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Health-related quality of life as a longitudinal mediator of the relationship between participation in organised sports and adiposity among young people

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ABSTRACT

The objective of this study was to investigate potential mediating effects of health-related quality of life between children's participation in organised sports and measures of adiposity. The sample consisted of 4116 children derived from the Longitudinal Study of Australian Children. Participants were aged 10.32 (*SD* = 0.47) years at baseline (2010), and followed up 24 and 48 months later. Participation in organised sports was assessed using child-completed time-use diary. Health-related quality of life and demographic data were reported by each child's primary parent. Measures of body mass index, body fat, and waist circumference were also taken at each Wave. Sport was indirectly associated with measures of body fat (β = −0.002, 95%CI −0.004, 0.000, p = .039) and waist circumference (β = −0.001, 95%CI −0.003, 0.000, p = .039) through the mediating effects of social functioning. Sport was also associated with body fat via physical functioning (β = −0.01, 95%CI −0.02, −0.003, p = .038), however, this was not replicated with other measures of adiposity. No other mediating effects were evident. Sport participation may enable children and adolescents to function well in groups and access social support which in turn promote health behaviours and influence adiposity. This may be one of multiple pathways through which sports participation is associated with adiposity. Replication and extension of these novel findings is warranted, as is a focus on the design and implementation of sports programs to maximise health benefits.

1. Participation in organised sports, social and emotional functioning, and adiposity during childhood: a mediational model

Participation in organised sports during childhood is associated with the development of many important indicators of good health. For example, children involved in organised sports show more favourable cardiometabolic profiles including thinner carotid intima-media thickness, greater levels of physical activity, and greater health-related quality of life (HRQOL) (Drake et al., 2012; Idris et al., 2015; Vella et al., 2013a; Nelson et al., 2011). Children who participate in organised sports also show higher levels of social and emotional skills, including self-esteem, greater social skills, and reduced risk for mental health problems (Eime et al., 2013a; Vella et al., 2015). Importantly, findings suggest that the psychosocial benefits of sports participation are independent of those that could be attributable to physical activity (Eime et al., 2013a; Vella et al., 2015).

Despite well-documented health benefits, the relationship between participation in organised sports during childhood and measures of adiposity is equivocal (Vella et al., 2013a; Nelson et al., 2011). The causal mechanisms which underpin these equivocal results are largely unknown. Results vary by type of sport and by various subpopulations with no clear pattern emerging (Nelson et al., 2011). One causal pathway that could potentially account for equivocal findings in the relationship between participation in organised sports and adiposity is the mediating role of HRQOL. Sport participation is associated with greater HRQOL over time during childhood (Eime et al., 2013b; Vella

Abbreviations: Health-related quality of life, (HRQOL); Body mass index, (BMI); Longitudinal study of Australian Children, (LSAC); Time-use diary, (TUD); Pediatric Quality of Life Scale, (PEDSQL); Socio-economic position, (SEP)

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et al., 2014). In turn, all components of HRQOL have been associated with body mass index (BMI) during childhood and adolescence. For example, social and emotional functioning are strongly inversely associated with measures of adiposity (Tsiros et al., 2009; Incledon et al., 2013). Further, there is some evidence that aspects of HRQOL predict change in BMI over time. Lower emotional awareness predicts greater increases in BMI over time during childhood (Whalen et al., 2015), and greater school functioning predicts 4-year change in BMI in overweight and obese children (Incledon et al., 2013). However, a robust understanding of causal pathways and directionality in the relationship between HRQOL and adiposity is lacking. Nonetheless, it is plausible that sports participation may indirectly be linked with adiposity through components of HRQOL by equipping children with the skills necessary to maintain a healthy body weight over time.

The aim of this paper was to provide evidence on the potential mediating effect of components of HRQOL between children's participation in organised sports and measures of adiposity in a sample of Australian children over a 4-year time period extending into early adolescence. Specifically, we tested the indirect effect of time spent participating in organised sports at age 10 on subsequent measures of body fat, waist circumference, and body mass index (BMI) at age 14 through the components of HRQOL at age 12, as measured by the Pediatric Quality of Life Scale (Varni et al., 2003; Varni et al., 2002).

2. Methods

2.1. Participants and procedures

The Longitudinal Study of Australian Children (LSAC) collects data about children's health and development from the age of 4–5 years (K-cohort), with follow-up data collected every two years. Beginning in 2004, LSAC randomly selected families from the nation's largest database (the Medicare database) to participate. The initial response rate was approximately 50%, with 4983 children included in the K-Cohort at Wave 1. Data were collected by trained data collectors, using face-to-face interviews with the child's primary parent (the mother in 96% of cases), parental self-report questionnaires, and child-reported time-use diaries (TUDs). This study utilised data collected from Wave 4 (10 or 11 years of age), Wave 5 (12 or 13 years of age) and Wave 6 (14 or 15 years of age). For clarity, we refer to these ages as 10, 12, and 14 years of age across Waves 4–6, respectively. The number and demographics of participant over each Wave is provided in Table 1. The research methodology and survey content of Growing Up in Australia is reviewed and approved by the Australian Institute of Family Studies Ethics Committee, which is a Human Research Ethics Committee registered with the National Health and Medical Research Council. Informed consent was obtained from all participants.

2.2. Measures

2.2.1. Sport participation

The duration of time spent in organised sports was calculated from the time-use diary (TUD) instrument which was completed by children at 10 years of age. An open-ended paper diary was mailed to children to complete over a 24-hour period on the day before their interview (Corey et al., 2014). Interviewers then transposed these diaries according to a predetermined coding framework during the home interviews (Corey et al., 2014). Interviewers were also trained to prompt the child for further information to fill gaps in the diary. The time-use-diary measured time spent in all activities during the day of completion, of which organised sports participation was only one potential activity. In the present study, two activity codes were combined to measure sports participation: “Organised team sports and training” and “Organised individual sports and training” (Corey et al., 2014). The duration of time spent in these activity codes was extracted in a series of steps performed by one researcher (BK). The duration of each activity was firstly calculated as the difference between the start time of the activity and the start time of the next activity in sequence for each child. The last activity of each child's day was assumed to end at the child's bed time. The total duration of organised sports over the 24-hour period was then aggregated for each participant. A similar process was also used to calculate a dummy variable for school attendance (yes/no) based on the activity code “School lessons”. Finally, although the TUD allowed children to record up to six activities concurrently, sport participation was based on the primary activity selected at any one time. Unlike other activities such as walking or listening to music, organised sport is less plausible as a concurrent activity.

2.2.2. Adiposity

BMI *z*-scores, waist circumference, and body fat percentage were used as measures of adiposity. Each child had their height and weight measured by trained professionals and these data were used to calculate BMI (kg/m^2). BMI *z*-scores were used to account for differences in BMI by sex and age, and were calculated based on the 2000 US Centers for Disease Control growth charts (Kuczmarski et al., 2000). Height was measured using a portable laser stadiometer (Invicta Plastics, Leicester, UK) and the average of two measurements was taken. Both weight and percentage body fat were measured using digital scales. Body fat percentage was measured using bioelectrical impedance analysis (Tanita Body Fat Scales, Kewdale, Western Australia). Weight was measured to the nearest 0.05 kg. Waist circumference was measured using the average of two measures taken by placing a non-stretch dressmakers tape horizontally over the navel. If measurements differed by more than 0.5 cm a third measure was taken and the average of the two closest measures was used.

2.2.3. HRQOL

Pediatric health-related quality of life was assessed using the parent-report version of Pediatric Quality of Life Scale (PedsQL) 4.0 (Varni

Table 1
Unadjusted mean adiposity and HRQOL data over the total sample and by sex for each Wave.

		Adiposity [*M* (*SD*)]			PedsQL Subscale Score [*M* (*SD*)]				
	N (%)	BMI-*z*	Body fat (%)	Waist (cm)	Physical	Social	Emotional	School	Psycho-social
Age 10 total	4116	0.36 (1.03)	19.63 (13.14)	66.60 (9.86)	79.18 (19.18)	80.18 (18.60)	73.95 (16.49)	85.40 (16.61)	76.60 (14.31)
Males	2104 (51.1)	0.43 (1.02)	17.93 (12.04)	67.43 (9.72)	79.35 (19.43)	79.80 (19.46)	73.68 (16.71)	85.30 (16.61)	75.52 (14.75)
Females	2012 (48.9)	0.30 (1.04)	21.42 (14.00)	65.73 (9.93)	79.00 (18.92)	80.58 (17.66)	74.24 (16.26)	85.51 (16.63)	77.72 (13.75)
Age 12 total	3767	0.35 (1.04)	21.13 (9.66)	71.88 (10.30)	82.86 (16.07)	82.42 (17.98)	75.59 (17.13)	84.39 (17.35)	77.36 (14.60)
Males	1928 (51.1)	0.32 (1.07)	17.77 (9.09)	72.75 (10.67)	83.14 (15.95)	82.31 (18.72)	75.98 (17.50)	84.31 (17.35)	76.52 (15.04)
Females	1839 (48.9)	0.37 (1.00)	24.65 (8.97)	70.90 (9.71)	82.60 (16.16)	82.56 (17.17)	75.11 (16.74)	84.63 (17.23)	78.26 (14.10)
Age 14 total	3208	0.36 (1.15)	20.91 (10.05)	75.11 (10.18)	–	–	–	–	–
Males	1647 (51.3)	0.29 (1.27)	16.27 (8.82)	76.96 (10.68)	–	–	–	–	–
Females	1561 (48.7)	0.45 (1.00)	25.99 (8.77)	73.19 (9.24)	–	–	–	–	–