Association of Sports Club Participation with Fitness and Fatness in Children

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BASIC SCIENCES

ABSTRACT

ZAHNER, L., T. MUEHLBAUER, M. SCHMID, U. MEYER, J. J. PUDER, and S. KRIEMLER. Association of Sports Club Participation with Fitness and Fatness in Children. *Med. Sci. Sports Exerc.*, Vol. 41, No. 2, pp. 344–350, 2009. Decreased fitness and increased fatness are relevant factors for decreased cardiovascular and bone health in children. One way to increase physical activity and hence fitness and to reduce the risk for overweight might be sports club participation (SCP). **Purpose**: To investigate the association of SCP with fatness and fitness in children in general and in those with increased risk for overweight and/or low fitness. **Methods**: A cross-sectional study was conducted in a random sample of 502 first- and fifth-grade primary school children. Fitness components were determined by 10 motor tests and body fatness by the sum of four skinfolds. SCP was defined as participation of at least once a week. **Results**: Two thirds of all children were participating in a sports club. Girls' and boys' participation rate as well as those of overweight children and of children with overweight parents were comparable to their respective normal weight peers. In contrast, children from migrant families (odds ratio = 0.31; 95% confidence interval = 0.20–0.48) and from inactive parents (odds ratio = 0.16; 95% confidence interval = 0.05–0.45) participated significantly less (all $P < 0.001$). SCP was associated with endurance ($0.53 > \beta > 0.37$, all $P < 0.05$) and partly with speed, strength, and coordination ($0.41 > \beta > 0.18$, all $P < 0.05$). In overweight children and in children from overweight parents and migrant families, this association was not found. There was no association between SCP and fatness in any of the groups. **Conclusions**: SCP rates were high and were associated with higher levels of most fitness components in children. Participation rates were lower for children of migrant families and children from inactive parents. In addition, the association between SCP and fitness components was not found in overweight children and in children from overweight parents and migrant families.
Key Words: PHYSICAL ACTIVITY, EXTRACURRICULAR SPORTS, MIGRANTS, PARENTS, OVERWEIGHT

A decrease in fitness and an increase in fatness have been widely documented in studies looking at secular trends in children (32,34). Several recent cross-sectional studies document a negative association between physical activity or fitness and obesity or cardiovascular risk in children (2). Some longitudinal studies add support for the hypothesis that higher levels of physical activity during childhood lead to the acquisition of less body fat by the time of early adolescence (20,21), and many lifestyle intervention studies in children could document significant increases in fitness and decreases in body mass index (BMI) or skinfold thickness (14). Another way to increase fitness and/or decrease fatness in children is through regular participation in sports clubs or extracurricular sport activities (13,18,35). Because 39% of US children attend local sport teams, 15% scouts, and 13% YMCA/YWCAs (28) and 70% of male and 53% of female high school students report participating in sport teams in school and/or in nonschool settings (23), the popularity of out-of-school activities is evident.

There are children with a special risk of being unfit and/or overweight, for example, overweight children, children of overweight or inactive parents, and those from migrant families. Overweight children and adolescents often show a lower level of physical activity (9) and hence physical fitness (4,33) than their normal weight peers. Parental obesity and inactivity have been found to be predictors for low physical activity levels in their children (20,26,29). Children and adolescents from migrants have been documented to have the highest obesity rates and the lowest physical activity or fitness levels (12,27). This resume is a broad oversimplification of the situation because lifestyle behavior and its consequences (i.e., physical activity, inactivity, and obesity) could be more influenced by the level of assimilation or acculturation of the migrant population rather than by the migrant status *per se* (27).

Children who attend extracurricular sport activities have been shown to be fitter and less fat than their nonactive counterparts (13,18,35). High school students engaging in

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school-based and/or nonschool based sports were more likely to report three or more 20-min sessions of vigorous physical activity during the previous week (23). However, data on extracurricular sports club participation (SCP) in relation to fitness/fatness in the general population of children and in children with increased risk of being unfit and overweight are lacking in the literature.

This study randomly selected a sample of Swiss primary school children to determine 1) whether children with increased risk for low fitness and high fatness (i.e., overweight children, children from inactive and/or overweight parents, and children from migrant families) participate at the same extent in sport clubs than children without such risk; and 2) whether SCP is associated with fitness and/or fatness in children with and without increased risk for low fitness and high fatness. We hypothesized that SCP compared with non-SCP is associated with higher fitness and lower fatness levels, and that children with increased risk for low fitness and high fatness participate less in sports clubs, but if they participate, they show a similar association between SCP and fitness/fatness as the remaining children.

METHODS

Subjects and study design. Data were taken from the baseline examination of the Kinder-Sportstudie (KISS), a randomized controlled physical activity intervention aiming at increasing physical activity, fitness, and health of primary school children in Switzerland (38). The project started in September 2005 and was performed in two provinces of Switzerland. Children (N = 535) were randomly selected and stratified by grade (first and fifth grade), living area (rural and urban), and ethnicity (10–30% immigrants) to be representative for the Swiss population. Of those, 502 (94%) of the selected children agreed to participate. All baseline measurements were taken at school before the physical activity intervention. A complete data set of all measurements was available in 438 children (80.2%). Two hundred and eighty-eight children (50.35% boys, 49.65% girls) regularly participated in a sports club at least once a week (SP group), and 150 children (44% boys, 56% girls) did not participate in a sports club (non-SP group). This information was given by parents for the first-grade children and by children and parents for the fifth-grade children. Sixty-four children were excluded because they did not answer the question regarding SCP. Children gave their verbal assent, and written informed consent was obtained from their parents. The study was approved by the Ethics Committee of the University of Basel, the ETH of Zurich, and the canton Aargau, Switzerland.

Anthropometric measurements. Body height was measured without shoes to the nearest 0.2 cm with a wall-mounted stadiometer (Seca, Basel, Switzerland). Body mass was determined in light clothing and without shoes to the nearest 50 g with an electronic scale (Seca). Body mass index (BMI) was calculated using body mass divided by height squared ($kg \cdot m^{-2}$). Normal weight was defined as BMI <90th percentile and overweight as BMI ≥90th percentile based on Swiss national reference data (25). Skinfold thickness was measured based on standard procedures (17) to the nearest 0.1 cm with Harpenden skinfold caliper (HSK-BI; British Indicators, West Sussex, UK) calibrated to exert a pressure of 10 $g \cdot cm^{-2}$ to the skin at four sites over biceps, triceps, subscapular, and suprailiac. The measurements were taken in triplicate, and the mean was calculated. The sum of the four skinfolds was taken for further analyses. The same two investigators took all measurements. Interobserver technical errors tested in a pilot study were 1.7 mm for biceps, 1.9 mm for triceps, 1.4 mm for subscapular, and 2.1 mm for suprailiac sites, respectively. Skinfold thickness was then normalized and expressed as grade- and gender-adjusted z-scores based on our study population.

Motor fitness and motor testing. Motor fitness was determined using different tests from standardized motor fitness test batteries of Kiphard (16), Bös (7), and the Eurofit test (8). Test items included balancing backward, jumping sideward, pushing a 1-kg ball, throwing a tennis ball on a target, 20-m sprint, jump-and-reach, 20-m shuttle run, sit-ups, bent-arm-hang, and plate tapping. All tests were performed in the respective school gyms. To be able to describe the different indices of physical fitness of the children, all test items were first transformed into grade- and gender-adjusted z-scores based on the study population. The z-scores of plate tapping and the 20-m sprint were inverted because in these tests, a low z-score was associated with high performance whereas a high z-score was representative for high performance in the remaining tests. The individual tests were then assigned into four subcategories including coordination (mean of balancing backward, throwing a tennis ball on a target), endurance (20-m shuttle run), strength (mean of pushing a 1-kg ball, jump-and-reach, sit-ups, bent-arm-hang), and speed (mean of 20-m sprint, plate tapping, jumping sideward). The categorization of the tests was done based on the decision of an expert panel of medical doctors and exercise physiologists.

Questionnaires. Parents filled out a questionnaire that was sent home. Questions included information about parental body height and weight, country of origin, and their participation in sport clubs (yes or no option). Overweight of the parents was defined as a BMI of >25 $kg \cdot m^{-2}$ after correcting for the underreporting of their BMI (37). A migrant family was defined based on regions from which they emigrated if both parents were born in countries of Southern or Eastern Europe, Asia, Africa, or Central or South America. Pubertal status was self-reported by the child or the parents. Breast and pubic hair were reported for girls; genital and pubic development was reported for boys. Only breast for girls and genital development for boys were used in the analyses.

Statistical analysis. All variables were checked for normality of distribution, and appropriate transformations were applied when necessary. Unadjusted odds ratios (OR)

BASIC SCIENCES

and 95% confidence intervals (CI) were calculated using the chi-square test to determine the association between children in different group constellations (girls vs boys, first vs fifth grade, overweight vs normal weight children, children with normal weight vs overweight parents, children from active vs inactive parents, and children from nonmigrant vs migrant families) and SCP. Linear regression analyses were then used to examine the relationship between children's SCP and their fitness/fatness level in the same group constellations mentioned above. The analyses were adjusted for chronological age and pubertal stage. All analyses were performed using the Statistical Package for the Social Sciences version 13.0 (SPSS Inc., Chicago, IL). The significance level was set at $P < 0.05$.

RESULTS

Descriptive characteristics of the study sample based on SCP, grade, and gender are shown in Table 1. There were no significant differences in age, height, weight, and BMI between those with SCP and those without.

SCP and motor fitness. Percentages, OR, and 95% CI for the associations between SCP and fitness/fatness are presented in Table 2 for all children and for those with special risk for overweight and/or low fitness. About two thirds of boys and girls participated in a sports club. Figure 1 shows the selection of sport clubs separated by gender and grade. Although boys preferred team sports (i.e., soccer, ice hockey, handball, basketball, and volleyball) and martial arts, girls preferred gymnastics and dance. The average time spent in sport clubs in 62% of the children who reported it was 118 ± 91 $\text{min}\cdot\text{wk}^{-1}$ for first-grade children and 215 ± 146 $\text{min}\cdot\text{wk}^{-1}$ for the fifth-grade children. Children in the first grade, children with inactive parents, and children from migrant families were significantly less likely than their peers to participate in a sports club. Parental and children's weight status had no effect on children's SCP.

In general, children participating in a sports club showed significantly higher scores in all motor fitness indices than children not participating in a sports club (Table 3). This was true for all components of motor fitness in first-grade children and in most motor fitness components for fifth-grade children. Furthermore, children's SCP was significantly associated with endurance (aerobic fitness) and most other motor fitness indices in normal weight children, in children of inactive parents, and in children from nonmigrant families (all $P < 0.001$). This association was not found for overweight children, children from overweight parents, and

TABLE 1. Description of the study population by grade and SCP (mean ± SD).

	First Grade (N = 189)		Fifth Grade (N = 249)	
	SCP (n = 106)	Non-SCP (n = 83)	SCP (n = 182)	Non-SCP (n = 67)
Age (yr)				
Boys	7.0 ± 0.3	6.9 ± 0.3	11.1 ± 0.6	11.3 ± 0.5
Girls	6.9 ± 0.4	6.9 ± 0.5	11.0 ± 0.5	11.3 ± 0.6
Height (cm)				
Boys	123.4 ± 5.3	122.0 ± 4.8	146.3 ± 7.2	146.1 ± 6.2
Girls	121.7 ± 5.5	123.2 ± 5.7	144.6 ± 7.1	147.4 ± 6.6
Weight (kg)				
Boys	24.2 ± 3.3	24.7 ± 5.6	38.6 ± 8.2	38.7 ± 9.5
Girls	23.7 ± 4.3	24.7 ± 4.9	38.5 ± 8.2	38.0 ± 6.5
BMI ($\text{kg}\cdot\text{m}^{-2}$)				
Boys	15.8 ± 1.4	16.5 ± 3.1	17.9 ± 2.8	18.0 ± 3.3
Girls	15.9 ± 2.1	16.2 ± 2.1	18.3 ± 2.7	17.4 ± 2.2

SCP, sports club participation; Non-SCP, nonsports club participation.

TABLE 2. Percentages and OR (95% CI) by children's SCP.

	SCP (%)	Non-SCP (%)	OR (95% CI)
All children (N = 438)	65.8	34.2	—
Gender			
Boys (n = 211)	68.7	31.3	1.29 (0.87–1.92)
Girls (n = 227)	63.0	37.0	
Grade			
first grade (n = 189)	56.1	43.9	0.47 (0.31–0.70)*
fifth grade (n = 249)	73.1	26.9	
Weight status children			
Overweight (n = 109)	66.1	33.9	1.02 (0.65–1.61)
Normal weight (n = 329)	65.7	34.3	
Weight status parents†			
Overweight (n = 71)	62.0	38.0	0.74 (0.44–1.26)
Normal weight (n = 323)	68.7	31.3	
Sports participation parents†			
Nonparticipation (n = 284)	58.5	41.5	0.16 (0.05–0.45)*
Participation (n = 40)	90.0	10.0	
Migration status parents†			
Migrants (n = 113)	45.1	54.9	0.31 (0.20–0.48)*
Nonmigrants (n = 266)	75.9	24.1	

* $P < 0.001$.
† Both parents represent the characteristic.
OR, odds ratio; 95% CI, 95% confidence interval; SCP, sports club participation; Non-SCP, nonsports club participation.

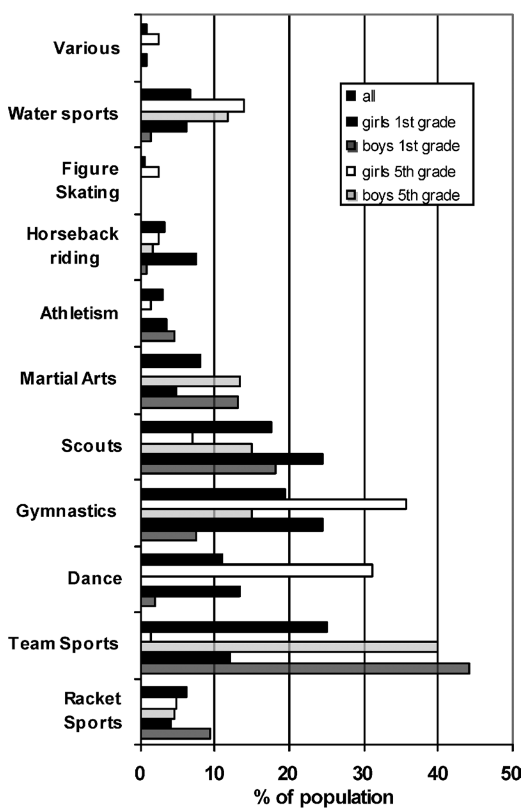

FIGURE 1—Description of SCP by gender and grade in percentage of the whole population.

BASIC SCIENCES

TABLE 3. Linear regression coefficients (95% CI) of children's SCP and motor abilities in children with and without special risk.

	Coordination (*z*-score)	Endurance (*z*-score)	Speed (*z*-score)	Strength (*z*-score)
All children	0.24 (0.08 to 0.39)*	0.45 (0.25 to 0.65)†	0.26 (0.10 to 0.41)*	0.21 (0.08 to 0.35)*
Gender				
Boys	0.38 (0.14 to 0.61)*	0.53 (0.23 to 0.83)*	0.34 (0.11 to 0.57)*	0.29 (0.08 to 0.49)*
Girls	0.12 (−0.09 to 0.33)	0.38 (0.11 to 0.66)*	0.19 (−0.02 to 0.40)	0.16 (−0.03 to 0.35)
Grade				
First grade	0.25 (0.02 to 0.47)‡	0.53 (0.24 to 0.82)†	0.36 (0.13 to 0.59)*	0.29 (0.09 to 0.49)*
Fifth grade	0.26 (0.04 to 0.48)‡	0.37 (0.08 to 0.65)‡	0.21 (−0.01 to 0.43)	0.19 (0.001 to 0.39)‡
Weight status children				
Overweight	0.41 (0.10 to 0.72)‡	0.31 (−0.07 to 0.70)	0.34 (0.04 to 0.65)‡	0.26 (−0.02 to 0.53)
Normal weight	0.19 (0.01 to 0.37)‡	0.51 (0.29 to 0.74)†	0.24 (0.06 to 0.41)‡	0.20 (0.05 to 0.36)‡
Weight status parents[a]				
Overweight	0.26 (−0.14 to 0.66)	0.50 (−0.02 to 1.02)	0.23 (−0.17 to 0.64)	0.29 (−0.06 to 0.64)
Normal weight	0.18 (−0.01 to 0.36)	0.44 (0.20 to 0.68)†	0.29 (0.10 to 0.48)*	0.24 (0.07 to 0.40)*
Sports participation parents[a]				
Nonparticipation	0.22 (0.05 to 0.38)‡	0.46 (0.24 to 0.67)†	0.23 (0.06 to 0.39)*	0.18 (0.04 to 0.33)‡
Participation	0.95 (0.14 to 1.76)‡	0.37 (−0.67 to 1.42)	0.84 (0.03 to 1.65)‡	0.78 (0.06 to 1.49)‡
Migration status parents[a]				
Migrants	0.11 (−0.18 to 0.40)	0.18 (−0.20 to 0.55)	0.19 (−0.10 to 0.48)	0.25 (−0.002 to 0.51)
Nonmigrants	0.26 (0.07 to 0.45)*	0.51 (0.26 to 0.76)†	0.31 (0.12 to 0.50)*	0.22 (0.05 to 0.39)‡

* $P < 0.01$.
† $P < 0.001$.
‡ $P < 0.05$.
[a] Both parents represent the characteristic; values were adjusted for pubertal stages and age.

BASIC SCIENCES

children from migrant families. As an example, a normal weight child showed 0.51 higher *z*-scores for endurance (95% CI = 0.29 to 0.74) when participating in a sports club compared with a normal weight child not participating in a sports club with a significant difference between the groups. On the other hand, an overweight child showed the same tendency of 0.31 higher endurance *z*-scores (95% CI = −0.07 to 0.70) when participating in a sports club than the overweight child not participating, although this was not significantly different. One *z*-score unit around the median of the whole population (e.g., −0.5 to 0.5) for endurance equals a 1.5-min difference in the shuttle run running time equivalent to a 25% difference between absolute values. A β coefficient of 0.52 therefore translates to a difference of 45 s or 12.5% among the groups. For the *z*-scores of the other motor fitness disciplines, one *z*-score unit difference around the median was similar and translated into a 20–35% difference of the absolute values.

SCP and body composition. There were no significant associations between the children's SCP and the sum of four skinfolds irrespective of the group considered.

DISCUSSION

The main findings of the present study were that two thirds of boys and girls participated in extracurricular sports. Children in first grade, children with inactive parents, and children from migrant families were significantly less likely than their "normal" peers to participate in a sports club, whereas the weight status of the children or their parents was not associated with participation rates. Furthermore, SCP was associated with a meaningful and significant 5–12% higher motor fitness, including coordination and endurance, but not with fatness irrespective of gender and grade. The association between motor fitness and SCP was, however, not found for overweight children, children of overweight parents, and migrant families.

Regular participation in extracurricular sports has been recommended as an easy mean to increase physical activity and fitness or to reduce body fat (13,18,35). It is reassuring that the majority of Swiss elementary school children (18), comparable to children and adolescents of other countries (23,24,28), participate in extracurricular activity programs. Children in Switzerland do this by participating in sport clubs. They go there once to three times per week, for at least 60 to 90 min per session, to perform sports at a quite competitive level. The teams compete against each other locally, regionally, or nationally depending on their skill level. Sport teams compete about once per month, and at higher skill levels they compete weekly. In individual sports, competitions are highly dependent on the skill levels and range from no competitions up to weekly competitions. This participation in organized or extracurricular sports is of great public health importance considering the fact that schools are reluctant to increase physical education time or even to reduce it (22). The minimum of physical education for elementary school children in Switzerland is three 45-min lessons per week. Similar to most countries in the world, this is not enough to fulfill the public health physical activity guidelines, which advice at least 1 h of physical activity per day (31). Also, school-based interventions aimed at increasing daily physical activity had little effect in doing so (36). It is therefore necessary to search for strategies outside school to increase the children's physical activity and fitness levels. Noncurricular approaches showed a promise for increasing vigorous physical activity (23), physical fitness (5,6), reducing body fat (5), or enhancing health behavior (23). Although we do not provide a causal relationship for this promise, our results support the hypothesis that extracurricular SCP may lead to higher fitness levels.

In contrary to the finding that girls are less physically active than boys (30), SCP was equally prevalent in girls and boys. It was lower in children of inactive parents and in those from migrant families but not in overweight children and in those from overweight parents. Thus, girls and boys participated equally in a sports club, which shows that at least two thirds of girls are willing to be active in sports. This finding is important because it shows that a positive attitude toward extracurricular SCP exists also in pubertal girls, who tend to become inactive and unfit with puberty (15). Yet, SCP does not equal physical activity; rather, participation in a club provides an opportunity for activity. Activities available for boys and girls may differ in potential for physical activity, and it is therefore possible that the latter may be related to sex differences in physical activity. The inconsistent association between motor fitness components and SCP in our girls supports this hypothesis.

Although some longitudinal data (21) show that overweight children are less active than normal weight children, our data indicate that they participate in sports at the same percentage as normal weight children, which is one precondition to increase daily physical activity. It is possible that adolescent girls and obese children for example participated equally in sport clubs as the usually more active population (i.e., boys, normal weight children) because they could freely select the discipline and how often they wanted to take part. The finding of a lower participation rate in children from inactive parents suggests the influence of the parents as mediators for organized sports participation (19,20,30). The finding that migrant children and adolescents participate less in extracurricular sports and also show lower physical activity levels in general has been documented in different countries (12,27). Yet, the lower participation rate of our children from migrant families has to be considered with caution given the lack of specific information on the children and their families. Migrant families differ in their traditional way of thinking about physical activity and body shape and will most likely have a different level of integration into the new culture. Depending on their level of acculturation, they may keep their traditional lifestyle habits; they may fully assimilate to the new culture or show a mix in between (27). These data suggest that the attitude and normative beliefs of the children and parents toward physical activity rather than the weight status of children and parents are instrumental in determining extracurricular sports participation of the children, as has been suggested previously by others (12,29). One consequence is that we have to learn more about how to reach inactive parents and migrant families, which include also possible barriers to be physically active or to participate in organized sports.

For boys and first-grade children, there was a significant association between SCP and all motor fitness components, but also in girls and fifth graders, significant associations were found for endurance (both), strength (fifth grade), and coordination (fifth grade). High endurance and SCP were consistently related among both genders and age groups. These results are in line with the findings of Ara et al. (5,6), who also reported a significantly higher aerobic fitness of boys participating in extracurricular sports compared with boys without participation. Aerobic fitness is important in the determination of cardiovascular risk not only in adults but also in children (2). Even more important, fitness training leads to a higher aerobic fitness with a parallel reduction of other cardiovascular risk factors (10,11). There is even a dose–response relationship because the number of cardiovascular risk factors such as high blood lipids, insulin resistance, and hypertension is increased with lower fitness and higher BMI (3). The associations with the other motor fitness components are less clearly related to the child's health *per se* but should be considered as preconditions to enjoy and to successfully perform sports throughout growth (30).

The question, which arises, is whether the association between fitness and SCP was also found in children at risk for being overweight and/or unfit. The association between most motor fitness components and SCP was indeed not found in overweight children, children from overweight parents, and migrant families. Possibly, sports clubs were not catering sufficiently for the specific needs of these subgroups. Coaches should learn to teach each child based on his or her individual needs. For example, an overweight child should be preferentially endurance trained intermittently or in a nonweight bearing manner. The consistent association between the SCP and the motor fitness in children of active and inactive parents could be due the low number of active parents in our study (N = 40).

The lacking association between SCP and fatness is not surprising, although it is discordant with findings by Ara et al. (5). In a further study by the same group (6), however, they were not able to find differences in sum of skinfolds between those participating in 3 h of extracurricular sports and those with less participation. Despite these contradictory findings, an important difference between their and our study was the amount of extracurricular sports participation. Although their criterion of inclusion in a sports participation group was at least 3 h of extracurricular sports per week, we divided children in participation or nonparticipation categories, irrespective of the amount of time spent in organized sports. It could be that the amount of active time spent in sports clubs by our subjects was simply not enough to induce body composition changes. This hypothesis is supported by several studies which have shown that children participating in competitive sports demonstrate significantly less body fat compared with children involved in noncompetitive sports (1).

There are some limitations to the present study. The study has a cross-sectional design. Therefore, we cannot determine whether the SCP might have led to higher fitness levels or whether higher fit children simply tended to participate in sports clubs. On the basis of many training and school-based physical activity intervention studies in which higher fitness levels were attained (14), one might suggest that at least part of the increased fitness in the group participating in a sports club was a reflection of this SCP. This is supported by a large study in high school students that reported higher vigorous physical activity levels in those students with extracurricular sport participation (23). We did not measure leisure time activities, which could also have influenced the children's motor fitness level. One should realize also that types of activities and time in the clubs are only proxies of physical activity. Hence, care is needed in generalizing, especially given the large SD for time in the sports clubs. And finally, our results for the migrant population should be considered with caution considering the lack of information about the adherence to their traditions as well as the extent and the level of assimilation to the host country by factors such as the children's birthplace, age of children at migration, time since migration, parental occupational status, reasons for migration, or preservation of the traditional language, which might all influence our results.

In conclusion, our data show that two thirds of both genders participate in extracurricular sport activities, with lower rates found in children from inactive parents and migrant families. This participation was associated with higher levels of motor fitness, but not with differences in fatness, in a broad, randomly selected sample of Swiss first- and fifth-grade children. Extracurricular SCP could serve as an easy and attractive mean of health enhancing daily physical activity. Omni-sports organizations with a broad range of sports disciplines, offering a combination of sports at recreational and competitive levels at moderate costs and with easy access for all children, may serve as possible model to increase daily physical activity in school children. Programs of such sport teams should especially focus on finding attractive ways to increase motor fitness in girls and in children at increased risk for overweight and low fitness because SCP was not associated with increased motor fitness in those groups. Further prospective studies should reveal whether there is a real cause–effect relationship between motor fitness and participation in extracurricular sports in children.

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