

1 **The Psychosocial Benefits of Sport Participation During COVID-19**
2 **Are Only Partially Explained by Increased Physical Activity**

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19 ABSTRACT

20 The purpose of this study was to determine whether physical activity (PA) increases were
21 responsible for the improvements in mental health and quality of life (QOL) seen among
22 adolescents who returned to sport during the COVID-19 pandemic. Adolescent athletes were
23 asked to complete a survey in October 2020 regarding demographic information, whether they
24 had returned to sport participation (no [DNP], yes [PLY]), school instruction type (virtual, in-
25 person, hybrid), anxiety, depression, QOL, and PA. Anxiety, depression, QOL and PA were
26 compared between PLY and DNP using least squares means from linear models adjusted for age,
27 gender, and instruction type. Mediation analysis assessed whether the relationship between sport
28 status and anxiety, depression, and QOL was mediated by PA. 171 athletes had returned to play,
29 while 388 had not. PLY athletes had significantly lower anxiety (3.6 ± 0.4 v 8.2 ± 0.6 , $p < 0.001$)
30 and depression (4.2 ± 0.4 v 7.3 ± 0.6 , $p < 0.001$), and significantly higher QOL (88.1 ± 1.0 v
31 80.2 ± 1.4 , $p < 0.001$) and PA (24.0 ± 0.5 v 16.3 ± 0.7 , $p < 0.001$). PA explained a significant, but
32 relatively small portion of the difference in depression (22.1%, $p = 0.02$) and QOL (16.0%,
33 $p = 0.048$) between PLY and DNP athletes, but did not explain the difference in anxiety (6.6%,
34 $p = 0.20$). Increased PA is only responsible for a small portion of the improvements in depression
35 and QOL among athletes who returned to sports and unrelated to improvements in anxiety. This
36 suggests that the majority of the mental health benefits of sport participation for adolescents
37 during the COVID-19 pandemic are independent of, and in addition to, the benefits of increased
38 PA.

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40 Keywords: Mental health, adolescents, SARS-CoV-2, sports health

41 INTRODUCTION

42 The cancelation of school and sports during the COVID-19 pandemic has been associated with
43 significant decreases in physical activity and worsening mental health and quality of life.[1-5] In a study
44 of over 13,000 adolescent athletes in May 2020, shortly after the nationwide cancelation of school and
45 sports, 37% reported moderate to severe symptoms of anxiety and 40% reported moderate to severe
46 symptoms of depression.[4] When the subset of this group of adolescent athletes from Wisconsin were
47 compared to historical data collected from adolescent Wisconsin athletes prior to the pandemic, it was
48 found that athletes restricted from sports during the COVID-19 lockdown reported significantly worse
49 QOL and dramatically higher symptoms of anxiety and depression, even after adjusting for age, gender,
50 and school instruction method.[6]

51 Physical activity (PA) has been consistently demonstrated to have significant mental health
52 benefits, and sports participation may also offer psychosocial benefits that are independent of, and in
53 addition to, the benefits of increased PA.[7-9] For example, sport participation is associated with
54 significant psychological and social health benefits, and athletes demonstrate higher QOL and self-esteem
55 than their non-athlete counterparts, as well as greater academic success.[9-11] Recent research has found
56 that survivors of the Severe Acute Respiratory Syndrome outbreak in 2002-2003 demonstrate a
57 significantly increased prevalence of mental illness twenty years later.[12] Given the worsening mental
58 health epidemic among adolescents during COVID-19, this suggests that interventions to reduce the
59 mental health impacts of the current pandemic could have vitally important long-term benefits among
60 adolescents.

61 Prior research has found that adolescent athletes who returned to participation in organized sports
62 had significantly higher PA and QOL, and significantly lower symptoms of anxiety and depression than
63 athletes who were unable to return to sports.[13] It remains unclear, however, whether the psychosocial
64 benefits of returning to sports that were identified are due to the increased PA or other facets of sport
65 participation such as the restoration of social networks or athletic identity. This can provide valuable
66 information to help inform discussions regarding the re-initiation of organized sports during the COVID-

67 19 pandemic. Therefore, the purpose of this study was to conduct a secondary analysis of previously
68 published data[13] to determine whether increases in PA mediate the psychosocial benefits of returning to
69 sports among adolescent high school athletes. We hypothesized that physical activity differences between
70 athletes who did or did not return to sports in the fall of 2020 would mediate a portion of the increased
71 QOL, anxiety and depression, but not a majority of the difference.

72

73 MATERIALS AND METHODS

74 This study was approved by the University of Wisconsin Health Sciences Institutional Review
75 Board in September 2020. Wisconsin high school athletes (male and female, grade: 9–12, age: 13-19)
76 were recruited to participate in the study by completing an anonymous online survey in October 2020.
77 Emails were sent to athletic trainers and coaches from a convenience sample of 44 schools to solicit their
78 athletes to participate in the study. The survey included a section to solicit demographic information, as
79 well as measures of PA, mental health and QOL. Demographic responses were obtained regarding the
80 participant's age, sex, grade, school name and whether the athlete planned to participate in their
81 respective sport if it was offered in the 2020-21 school year.

82 The remainder of the survey consisted of an assessment of mental health, PA and QOL. The
83 General Anxiety Disorder-7 Item (GAD-7) and Patient Health Questionnaire-9 Item (PHQ-9) surveys
84 were used to evaluate anxiety and depression symptoms. The questionnaires ask participants to rate the
85 frequency of anxiety or depression symptoms experienced in the past two weeks. The GAD-7 scale is a
86 valid, reliable and sensitive measure of anxiety symptoms and is able to differentiate between mild and
87 moderate GAD in adolescents. [14] Scores range from 0-21 with a higher score indicating increased
88 anxiety. In addition to the total score, GAD-7 categorical scores of 0–4, 5-9, 10–14, and 15–21
89 correspond to no, mild, moderate, and severe anxiety symptoms, respectively. The PHQ-9 is a 9-item
90 screening questionnaire for depression symptoms with scores ranging from 0-27 with a higher score
91 indicating a greater level of depression.[15]

92 PA was assessed with the Hospital for Special Surgery Pediatric Functional Activity Brief Scale
93 (PFABS). This represents a measure of overall physical activity that has been validated in adolescents[16]
94 and has published normative adolescent data.[17] QOL was measured with Pediatric Quality of Life
95 Inventory 4.0 (PedsQL). The type of instructional delivery method (online only, in person or hybrid [a
96 combination of in person and online]) was determined by reviewing information on each school's
97 website. Participants were excluded if they did not complete the entire survey, were not in grades 9-12, or
98 indicated they did not plan to play interscholastic sports at their school for reasons other than COVID-19
99 restrictions. Participants were classified as playing a fall sport (PLY) or as not playing a fall sport (DNP).

100 Data were initially grouped by sport status (DNP, PLY). To evaluate the association between
101 sport status and anxiety, depression, QOL, and PA, least squares means from separate linear regression
102 models adjusted for age, sex, and school instruction type were used to compare groups. The relationship
103 between PA and anxiety, depression, and QOL was evaluated using similar adjusted regression models. In
104 order to identify the relationship between PA and psychosocial outcomes, PA was included in separate
105 similarly adjusted linear models to predict anxiety, depression, and QOL. Finally, separate mediation
106 analyses were conducted to evaluate the proportion of the difference in anxiety, depression, and QOL
107 between the DNP and PLY groups that was explained by differences in PA (see Figure 1).

108 Specifically, for each psychosocial outcome variable, two models were developed: 1) a linear
109 model to predict the variable with age, sex, school instruction type and sport status as covariates, and 2) a
110 linear model to predict the variable with PA, age, sex, school instruction type and sport status as
111 covariates. Using the mediate() function in R, the outputs from the 2 models were used to generate 500
112 quasi-Bayesian Monte Carlo simulations that yield parameter estimates and 95% confidence intervals.
113 Statistical significance in the final mediation analysis was considered *a priori* at $p < .05$, and all tests were
114 2-tailed. Data are presented as n (%) for categorical variables and mean(standard deviation) for
115 continuous variables. Statistical analyses were performed in R.[18]

116

117 RESULTS

118 As previously reported, a total of 559 high school athletes (age = 15.7+1.2 yrs., female = 43.6%, male =
119 56.4%) completed the survey. Three hundred eighty-eight (69.4%) participants reported they did not play
120 (DNP) an interscholastic sport at their school, while 171 (30.6%) reported they did play (PLY) an
121 interscholastic sport. PLY athletes were found to have higher PA and QOL, and lower depression and
122 anxiety than DNP (see Table 1). PA was significantly and positively related to QOL and significantly,
123 inversely related to anxiety and depression symptoms (see Table 2). Finally, PA was found to mediate a
124 significant portion of the relationship between sport status and depression and QOL, but not anxiety (see
125 Table 3).

126

127 DISCUSSION

128 Sport participation has been associated with a number of beneficial physical and mental health
129 outcomes for adolescents, as well as higher academic success.[9, 11] Following the widespread sport and
130 school cancelations in response to the COVID-19 pandemic in the spring of 2020, adolescent athletes
131 demonstrated decreases in PA and QOL, as well as marked increases in anxiety and depression.[4] In fall
132 2020, athletes who were able to return to sports demonstrated higher PA and QOL that approached
133 historical, pre-pandemic values, as well as significantly better mental health scores compared to those
134 athletes unable to return to sports.[3] Specifically, after adjusting for age, sex, school instruction type and
135 socioeconomic status, athletes who were unable to return to sports were more than 6 times as likely to
136 report moderate to severe anxiety and more than twice as likely to report moderate to severe symptoms of
137 depression.[13] This is consistent with prior research that has found that social connections through
138 sports have an important influence on mental health in student-athletes,[19] and that student-athletes with
139 more social support and connectedness had less dissolution of athletic identity and improved mental
140 health.[20]

141 In this study, we demonstrate that increases in PA among those who returned to sports explained
142 only a small portion of the overall benefits of sports participation on mental health and QOL among
143 adolescent athletes during the COVID-19 pandemic. Specifically, we found that PA explained 22% of

144 the difference in depression and 16% of the difference in QOL between PLY and DNP athletes. In
145 addition, PA explained only 7% of the difference in anxiety, which was not statistically significant. This
146 seems to align with prior research suggesting that increased PA is associated with improvements in a wide
147 range of psychosocial outcomes, but suggests that the majority of the difference in mental health and
148 QOL between DNP and PLY athletes in the current study is attributable to aspects of sport participation
149 beyond just increased levels of PA. It also suggests that the increased anxiety experienced by student-
150 athletes unable to return to sports in the fall of 2020 sports is largely unrelated to the loss of physical
151 activity. While we cannot directly address the underlying cause, this may be primarily attributable to
152 other factors, such as loss of athletic identity, uncertainty regarding the future of their sports career,
153 increased exposure to negative home or peer environments without time in sports, and/or the loss of social
154 connections that sports provide.[19, 20]

155 Participation in organized sports can offer social connections, interactions with peer networks and
156 role models, as well as a broader sense of purpose and identity for adolescents.[21] During the COVID-
157 19 pandemic, organized sports may offer an even more pronounced influence as a means to combat social
158 isolation and the pervasive sense of uncertainty that surrounds the cancelation of “normal” activities for
159 children and adolescents. Here we demonstrate that the myriad psychosocial benefits of sport
160 participation are not only significant during the COVID-19 pandemic, but that they are only partly
161 attributable to PA. This suggests that while efforts to increase or maintain PA may be helpful in reducing
162 symptoms of depression or improving quality of life through the pandemic, the re-initiation of youth
163 sports can have even greater benefits for QOL and mental health among adolescent athletes.

164 This study has several limitations. Although we attempted to account for differences between the
165 groups with respect to age, sex, and school instruction type through adjusted models, it is possible that
166 other factors that differ between the DNP and PLY groups are not accounted for could confound our
167 results. We cannot be certain that the differences in PA are entirely explained by participation in sports as
168 athletes in both groups may have sources of PA outside of sports. We did not directly measure
169 differences between groups with respect to factors that could potentially influence psychosocial

170 outcomes, such as the social benefits or athletic identity, and can only speculate about the role that these
171 may play in influencing the differences between groups. It is unknown if the relationships between PA
172 and psychosocial outcomes in adolescent athletes during the COVID-19 pandemic will differ after the
173 pandemic is over. Finally, this analysis represents a group of adolescent athletes from a single state,
174 which may not be generalizable to other populations.

175

176 CONCLUSIONS

177 In summary, return to participation in sports during the COVID-19 pandemic is associated with
178 higher PA, improved QOL, and reduced symptoms of anxiety and depression in adolescent athletes. We
179 found that although increased PA is associated with improved QOL and reduced anxiety and depression
180 symptoms, it only explains a small portion of the difference in these outcomes between those athletes that
181 did or did not return to sports. This suggests that elements of organized sport participation beyond PA
182 play an important role in helping improve psychosocial outcomes for adolescent athletes during the
183 COVID-19 pandemic. While PA can have psychosocial benefits for adolescents during the pandemic,
184 participation in sports may offer greater benefits than PA alone. This information may help inform
185 stakeholders regarding the re-initiation and/or continuation of organized youth sports during COVID-19.

186

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252 development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*.
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- 254

255 **Figure Legend**

256 Figure 1. Mediation analysis, demonstrating the independent variable (sport status), the mediator
257 variable (physical activity), and the dependent psychosocial variable (anxiety, depression, or
258 quality of life). This approach evaluates the proportion of the effect of the independent variable
259 on the dependent variable that is explained by the mediator variable. DNP = did not play sports
260 in fall 2020. PLY = did play sports in fall 2020.

261

262 Table 1. Differences in physical activity, anxiety, depression, and quality of life between
263 adolescent athletes who did or did not return to sport participation in fall 2020.^a

| Variable | DNP | PLY | p |
|---------------------------|-------------|-------------|----------|
| Physical Activity (PFABS) | 16.3 ± 0.7 | 24 ± 0.49 | <0.001 |
| Anxiety (GAD-7) | 8.21 ± 0.57 | 3.6 ± 0.4 | <0.001 |
| Depression (PHQ-9) | 7.34 ± 0.61 | 4.18 ± 0.43 | <0.001 |
| Quality of Life (PedsQL) | 80.2 ± 1.4 | 88.1 ± 0.99 | <0.001 |

264 Data are presented as mean ± SD. ^aComparisons between groups using least squares means from
265 linear regression models adjusted for age, sex, and school instruction type. DNP = did not return
266 to sport participation; GAD-7 = Generalized Anxiety Disorder 7-Item; PedsQL = Pediatric
267 Quality of Life inventory; PHQ-9 = Patient Health Questionnaire 9-Item; PLY=did return to
268 sport participation.

269 Table 2. Relationship between physical activity and psychosocial outcomes in adolescent Wisconsin
270 athletes in fall 2020.^a

| | Estimate | SE | p |
|--------------------------|----------|-------|--------|
| Anxiety (GAD-7) | -0.103 | 0.034 | 0.002 |
| Depression (PHQ-9) | -0.130 | 0.035 | <0.001 |
| Quality of Life (PedsQL) | 0.269 | 0.081 | <0.001 |

271 ^aRelationships evaluated by linear regression models adjusted for age, gender, and school instruction
272 type. DNP: did not return to sport participation; GAD-7 = Generalized Anxiety Disorder 7-Item; PedsQL
273 = Pediatric Quality of Life inventory; PHQ-9 = Patient Health Questionnaire 9-Item.

274 Table 3. Proportion of the difference in psychosocial outcomes between adolescent athletes who
275 did or did not return to sport participation in fall 2020 that is explained by physical activity.

| | Proportion Mediated by PA | Lower CI | Upper CI | p |
|--------------------------|---------------------------|----------|----------|-------|
| Anxiety (GAD-7) | 6.6% | -3.4% | 19.5% | 0.196 |
| Depression (PHQ-9) | 22.1% | 3.8% | 74.3% | 0.020 |
| Quality of Life (PedsQL) | 16.0% | 0.29% | 46.6% | 0.048 |

276 CI = 95% confidence interval; GAD-7 = Generalized Anxiety Disorder 7-Item; PA = physical activity;

277 PedsQL = Pediatric Quality of Life inventory; PHQ-9 = Patient Health Questionnaire 9-Item.

