

# COVID-19 Risk in Youth Club Sports: A Nationwide Sample Representing More Than 200 000 Athletes

Kevin M. Biese, MA, ATC\*; Timothy A. McGuine, PhD, ATC†; Kristin Haraldsdottir, PhD†; Leslie Goodavish, PA†; Andrew M. Watson, MD, MS†

\*Department of Kinesiology, University of Wisconsin–Madison; †Department of Orthopedics and Rehabilitation, University of Wisconsin School of Medicine and Public Health, Madison

**Context:** The COVID-19 pandemic has affected almost every aspect of life, including youth sports. Few data exist on COVID-19 incidences and risk-mitigation strategies in youth club sports.

**Objective:** To determine the incidence of reported COVID-19 cases among youth club sport athletes, describe the reported sources of infection for reported cases, and identify the information sources used to develop COVID-19 risk-mitigation procedures.

**Design:** Cross-sectional study.

**Setting:** Online surveys.

**Patients or Other Participants:** Soccer and volleyball youth club directors.

**Main Outcome Measure(s):** Surveys were completed by directors of youth soccer and volleyball clubs across the country in October 2020. Surveys addressed the self-reported date of re-initiation, number of players, player COVID-19 cases, sources of infection, COVID-19 mitigation strategies, and information sources for the development of COVID-19 mitigation strategies. The total number of cases reported, number of players, and days since club re-initiation were used to calculate an incidence rate of cases per 100 000 player-days. To compare reported

incidence rates between soccer and volleyball, a negative binomial model was developed to predict player cases with sport and state incidence as covariates and log (player-days) as an offset. Estimates were exponentiated to yield a reported incidence rate ratio with Wald CIs.

**Results:** A total of 205 136 athletes (soccer = 165 580; volleyball = 39 556) were represented by 437 clubs (soccer = 159; volleyball = 278). Club organizers reported 673 COVID-19 cases (soccer = 322; volleyball = 351), for a reported incidence rate of 2.8 cases per 100 000 player-days (soccer = 1.7, volleyball = 7.9). Volleyball had a higher reported COVID-19 incidence rate than soccer (reported incidence rate ratio = 3.06 [95% CI = 2.0, 4.6],  $P < .001$ ). Out of 11 possible mitigation strategies, the median number of strategies used by all clubs was 7, with an interquartile range of 2.

**Conclusions:** The incidence of self-reported cases of COVID-19 was lower in soccer clubs than in volleyball clubs. Most clubs reported using many COVID-19 mitigation strategies to reduce the risk of infection.

**Key Words:** coronavirus, pandemic, SARS-CoV-2, adolescents, mask use

## Key Points

- Overall COVID-19 incidence rates reported in youth club sports did not appear to be higher than national pediatric COVID-19 incidence rates during the same timeframe.
- Reported COVID-19 incidence rates were lower in soccer clubs than in volleyball clubs.
- Clubs consistently used COVID-19 mitigation strategies and relied on local health authorities and the Centers for Disease Control and Prevention as their main resources for creating these mitigation strategies.

In March 2020, the novel SARS-CoV-2 (COVID-19) was declared a global pandemic, and much of the United States was issued stay-at-home orders to help prevent the spread of the disease. These orders effectively halted most aspects of everyday life and restricted most individuals to the confines of their own homes. Though these measures were critical in slowing the spread of COVID-19 and have been effective in protecting the health care system,<sup>1–3</sup> the short- and long-term effects of these orders on mental health and wellbeing among youth athletes represent a growing concern. With the cessation of most public activities, youth sports were nearly universally discontinued in the spring of 2020, and their reinstatement has been mixed throughout the country. Youth sports offer a myriad of social, physical, and mental health

benefits for adolescents.<sup>4,5</sup> Researchers have demonstrated an increase in symptoms of depression and anxiety in adolescents related to quarantines and lockdown orders,<sup>6,7</sup> and youth athletes may have been particularly negatively affected by the cancellation of school and sports.<sup>8</sup>

Physical activity levels in youth athletes have also been affected by the cancellation of youth sports. Authors<sup>9,10</sup> of recent studies noted a decrease in physical activity among youth during the pandemic. The cancellation of youth sports may accelerate the decrease in sport participation and physical activity, which was observed to decrease as children age before the current pandemic.<sup>11,12</sup> This may have significant long-term consequences as youth sport activity is a predictor of health and physical activity into adulthood.<sup>13–15</sup> Participa-

tion in organized sport has been shown to be a major component in reduced childhood obesity rates,<sup>16,17</sup> which have persisted in the United States and increased over the years. Furthermore, with the COVID-19 pandemic, physical activity rates have decreased dramatically in adolescents and especially youth from areas of low socioeconomic status.<sup>18</sup> These findings add clarity to projection models that suggested childhood obesity in the United States may increase disproportionately among non-Hispanic blacks and Hispanic children.<sup>19</sup> Therefore, balancing of the risks and benefits of youth sports during the COVID-19 pandemic as they pertain to the short- and long-term health of youth in the United States is needed.

Though COVID-19 appeared to result in less severe disease and lower overall mortality rates among younger populations,<sup>20</sup> how participation in sports results in transmission among participants is unknown. Yet new evidence<sup>21,22</sup> seemed to indicate that youth sports were not a large contributor to COVID-19 transmission. Despite media reports to the contrary, early findings in adult professional athletes and preprint publications involving club and high school sports appeared to suggest that COVID-19 transmission between athletes was relatively rare.<sup>23,24</sup> The Centers for Disease Control and Prevention (CDC) and National Federation of State High School Associations (NFHS) have provided guidelines for restarting sport activities in the United States.<sup>25,26</sup> Furthermore, the NFHS continues to provide recommendations for holding high school sporting events based on 5 factors related to the current evidence on COVID-19 transmission among participants.<sup>26</sup> However, because different sports potentially represent different risk factors for COVID-19,<sup>24</sup> more research is needed on specific sports and their associated risks. Soccer and volleyball are popular sports offered for broad age ranges and some of the most inexpensive sports in the United States.<sup>27,28</sup> Therefore, understanding the risks associated with these 2 sports may allow more sporting opportunities for children at all socioeconomic levels. Investigators<sup>24</sup> have proposed that indoor sports may pose a greater risk of SARS-CoV-2 virus transmission than outdoor sports; still, volleyball is a noncontact sport that separates 2 teams during play. Overall, more information is needed on how the risk of COVID-19 in volleyball compares with other sports such as soccer, which has been suggested to have a relatively low rate of COVID-19 transmission.<sup>21,22,24</sup> Given the many beneficial effects of youth sport participation, this research is critical to help inform decisions about the re-initiation and continuation of youth sports. Thus, the purposes of our study were to determine the incidence of reported COVID-19 cases among youth club sport athletes, describe the reported sources of infection for reported cases, and identify the information sources used to develop COVID-19 risk-mitigation procedures.

## METHODS

This study was approved by the Institutional Review Board of The University of Wisconsin–Madison. The overall study design was cross sectional, using an online survey. The survey was given to US Youth Soccer and the National Volleyball Association, which subsequently passed it on to member organizations, leagues, and other stakeholders in youth soccer and volleyball at their discretion. The surveys were explicitly intended for the

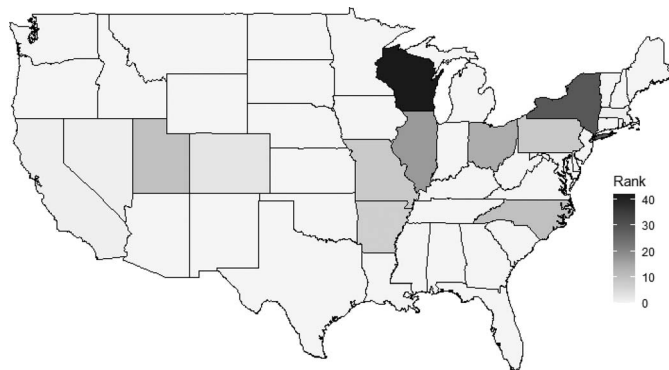
director of the recipient club and asked for responses on behalf of the entire organization. (Sport club directors are generally the administrators for their youth sport clubs.) The survey was distributed on October 1, 2020, and responses were accepted until November 3, 2020. Clubs were excluded from the study analysis if they had not restarted sports at the time of survey completion.

## Survey

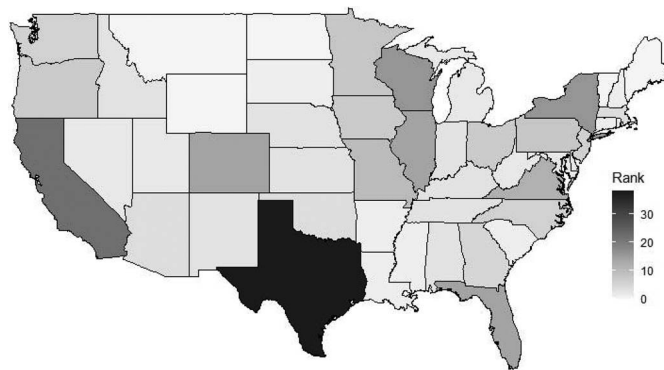
The survey demographics addressed the name of the club, zip code of the club's primary facility, state in which the club was located, and sport offered by the club. Each director was asked if his or her club had restarted playing sports since COVID-19 restrictions began in the area. A director who answered that his or her organization had restarted sports was asked to provide the date that sport activity resumed, how many athletes participated in the club during that time, whether formal procedures for COVID-19 risk reduction were in place, and how many players had been diagnosed with, hospitalized for, or died from COVID-19 since the reinitiation. Respondents were asked to report the source of any infections in players (household member, school contact, community or social contact, club sport activity, other, or unknown). If the respondent endorsed having a plan regarding COVID-19 risk reduction, he or she was asked which procedures the organization had been implementing to reduce the COVID-19 incidence and which information sources were used to develop the plan. A total of 11 defined procedures to mitigate the risk of COVID-19 were offered as choices as well as 8 possible information sources (shown in Supplemental Table 1). These mitigation strategies and sources of information were based on the most common mitigation strategies proposed by the CDC or in the current literature on preventing the spread of COVID-19.

## Statistical Analysis

Data were presented as means and SDs for continuous variables, while counts and percentages were used for categorical variables. Time since the organization reinitiated sport participation was expressed as a median and interquartile range (IQR). The overall COVID-19 case rate was calculated as the number of reported cases per 100 000 players (reported cases/total number of players  $\times$  100 000). Participation duration was the difference in days between the date of reinitiation and date of survey completion, and player-days were the product of the number of participating players and duration. The COVID-19 incidence rate was expressed as the number of reported cases per 100 000 player-days (reported cases/total number of player-days  $\times$  100 000) separately for volleyball and soccer. Additionally, based on the median duration of participation of 108 days for reporting clubs, the number of cases, total population, case rate, and incidence rate for US children for 15 weeks before survey closure (July 23, 2020 to November 5, 2020) were identified using data from the American Academy of Pediatrics.<sup>29</sup> Similarly, total cases, total population, case rate, and incidence rate were identified for the prior 15 weeks among the general population for each of the states in which the clubs were located. To compare incidence rates between soccer and volleyball, we developed a negative binomial model to predict player cases with sport and state incidence as covariates and log (player-days) as an offset. Estimates were exponentiated to yield an incidence rate ratio



**Figure 1. Number of soccer clubs surveyed per state.**



**Figure 2. Number of volleyball clubs surveyed per state.**

(IRR) with Wald CIs. A  $\chi^2$  analysis was conducted to compare the proportion of reported known sources of COVID-19 cases among players between soccer and volleyball clubs. The proportions of soccer and volleyball clubs that endorsed each risk-mitigation procedure and each information source were compared using  $\chi^2$  tests. For significant  $\chi^2$  tests, we calculated the standardized residuals for each cell to determine which cells were the largest contributors to the  $\chi^2$  analysis; a standardized residual  $>2$  or  $<-2$  was considered a significant contributor.<sup>30</sup> Statistical significance was set a priori at  $P < .05$ , and all analyses were performed using R Foundation for Statistical Computing.

## RESULTS

The distribution of soccer and volleyball clubs in various states that responded to the survey is outlined in Figures 1 and 2. A total of 437 directors (159 from soccer clubs, 278 from volleyball clubs) in 44 states (soccer = 15, volleyball = 44; Figures 1 and 2) responded to the survey. Reported COVID-19 case and incidence rates for youth club sports and US children are shown in Table 1. After adjusting for background state incidence rates, we found that volleyball had a higher COVID-19 reported incidence rate than soccer (reported IRR = 3.06 [95% CI = 2.0, 4.6],  $P < .001$ ). The reported sources of infection are outlined in Table 2. A difference was present in reported sources between soccer and volleyball clubs: volleyball clubs were more likely to cite sport as the source of infection than soccer clubs (11%, standardized residual =  $-3.6$  versus 1%, standardized residual = 3.3, respectively), and soccer clubs were more

likely to identify school or community as a source of infection for players than volleyball clubs (Table 2).

All 437 directors described having a formal risk-reduction procedure. Of the 11 defined COVID-19 mitigation procedures, the median number of procedures selected by all clubs was 7 (IQR = 2). Soccer and volleyball clubs reported different uses of various COVID-19 risk-reduction procedures (Table 3). Although both soccer and volleyball clubs predominantly used information from local health authorities and the CDC to develop risk-mitigation procedures, volleyball clubs were more likely to use information from their sport governing body and the NFHS (Table 4).

## DISCUSSION

The overall reported incidence rate of COVID-19 among all youth club athletes during the summer and fall of 2020 was comparable with the incidence reported among US children during a similar timeframe. In addition, most cases were attributed to contacts outside of sport, with only a small number ascribed to transmission during sport activities. This seems to agree with researchers<sup>24</sup> who found that COVID-19 incidence rates described by high school athletic directors were highly correlated with local, background COVID-19 incidence rates. It also appears to agree with the growing body of evidence that suggests COVID-19 cases among athletes are predominantly attributed to community and social contacts rather than transmission during sports.<sup>21,22</sup> Although caution is needed in making inferential comparisons between data aggregated from state health authorities and data collected through self-reporting from youth sports organizations, nationwide

**Table 1. Reported COVID-19 Cases, Case Rates, and Incidence Rates for Respondent Club Soccer and Club Volleyball and US Children During the Summer and Fall of 2020**

Variable	Club			US Children <sup>a</sup>
	Soccer	Volleyball	Total	
Total cases, No.	322	351	673	639 231
Total population, No. <sup>b</sup>	165 580	39 556	205 136	75 471 700
Total person-days (players $\times$ days since restart) <sup>b</sup>	19 476 766	4 445 197	23 921 963	7 924 528 500
Cases/100 000 players	194	887	328	847
Incidence rate (cases/100 000 player-days)	1.65	7.90	2.81	8.07

<sup>a</sup> Total person-days were calculated from the American Academy of Pediatrics data using the 15 weeks before survey closure (November 3) to align with the median duration of participation of reporting clubs.

<sup>b</sup> Total population (adults and children) and cases reported in the states where clubs were located. Total person-days were calculated from state case information using the 15 weeks before survey closure (November 3) to align with the median duration of participation of reporting clubs.



**Table 2. Frequency and Percentage of Reported Sources of COVID-19 Infection Among Youth Club Sport Athletes During the Summer and Fall of 2020**

Source Contact	No. (%)		
	Overall (N = 580 <sup>a</sup> )	Soccer (n = 267)	Volleyball (n = 313)
Household	302 (52)	137 (51)	165 (53)
School	142 (25)	75 (28)	67 (21)
Community	93 (16)	53 (20)	40 (13)
Sport	36 (6)	2 (1)	34 (11)
Other	7 (1)	0 (0)	7 (2)

<sup>a</sup> Not all cases had a reported source; hence, only 580 cases are represented in this table out of 673 total cases.

<sup>b</sup> A  $\chi^2$  analysis was used to compare reported known sources of COVID-19 between soccer and volleyball:  $\chi^2 = 36.9$ ,  $P < .001$ .

pediatric data during a similar timeframe may nonetheless offer context regarding the overall COVID-19 case rate for children during the time when respondent clubs were participating in sports.

The adjusted incidence rate reported in soccer clubs was about 67% lower than the adjusted incidence rates reported in volleyball clubs. These results agree with those of investigators<sup>24</sup> who observed that high school outdoor sports had lower incidences of COVID-19 than high school indoor sports. This finding was further supported by the fact that volleyball clubs were more likely to attribute COVID-19 cases to club sporting activities than soccer clubs (Table 3). Drezner et al<sup>21</sup> demonstrated that no cases of COVID-19 were attributed to playing or coaching club soccer when physical distancing and noncontact rules were in place, similar to our data, in which only 2 COVID-19 club soccer cases were attributed to participating in club soccer. These results support recent reports and current guidelines<sup>31–33</sup> indicating that indoor gatherings and activities pose a greater risk of COVID-19 than outdoor activities. It is also possible that this is due to the differences in the distribution of respondent clubs between the sports (Figures 1 and 2). For instance, in July and August, Texas and California, where most of our volleyball clubs were located, had much higher case numbers than Wisconsin and New York, where most of our soccer clubs were located.<sup>34</sup> Case trends

became similar between these states in October and November.<sup>34</sup> Nonetheless, we attempted to account for this by including the COVID-19 incidence rate for the state of each respondent club as a covariate in the models to compare sports.

It is important to note that several other explanations for the difference in reported rates between soccer and volleyball may account for this observation. Anecdotally, volleyball is a highly communicative sport between teammates. Loud, vocal communication may increase the likelihood of spreading COVID-19 from participant to participant, regardless of the outdoor or indoor atmosphere. This communication also happens in a smaller space than a soccer field. This may mean that volleyball athletes spend a greater amount of time within 6 ft (2 m) of one another during practice and competition than soccer athletes. It is also possible that volleyball athletes represent an older population of athletes, which may predispose them to a higher incidence rate relative to younger soccer athletes. These are all speculative rationales for our results and suggest that further research is needed on the risk associated with contracting the SARS-CoV-2 virus for each individual sport. Every respondent club reported the development and use of a formal plan to mitigate the risk of COVID-19, and most clubs described using many risk-reduction procedures. The most common practices were symptom monitoring, face mask use, and increased facility disinfection. Volleyball clubs were more likely to check players' and coaches' temperatures on site, use face masks during play, and increase facility disinfection than soccer clubs, whereas soccer clubs were more likely to have players and staff check temperatures at home and implement face mask use for players off the field, face mask use for staff, social distancing for players and staff off the field, and staggered arrival and departure times. Some of these differences may reflect the nature of indoor versus outdoor facility use. For example, it may be easier for a volleyball facility with a controlled entrance to take player and staff temperatures before these individuals enter the facility, whereas soccer clubs may find it easier to implement home monitoring of temperature. Several of these mitigation strategies, such as social distancing, face mask use, and disinfecting surfaces, have been demonstrat-

**Table 3. Reported Use of Various COVID-19 Risk-Reduction Strategies Between Youth Soccer and Volleyball Clubs During the Summer and Fall of 2020**

Procedure	No. (%)			P Value <sup>a</sup>
	Overall	Soccer	Volleyball	
Player or staff symptom monitoring	369 (84)	132 (83)	237 (85)	.536
Player or staff temperature checks				
At home	206 (47)	112 (70)	94 (34)	<.001
On site	234 (54)	35 (22)	199 (72)	<.001
Face mask use				
Athletes while playing	117 (27)	9 (6)	108 (39)	<.001
Athletes off the field	308 (70)	128 (81)	180 (65)	.001
Staff	350 (80)	139 (87)	211 (76)	.004
Social distancing				
Athletes while playing	147 (34)	46 (29)	101 (36)	.115
Athletes off the field	278 (64)	132 (83)	146 (53)	<.001
Staff	283 (65)	122 (77)	161 (58)	<.001
Increased facility disinfection	304 (70)	79 (50)	225 (81)	<.001
Staggered arrival and departure times for events	269 (62)	108 (68)	161 (58)	.038

<sup>a</sup>  $\chi^2$  analysis was used to compare procedures used by soccer and volleyball clubs.

**Table 4. Reported Use of Various Sources of Information on COVID-19 Risk-Reduction Strategies Between Youth Soccer and Volleyball Clubs During the Summer and Fall of 2020**

Source	No. (%)			P Value <sup>a</sup>
	Overall	Volleyball	Soccer	
Local health authority	386 (88)	245 (88)	141 (89)	.863
Centers for Disease Control and Prevention	306 (70)	193 (69)	113 (71)	.718
US sport governing body	290 (66)	194 (70)	96 (60)	.045
American Academy of Pediatrics	32 (7)	16 (6)	16 (10)	.096
American Medical Society for Sports Medicine	24 (5)	16 (6)	8 (5)	.749
National Athletic Trainers' Association	19 (4)	13 (5)	6 (4)	.656
National Federation of State High School Associations	80 (18)	62 (22)	18 (11)	.004

<sup>a</sup>  $\chi^2$  analysis was used to compare procedures used by soccer and volleyball clubs.

ed to be effective in reducing the spread of SARS-CoV-2<sup>35,36</sup>; however, many of these strategies lack significant research regarding their efficacy, especially within youth sports contexts. The overwhelming majority of clubs (~90%) reported using information from local health authorities, suggesting a willingness of clubs to work alongside local authorities to provide safe sport and physical activity opportunities for youth athletes. This information may help facilitate the dissemination and implementation of information regarding COVID-19 mitigation strategies among stakeholders in youth sports.

### Limitations

This study had several limitations. The information was self-reported by soccer and volleyball club directors and could not be verified through medical records or other sources. The self-reporting nature of the survey may also introduce recall bias, as directors were asked to remember how many cases they had since their restart, which may have been months before they completed the survey. Nonetheless, we do not have reason to believe that a systematic bias existed between sports with respect to self-reporting that would account for differences between soccer and volleyball. Our method of survey distribution may have introduced sampling bias into our results, and we cannot account for the total number of organizations that received our survey, only the number that ultimately completed it. Additionally, our number of player-days assumes that all players participated at every practice and game between the start date and the end of the survey. As mentioned earlier, caution is needed when comparing our data with those reported by the American Academy of Pediatrics for nationwide pediatric COVID-19 incidence, but we have provided this to contextualize our findings. Furthermore, we did not use a validated survey; however, as COVID-19 is a new and rapidly growing concern, we feel confident that the developed survey asked the necessary questions to answer the current research questions. Clubs reported COVID-19 cases over different timelines based on reinitiation and survey completion dates and came from areas with various background COVID-19 incidences, both of which may have affected the reported incidence rates. When comparing club soccer and volleyball incidences, we tried to account for this by adjusting for state-level COVID-19 incidence rates. Reported sources of infection were provided by the club director and not by formal contact tracing by health authorities. Lastly, though these clubs represented many youth athletes from a national sample, they may not be generalizable to other populations.

### CONCLUSIONS

In this survey-based study, reported COVID-19 incidence rates among youth club sport athletes were comparable with those reported for US children during a similar timeframe. After adjusting for background state incidence rates, we noted that soccer clubs reported a lower COVID-19 incidence rate than volleyball clubs. This may be due to the indoor nature of Volleyball, which is in line with previous research on indoor and outdoor sporting activities and the risk of COVID-19; however, additional factors may add to this difference, such as the difference in state locations between soccer and volleyball in this study. Although both soccer and volleyball clubs indicated that only a small percentage of COVID-19 cases were attributable to sport participation, this was more likely in volleyball than in soccer. All clubs described having a formal plan regarding COVID-19 mitigation, and most clubs stated they used many risk-reduction procedures. Variations in incidence rates, reported infection sources, and the procedures used may be due to the differences between indoor and outdoor sport participation and may reflect the nature of each sport, such as proximity to opponents and teammates, vocal communication, and the cultures surrounding each sport that could translate into different interactions and behaviors outside of play.

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Address correspondence to Kevin M. Biese, MA, AT, Department of Kinesiology, University of Wisconsin–Madison, 1300 University Avenue, Madison, WI 53706. Address email to [kbiese@wisc.edu](mailto:kbiese@wisc.edu).