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Original Research

Does Increased Physical Activity Explain the Psychosocial Benefits of Sport Participation During COVID-19?

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Context: Although the return to sports during COVID-19 has been associated with improvements in mental health and quality of life (QOL), whether these benefits are primarily due to increases in physical activity (PA) is unknown.

Objective: To determine whether PA increases were responsible for the improvements in mental health and QOL among adolescents who returned to sport during the COVID-19 pandemic.

Design: Cross-sectional study.

Setting: Wisconsin secondary schools.

Patients or Other Participants: A total of 559 adolescent athletes (age = 15.7 + 1.2 years, females = 43.6%) from 44 schools completed a survey in October 2020.

Main Outcome Measure(s): Demographic information, whether they had returned to sport participation, school instruction type, anxiety (Generalized Anxiety Disorder-7), depression (Patient Health Questionnaire-9), QOL (Pediatric Quality of Life Inventory 4.0), and PA (Hospital for Special Surgery Pediatric Functional Activity Brief Scale). Mediation analysis was used to assess whether the relationships between sport status and anxiety, depression, and QOL were mediated by PA.

Results: At the time of the study, 171 (31%) had returned to play and 388 (69%) had not. Athletes who had returned to play had less anxiety (3.6 ± 0.4 versus 8.2 ± 0.6, $P < .001$) and depression (4.2 ± 0.4 versus 7.3 ± 0.6, $P < .001$) and higher QOL (88.1 ± 1.0 versus 80.2 ± 1.4, $P < .001$) and more PA (24.0 ± 0.5 versus 16.3 ± 0.7, $P < .001$). Physical activity explained a significant, but small, proportion of the difference in depression (22.1%, $P = .02$) and QOL (16.0%, $P = .048$) but not anxiety (6.6%, $P = .20$) between athletes who had and those who had not returned to play.

Conclusions: Increased PA was responsible for only a small portion of the improvements in depression and QOL among athletes who returned to sports. This suggests that most of the mental health benefits of sport participation for adolescents during the COVID-19 pandemic were independent of the benefits of increased PA.

Key Words: mental health, psychology, adolescents, SARS-CoV-2

Key Points

- Although adolescent athletes who were able to return to sports during the COVID-19 pandemic reported better mental health and quality of life, only a small portion of this difference was attributable to higher physical activity levels.
- The mental health benefits of returning to sports during COVID-19 may have been primarily due to the psychosocial elements of sport participation, such as the reestablishment of peer networks, athletic identity, and role models.

The cancellation of school and sports during the COVID-19 pandemic has been associated with significant decreases in physical activity (PA) and worsening mental health and quality of life (QOL).[1–4] In a study of more than 13 000 adolescent athletes in May 2020, shortly after the nationwide cancellation of school and sports, 37% reported moderate to severe symptoms of anxiety and 40% reported moderate to severe symptoms of depression.[3] A comparison of the subset of this group of adolescent athletes from Wisconsin with historical data collected from adolescent Wisconsin athletes before the pandemic indicated that athletes restricted from sports during the COVID-19 lockdown described significantly worse QOL and dramatically higher symptoms of anxiety and depression, even after adjustments were made for age, sex, and school instruction method.[5]

Physical activity has been consistently demonstrated to offer mental health benefits, and sport participation may also provide psychosocial benefits that are independent of, and in addition to, the benefits of increased PA.[6–8] For example, sport participation is associated with psychological and social health benefits, and athletes displayed better

QOL and self-esteem than their nonathlete counterparts, as well as greater academic success.[8–10] Authors[11] of a recent study found that survivors of the severe acute respiratory syndrome outbreak in 2002 to 2003 had an increased prevalence of mental illness 20 years later. Given the worsening mental health epidemic among adolescents during COVID-19, this suggests that interventions to reduce the mental health effects of the current pandemic could have important long-term benefits.

Prior researchers[12] determined that adolescent athletes who returned to participation in organized sports had higher levels of PA and QOL and fewer symptoms of anxiety and depression than athletes who were unable to return to sports. It remains unclear, however, whether these psychosocial benefits of returning to sports were due to the increased PA or other facets of sport participation, such as the restoration of social networks or athletic identity. A better understanding of these factors can help inform discussions regarding the reinitiation of organized sports during the COVID-19 pandemic. Therefore, the purpose of our study was to conduct a secondary analysis of previously published data[12] to explore whether increases in PA mediated the psychosocial benefits of returning to sports among adolescent high school athletes. We hypothesized that the PA differences between athletes who did and those who did not return to sports in the fall of 2020 would mediate a significant portion of the differences in anxiety, depression, and QOL between the groups but less than half of the difference.

METHODS

Participants

This study was approved by the University of Wisconsin Health Sciences Institutional Review Board in September 2020. Wisconsin high school athletes (males and females, grades 9–12, ages 13–19 years) were recruited to participate by completing an anonymous online survey via Qualtrics in October 2020. Emails were sent to athletic trainers and coaches from a convenience sample of 44 schools to recruit any interested athletes.

Procedures

The survey included a section on demographic information, as well as measures of PA, mental health, and QOL. Demographic responses were obtained regarding age, sex, grade, and school name and whether individuals planned to participate in their respective sport if it was offered in the 2020–2021 school year. The remainder of the survey consisted of an assessment of mental health, PA, and QOL. The General Anxiety Disorder-7 Item (GAD-7) and Patient Health Questionnaire-9 Item surveys were used to evaluate anxiety and depression symptoms. These questionnaires ask participants to rate the frequency of anxiety or depression symptoms experienced in the past 2 weeks. The GAD-7 scale is a valid, reliable, and sensitive measure of anxiety symptoms that can differentiate between mild and moderate GAD in adolescents.[13] Scores range from 0 to 21, with a higher score indicating increased anxiety. In addition to the total score, GAD-7 categorical scores of 0 to 4, 5 to 9, 10 to 14, and 15 to 21 correspond to *no*, *mild*, *moderate*, and *severe anxiety symptoms*, respectively. The Patient Health Questionnaire-9 Item is a 9-item screening questionnaire for depression symptoms that has been used extensively among adolescent athletes.[13–15] Scores range from 0 to 27, with a higher score indicating a greater level of depression.[16]

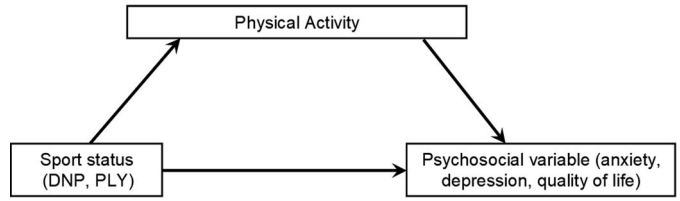

Figure. Mediation analysis, demonstrating the independent variable (sport status), the mediator variable (physical activity), and the dependent psychosocial variable (anxiety, depression, or quality of life). This approach evaluates the proportion of the effect of the independent variable on the dependent variable that is explained by the mediator variable. Abbreviations: DNP, did not play sports in fall of 2020; PLY, did play sports in fall of 2020.

Physical activity was assessed using the Hospital for Special Surgery Pediatric Functional Activity Brief Scale, which contains 8 items regarding the activity of children between 10 and 18 years old during the preceding month. Scores range from 0 to 30, with a higher score indicating greater PA. This measure has been validated in adolescents[17] and normative adolescent data have been published.[18] Quality of life was measured using the Pediatric Quality of Life Inventory 4.0. This inventory consists of 23 items assessing health-related QOL during the previous 7 days and has been validated[19] for use in children ages 2 to 18. Total scores range from 0 to 100, with a higher score indicating greater QOL. The type of instructional delivery method (online only, in person, or hybrid [a combination of in person and online]) was determined by reviewing information on each school's website. Participants were excluded if they did not complete the entire survey, were not in grades 9 to 12, or indicated they did not plan to play interscholastic sports at their school for reasons other than COVID-19 restrictions. In other words, participants were included only if they indicated that they were planning to engage in sports during the 2020–2021 school year. Participants were then classified as playing a fall sport (PLY) or not playing a fall sport (DNP).

Statistical Analysis

Data were grouped by sport status (DNP, PLY). To evaluate the associations between sport status and anxiety, depression, QOL, and PA, we calculated the least squares means from separate linear regression models adjusted for age, sex, and school instruction type to compare groups. The associations between PA and anxiety, depression, and QOL were evaluated using similar adjusted regression models. To evaluate the influence of PA on the relationship between sport status and psychosocial outcomes, we conducted similarly adjusted regression models to identify the association between sport status and each psychosocial variable while including PA as a covariate. Finally, separate mediation analyses were performed to determine the proportions of the differences in anxiety, depression, and QOL between the DNP and PLY groups that were explained by differences in PA (Figure). The proportion of the difference between groups with respect to each

Table 1. Relationships Between Physical Activity and Psychosocial Outcomes in Adolescent Wisconsin Athletes in Fall of 2020[a]

Outcome	Estimate	SE	*P* Value
Anxiety (Generalized Anxiety Disorder 7-Item)	−0.103	0.034	.002
Depression (Patient Health Questionnaire 9-Item)	−0.130	0.035	<.001
Quality of life (Pediatric Quality of Life Inventory)	0.269	0.081	<.001

[a] Relationships evaluated by linear regression models were adjusted for age, sex, and school instruction type.

psychosocial variable (anxiety, depression, QOL) that is mediated by PA is the proportion of the effect of sport status on the psychosocial variable that goes through the mediator (PA). This is calculated by dividing the *average causal mediation effect* (the effect of sports status on PA multiplied by the effect of PA on the psychosocial variable) by the *total effect* (average causal mediation effect plus the direct effect of sports status on the psychosocial variable while controlling for the mediator [PA]).

Specifically, for each psychosocial outcome variable, we developed 2 linear models to predict the variable with (1) age, sex, school instruction type, and sport status as covariates and (2) PA, age, sex, school instruction type, and sport status as covariates. Using the mediate() function in R, the outputs from the 2 models were used to generate 500 quasi-Bayesian Monte Carlo simulations that yielded parameter estimates and 95% CIs. Statistical significance in the final mediation analysis was considered a priori at $P < .05$, and all tests were 2 tailed. Data in the Results are presented as No. (%) for categorical variables and mean ±SD for continuous variables. Statistical analyses were performed in R (version 4.1.2; The R Project for Statistical Computing).[20]

RESULTS

A total of 559 high school athletes (age = 15.7 ± 1.2 years, females = 43.6%, male = 56.4%) completed the survey. Of these, 388 participants (69.4%) were in the DNP group and 171 (30.6%) were in the PLY group. As reported previously,[13] the PLY group had more females (55% versus 40%) and more in-person instructional delivery (40.3% versus 0.08%) than the DNP group, but no differences in age were identified (15.7 ± 1.2 versus 15.7 ± 1.2 years). The PLY athletes had higher levels of PA (24.0 ± 0.5 versus 16.3 ± 0.7, $P < .001$) and QOL (88.1 ± 1.0 versus 80.2 ± 1.4, $P < .001$) and less anxiety (3.6 ± 0.4 versus 8.2 ± 0.6, $P < .001$) and depression (4.2 ± 0.4 versus 7.3 ± 0.6, $P < .001$) than the DNP athletes (Table 1). Physical activity was significantly and positively related to QOL and significantly and inversely related to anxiety and depression symptoms (Table 1). The associations between sport status and psychosocial outcomes before and after adjustment for PA are shown in Table 2. Finally, PA mediated a significant portion of the relationships between sport status and depression and QOL but not anxiety (Table 3).

DISCUSSION

Sport participation has been associated with a number of beneficial physical and mental health outcomes for adolescents, as well as a higher level of academic success.[8,10] After the widespread sport and school cancellations in response to the COVID-19 pandemic in the spring of 2020, adolescent athletes demonstrated decreases in PA and QOL as well as marked increases in anxiety and depression.[3] In the fall of 2020, athletes who were able to return to sports displayed more PA and better QOL that approached historical prepandemic values, as well as improved mental health scores compared with those athletes unable to return to sports.[3] Specifically, after adjusting for age, sex, school instruction type, and socioeconomic status, we found that athletes who were unable to return to sports were more than 6 times as likely to report moderate to severe anxiety and more than twice as likely to report moderate to severe symptoms of depression.[12] These results are consistent with those of prior researchers who noted that social connections through sports had an important influence on mental health in student-athletes[21] and that student-athletes with more social support and connectedness had less dissolution of athletic identity and improved mental health.[22]

In this study, we showed that increases in PA among those who returned to sports explained only a small portion of the overall benefits of sport participation on mental health and QOL among adolescent athletes during the COVID-19 pandemic. Specifically, PA explained 22% of the difference in depression and 16% of the difference in QOL between PLY and DNP athletes. In addition, PA explained only 7% of the difference in anxiety, which was not statistically significant. This finding seems to align with prior research[6–8] suggesting that increased PA was associated with improvements in a wide range of psychosocial outcomes; however, the majority of the difference in mental health and QOL between DNP and PLY athletes in the current study was likely attributable to aspects of sport participation beyond simply increased levels of PA. It also

Table 2. Associations Between Sport Status (Did or Did Not Return to Sport Participation) and Psychosocial Outcomes Among Adolescent Athletes in Fall of 2020, With and Without Adjustment for Physical Activity Level[a]

	Adjustment for Physical Activity Level					
	No			Yes		
Outcome	Estimate	SE	*P* Value	Estimate	SE	*P* Value
Anxiety (Generalized Anxiety Disorder 7-Item)	−4.59	0.78	<.001	−3.81	0.78	<.001
Depression (Patient Health Questionnaire 9-Item)	−3.15	0.84	<.001	−2.10	0.83	.012
Quality of life (Pediatric Quality of Life Inventory)	7.98	1.92	<.001	6.05	1.90	.0015

[a] Relationships evaluated by linear regression models were adjusted for age, sex, and school instruction type, with and without adjustment for physical activity level.

Table 3. Proportion of the Difference in Psychosocial Outcomes Between Adolescent Athletes Who Did or Did Not Return to Sport Participation in Fall of 2020 Explained by Physical Activity

Outcome	Proportion Mediated by Physical Activity, %	95% CI, %	*P* Value
Anxiety (Generalized Anxiety Disorder 7-Item)	6.6	−3.4, 19.5	.196
Depression (Patient Health Questionnaire 9-Item)	22.1	3.8, 74.3	.020
Quality of life (Pediatric Quality of Life Inventory)	16.0	0.29, 46.6	.048

indicated that the increased anxiety experienced by student-athletes who were unable to return to sports in the fall of 2020 was largely unrelated to the loss of PA. Although we cannot directly address the underlying cause, other factors may be primarily responsible, such as loss of athletic identity, uncertainty regarding the future of their sports career, increased exposure to negative home or peer environments without time in sports, and the loss of social connections that sports provide.[22,23] Further exploration is needed to evaluate the role of these potential factors on psychosocial outcomes in athletes. More information may allow athletic trainers and other health care providers to better identify individuals at risk and facilitate early intervention.

Participation in organized sports can offer social connections, interactions with peer networks, and role models, as well as a broader sense of purpose and identity for adolescents.[2] During the COVID-19 pandemic, organized sports may offer an even more pronounced influence as a means to combat social isolation and the pervasive sense of uncertainty that surrounds the cancellation of "normal" activities for children and adolescents. Here we demonstrated not only that the myriad psychosocial benefits of sport participation were significant during the COVID-19 pandemic but that they were only partly attributable to PA. This suggests that although efforts to increase or maintain PA may be helpful in reducing symptoms of depression or improving QOL through the pandemic, the reinitiation of youth sports can have even greater benefits for mental health and QOL among adolescent athletes.

This study had several limitations. We attempted to account for differences between the groups with respect to age, sex, and school instruction type through adjusted models, yet other factors that differed between the DNP and PLY groups and were not accounted for might have confounded our results. For example, racial minority status and socioeconomic status were not included in these analyses but represent an important future research direction to identify which athletes may experience the greatest psychosocial consequences of sport restriction. We did not ask for the specific reasons that athletes were unable to participate as we included only those individuals who were intending to return during the academic year. It is also worth noting that the CIs for the proportions of the difference in psychosocial outcomes between the DNP and PLY groups that were mediated by PA were rather large. Although estimates for proportion-mediated results are typically stable with samples >500, this may nonetheless be a function of a relatively small sample (N = 559) relative to the predictors in the model. Further examination is warranted to replicate these relationships with larger samples of athletes. We cannot be certain that the differences in PA were entirely explained by participation in sports, as athletes in both groups may have had sources of PA outside of sports. We did not directly measure differences between groups with respect to factors that could have influenced psychosocial outcomes, such as social benefits or athletic identity, and can only speculate about the role these may have played in influencing the differences. Whether the relationships between PA and psychosocial outcomes in adolescent athletes during the COVID-19 pandemic will differ after the pandemic is over is unknown. Finally, this analysis represents a group of adolescent athletes from a single state and may therefore not be generalizable to other populations.

CONCLUSIONS

Return to participation in sports during the COVID-19 pandemic was associated with higher PA, reduced symptoms of anxiety and depression, and improved QOL in adolescent athletes. We found that although increased PA was associated with reduced anxiety and depression symptoms and improved QOL, it explained only a small portion of the difference in these outcomes between athletes who did and those who did not return to sports. This suggests that elements of organized sport participation beyond PA play an important role in helping to enhance psychosocial outcomes for adolescent athletes during the COVID-19 pandemic. Although PA can have psychosocial benefits for adolescents during the pandemic, participation in sports may offer greater benefits than PA alone. This information may help inform stakeholders regarding the reinitiation or continuation of organized youth sports during COVID-19.

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