

Bidirectional Associations between Sport Involvement and Mental Health in Adolescence

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ABSTRACT

VELLA, S. A., C. SWANN, M. S. ALLEN, M. J. SCHWEICKLE, and C. A. MAGEE. Bidirectional Associations between Sport Involvement and Mental Health in Adolescence. *Med. Sci. Sports Exerc.*, Vol. 49, No. 4, pp. 687–694, 2017. **Purpose:** This study aimed to investigate potential bidirectional relationships between sport participation and mental health during early adolescence. **Methods:** Data were taken from wave 5 (2012) and wave 6 (2014) of the K cohort of the Longitudinal Study of Australian Children. In total, there were 4023 participants (mean age = 12.41 yr, SD = 0.49 yr, at baseline), and this sample was followed up 24 months later. Cross-lagged panel models were used to examine bidirectional relationships between sport participation (hours per week for team, individual, and total sport participation) and mental health (total psychological difficulties, internalizing problems, and externalizing problems) as measured by the parent-report version of the Strengths and Difficulties Questionnaire (SDQ). **Results:** Bidirectional relationships were evident between time involved in sport and overall mental health (Sport_{t12}→SDQ_{t14}: $\beta = -0.048$; SDQ_{t12}→Sport_{t14}: $\beta = -0.062$). Bidirectional relationships were also evident between time involved in sport participation and internalizing (social and emotional) problems (Sport_{t12}→SDQ_{t14}: $\beta = -0.068$; SDQ_{t12}→Sport_{t14}: $\beta = -0.067$). The relationship between time in organized sport and externalizing problems (conduct problems and inattention/hyperactivity problems) was not bidirectional. Externalizing problems predicted later sports participation ($\beta = -0.039$), but not *vice versa*. **Conclusion:** Findings demonstrate bidirectional relationships between sport participation and adolescent mental health. The design and implementation of youth sport programs should maximize mental health benefits, and programs should be designed, implemented, and marketed to be attractive to participants with poor psychosocial health. **Key Words:** INTERNALIZING PROBLEMS, EXTERNALIZING PROBLEMS, PSYCHOLOGICAL DIFFICULTIES, CROSS-LAGGED MODELS

The prevention and treatment for many adolescent problems, including suicide, depression, anxiety, eating disorders, and substance abuse, has become a major focus of contemporary medicine (30). Such problems have a considerable psychological and emotional cost for youth, accompanied by an equally substantial resource and financial burden on society (8). One developmental solution to the promotion of psychological assets (such as self-esteem) and risk reduction of mental health problems (such as

depressive disorders) is a positive youth development program. The worldwide popularity and reach of organized sport—approximately two-thirds of all children and young people participate in organized sports around the world (34)—makes organized sport a particularly attractive avenue for developing psychosocial assets and reducing risk of mental health problems in young people. Organized youth sports are adult-organized and adult-led sporting programs that involve the participation of children and adolescents. Typically, participants are formally arranged into teams to participate within local leagues and/or competitions. The participants attend training and competitive fixtures under the formal guidance and supervision of an adult leader, most often the coach (32). Further, participation generally occurs outside the school context.

Although estimates are highly variable, the wide use of population-level screening tools such as the Strengths and Difficulties Questionnaire (SDQ) (19) demonstrates that up to 25% of children and adolescents experience some form of mental health issue before they reach adulthood (13). On the

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basis of several decades of research, the most prevalent mental health problems among children and adolescents are serious emotional disturbances, including anxiety and depressive disorders, and behavioral and conduct disorders (13). In addition to estimates of prevalence, an important use of screening tools such as the SDQ is to gauge population-level estimates of mental health among young people. Estimates of mental health are based on a conceptualization of mental health as incorporating both deficit-based (e.g., depressive symptoms) and strengths-based (e.g., self-esteem) components. Deficit-based conceptualizations of mental health have traditionally been the dominant approach (13), whereas the strengths-based approach has more recently been proliferated by the positive youth development movement (9). An amalgamation of these approaches is typified by models of mental health such as Keyes Mental Health Continuum (25) and in screening tools such as the SDQ (19), and these are argued to provide a more holistic account of mental health.

Evidence for the developmental effect of organized sport participation on both deficit- and strengths-based approaches to mental health has been mixed. For example, sport participation had been associated with a high occurrence of psychological difficulties such as pressure, stress, burnout, and immoral behavior (17). However, there is consensus that sport can facilitate the development of psychological well-being (17). A recent systematic review found that participation in organized sport during childhood and adolescence is associated with higher levels of self-esteem, greater social skills, and fewer depressive symptoms (14). In addition, sport participation is associated with psychological health in childhood (5), and children who drop out of organized sport show fewer psychological strengths and greater psychological difficulties than those who maintain sport involvement (35). Moreover, noninvolvement in sport puts children at a 10%–20% increased risk of mental health problems (35). Importantly, the findings of both a systematic review by Eime et al. (14) and the original findings of Vella et al. (35) suggest that the psychosocial benefits of organized sport are independent of those that can be attributed to general physical activity.

There has been an overreliance on a cross-sectional research to establish associations between sport participation and psychosocial health in adolescence, and studies have generally applied the assumption that participation in organized sport is the causal variable in this relationship (14,17). However, evidence suggests that it is likely that psychosocial assets such as self-esteem influence one's participation in organized sports (1). A conceptual model of health through sport (14) proposes that the relationships between sport participation and psychosocial health is bidirectional in nature. On the basis of a systematic review of the psychosocial outcomes associated with sports participation, Eime et al. (14) have proposed a model whereby young people with greater psychosocial assets such as confidence and well-established social networks, and fewer psychosocial deficits such as depressive symptoms, are more likely to participate in organized

sport that, in turn, may serve to further facilitate the development of psychosocial assets and reduce psychosocial deficits. By contrast, young people who have high levels of behavioral or social difficulties and low levels of psychosocial assets, or poor mental health, are less likely to participate in organized sport (or more likely to drop out of sport), which may continue to place those with poor mental health at a disadvantage. As such, a fundamental assumption of the model is that the relationship between participation in organized sports and mental health is bidirectional in nature. By testing whether both of these plausible effects exist among youth sport participants, this research will develop an understanding of the causal mechanisms that underpin both sport participation and adolescent mental health. This is important because previous studies using the same sample have shown that sport participation is associated with greater health-related quality of life and better mental health (35,36); however, the directionality of these associations remains unclear.

In recognition that mutually influential relations exist among individuals and their developmental contexts (such as sports participation), Agans and Geldhof (2) have provided partial support for the hypothesis that different types of sports (such as team and individual sports) may provide unique developmental contexts for participants. Importantly, participation in multiple types of sports seems to be associated with more desirable outcomes, perhaps because of exposure to a greater range of experiences (2,36). Although, on balance, all types of sports participation seem beneficial for children and adolescents, the weight of evidence suggests that participation in team sports may be more strongly linked to positive social and psychological outcomes when compared with individual sports (14). However, these differences may also vary by sex (2), leading to the conclusion that the role of sports participation in the psychosocial development of children and adolescents is complex and not uniform (38).

The purpose of this study was to test for evidence of bidirectional relationships between sport participation and mental health in a large nationally representative sample of Australian adolescents. On the basis of the conceptual model of health through sport (14), we hypothesized that adolescents reporting fewer psychological difficulties would participate in higher levels of subsequent organized sport and that adolescents participating in greater amounts of organized sport would report fewer subsequent psychological difficulties. On the basis of previous evidence showing greater psychosocial benefits of team sport participation compared with individual sport participation (35), we further hypothesized that these relationships would be stronger for team sport participants than individual sport participants. Lastly, we also explored the potential moderating effect of gender.

METHOD

Study Design and Participants

The Longitudinal Study of Australian Children (LSAC) is a biennial study of the social, environmental, and economic

influences on the health and development of Australian children. The LSAC sample was recruited in 2004 after participants were selected at random from the Medicare database (the most comprehensive database of the Australian population). Waves 5 and 6 (used in the current data set) were collected in 2012 and 2014, respectively. Data are collected for two cohorts—a kindergarten (K) cohort and a birth (B) cohort. This study used data collected from the K cohort where children were 4–5 yr old at wave 1. Data used in this study were collected by trained professionals using face-to-face interviews with the children's primary parent (the child's mother in 96% of cases). At wave 1, the response rate for the K cohort was 50%, resulting in an initial sample size of 4983.

This study used data obtained during waves 5 and 6 when children were 12 and 14 yr old. These waves were chosen as they are the only waves where a measure of time spent in extracurricular organized sport was included. Sport data were reported by the primary parent of the child, and mental health data were self-reported by the child. The sample size at wave 5 was 4023 participants and represents an attrition rate of 19% from wave 1. Ethical approval for the LSAC study was granted by the University of Melbourne's Human Research Ethics Committee. Parents provided written informed consent before participation.

Measures

Mental health. The self-report version of the SDQ (19) was used to measure children's mental health. The SDQ is a 25-item behavioral screening tool that provides meaningful epidemiological data by quantifying children's psychological difficulties. In low-risk and general population studies (such as LSAC), the SDQ is used to provide a measure of total psychological difficulties, which can in turn be compartmentalized into subscale scores for internalizing problems (i.e., emotional and peer problems) and externalizing problems (i.e., conduct and hyperactivity/inattention problems). The SDQ also provides a measure of prosocial behaviors (five items). The SDQ is sensitive to change over time (16) and can be used to quantify the risk of diagnosis of a psychiatric disorder within 3 yr using the total difficulties score. A one-point increase in total difficulty score represents an increased risk of between 14% and 28% of a subsequent psychiatric diagnosis within 3 yr (18). Example items include the following: “I worry a lot” (emotional symptoms; factor loading = 0.713), “I am often accused of lying or cheating” (conduct problems; factor loading = 0.796), “I am easily distracted, I find it difficult to concentrate” (hyperactivity/inattention; factor loading = 0.817), “Other people my age generally like me” (peer problems; factor loading = 0.817), and “I am kind to younger children” (prosocial behavior; factor loading = 0.732) (21). Items from the subscales emotional symptoms (five items) and peer problems (five items) are summed to calculate internalizing problems (10 items), whereas items from the subscales

conduct problems (five items) and inattention/hyperactivity (five items) are summed to calculate externalizing problems (10 items). All items are scored as 0 (*not true*) through 1 (*somewhat true*) to 2 (*certainly true*). The SDQ has been widely used in studies within this sample (23,31,35).

Sport participation. The average weekly time spent in team and individual sports was calculated from six parental reported items. First, two items assessed regular participation in either team or individual sports. For team sports, parents were asked, “In the last week, has (your) child participated in team sport (e.g., football, cricket, or netball)?” For individual sports, parents were asked, “In the last week, has (your) child regularly participated in individual sport (e.g., tennis, karate, or gymnastics)?” Sport participation was further specified as a regular activity undertaken outside school hours. Second, if parents answered yes to one of these items, they were asked to report the number of days that the child had participated in team and/or individual sports, as well as the number of hours per day (categorized as up to 1 h·d⁻¹, more than 1 but less than 2 h·d⁻¹, and more than 2 h·d⁻¹). To calculate a proxy measure of weekly time in organized sports, we multiplied the number of days of participation by the number of hours per day. For the category “up to 1 h,” we multiplied by 0.5 h. For the category “more than 1 but less than 2 h,” we multiplied by 1.5. Finally, for the category of “more than 2 h,” we multiplied by 2.5. Parents reporting that their child did not participate in sport were scored as 0 h participation. This measure of sports participation has been used in this sample and has shown associations with a range of demographic, socioeconomic, and environmental factors known to be associated with health and health behaviors (3).

Covariates. All covariates were assessed at wave 5 when children were 12 yr old and included child sex, neighborhood socioeconomic position, and language spoken at home. The primary parent reported the child's sex, home postcode, and language spoken at home. Neighborhood socioeconomic position was determined according to the Socio-Economic Indexes for Areas Index of Relative Socio-Economic Disadvantage (4) using the child's home postcode. Language spoken at home was self-reported and was categorized as English or non-English.

Statistical Analyses

Cross-lagged panel models were used to test potential bidirectional relationships between sports participation and mental health (28). This approach enables the simultaneous examination of reciprocal relationships between two variables over time by testing stability paths (e.g., mental health at age 12 yr → mental health at age 14 yr), concurrent paths (e.g., sport participation at age 12 yr → mental health at age 12 yr), and cross-lagged paths (e.g., sport participation at age 12 yr → mental health at age 14 yr; mental health at age 12 yr → sport participation at age 14 yr). Three distinct models were tested for total time spent in sport and mental health (total mental health, internalizing problems, and

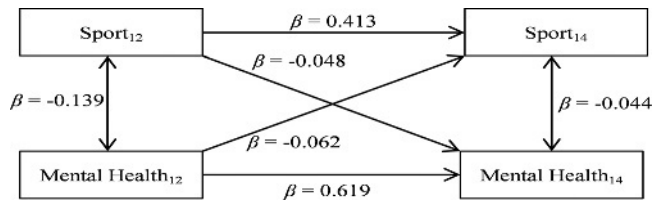


FIGURE 1—Cross-lagged panel model.

externalizing problems), with each representing an overall or distinct dimension of mental health. Prosocial behaviors were not analyzed in this study. Each model controlled for all covariates. Figure 1 provides a graphical representation of the cross-lagged panel model. Missing data were imputed using full information maximum likelihood estimation, which uses all available data to estimate model parameters (15). Analyses were computed using *Mplus* version 6.11. (Muthén & Muthén, Los Angeles, CA).

To test potential interaction effects, the multiple group function in *Mplus* was used. This function allows an examination of whether the cross-lagged associations varied by the type of sport played or by gender by constraining the lagged paths to be equal across groups (28). The model was subsequently retested with one path unconstrained, and the chi-square difference relative to the fully constrained model was derived. This was sequentially repeated for each lagged path. A statistically significant difference between the chi-square statistics indicated that the unconstrained path differed significantly between groups, and it could be concluded that an interaction effect was present.

RESULTS

Participants. Across the two waves of data, there were a total of 4023 eligible adolescents (51% male and 49% female). The average age at time 1 was 12.41 yr (SD = 0.49 yr). Sixty-one percent of the sample participated in some form of organized sport at time 1 (age 12 yr), whereas 60% participated at time 2 (age 14 yr). The mean duration of sport participation among all participants at time 1 was 2.59 h·wk⁻¹ (SD = 3.36), and at time 2 was 2.45 h·wk⁻¹ (SD = 3.53). Mean time spent in organized sport and mean scores for psychosocial difficulties by sex and sport participation are provided in Table 1. As expected, total sports participation at age 12 and 14 yr were positively skewed (skewness at 12 = 1.94, skewness at 14 = 2.10) with an expected tendency toward zero inflation (the mode for each age was zero participation each week). The median value for sports participation at age 12 yr was 1.5 h, and 0.5 h at age 14 yr. The distribution for sports participation data at both ages 12 and 14 yr was consistent with the expected distributions of sports participation during adolescence. Given that data were distributed as expected and that the use of robust maximum likelihood estimation using the *Mplus* program allows for nonnormally distributed data, the data were not treated as problematic (28).

TABLE 1. Mean sport participation and SDQ scores by selected demographic variables.

	Mean SDQ Score (SD)												
	Time Spent in Sport Participation (h·wk ⁻¹) (SD)				Time 1 (12 yr)				Time 2 (14 yr)				
	Time 1 (12 yr)		Time 2 (14 yr)		Time 1 (12 yr)		Time 2 (14 yr)		Time 1 (12 yr)		Time 2 (14 yr)		
	N (%)	Individual	Team	Total	Individual	Team	Total	Internalizing Problems	Externalizing Problems	Total Difficulties	Internalizing Problems	Externalizing Problems	Total Difficulties
Total sample	3956	0.81 (2.06)	1.77 (2.64)	2.59 (3.36)	0.76 (2.13)	1.68 (2.76)	2.45 (3.53)	3.89 (3.12)	5.14 (3.38)	9.03 (5.56)	4.53 (3.49)	5.31 (3.45)	9.84 (5.93)
Males	2020 (51)	0.77 (1.94)	2.17 (2.90)	2.95 (3.51)	0.77 (2.10)	2.01 (2.99)	2.78 (3.65)	3.68 (3.09)	5.46 (3.47)	9.15 (5.59)	3.63 (3.02)	5.42 (3.47)	9.05 (5.50)
Females	1936 (49)	0.84 (2.18)	1.36 (2.26)	2.21 (3.14)	0.77 (2.18)	1.35 (2.46)	2.11 (3.39)	4.10 (3.13)	4.80 (3.25)	8.90 (5.53)	5.45 (3.71)	5.18 (3.43)	10.63 (6.26)
Sport age 12 yr													
Nil	1510 (39)	—	—	—	0.40 (1.62)	0.70 (1.75)	1.11 (2.41)	4.51 (3.33)	5.56 (3.45)	10.07 (5.82)	5.20 (3.66)	5.65 (3.56)	10.85 (6.22)
Individual	526 (13)	3.38 (3.32)	—	3.38 (3.32)	1.73 (2.98)	0.81 (1.77)	2.54 (3.31)	3.84 (3.12)	4.85 (3.34)	8.69 (5.49)	4.57 (3.35)	5.04 (3.37)	9.62 (5.62)
Team	1337 (34)	—	3.73 (2.69)	3.73 (2.69)	0.49 (1.65)	2.53 (3.11)	3.01 (3.59)	3.50 (2.84)	5.09 (3.30)	8.59 (5.23)	4.14 (3.42)	5.29 (3.40)	9.43 (5.83)
Both	538 (14)	2.63 (2.68)	3.65 (2.77)	6.27 (4.12)	1.43 (2.74)	3.05 (3.47)	4.48 (4.47)	3.21 (2.82)	4.39 (3.22)	7.60 (5.20)	3.67 (3.08)	4.85 (3.26)	8.32 (5.30)

TABLE 2. Path coefficients for the cross-lagged panel models tested.

SDQ Outcome	Concurrent Paths			Stability Paths			Cross-Lagged Paths		
	T1 (12 yr)	T2 (14 yr)	Time in Sport	SDQ Score	Sport → SDQ	SDQ → Sport			
Unstandardized results, <i>b</i> (95% CI)									
Internalizing	-1.578 (-1.912 to -0.130)**	-0.599 (-1.003 to -0.292)**	0.432 (0.400 to 0.466)**	0.571 (0.539 to 0.603)**	-0.071 (-0.101 to -0.042)**	-0.076 (-0.111 to -0.041)**			
Externalizing	-1.013 (-1.372 to -0.654)**	-0.107 (-0.391 to 0.178)	0.438 (0.405 to 0.470)**	0.667 (0.640 to 0.694)**	-0.024 (-0.051 to 0.004)	-0.041 (-0.074 to -0.009)*			
Total	-2.594 (-3.189 to -1.999)**	-0.636 (-1.129 to -0.143)*	0.433 (0.401 to 0.466)**	0.663 (0.634 to 0.691)**	-0.039 (-0.059 to -0.019)**	-0.085 (-0.132 to -0.037)**			
Standardized results, β (95% CI)									
Internalizing	-0.151 (-0.182 to -0.120)**	-0.067 (-0.101 to -0.033)**	0.412 (0.384 to 0.440)**	0.508 (0.483 to 0.533)**	-0.068 (-0.097 to -0.040)**	-0.067 (-0.098 to -0.036)**			
Externalizing	-0.089 (-0.121 to -0.058)**	-0.013 (-0.047 to 0.021)	0.417 (.389 to 0.445)**	0.650 (.630 to 0.670)**	-0.023 (-0.049 to 0.004)	-0.039 (-0.071 to -0.008)*			
Total	-0.139 (-0.170 to -0.108)**	-0.044 (-0.078 to -0.010)*	0.413 (0.385 to 0.441)**	0.619 (0.598 to 0.540)**	-0.048 (-0.075 to -0.021)**	-0.062 (-0.093 to -0.031)**			

***P* < 0.01.

**P* < 0.05.

Overall mental health. There were significant bidirectional associations between overall mental health and sport participation (Table 2). Total sport participation at age 12 yr was associated with mental health at age 14 yr ($\beta = -0.039$, 95% confidence interval [CI] = -0.059 to -0.019), with mental health at age 12 yr also associated with sport participation at age 14 yr ($\beta = -0.85$, 95% CI = -0.132 to -0.037). There were no significant differences in either relationship by type of sport or by sex.

Internalizing problems. Significant bidirectional relationships were evident between internalizing (social and emotional) problems and all measures of organized sport (Table 2). Total sport participation at age 12 yr was negatively associated with internalizing problems 2 yr later ($\beta = -0.071$, 95% CI = -0.101 to -0.042), and internalizing problems at age 12 yr was negatively associated with total sport participation 2 yr later ($\beta = -0.076$, 95% CI = -0.111 to -0.041). There were no significant differences in the strength of either relationship by type of sport or by sex.

Externalizing problems. Externalizing problems at age 12 yr predicted total sport participation at age 14 yr ($\beta = -0.041$, 95% CI = -0.074 to -0.009), but total sport participation at age 12 yr did not predict externalizing problems at age 14 yr ($\beta = -0.024$, 95% CI = -0.051 to 0.004). There were no significant differences by type of sport or by sex.

DISCUSSION

This study examined bidirectional relationships between sport participation and mental health in a nationally representative sample of Australian adolescents. Findings show that bidirectional relationships exist between time involved in organized sport and overall mental health. Further, bidirectional relationships also exist between time involved in organized sports and internalizing (social and emotional) problems. By contrast, externalizing (behavioral and attentional) problems at 12 yr of age predicted time spent in sport at 14 yr of age; however, time spent in sports did not predict later externalizing problems. In sum, the results suggest that, consistent with the conceptual model of health through sport (14), the relationships between sport participation and adolescent mental health are largely bidirectional in nature and do not differ by type of sport (individual/team) or sex.

A large body of research suggests that sport participation is associated with better psychosocial health, and in particular higher self-esteem, greater interpersonal interactions, and fewer symptoms of depression (14). However, there is some evidence to suggest that psychosocial assets such as self-esteem predict later sports participation, rather than sports participation predicting later self-esteem (1). Our findings show that, after controlling for established predictors of sport participation and mental health (such as socioeconomic position [24,37]), parental measures of adolescent time in organized sport predicted change in mental health and *vice versa* for a 2-yr period. Moreover, the strength of the cross-lagged paths tested in this study

demonstrates that mental health was a somewhat stronger predictor of later sports participation than *vice versa*. These findings add to previous research that has demonstrated that young people who drop out of sport experience higher subsequent levels of psychological difficulties (35) and indicates that young people who experience greater levels of psychological difficulties show lower subsequent levels of sport participation. Importantly, the large number of cross-sectional associations reported between sports participation and psychosocial health (14,17) is in large part explained by the demonstrated bidirectional relationships.

Conceptual models have been developed to help explain why sport participation might facilitate positive mental health (14,17). These models have received partial support through experimental work that has shown that manipulating the sport environment by training youth sport coaches can lead to better psychosocial outcomes for young children (33). However, little attention has been paid as to why children with greater psychosocial health are more likely to participate in organized sport. It is possible that children and adolescents who possess a greater depth and range of psychosocial skills (e.g., interpersonal skills) are more attracted to organized sport given that this environment offers opportunities to engage in these behaviors. This has implications in terms of developing youth sport programs to be more attractive to children and adolescents reporting high levels of psychological difficulties or low levels of psychosocial (e.g., interpersonal) skills. Indeed, there is a large evidence base for physical activity programs in the treatment of depression (10,12), but sport-based programs are much less popular. One reason that sport programs are not more popular in the treatment of psychological disorders might be the reluctance of clinical or subclinical populations to engage in organized sport. For example, the most commonly cited barriers to participation during early adolescence are intrapersonal and social in nature. This includes being shy, fears of not fitting in, and not being comfortable in sports (7). Although limited research exists to suggest how sporting programs may be designed to be attractive to clinical or subclinical populations, there is some theoretical and empirical suggestion that motivational climates such as those based on self-determination theory (autonomy supportive) may increase intrinsic motivation once participation has commenced (27). Further, caring and mastery motivational climates may also be beneficial for such populations (20).

One interesting finding from this study was that the relationships between sport participation and externalizing problems were not bidirectional. Externalizing problems at age 12 yr predicted sport participation at age 14 yr, but sport participation did not predict later externalizing problems. There is an abundance of cross-sectional evidence to demonstrate associations exist between participation in organized sports and psychosocial assets such as social and emotional skills (14). However, fewer studies have investigated the relationships between sports participation and externalizing problems such as behavioral control and

attentional problems. One notable study demonstrated that, among more than 25,000 U.S. children, those who participated in an extracurricular sports team and/or lesson at least once in the last 12 months had greater social skill scores, but no difference in behavioral problems was evident (22). This may be because children with attention deficit hyperactivity disorder (a total of 7.7% of the possible sample) were removed before analyses and thereby potentially attenuating any cross-sectional associations between sports participation and behavioral problems. As such, it is unclear if the relationship between sports participation and problem behaviors would have held if the full sample had been analyzed. This study then is the first that we are aware to demonstrate that children lower in externalizing problems are more likely to participate in organized sports. It is currently unclear why this finding was not mirrored in the opposite direction. It is possible that sports participation is more likely to lead to the development of psychosocial skills related to interpersonal interactions (such as communication and sportsmanship) when compared with skills such as patience, discipline, and attentional control. Given that sports participation has been theoretically and empirically linked to the ability to self-regulate, especially among boys (26), further exploration of the relationship sports participation and externalizing behaviors is warranted.

A noteworthy finding was that the strength of the bidirectional associations did not differ by sport type or by sex. Findings in this area have been inconsistent. For example, of two studies published using the same sample as the current study, one showed that the association between sports participation and health-related quality of life differed by sex and by type of sport (36), whereas no differences were reported using a measure of mental health (35). It is notable that inconsistent findings in this area have been reported using both strengths-based (2) and deficit-based conceptualizations (29) of mental health, although benefits for team sports participation over (or in combination with) individual sports have been the most consistent findings so far (2,35,38). It may be that the differences between team and individual sports are not great at this age. For example, both team and individual sports are typically practiced in groups/teams with a mixture of interactive and individual drills. Further, competitive individual sports (such as golf, tennis, or gymnastics) are often team based despite their “individual” nature. It is clear that higher-quality evidence is needed in this area, including experimental evidence, with multiple conditions including team and individual sports. Lastly, the interaction of both gender and sport type may be important. Future research should endeavor to use more rigorous experimental designs to test the moderating effects of sport type and gender (both separately and in combination) on the mental health outcomes of organized sport participation.

There are some important implications emerging from the current study. First, the quality and the implementation of organized youth sporting programs are important for the development of positive psychosocial health in adolescence.

As sport participation predicts subsequent mental health, the design of high quality sport programs that facilitate psychosocial skills appears important for preventive mental health. The salient features of youth sport programs that enhance mental health include a clear and age-appropriate structure, supportive adult relationships, the provision of positive social norms, the promotion of empowerment and autonomy, and the provision of skill-building opportunities (17). Second, the design, delivery, and marketing of youth sport programs should be made attractive and accessible to children and adolescents with poor psychosocial health. Lastly, the bidirectional nature of the relationship between sport participation and mental health suggests that the benefits of sport participation are likely to be cyclical whereby those who participate in sport receive some benefit to their mental health that, in turn, contributes to continued participation that will accrue further mental health benefits. An emphasis on the prevention of dropout from organized youth sport might therefore be particularly beneficial to adolescent mental health (6).

Strengths of this study include the large representative sample and the prospective nature of the study design. However, there are also some important limitations reader must consider when interpreting effect sizes. First, we were unable to account for the quality of the sporting experience that has previously been found to contribute to the mental health benefits of organized sports, as well as decisions to continue or discontinue participation (17). Measures of sport participation that include a quality assessment might identify stronger effect sizes that those identified in the current investigation. Second, the study did not take into account the adolescents' previous sport involvement. Longitudinal studies have found that continued participation in sport leads to cumulative benefits that are lost after dropout (35). Third, the optimal timeframe in which to explore mental health benefits through sport is unknown. The 2-yr timeframe allowed us to analyze whether reciprocal relationships unfolded over time, but the magnitude of these effects is likely to differ over longer and shorter periods. Further research is needed to explore bidirectional associations over longer time frames and, in particular, might look to explore associations from adolescence to early or middle adulthood. Lastly, we used a parent-reported measure of time spent in extracurricular

sports that was derived from two distinct items measuring frequency of participation in days per week and average duration of participation in hours per day. Although this approach provides only a proxy measure of time spent in extracurricular sports, it is closely related to the measures considered as the gold standard in measuring sports participation, including the Adolescent Physical Activity Recall Questionnaire (11), which measures frequency and duration separately to provide the most reliable measure of time spent in organized sports. Notably, however, the use of an arbitrary median value for duration of participation may lead to the positive skew apparent in the data.

To conclude, this study has found evidence for bidirectional relationships between sport participation and mental health for 2 yr. Bidirectionality was evident between sports participation and overall mental health, as well as social and emotional problems. However, externalizing problems predicted later sports participation but not *vice versa*. The underlying cause of the difference between internalizing and externalizing problems warrants further investigation. Indeed, if the skills developed through sport do not accrue the same benefits across a range of problem types, then practitioners might look to implement changes to the sport environment to facilitate change in externalizing problems. Further research is needed to explore how sport-based programs might maximize mental health benefits among adolescent boys and girls. In particular, the prevention of dropout from youth sport and its association with mental health benefits over time are recommended.

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