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A Multiyear Assessment of the Effect of Sport Participation on the Health of Adolescent Athletes During the COVID-19 Pandemic

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Context: Sport cancellations early in the COVID-19 pandemic had a significant negative effect on the health of US adolescents. The effect of restarting sports during the pandemic has not been described.

Objective: To identify the effect of sport participation on the health of adolescents before and during the COVID-19 pandemic.

Design: Cross-sectional study.

Setting: Sample recruited via social media.

Patients or Other Participants: Wisconsin adolescent athletes.

Main Outcome Measure(s): Participants provided information regarding their age, sex, and sport(s) involvement and completed the Patient Health Questionnaire-9 Item to assess depression symptoms, the Hospital for Special Surgery Pediatric Functional Activity Brief Scale to measure physical activity, and the Pediatric Quality of Life Inventory 4.0 to measure quality of life (QoL). Data were collected in spring 2021 (Spring21; n = 1906, age = 16.0 ± 1.2 years, females = 48.8%), when interscholastic sports had fully resumed, and were compared with similar cohorts of adolescent athletes at 2 time points: (1) spring 2020 (Spring20; n = 3243, age = 16.2 ± 1.2 years, females = 57.9%) when sports were cancelled and (2) 2016–2018 (PreCOVID-19) before the pandemic (n = 5231, age = 15.7 ± 1.1 years, females = 65.0%). Comparisons were conducted via analysis-of-variance models and ordinal regressions with age and sex as covariates.

Results: The prevalence of moderate to severe depression was lower in Spring21 than in Spring20 but higher than in PreCOVID-19 (PreCOVID-19 = 5.3%, Spring20 = 37.8%, Spring21 = 22.8%; $P < .001$). Physical activity scores (mean [95% CI]) were higher in Spring21 than in Spring20 but lower than in PreCOVID-19 (PreCOVID-19 = 23.1 [22.7, 23.5], Spring20 = 13.5 [13.3, 13.7], Spring21 = 21.9 [21.6, 22.2]). Similarly, QoL scores were higher in Spring21 than in Spring20 but lower than in PreCOVID-19 (PreCOVID-19 = 92.8 [92.5, 93.1], Spring20 = 80.7 [80.3, 81.1], Spring21 = 84.3 [83.8, 84.8]).

Conclusions: Although sports have restarted, clinicians should be aware that physical activity, mental health, and QoL are still significantly affected in adolescent athletes by the ongoing pandemic.

Key Words: youth athletes, depression, public health

Key Points

- Adolescent athletes who participated in sports during the COVID-19 pandemic reported better mental health (reduced depression symptoms) than adolescent athletes during sport cancellations early in the pandemic but worse mental health and physical activity levels than athletes reported before the pandemic.
- Adolescent athletes who participated in sports during the COVID-19 pandemic reported better quality of life than adolescent athletes during sport cancellations early in the pandemic but worse than athletes reported before the pandemic.
- Although sport participation during the COVID-19 pandemic has had a significant positive effect on the mental health and physical activity of adolescents, the negative health effects reported early in the COVID-19 pandemic may persist for some time.

Sport participation is recognized as having profound positive influences on the health and well-being of adolescents in both the short and long term.[1–4] During the spring of 2020, COVID-19, the disease caused by the novel severe acute respiratory syndrome coronavirus 2 virus, reached pandemic levels in the United States. Virtually all high school and club sport opportunities were cancelled to slow the spread of the disease. Researchers[5–8] of a growing body of evidence suggested that the COVID-19 pandemic and the associated mitigation strategies may have had profound health consequences for youth and adolescents. Investigators[9–11] who specifically focused on adolescent athletes showed that the cancellation of sport was associated with dramatic increases in anxiety and depression as well as decreases in both physical activity and quality of life (QoL).

During the late summer 2020 and the 2020–2021 academic year, some US adolescents were once again provided with sport participation opportunities at the community, club, and high school level.[12,13] Although sport participation opportunities were reinitiated, the effect of restarting sport participation during the COVID-19 pandemic has not been described. Furthermore, current data are limited to those collected only after the COVID-19 pandemic, without comparing the data with similar populations before the pandemic.[7]

During the 2020–2021 academic year, individual Wisconsin school districts were allowed to determine the type of instruction provided (in person, online, or a combination of in person and online) based on guidance from local public health and medical officials. During the fall 2020, approximately 305 (60%) of the 510 schools opted to sponsor teams for all fall sports, whereas 104 (20%) offered limited sports, and the remaining 101 (20%) offered no fall sports.[14] In the late winter and early spring 2021, approximately 120 schools that did not offer the traditional fall sport season offered an alternate fall sport season for their student-athletes. By the late spring 2021 (April–June), all Wisconsin schools once again offered interscholastic spring sport participation opportunities for their student-athletes.

The purpose of our study was to identify the effect of sport participation on the mental health, physical activity, and QoL of adolescent athletes before and during the COVID-19 pandemic. To measure this effect, we compared athlete self-reported data on depression, physical activity, and QoL with similar data that our study team collected on cohorts of adolescent athletes before and during the early months of the COVID-19 pandemic.[10]

We hypothesized that adolescent athletes who participated in sports during the COVID-19 pandemic would report better health (fewer symptoms of depression, increased physical activity, and better QoL) than athletes who reported when sports were cancelled early in the COVID-19 pandemic. Furthermore, we hypothesized that the values reported by athletes in the years before the COVID-19 pandemic would be similar to those reported by athletes who participated in sports during the pandemic. Identifying the potential effect of sport participation for adolescents is crucial, as public health experts have advocated for sport participation as 1 method of improving the health of adolescents before and during the COVID-19 pandemic.[15–17]

METHODS

This study was approved by the University of Wisconsin Health Sciences Institutional Review Board. Wisconsin adolescent athletes (males and females, grades = 9–12, age range = 13–19 years) were recruited via social media postings, and emails sharing the posting were sent to all Wisconsin high school administrators, inviting student-athletes to participate in the study by completing an anonymous online survey in April–June 2021.

Consent and assent to take part in the study were obtained by asking potential participants to read the information regarding the study's purpose and design and to obtain permission from their parent or guardian to complete the survey. The online survey was completed by most of the participants in less than 10 minutes. The demographic portion of the survey consisted of 29 questions for participants to report their age, sex, and grade, as well as a list of all the club or school sports they played in the summer 2020 and during the 2020–2021 academic year (ie, since the onset of the COVID-19 pandemic). The remainder of the survey consisted of 40 questions to assess the participants' mental health, physical activity level, and QoL as described in the following paragraphs. We compared data collected in the spring 2021 (Spring21) with those we collected and reported on similar cohorts of adolescent athletes during the spring 2020 (Spring20) when sports were cancelled and in the years 2016–2018 (PreCOVID-19) when full sport participation was allowed.[10,18–21]

Depression

The Patient Health Questionnaire-9 Item (PHQ-9) survey was used to evaluate depressive symptoms. This 9-item questionnaire asks participants to rate the frequency of depression symptoms experienced in the past 2 weeks.[22] The PHQ-9 scores range from 0 to 27, with a higher score indicating a greater level of depression symptoms. The PHQ-9 has demonstrated high sensitivity and specificity for depression screening in adolescent patients aged 13 to 17 years.[23] In addition to the total score, a PHQ-9 categorical score of 0 to 4 corresponded with *minimal or no depression symptoms*, 5 to 9 with *mild symptoms*, 10 to 14 with *moderate symptoms*, 15 to 19 with *moderately severe symptoms*, and $\geq$20 with *severe symptoms*.[23,24]

Physical Activity

We assessed physical activity level using the Hospital for Special Surgery Pediatric Functional Activity Brief Scale (HSS-PFABS). This instrument contains 8 items and was designed to measure the activity of children between 10 and 18 years for the past month.[25] Scores range from 0 to 30, with a higher score indicating greater physical activity; the HSS-PFABS has demonstrated validity in adolescent populations.[25,26]

Quality of Life

The Pediatric Quality of Life Inventory 4.0 (PedsQL) has been shown to be a valid measurement of QoL in children and adolescents between the ages of 6 and 18 years.[27,28] The PedsQL questionnaire assesses QoL during the previous 7 days and contains 23 items. Physical summary (physical function) and psychosocial (emotional, social, and school function) summary scores can be calculated, as well as the total PedsQL score. Each score ranges from 0 to 100, with a higher score indicating better QoL.[27]

Statistical Analyses

Statistical analyses were performed for data from participants who provided complete surveys. Participants were excluded if they (1) did not complete the entire survey or (2) were not in grades 9–12.

Demographic variables were summarized (mean [SD] or No. [%]) by cohort (PreCOVID-19, Spring2020, and Spring2021). Univariable comparisons among cohorts were performed via analysis of variance for continuous variables

Table 1. Participant Demographics and Characteristics of Wisconsin Adolescent Athletes in the 2016–2018 (PreCOVID-19), Spring 2020 (Spring20), and Spring 2021 (Spring21) Cohorts[a]

Variable	Time			*P* Value
	PreCOVID-19 (n = 5231)	Spring20 (n = 3243)	Spring21 (n = 1906)	
Age, y	15.7 ± 1.1	16.2 ± 1.2	16.0 ± 1.2	<.001
Sex				<.001
Female	3402 (65.0)	1877 (57.9)	933 (48.8)	
Male	1829 (35.0)	1366 (42.1)	973 (51.2)	
Grade in school				<.001
9	1763 (33.7)	862 (26.6)	465 (24.4)	
10	1388 (26.5)	845 (26.1)	538 (28.2)	
11	1153 (22.0)	848 (26.1)	489 (25.7)	
12	927 (17.7)	688 (21.2)	414 (21.7)	

[a] Data are reported as No. (%) except for age, which are reported as mean ± SD.

or χ^2 tests for categorical variables. Means and 95% CIs for each cohort were estimated using separate analysis-of-variance models for depression, physical activity, and QoL. We recognize that the 3 cohort groups may have had systematic differences in participant characteristics (age, sex, and sport[s] played), which often occurs with nonrandomized observational studies in which researchers seek to document the changes in health among various populations. The methods we used are similar to those in multiple prior publications from various countries in which investigators[10,29–31] documented the changes in mental health among various populations before and during the COVID-19 pandemic.

Survey weights for athletes were based on the most common sport played, and inverse propensity score weights were calculated to account for design-based differences in the 3 groups.[32] Propensity score weights were assigned using logistic regression, which was weighted based on the sample survey weights. Group assignment was the dependent variable, and age, sex, and high school sport were the predictor variables. The PHQ-9, HSS-PFABS, and PedsQL scores were compared with data previously reported. Final models comparing the 3 cohorts included weights as the multiplication of the sampling weights and inverse propensity score weights.[33]

We used an ordinal logistic regression model to estimate the proportion (95% CI) of each cohort within the different levels of depression (PHQ-9). Post hoc comparisons were made with a Tukey honestly significant difference adjustment. All models controlled for age and sex as covariates. The analyses were conducted in the R Project for Statistical Computing (version 3.5) with significance set a priori at $P < .05$.

RESULTS

Of the 2326 respondents who started the survey, 82% (n = 1906, age = 16.0 ± 1.2 years, female = 48.8%) completed it. The responses from this cohort were compared with responses from adolescent athletes in the Spring20 cohort (n = 3243, age = 16.2 ± 1.2 years, females = 57.9%) and PreCOVID-19 cohort (n = 5231, age = 15.7 ± 1.1 years, females = 65.0%). Due to the convenience sampling design, the total number of individuals who received the survey is unknown, and therefore, we could not determine the response rate. A summary of the participant characteristics for all 3 cohorts is found in Table 1. A summary of the sports played by the participants in each cohort is provided in Supplemental Table 1 (available online at 10.4085/1062-6050-0679.21.S1).

The Spring21 participants reported lower PHQ-9 scores for depression than the Spring20 participants but higher depression scores than the PreCOVID-19 participants (Table 2). Similarly, the participants in the Spring21 cohort were less likely to report moderate to severe symptoms of depression than athletes in the Spring20 cohort. However, the Spring21 participants were more likely to report moderate to severe depression symptoms than the PreCOVID-19 participants (Figure 1).

Physical activity, as measured by HSS-PFABS scores (mean, 95% CI), for the Spring21 cohort was higher than that in the Spring20 cohort but lower than in the PreCOVID-19 participants. Similarly, the QoL scores for the Spring21 cohort were higher than those for athletes in the Spring20 cohort but lower than in the PreCOVID-19 participants. A comparison of the physical activity and QoL scores for all 3 cohorts is found in Table 2.

DISCUSSION

To our knowledge, this is the first study to compare depression, physical activity, and QoL among samples of adolescent athletes collected before the COVID-19 pandemic (PreCOVID-19), early in the COVID-19 pandemic (Spring2020) when sports were cancelled, and later in the pandemic (Spring2021) when sport participation opportunities were restored for many student-athletes. Here, we build on the work of prior researchers[9,10] who demonstrated the dramatic worsening of health among adolescent athletes after the cancellation of sports in the spring of 2020. Our results also agree with those of recent authors[11] who observed that high school athletes who played sports in the fall 2020 reported better health than high school athletes from the same state who did not play a sport during the same timeframe. This information suggests that sport participation may represent a vital tool for facilitating improvements in the health of adolescents during the COVID-19 pandemic. Nonetheless, notably, in the Spring21 group, adolescents reported higher levels of depression, lower levels of physical activity, and worse QoL scores than those reported by athletes before the COVID-19 pandemic. Thus, although sport participation during the COVID-19 pandemic has a significant positive effect on the health of adolescents, the negative health effects reported early in the COVID-19 pandemic may persist for some time.

Depression

Athletes who played sports in spring 2021 reported fewer symptoms of depression than athletes in the Spring20 group but more symptoms than athletes before the COVID-19 pandemic. Specifically, in the Spring21 group, approximately half of the participants described minimal or no depression, compared with only 32% in the Spring20 group. Although the scores of the Spring21 cohort were better than those of the Spring20 cohort, they were still worse than those of the PreCOVID-19 cohort, in whom minimal or no depression symptoms were reported by more

Table 2. Anxiety, Depression, Physical Activity, and Quality of Life Scores in Wisconsin Adolescent Athletes for the 2016–2018 (PreCOVID-19), Spring 2020 (Spring20), and Spring 2021 (Spring21) Cohorts[a]

Score	Time			*P* Value
	PreCOVID-19 (n = 5231)	Spring20 (n = 3243)	Spring21 (n = 1906)	
Mental health				
Patient Health Questionnaire-9 Item total[b]	2.0 (1.8, 2.2)	7.0 (6.8, 7.2)	5.0 (4.8, 5.2)	<.001
Physical activity				
Hospital for Special Surgery Pediatric Functional Activity Brief Scale total[c]	23.1 (22.7, 23.5)	13.5 (13.3, 13.7)	21.9 (21.6, 22.2)	<.001
Quality of life				
Pediatric Quality of Life Inventory 4.0[d]				
Physical	93.7 (93.4, 94.0)	85.5 (85.1, 85.9)	88.4 (87.8, 88.9)	<.001
Psychosocial	92.4 (92.0, 92.8)	78.1 (77.7, 78.6)	82.1 (81.5, 82.7)	<.001
Total	92.8 (92.5, 93.1)	80.7 (80.3, 81.1)	84.3 (83.8, 84.8)	<.001

[a] All data for cohorts are reported as the estimated mean (95% CI) when controlling for age and sex. All 2-way cohort comparisons have adjusted $P < .001$.
[b] Lower score = lower prevalence of depression symptoms.
[c] Higher score = increased physical activity.
[d] Higher score = better quality of life.

than 80% of adolescent athletes before the pandemic. Similarly, the percentage of adolescents endorsing moderate to severe depression decreased by more than a third from spring 2020 to spring 2021 but was still nearly 4 times higher than that identified before the COVID-19 pandemic.

The improvement in mental health after the reinitiation of sport participation opportunities is consistent with the findings of previous researchers[24–36] who described clear mental health benefits for adolescents. However, experts[35–39] have pointed out that the COVID-19 pandemic has negatively affected the mental health of youth and may be related to decreased socialization, increased family strain, and reduced access to support services. As such, we recognize that factors beyond sport participation contribute to adolescent depression and that the reinitiation of sports may only partially ameliorate these effects for young athletes. Nonetheless, after we controlled for sex and age, the reinitiation of sport participation between the spring 2020 and spring 2021 was associated with a large reduction in depression symptoms. This result supports the premise that sport participation may represent an important mechanism for improving the mental health of adolescents as society continues to attempt to mitigate the effect of COVID-19 in the months and years to come.

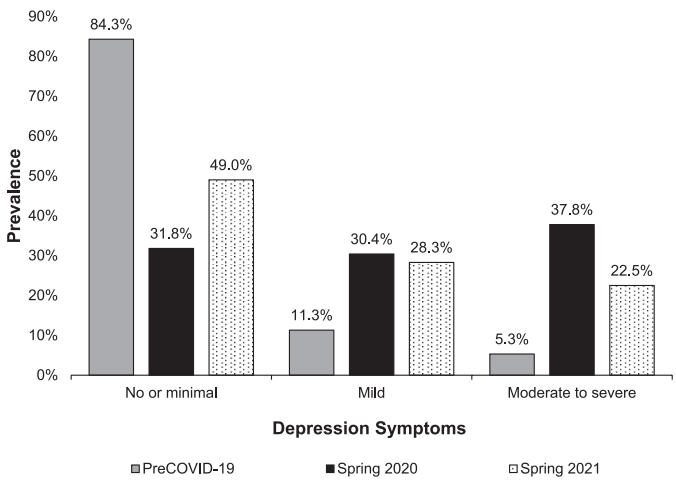

Figure 1. Prevalence of depression symptoms among adolescent athletes in the 2016–2018 (PreCOVID-19), spring 2020 (Spring20), and spring 2021 (Spring21) cohorts.

Physical Activity

Adolescent athletes in the Spring21 group reported more physical activity than athletes unable to play in spring 2020 and similar levels to those reported before the pandemic. In addition, the HSS-PFABS scores for the Spring21 cohort were similar to adolescent normative data provided by Fabricant et al[26] (20.2 ± 7.2). This information suggests that sport participation may be an important means of countering the low level of physical activity characterized during the onset of the COVID-19 pandemic.

Physical activity is known to have a beneficial effect on a wide range of health outcomes in adolescents, including sleep, academic success, well-being, and mental health.[1,40–42] Decreased physical activity in adolescents may have long-term negative effects with respect to an increased risk for obesity and cardiometabolic disease.[43] Chronically low levels of physical activity may also compound the mental health consequences of the current crisis and increase the risk of long-term mental health concerns.[44]

The importance of promoting physical activity in adolescents in the coming months and years is paramount. In a large cohort study of persons aged 2 to 19, Lange et al[45] found that the monthly rate increase of the body mass index nearly doubled during the COVID-19 pandemic compared with that in the prepandemic period. In a retrospective cohort study, Woolford et al[46] noted that the relative increase in overweight or obesity for participants aged 12 to 15 years was 13.4% and 8.3% for participants aged 16 to 17 years. With the documented increase in childhood obesity rates during the COVID-19 pandemic[6], public health stakeholders should consider the promotion of sport participation as a mechanism for increasing physical activity and limiting the potential long-term implications of the increased obesity resulting from the loss of physical activity during the COVID-19 pandemic.

Quality of Life

Adolescent athletes who participated in sports during the pandemic (Spring21) described a significantly higher QoL

than athletes who did not (Spring20). These results are in alignment with prior studies[2,47,48] whose authors detailed the importance of sport participation in improving the health of adolescents. Our data are also consistent with those of earlier researchers[48,49] who showed that increased physical activity and interscholastic sport participation in adolescents were associated with higher QoL scores relative to inactive adolescents and high school nonathletes. In addition to the benefits of physical activity itself, the increased QoL for the Spring21 cohort may also be due to aspects of sport participation such as goal setting, emotional support, and social interaction with teammates.[50]

On the other hand, the total PedsQL scores reported by the Spring21 participants were lower than those before the COVID-19 pandemic in our cohort, as well as those in adolescent athletes before the pandemic reported by Snyder et al[48] (89.5 ± 10.1 to 93.6 ± 7.6) and Lam et al[49] (89.4 ± 9.6 to 90.5 ± 10.2). Furthermore, the total PedsQL scores reported by the Spring21 athletes were lower than those in nonathletes (84.7 ± 12.7 to 85.8 ± 11.4) before the pandemic.[49] Therefore, sport participation opportunities can positively affect multiple dimensions of adolescent health but may be insufficient to fully return these adolescents to a normal QoL level similar to that before the COVID-19 pandemic. The inability to return to a fully normal QoL may be due in part to the decreased physical activity levels we noted previously, as well as other factors such as school closure or learning modifications, socialization, and economics associated with the COVID-19 pandemic that we did not address in this study.[50–54]

Limitations

This study had several limitations. First, the data were self-reported from online surveys and were not the result of a clinical examination. However, our findings are consistent with descriptions from researchers[7,8,16] who stated that COVID-19 significantly affected the health of youth. Second, due to the survey delivery method, our sample may be biased toward athletes from higher socioeconomic cohorts with easy access to internet services. Third, we did not compare adolescent athletes with adolescent nonathletes, which would help us better understand the role of sport during the pandemic. Fourth, other factors, such as the total days of in-person instruction or full access to school-related activities each participant may have had during the entire COVID-19 pandemic, may have played a role in how they responded to specific items on the surveys. However, collecting data for all possible variables that may have affected the athletes' health would have made the survey quite lengthy and most likely would have reduced the number of participants who fully completed it. Finally, we recognize that mental health and well-being are complex and may be affected by other factors for which we were not able to account in our study and which could have confounded the results.

Due to these limitations, future investigators should seek to identify factors beyond sport participation that may affect the health of adolescent athletes during the COVID-19 pandemic. Specifically, we recommend that researchers identify a cohort of adolescents that can provide data on a variety of variables and be queried periodically in the coming months and years to assess changes in their health status.

CONCLUSIONS

The resumption of sport participation opportunities for adolescents during the COVID-19 pandemic was associated with significant improvements in mental health, physical activity, and QoL since early in the pandemic when sports were cancelled. However, depression, physical activity, and QoL scores in spring 2021 remained worse than those recorded before the COVID-19 pandemic. These results suggest that although sport participation during the COVID-19 pandemic has a significant positive effect on the health of adolescents, the negative health effects reported early in the COVID-19 pandemic may persist for some time. As the pandemic continues, stakeholders should prioritize the health benefits of sport participation for adolescents when considering the reinitiation and continuation of youth sports opportunities.

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SUPPLEMENTAL MATERIAL

Supplemental Table. School Sports Played by the Athletes in Each Cohort

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