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

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ABSTRACT

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

Objective: The purpose of this study was 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

Setting: Wisconsin secondary schools

Participants: 559 adolescent athletes (15.7±1.2 yrs., female = 43.6%) from 44 schools completed a survey in October 2020.

Main Outcome Measures: Demographic information, whether they had returned to sport participation (no [DNP], yes [PLY]), 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 assessed whether the relationship between sport status and anxiety, depression, and QOL was mediated by PA.

Results: Of the 559 total athletes included, 171 (31%) athletes had returned to play, while 388 had not. PLY athletes had significantly lower anxiety (3.6 ± 0.4 v 8.2 ± 0.6 , $p<0.001$) and depression (4.2 ± 0.4 v 7.3 ± 0.6 , $p<0.001$), and significantly higher QOL (88.1 ± 1.0 v 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 small

24 proportion of the difference in depression (22.1%, $p=0.02$) and QOL (16.0%, $p=0.048$) between
25 PLY and DNP athletes, but not anxiety (6.6%, $p=0.20$).

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

30 Keywords: Mental health, adolescents, SARS-CoV-2, psychosocial

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33 KEY POINTS

- 34 • Although adolescent athletes who were able to return to sports during the COVID-19
35 pandemic reported significantly better quality of life and mental health, only a small
36 portion of the this difference was attributable to higher physical activity levels.
- 37 • The mental health benefits of returning to sports during COVID-19 may be primarily due
38 to the psychosocial elements of sport participation, such as the re-establishment of peer
39 networks, athletic identity and role models.

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

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

59 Prior research has demonstrated that adolescent athletes who returned to participation in
60 organized sports had significantly higher PA and QOL, and significantly lower symptoms of
61 anxiety and depression than athletes who were unable to return to sports.[13] It remains unclear,
62 however, whether the psychosocial benefits of returning to sports that were identified are due to

63 the increased PA or other facets of sport participation such as the restoration of social networks
64 or athletic identity. This can provide valuable information to help inform discussions regarding
65 the re-initiation of organized sports during the COVID-19 pandemic. Therefore, the purpose of
66 this study was to conduct a secondary analysis of previously published data[13] to explore
67 whether increases in PA mediate the psychosocial benefits of returning to sports among
68 adolescent high school athletes. We hypothesized that the physical activity differences between
69 athletes who did or did not return to sports in the fall of 2020 would mediate a significant portion
70 of the differences in QOL, anxiety and depression between the groups, but less than half of the
71 difference.

72 METHODS

73 *Participants*

74 This study was approved by the XXX Institutional Review Board in September 2020.
75 Wisconsin high school athletes (male and female, grade: 9–12, age: 13-19) were recruited to
76 participate in the study by completing an anonymous online survey via Qualtrics in October
77 2020. Emails were sent to athletic trainers and coaches from a convenience sample of 44 schools
78 to recruit any interested athletes to participate in the study.

79 *Procedures*

80 The survey included a section to obtain demographic information, as well as measures of
81 PA, mental health and QOL. Demographic responses were obtained regarding the participant's
82 age, sex, grade, school name and whether the athlete planned to participate in their respective
83 sport if it was offered in the 2020-21 school year. The remainder of the survey consisted of an
84 assessment of mental health, PA and QOL. The General Anxiety Disorder-7 Item (GAD-7) and
85 Patient Health Questionnaire-9 Item (PHQ-9) surveys were used to evaluate anxiety and

86 depression symptoms. The questionnaires ask participants to rate the frequency of anxiety or
87 depression symptoms experienced in the past two weeks. The GAD-7 scale is a valid, reliable
88 and sensitive measure of anxiety symptoms and is able to differentiate between mild and
89 moderate GAD in adolescents. [14] Scores range from 0-21 with a higher score indicating
90 increased anxiety. In addition to the total score, GAD-7 categorical scores of 0–4, 5-9, 10–14,
91 and 15–21 correspond to no, mild, moderate, and severe anxiety symptoms, respectively. The
92 PHQ-9 is a 9-item screening questionnaire for depression symptoms that has been used
93 extensively among adolescent athletes.[4, 15, 16] Scores range from 0-27 with a higher score
94 indicating a greater level of depression.[17]

95 PA was assessed with the Hospital for Special Surgery Pediatric Functional Activity
96 Brief Scale (PFABS), which includes 8 items regarding the activity of children between 10 and
97 18 years old during the past month. Scores range from 0 to 30, with a higher score indicating
98 greater physical activity. This measure has been validated in adolescents[18] and has published
99 normative adolescent data.[19] QOL was measured with Pediatric Quality of Life Inventory 4.0
100 (PedsQL). This inventory includes 23 items assess health-related QOL during previous 7 days
101 that has been validated for use in children ages 2 to 18.[20] Total scores range from 0 to 100 with
102 a higher score indicating greater QOL. The type of instructional delivery method (online only, in
103 person or hybrid [a combination of in person and online]) was determined by reviewing
104 information on each school's website. Participants were excluded if they did not complete the
105 entire survey, were not in grades 9-12, or indicated they did not plan to play interscholastic
106 sports at their school for reasons other than COVID-19 restrictions. In other words, participants
107 were only included if they indicated that they were planning to participate in sports during the

108 2020-21 school year. Participants were then classified as playing a fall sport (PLY) or as not
109 playing a fall sport (DNP).

110 *Statistical Analysis*

111 Data were grouped by sport status (DNP, PLY). To evaluate the association between
112 sport status and anxiety, depression, QOL, and PA, least squares means from separate linear
113 regression models adjusted for age, sex, and school instruction type were used to compare
114 groups. The association between PA and anxiety, depression, and QOL was evaluated using
115 similar adjusted regression models. In order to evaluate the influence of PA on the relationship
116 between sport status and psychosocial outcomes, we also conducted similarly adjusted regression
117 models to evaluate the association between sport status and each psychosocial variable, while
118 also including PA as a covariate. Finally, separate mediation analyses were conducted to
119 evaluate the proportion of the difference in anxiety, depression, and QOL between the DNP and
120 PLY groups that was explained by differences in PA (see Figure). The proportion of the
121 difference between groups with respect to each psychosocial variable (anxiety, depression, QOL)
122 that is mediated by PA is the proportion of the effect of sport status on the psychosocial variable
123 that goes through the mediator (PA). This is calculated by dividing the average causal mediation
124 effect (the effect of sports status on PA multiplied by the effect of PA on the psychosocial
125 variable) by the total effect (average causal mediation effect plus the direct effect of sports status
126 on the psychosocial variable while controlling for the mediator [PA]).

127 Specifically, for each psychosocial outcome variable, two models were developed: 1) a
128 linear model to predict the variable with age, sex, school instruction type and sport status as
129 covariates, and 2) a linear model to predict the variable with PA, age, sex, school instruction type
130 and sport status as covariates. Using the mediate() function in R, the outputs from the 2 models

131 were used to generate 500 quasi-Bayesian Monte Carlo simulations that yield parameter
132 estimates and 95% confidence intervals. Statistical significance in the final mediation analysis
133 was considered *a priori* at $p < .05$, and all tests were 2-tailed. Data are presented as n (%) for
134 categorical variables and mean(standard deviation) for continuous variables. Statistical analyses
135 were performed in R.[21]

136 RESULTS

137 Five hundred fifty-nine high school athletes (age = 15.7 ± 1.2 years, female = 43.6%, male =
138 56.4%) completed the survey. Three hundred eighty-eight (69.4%) participants reported they did
139 not play (DNP) an interscholastic sport at their school, while 171 (30.6%) reported they did play
140 (PLY) an interscholastic sport. As reported previously,[22] the PLY group had more females
141 (55% v. 40%) and more in-person instructional delivery (40.3% v 0.08%) than the DNP group,
142 but no differences in age were identified (15.7 ± 1.2 v. 15.7 ± 1.2 years). PLY athletes were found
143 to have higher PA (24.0 ± 0.5 v 16.3 ± 0.7 , $p < 0.001$) and QOL (88.1 ± 1.0 v 80.2 ± 1.4 , $p < 0.001$), and
144 lower depression (4.2 ± 0.4 v 7.3 ± 0.6 , $p < 0.001$) and anxiety (3.6 ± 0.4 v 8.2 ± 0.6 , $p < 0.001$) than
145 DNP (see Table 1). PA was significantly and positively related to QOL and significantly,
146 inversely related to anxiety and depression symptoms (see Table 1). The association between
147 sport status and psychosocial outcomes before and after adjustment for PA are shown in Table 2.
148 Finally, PA was found to mediate a significant portion of the relationship between sport status
149 and depression and QOL, but not anxiety (see Table 3).

150 DISCUSSION

151 Sport participation has been associated with a number of beneficial physical and mental
152 health outcomes for adolescents, as well as higher academic success.[9, 11] Following the
153 widespread sport and school cancelations in response to the COVID-19 pandemic in the spring

154 of 2020, adolescent athletes demonstrated decreases in PA and QOL, as well as marked increases
155 in anxiety and depression.[4] In fall 2020, athletes who were able to return to sports
156 demonstrated higher PA and QOL that approached historical, pre-pandemic values, as well as
157 significantly better mental health scores compared to those athletes unable to return to sports.[3]
158 Specifically, after adjusting for age, sex, school instruction type and socioeconomic status,
159 athletes who were unable to return to sports were more than 6 times as likely to report moderate
160 to severe anxiety and more than twice as likely to report moderate to severe symptoms of
161 depression.[13] This is consistent with prior research that has found that social connections
162 through sports have an important influence on mental health in student-athletes,[23] and that
163 student-athletes with more social support and connectedness had less dissolution of athletic
164 identity and improved mental health.[24]

165 In this study, we demonstrate that increases in PA among those who returned to sports
166 explained only a small portion of the overall benefits of sports participation on mental health and
167 QOL among adolescent athletes during the COVID-19 pandemic. Specifically, we found that
168 PA explained 22% of the difference in depression and 16% of the difference in QOL between
169 PLY and DNP athletes. In addition, PA explained only 7% of the difference in anxiety, which
170 was not statistically significant. This seems to align with prior research suggesting that increased
171 PA is associated with improvements in a wide range of psychosocial outcomes, but suggests that
172 the majority of the difference in mental health and QOL between DNP and PLY athletes in the
173 current study is attributable to aspects of sport participation beyond just increased levels of PA.
174 It also suggests that the increased anxiety experienced by student-athletes unable to return to
175 sports in the fall of 2020 sports is largely unrelated to the loss of physical activity. While we
176 cannot directly address the underlying cause, this may be primarily attributable to other factors,

177 such as loss of athletic identity, uncertainty regarding the future of their sports career, increased
178 exposure to negative home or peer environments without time in sports, and/or the loss of social
179 connections that sports provide.[23, 24] Further research is needed to evaluate the role that these
180 potential factors play on psychosocial outcomes in athletes. This may allow for athletic trainers
181 and other healthcare providers to better identify individuals at risk and facilitate early
182 intervention.

183 Participation in organized sports can offer social connections, interactions with peer
184 networks and role models, as well as a broader sense of purpose and identity for adolescents.[25]
185 During the COVID-19 pandemic, organized sports may offer an even more pronounced
186 influence as a means to combat social isolation and the pervasive sense of uncertainty that
187 surrounds the cancelation of “normal” activities for children and adolescents. Here we
188 demonstrate that the myriad psychosocial benefits of sport participation are not only significant
189 during the COVID-19 pandemic, but that they are only partly attributable to PA. This suggests
190 that while efforts to increase or maintain PA may be helpful in reducing symptoms of depression
191 or improving quality of life through the pandemic, the re-initiation of youth sports can have even
192 greater benefits for QOL and mental health among adolescent athletes.

193 This study has several limitations. Although we attempted to account for differences
194 between the groups with respect to age, sex, and school instruction type through adjusted
195 models, it is possible that other factors that differ between the DNP and PLY groups are not
196 accounted for could confound our results. For example, racial minority status and
197 socioeconomic status were not included in these analyses but represent an important future
198 research direction to identify which athletes may experience the greatest psychosocial
199 consequences of sport restriction. We did not ask for the specific reasons that athletes were

200 unable to participate beyond including only those that were intending to return during the
201 academic year. It is also worth noting that the confidence intervals for the proportions of the
202 difference in psychosocial outcomes between the DNP and PLY groups that is mediated by PA
203 are rather large. Although estimates for proportion mediated results are typically stable with
204 samples greater than 500, this may nonetheless be a function of a relatively small sample
205 ($n=559$) relative to the predictors in the model. Further research is warranted to replicate these
206 relationships with larger samples of athletes. We cannot be certain that the differences in PA are
207 entirely explained by participation in sports as athletes in both groups may have sources of PA
208 outside of sports. We did not directly measure differences between groups with respect to
209 factors that could potentially influence psychosocial outcomes, such as the social benefits or
210 athletic identity, and can only speculate about the role that these may play in influencing the
211 differences between groups. It is unknown if the relationships between PA and psychosocial
212 outcomes in adolescent athletes during the COVID-19 pandemic will differ after the pandemic is
213 over. Finally, this analysis represents a group of adolescent athletes from a single state, which
214 may not be generalizable to other populations.

215 In summary, return to participation in sports during the COVID-19 pandemic is
216 associated with higher PA, improved QOL, and reduced symptoms of anxiety and depression in
217 adolescent athletes. We found that although increased PA is associated with improved QOL and
218 reduced anxiety and depression symptoms, it only explains a small portion of the difference in
219 these outcomes between those athletes that did or did not return to sports. This suggests that
220 elements of organized sport participation beyond PA play an important role in helping improve
221 psychosocial outcomes for adolescent athletes during the COVID-19 pandemic. While PA can
222 have psychosocial benefits for adolescents during the pandemic, participation in sports may offer

223 greater benefits than PA alone. This information may help inform stakeholders regarding the re-
224 initiation and/or continuation of organized youth sports during COVID-19.

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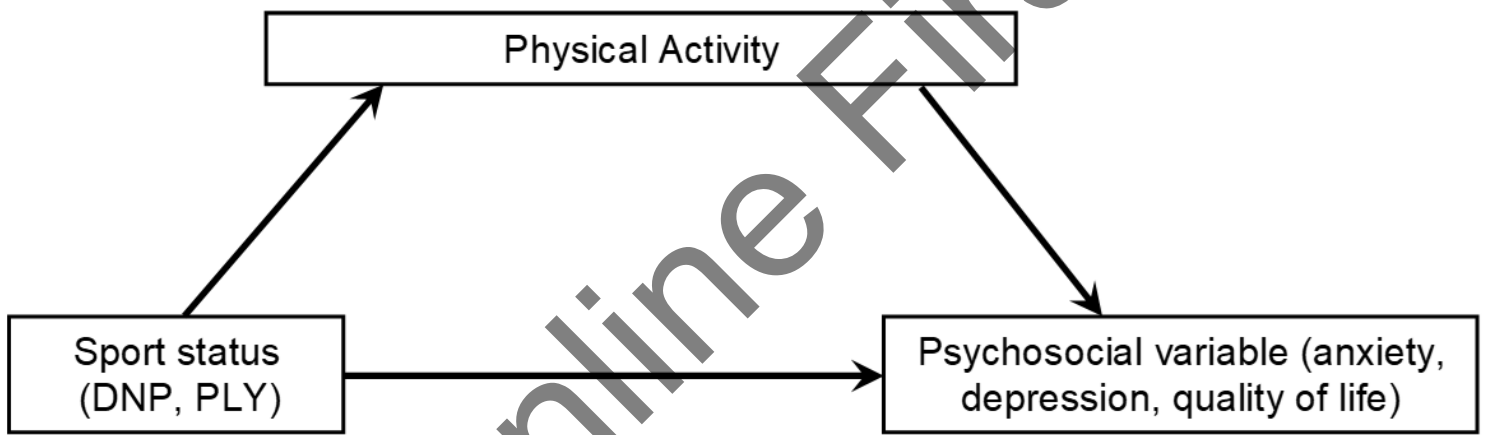
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300 Figure 1. Mediation analysis, demonstrating the independent variable (sport status), the mediator
301 variable (physical activity), and the dependent psychosocial variable (anxiety, depression, or
302 quality of life). This approach evaluates the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

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Table 1. Relationship between physical activity and psychosocial outcomes in adolescent Wisconsin 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

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

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Table 2. Associations between sport status (did or did not return to sport participation) and psychosocial outcomes among adolescent athletes in fall 2020, with and without adjustment for physical activity level.^a

	<u>No adjustment for PA</u>			<u>Adjusted for PA</u>		
	Estimate	SE	p	Estimate	SE	p
Anxiety (GAD-7)	-4.59	0.78	<0.001	-3.81	0.78	<0.001
Depression (PHQ-9)	-3.15	0.84	<0.001	-2.10	0.83	0.012
Quality of Life (PedsQL)	7.98	1.92	<0.001	6.05	1.90	0.0015

^aRelationships evaluated by linear regression models adjusted for age, gender, and school instruction type, with and without adjustment for physical activity level. GAD-7 = Generalized Anxiety Disorder 7-Item; PedsQL = Pediatric Quality of Life inventory; PFABS = Hospital for Special Surgery Pediatric Functional Activity Brief Scale; PHQ-9 = Patient Health Questionnaire 9-Item; PA = physical activity.

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Table 3. Proportion of the difference in psychosocial outcomes between adolescent athletes who 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

CI = 95% confidence interval; GAD-7 = Generalized Anxiety Disorder 7-Item; PA = physical activity; PedsQL = Pediatric Quality of Life inventory; PHQ-9 = Patient Health Questionnaire 9-Item.

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