something to look forward to without the events... Events [are] something you look forward to doing... Because the events have stopped, it's that new experience, that is something different, that once-in-a-lifetime opportunity that has been taken away from you"* (Volunteer D). It can be suggested that these reported feelings were magnified by the current context where people are experiencing restrictions due to the pandemic. Based on these findings, it can be inferred that volunteers would be eager to return to volunteering post-pandemic or whenever the epidemiological situation would significantly improve to allow for re-opened doors. Indeed, an increased desire for social interaction is a recognized motivation for event volunteering (Lee et al., 2016), which could, therefore, prompt fresh engagement in volunteerism. Yet, given the context, this appears to be subject to such volunteer characteristics as age and gender as well as COVID-19 related environmental, administrative, and managerial factors.

Thus, while most surveyed volunteers reported a clear intent to return to event volunteering post-pandemic, this research further revealed a worrying 15% considering themselves either "uncertain" or "unlikely to return" (see **Figure A2**), which represents a significant proportion of volunteer workforce. Additionally, of those volunteers "likely to return", over 37% reported being only "somewhat" likely to return. Such an eventuality could have serious repercussions for the effective delivery of sport events. With a general trend in recent years of decline in formal volunteering (Cuskelly et al., 2006a; Department of Media Culture Sport, 2019), a further drop-off would exacerbate the situation and pose challenges to volunteer recruitment for sport events. Importantly, a significant proportion of volunteers who were unsure or unlikely to return to event volunteering were female (73.3%). While this figure would have been influenced by the fact that 59.4% of overall survey

respondents were female, this remains an important finding. This is noteworthy because while females generally volunteer more than males (Downward et al., 2020), there is a higher proportion of males who volunteer in sport environments (Sport England, 2019)—a trend that some studies suggest also applies to sport events (Skirstad and Hanstad, 2013). If accurate, a further decline in female engagement would risk widening the gender gap all the more. However, the literature appears divided on this issue with some studies reporting higher levels of female engagement in sport event volunteering than males (Dickson and Benson, 2013; Nedvetskaya et al., 2015) while others suggest that sport events have an equal appeal to both males and females (Downward et al., 2005). Nonetheless, it can be argued that a decrease in female engagement in volunteering would pose a significant threat to volunteer recruitment programs for sport events.

Furthermore, most survey respondents uncertain about returning to volunteering were aged 45 or over, with the least confident group aged 55+. This finding should be of concern for managers in charge of volunteer programs, as 45+ demographics is traditionally the most likely group to volunteer (Downward et al., 2005). This also correlates with those people most worried about contracting the virus. The greatest proportion (68.4%) of surveyed respondents aged 55+ cited factors relating to fear of the virus as their primary concerns. By comparison, a much lower proportion (31.5%) of the younger age categories expressed similar views. This finding could be attributable to the identified increased risk posed by the virus to older generations (National Health Service, 2021). Similar trends were evident in the results of the volunteer interviews revealing a generally cautious mindset among older interviewees: *"Recruitment levels will fall because there is a cohort of volunteers who are of an older age range who will maybe just not feel safe, and maybe won't want to commit to [event volunteering] again"* (Volunteer B). This contrasted with higher levels of confidence expressed by younger volunteers: *"If [events] started to come back... I would go ahead and do it no problem at all"* (Volunteer D). In support, volunteer managers anticipated a shift in the volunteer age demographic. Less engagement was expected from older volunteers, while there was speculation that more younger people might engage due to reported eagerness for social interaction. As one volunteer manager expressed: *"The older age group of volunteers [would] fear coming back into those [event environments] and being exposed [to the virus]"* (Volunteer Manager C), while another stated: *"I actually think younger people have probably been impacted most during the pandemic... So, I think there's an opportunity to use events to try and bring some of those experiences back"* (Volunteer Manager F). Such a view finds support from a recent report by the Youth Sport Trust (2020) that found young people were hungry for increased social interaction due to the pandemic. Importantly, pre-existing patterns of increased youth volunteering contrasted by trends of decline among older generations appears to be a shift that has been accelerated during the COVID-19 pandemic (NFP Synergy, 2020). Arguably though, whether this trend would translate into increased event volunteering in the longer term remains to be seen. As one volunteer manager put it: *"I think [engagement] could go either way... We might see a shift with some people who didn't volunteer*

before now wanting to... [while] those who did volunteer might have decided actually, it's not for me [anymore]" (Volunteer Manager C).

The critical revelation of this research is that sport event volunteering in the current circumstances is conditional on perceived levels of safety and changing environmental factors related to the stage and effectiveness of vaccination programs, infection rates, and COVID-19 Alert Levels, making it a rather complex issue. Although there was in varying degrees a general desire reported among volunteers interviewed to re-engage in event volunteering, it depended on the need to feel safe and robust safety measures being implemented by events. Volunteers expressed that their re-engagement would *"depend on the level of the pandemic"* (Volunteer G), be provisional on whether *"we are all vaccinated"* (Volunteer E), and conditional on whether appropriate *"safety procedures were put in place"* (Volunteer D). From the perspective of volunteer managers, concerns were surrounding potential new additional administrative burdens. These were related to the implementation of new COVID-19 related policies, such as risk assessments, supply of Personal Protective Equipment (PPE), social distancing and social isolation measures, sanitization, and track and trace procedures (Health Safety Executive, 2021; UK Government, 2021). However, these measures relate to guidance for organizations put in place or changed as things stand during the pandemic. It remains to be seen what the expectations will be post-pandemic. It can be reasonably expected that certain procedures will remain, at least for some time, as society re-emerges from the pandemic with a gradual return to pre-pandemic practices anticipated (He and Harris, 2020).

Historically, large sport events attract volunteers from local, national, and international spheres, with volunteer tourism becoming an increasing trend (Fairley et al., 2007; Smith and Holmes, 2009). This was reflected in the concerns of volunteer managers who cited travel restrictions and quarantine requirements as potential barriers to volunteer recruitment in the aftermath of the pandemic: *"International travel is going to be highly regulated, so I think for any events using international volunteers things could be very difficult"* (Volunteer Manager B). This suggests that a greater emphasis on the recruitment of volunteers from local areas is needed. However, the extent of this impact would be relative to national and international restrictions on travel, quarantine requirements, and the existing threat of the virus at the time. Even so, such an approach could bring benefits for sport events. Local recruitment could enhance the event legacy through the resulting increased localized skills transfer. In addition, recruitment from local areas would help generate a volunteer workforce possessing higher levels of local knowledge—often a weakness of transient events (Blackman et al., 2017).

A further consideration that emerged from the interview data is related to volunteer roles after the pandemic. While there was a general acceptance that traditional volunteer roles would remain, there was an expectation that some roles may require additional volunteers (e.g., relating to crowd management and signposting). This change might be needed to ensure compliance with safety measures such as segregation and limitations on the number of people in one place. Furthermore, potential new volunteer

roles were also identified by volunteer managers. These included the proposal of new "COVID-19 volunteer" roles to support the implementation of COVID-19 safety procedures, such as the enforcement of social distancing, temperature checking, and symptom recording. Additionally, an increased need for volunteer roles relating to digital engagement was mentioned by volunteer managers: *"I think there will be a greater emphasis on digital engagement roles in the lead-up and during the event"* (Volunteer Manager F). These roles relate to pre-event support for recruitment and training, as well as during events as a means for enhancing online engagement among participants, fans, and spectators.

The identified potential changes to volunteer roles have implications for the need to increase human resource requirements in terms of the number of volunteers, their skill sets and, potentially, the number of volunteer managers. Reflective of the findings related to changes in volunteer demographics, sport events can expect heightened levels of engagement among the younger generations. An outcome of this nature may provide some further benefits for event organizers. Older people generally engage less with digital media than younger people (Green and Rossal, 2013; Matthews and Nazroo, 2015), whereas younger generations largely possess greater levels of digital literacy, which highlights a negative correlation between age and digital media competence (Andreou and Nicolaidou, 2019).

These findings combined with the potential increased need for digitally focused volunteer roles suggest that volunteer programs should be flexible in possibly targeting recruitment of younger demographics possessing the required digital skill sets. It can be argued that if volunteer managers do not adjust their recruitment approach but continue targeting the same demographics as pre-pandemic, they may risk experiencing a drop off in volunteer engagement. Furthermore, they may also struggle to recruit volunteers with the right skills and competencies required by the changing nature of certain volunteer roles. Establishing strategic links with Further and Higher Education providers was a suggestion that emerged from this study as an avenue to unlock access to potential skill-possessing volunteers. As noted by one interviewee: *"There will be technological implications for [volunteer programmes], [resource] implications, [and] human resource will probably be determined by skill set. I think it could be a question of, rather than going out to recruit [in a general way], being a bit more targeted in terms of how we approach recruiting volunteers—going to FE and HE organisations where there are relevant courses on digital engagement, social media, etc. to recruit these volunteers"* (Volunteer Manager F). Such an approach would have the potential to produce recognized mutual benefits for event organizers, academic institutions, and individual students alike (Ribarić et al., 2013).

Despite the challenges facing event organizers posed by the pandemic, some further positive outcomes emerged from the study. The subject of digital technology was a common theme not only related to the required skillsets for newly developed volunteer roles but also changes in volunteer management practices. The pandemic has seen a significant rise in the use of digital technology and social media across the population (Baker et al., 2020). Both volunteers and volunteer managers identified

this change in behavior as an opportunity to make more effective use of technology in the organisation and delivery of volunteer programs. For example: *“We’ve never done online virtual briefings because we’ve never needed to. But actually, when we look at the events and what we could do better, we can improve the pre-event engagement to improve the experience... So, we will definitely be utilising the online platforms more moving forward”* (Volunteer Manager D). The main proposal was the use of blended online-offline approaches in the facilitation of volunteer orientation (e.g., delivery of online training, virtual tours of venues etc.). It was conceded that an element of in-person training would still be required for most roles. However, as changes in human interaction and learning have shifted during the pandemic (Vargo et al., 2021), it is evident that this is an avenue worth exploring. There are clear benefits to online training, including efficiencies around time, travel, and expense, in addition to added levels of convenience, flexibility, and practicalities such as recording training sessions and attendance monitoring (Mukhtar et al., 2020). Yet, it should be noted that such an approach may further contribute to the emerging digital divide between those with and without access (e.g., internet connection and computer equipment), confidence, and capability when it comes to engaging in online learning (Morgan, 2020; Vargo et al., 2021). Consideration should also be given to the additional resources needed in terms of people, time, technology, and finances to effectively implement such an approach (Morgan, 2020).

CONCLUSIONS AND IMPLICATIONS

This study aimed to critically examine the extent and reasons behind the theory-practice divide in volunteer-volunteer management relationship in the UK context of large sport events and investigate implications for volunteer programs within the context of the COVID-19 pandemic. The intention was to provide recommendations to inform event planning and delivery to enhance volunteer experiences and volunteer program outcomes.

This study identified an alarming deficiency in volunteer management resources throughout the sport event lifecycle, especially at the pre- and during event stages. A direct implication of what appears to be a theory-practice disconnect is in the resulting pressure on volunteer managers that may further restrict them in carrying out their roles as they are expected to, thus inhibiting their ability to effectively implement best practices. This reveals the discrepancy posited by this research between known good practice in theory (“how to do”) and the management behavior exhibited in the field (“how it’s been done”). Such strain on volunteer managers would only be further exacerbated by the potential extra administrative workloads created by the need to implement additional COVID-19 related policies and procedures. A recommendation would, therefore, be for event organizers to consider greater support and resources allocation in terms of the staffing and funding of event volunteer programs to ensure sufficient capacity to implement known good practices in terms of volunteer management as well as address new challenges posed by the pandemic. Among such challenges

are increased digitalization, the introduction of new volunteer roles to encourage compliance to COVID-19 procedures and help facilitate the safe operation of events upon the return of crowds. This would certainly lead to the associated increased need for volunteers that would be difficult to achieve considering the projected general reduction in the number of volunteers engaging or re-engaging in event volunteering post-pandemic and changing volunteer demographics.

Importantly, this study reported the uncertainty and nervousness among the volunteer workforce about re-engaging with sport events. Given the need for volunteer programs to overcome potential challenges in volunteer recruitment and retention post-pandemic, events must create positive volunteer expectations and experiences, which is closely linked to the resource element identified earlier. Evidence from this research suggested that effective volunteer management can positively influence the achievement of this aspiration; however, this requires sufficient resourcing to be done successfully (Cuskelly et al., 2006b; Allen and Bartle, 2013). Although this study did reveal a general desire and intention among volunteers to re-engage in event volunteering post-pandemic, the level of confidence appeared a determining factor. The decision to return to volunteering seemed to be conditional upon the effective rollout of a vaccination program, low levels of the virus in circulation, and the implementation of robust safety measures at events. Albeit not all these factors depend on volunteer managers along and is a joint effort of many stakeholders (e.g., various levels of government, international and national sport event governing bodies etc.), a further emphasis is placed on the need for effective volunteer management. The adoption of positive marketing approaches to recruitment by volunteer managers highlighting the benefits of volunteering is strongly advocated, with an emphasis on volunteering being the means to fulfill desires and experiences missed during the pandemic (e.g., social interaction, group identity, new experiences, use of existing or acquiring new skills, etc.). This practice combined with reassuring messages relating to the safety of events, and the maintenance of contact with existing volunteers during the pandemic are all considerations that could positively impact volunteer re-engagement. Additional considerations for enhancing the safety of volunteer programs and building confidence in volunteers may include the introduction of volunteer bubbles, outdoor volunteering opportunities, ventilation of indoor spaces, smaller volunteer teams, and flexible volunteer roles (e.g., remote working where possible).

This study further revealed a shift in the volunteer demographics, establishing a potential drop-off among the older generation and an increase in younger people willing to volunteer. These conclusions find support from recent reports identifying a decrease in active volunteerism among older people in the UK during the pandemic, and an increased desire to volunteer among the youth (NFP Synergy, 2020; Youth Sport Trust, 2020). A practical implication for sport events is, therefore, to consider the targeted recruitment of younger people, particularly through Further and Higher Education institutions, who have the skills and competencies that are most in-demand. This may help address the changes in the type of volunteer roles

required by events in the aftermath of COVID-19. For example, opportunities for greater digital engagement between events and the public could be seized through digital volunteer roles—an area that could benefit from the engagement of digital-savvy younger volunteers. This study also identified the potential for volunteer programs to harness the increased digitalization of day-to-day life during the pandemic (Baker et al., 2020). This includes utilizing online training and virtual orientations to make volunteer engagement more convenient, while also enhancing learning (Mukhtar et al., 2020), improving volunteer experiences, and delivering organizational and personal efficiencies (e.g., decreasing venue hire costs or cutting on travel expenses). To achieve this, digital literacy becomes an essential factor that may attract new demographics yet exclude others from taking part based on either ability or access (or both).

Event organizations may be unable to influence national alert levels, vaccination programs, and global infection rates. Yet, as the sport event industry continues to re-emerge from the pandemic, the findings of this study suggest that the effective management of volunteer programs may play an even more important role in re-engaging previously active volunteers and attracting new ones than this was the case pre-pandemic.

Research Limitations

The study took place at the height of the second wave of the COVID-19 pandemic in the UK (December 2020–February 2021). Albeit time-sensitive given the topic of research, this resulted in the study being impacted by the social restrictions in place at the time. Consequently, all data collection (survey and interviews) was conducted completely electronically. This would have limited participation to populations with access, confidence, and capability to engage in online-based research. Additionally, conducting the interviews remotely *via* a video link could potentially have inhibited the establishment of rapport and creation of an open environment. This could have influenced participant responses and prevented the interviewer from fully observing the environment and body language of the participant. These factors potentially could have limited the effective management of interviews and the authenticity of the data (Gratton and Jones, 2010).

Whilst able to provide critical data, the use of surveys is not always conducive for more complex questions and provide no opportunity to probe for further understanding (Jones, 2015). An ability to increase the amount of data captured *via* interviews instead of surveys could have produced more in-depth results. Furthermore, having an increased timescale for the study could have enabled broader data gathering and greater depth of analysis.

The study focused on volunteers and sport events based in Cardiff. The Cardiff-specific nature of the study may have limited the relevance of the research for other geographical locations and cultures. Yet, Cardiff is home to many national and international sport events which makes the findings of this study applicable beyond the Cardiff context. Additionally, the geographical focus and relatively small sample sizes for both the survey and interviews would have restricted the ability to generalize research findings to broader populations. Greater diversity in the population sample could have increased the

potential of the study to gather more data and produce more broadly applicable results.

Future Research

Intensified digitalization of volunteer engagement and volunteer management practices require further exploration by the events sector and academics alike. Future research should be endorsed to explore the engagement in event volunteering of previously non-volunteering populations, and the impact of the COVID-19 pandemic on event volunteering once the sport events industry re-opens its doors and associated volunteering opportunities. Newly developed government policies around QR codes and COVID passports to help combat the pandemic are of a particular interest, especially considering possible access restrictions. This leads to open questions regarding social stratification and key determinants of inclusion/exclusion from volunteer participation. Further consideration should also be given to the impact of the pandemic on the socio-psychosocial wellbeing of volunteers. Follow-up research with a greater number of participants conducted in different contexts and locations (either in the UK or another country) would allow for important comparisons that would further strengthen volunteer-related research, policy, and management practice to help the sector navigate its way beyond the current crisis.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because of Data Protection rules. Requests to access the datasets should be directed to gpower@cardiffmet.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Cardiff Metropolitan University Ethics Committee. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

GP and ON were involved in the conceptualization and design of the study. GP recruited the participants and collected, processed, analyzed the data, and drafted the manuscript. ON critically revised the manuscript and approved the final submission. Both authors contributed to the article and approved the submitted version.

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APPENDIX

TABLE A1 | Volunteer demographics.

Age group	Gender			Employment status					
	Male	Female	Non-disclosure	Employed (full-time)	Employed (part-time)	Retired	Student	Unemployed	Other
18–25	2	9	0	4	1	0	6	0	0
26–35	5	7	0	7	2	0	1	1	0
36–45	1	4	0	4	0	0	1	0	1
46–55	8	15	0	18	2	0	0	0	3
56–65	16	13	1	10	5	12	0	1	2
65+	8	12	0	1	1	18	0	0	0
Overall	40	60	1	44	11	30	8	2	6

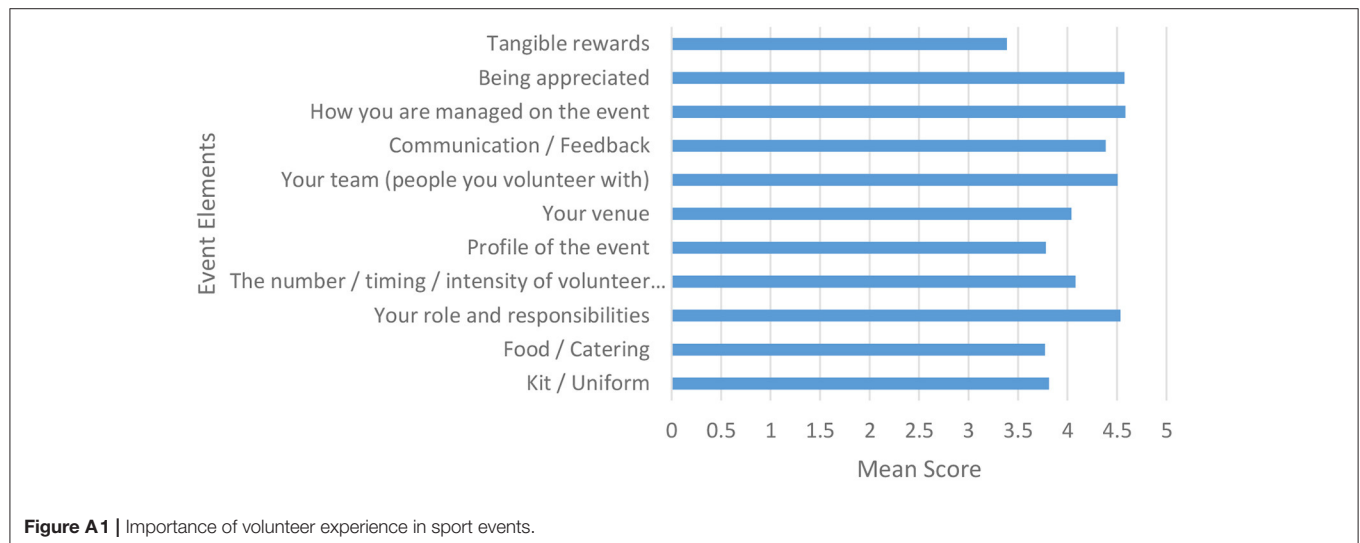


Figure A1 | Importance of volunteer experience in sport events.

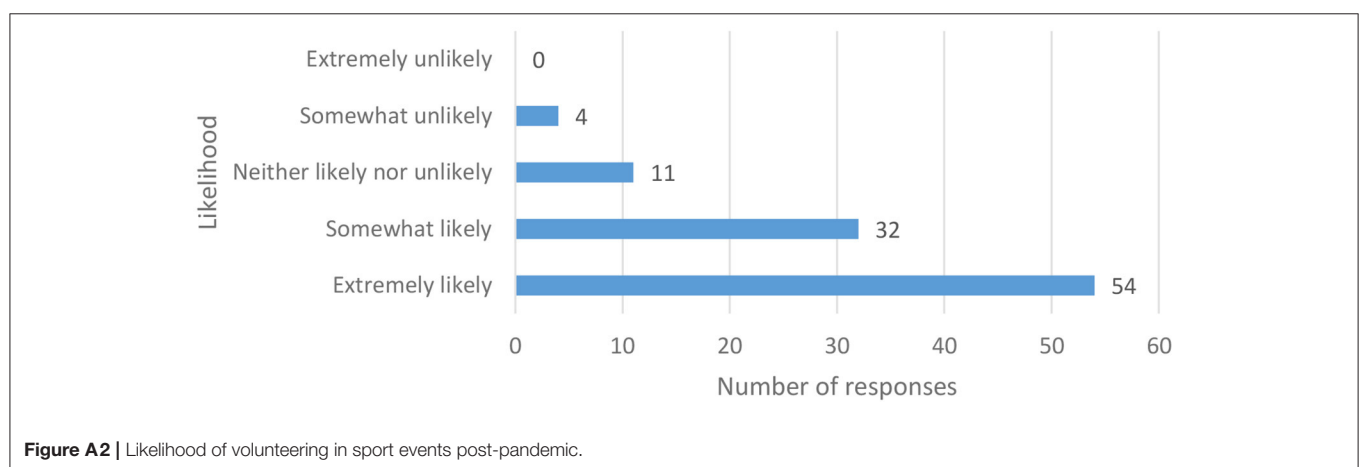


Figure A2 | Likelihood of volunteering in sport events post-pandemic.

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