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Physical activity preferences of 10-year-old children and identified activities with positive and negative associations to cardiorespiratory fitness

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ABSTRACT

Aim

This study investigated children's physical activity preferences, as these can aid the design of school-based interventions.

Methods

Data were collected in 2014 as a part of the Active Smarter Kids study and 1,026 students (52% boys) from 57 Norwegian primary schools completed a questionnaire about their favourite physical activities at a mean age of 10.2 ±0.3 years. We identified five patterns of physical activity and studied whether gender, cardiorespiratory fitness and abdominal adiposity were associated with these patterns.

Results

Soccer and slalom skiing were the favourite activities and the most pronounced gender differences were for activities favoured by girls, which included dancing, gymnastics, exercising to music and jumping rope ($p < 0.001$). When the five component patterns were analysed using linear mixed-effect models, this showed a strong female preference for dancing, gymnastics, exercising to music and climbing. Cardiovascular fitness was negatively associated with frisbee, dodgeball, baseball and floorball, and positively associated with team handball, volleyball and basketball and with slalom skiing and cross-country skiing. It was interesting that the children's preferences were not related to their abdominal adiposity.

Conclusion

The results showed different gender-based PA preferences and positive and negative associations with cardiovascular fitness, but no relationship with abdominal adiposity.

Abbreviations

CRF, Cardiorespiratory fitness; PA, Physical activity; IQR, Interquartile range; PCA, Principal component analysis; SD, Standard deviation

Key notes

- Investigating children's physical activity (PA) preferences can help to design effective interventions in schools.
- We asked 1,026 students (52% boys) from 57 Norwegian primary schools to complete a questionnaire about their favourite physical activities at the age of 10 at part of the Active Smarter Kids study.
- The results showed different gender-based PA preferences and positive and negative associations with cardiovascular fitness, but no relationship with abdominal adiposity.

Key words: abdominal adiposity, cardiorespiratory fitness, children, gender, physical activity.

INTRODUCTION

Studies have shown that a worrying number of children do not meet physical activity (PA) recommendations (1) and PA levels steadily decline with age in schoolchildren (1,2). Moreover, it has been reported that patterns of reduced PA and increased sedentary behaviour appear to persist into adulthood (3,4), which could negatively affect children's future health (5). That is why it is critical to provide early interventions that offer opportunities for increased physical activity throughout childhood. Schools provide an ideal setting for these interventions (6) and are in a unique position to contribute to the recommended minimum of 60 minutes of daily PA for children (7). In addition, many of the barriers for children's leisure-time PA, including their parent's socioeconomic status, parental support for active modes of travel, such as cycling, and the cost of sporting activities, do not apply in the school setting (8). Numerous efforts have been made to intervene and increase children's PA levels in school (9). A large number of studies have researched children's PA levels (1), but most of these have focussed on the dose, such as 15, 30 or 60 minutes of PA per day, or active transportation (10), while few have considered the type and content of the activities that children prefer (9). Consequently, while we know a lot about how much activity we want children to achieve, less is known about their PA preferences and the factors that might have an impact on these. This is surprising, as children are likely to engage in physical activities that they enjoy (11) and they cite fun and enjoyment as the main reasons why they participate in PA (12). Hence, an improved understanding of children's PA preferences could provide researchers and practitioners with better tools to design interventions and programmes in schools that are tailored to children's preferences.

The limited number of studies that have investigated children's PA preferences (8,13-20) have identified four associated variables, namely ethnicity, gender, age and body mass index

(BMI). However, these studies were based on relatively simple comparisons within special populations and included relativity few children. Specifically, Posner and Vandell (13) investigated after-school activities in 194 children from low-income urban areas, Sherwood et al (15) investigated 96 African-American girls and Wilson et al (16) included 51 underserved adolescents in their study. Grieser et al (17) limited their study to 130 girls, Nemet et al (18) only investigated 202 kindergarten children and Larson et al (20) focused on 35 overweight and obese four and fifth grade students. As such, there has been little work on the general child population that has had sufficient power to adequately test the differences between the key sub-groups.

A more robust study was carried out by Olvera and McCarley (19), which assessed the children's PA preferences of 191 Latino and white American children at the age of 12. What set this study apart was the use of exploratory factor analysis to identify patterns of activities and this indicated a three-factor solution: free play, sports and exercise. Multiple linear regression models revealed that the children's PA preferences for these three groups varied with regard to ethnicity, gender, age and BMI. However, the study included relativity few children for this kind of analysis, their selection was biased by self-selection into the study and the primary outcome was measured through children raising their hand within a group to indicate their preference. A similar analysis was used in a prospective study that followed 118 girls and 127 boys from the Czech Republic from 10 to 14 years of age and assessed sport and PA preferences twice a year (14). The results indicated that girls preferred activities with an aesthetic orientation, while boys showed preferred fitness activities. These were interpreted to support gender-specific activity programmes with revised physical education curricula based on children's PA preferences (14).

The combined results from these studies illustrate the importance of children's PA preferences and the need to consider differences across clusters of sport, not just simple difference between sports. Moreover, none of the existing research examined cardiorespiratory fitness (CRF) as a predictor of children`s PA preferences. Given the different fitness levels required for various sports, such as soccer versus dodgeball, it is likely that this will have an impact on children`s PA preferences. In fact, it may be that earlier studies that have shown differences in BMI may have served as a proxy for CRF, as these factors are highly correlated in children (21). This is, of course, highly speculative and requires a direct assessment of both CRF and body size and their relationship to children's PA preferences. Ideally, this would be a direct measure of CRF rather than an estimate based on reported activity and would use a measure of central adiposity rather than BMI (22). It would also need to involve a large sample of children. This aim of this study of 10-year-old Norwegian children was to assess their physical activity preferences and explore whether gender, cardiorespiratory fitness and abdominal adiposity were associated with these patterns.

METHODS

This paper presents baseline data from the Active Smarter Kids (ASK) study. Detailed descriptions of the Active Smarter Kids study have previously been published (23, 24) and this paper provides a brief overview of the relevant procedures.

Sample

We invited 1,202 primary school pupils from 60 schools in Sogn og Fjordane County, which is situated in the western part of Norway, to take part in the ASK study. The inclusion criteria were that the schools should have at least seven children aged 10 years in the fifth grade and that the children were healthy, with no serious or chronic illnesses, and able to participate in daily physical activities and physical education.

In total, 57 schools (95%) and 1,145 children (97%), aged 10.2 ±0.3 years agreed to participate. Of the 1,145 children who agreed to participate, 1,129 participated in the study and 1,026 children provided data on PA preferences, which were collected during autumn 2014 in the children's classroom.

The study protocol was approved by The Regional Committee for Medical Research Ethics and we obtained written consent from each child's parent or guardian prior to all testing. The data were anonymous and it is not be possible to identify individual participants in any of the published materials.

PA preferences

The children indicated their PA preferences on a scale of one to 10, where one was the lowest and 10 was the highest. To achieve a more complete overview of the children's PA preferences, we included activities that were normally carried out at school, for example exercising to music and excluded those that were not, such as cycling. All the activities we included are shown in Table 2. A minimum of 700 children had to rate each activity for it to be included in the analyses.

Independent variables

CRF was measured with the Andersen test (25), a 10-minute intermittent running test that has demonstrated acceptable levels of reliability and validity in the target population (26). Abdominal adiposity was measured with a Seca 201 (SECA GmbH, Hamburg, Germany) ergonomic circumference measuring tape. In addition, gender was included as an independent variable.

Covariates

Body mass was measured using a Seca 899 electronic scale (SECA GmbH, Hamburg, Germany) and height was measured with a portable Seca 217 scale (SECA GmbH, Hamburg, Germany). BMI (kg/m^2) was analysed using the cut-points published by Cole et al (27). Parental education levels were obtained by a parental questionnaire and categorised into three levels using the highest educational level obtained by the mother or father: upper or lower secondary school, university for less than four years and university for more than four years.

Data analyses

The children's characteristics were reported as frequencies, means and standard deviations (SD). We tested for differences in characteristics between included and excluded children, using linear mixed models for continuous outcomes or generalised estimating equations for categorical outcomes, to account for the clustering among schools. PA preference scores between one and 10 were reported as medians and interquartile ranges (IQR) as the data were skewed. Differences between genders for the medians of PA preferences were tested on ranked outcome variables using linear mixed effects models.

To identify patterns among the different types of activity, the 21 items that formed the children's PA preferences were subjected to principal component analysis (PCA). To aid the interpretation of the results, varimax rotation was performed. Linear mixed-effect models with the activity components as outcomes were conducted by simultaneously entering all the independent variables, namely gender, CRF and abdominal adiposity, into the analyses. The continuous independent variables were standardised before the analyses. We report estimates regression coefficients and their 95% confidence intervals (95% CI). These estimates reflect changes in the activity component scores that occurred for each when there was a 2 SD change in the independent variables. The PCA resulted in the dependent variables having a mean of zero and an SD of one. Age and parental education were included as covariates. To account for possible effects of clustering of observations within schools, the school site was included as a random effect in all models.

Results

We obtained data from 1,026 children (52% boys) for the current analyses (Table 1). Just under a third (31%) of the parents of the included children did not go to university, 30% went to university for less than four years and 39% spent four or more years at university. The respective figures for the excluded children were 49%, 33% and 18 ($p = 0.001$). The mean and 95% CI CRF level was higher for the included children, at 896 (890-903) m, than the excluded children, at 853 (832-874) m ($p = 0.001$). Otherwise, the children were similar ($p > 0.375$).

TABLE 1

The total and gender-specific ratings of the included activities are given in Table 2. The median ratings varied from four for jumping rope to nine for soccer and slalom skiing in the joint sample, whereas the median ratings varied from two for dancing to 10 for soccer in boys and from four for basketball to 10 for slalom skiing in girls. The girls preferred dancing, gymnastics, exercising to music, jumping rope, handball, swimming, climbing and mountain hiking ($p < 0.001$) to the boys. Meanwhile, the boys preferred soccer, floorball, basketball and strength training to the girls ($p < 0.032$). The preferences were similar across genders for other activities.

TABLE 2

TABLE 3

Factor analyses

The PCA revealed five components with eigenvalues that exceeded one and these explained 30.6%, 9.9%, 6.6% 6.5% and 5.2% of the variance in the five components, with a total variance of 58.8%. Varimax rotation revealed the presence of five clear activity preference components (Table 3). Component one comprised jogging, strength training, cycling and track and field. Component two comprised dancing, gymnastics, exercising to music and climbing. Component three comprised frisbee, dodgeball, baseball and floorball. Component four comprises team handball, volleyball and basketball. Component five comprised slalom skiing and cross-country skiing.

The linear mixed-effect analysis showed that girls demonstrated a strong preference for component two (Table 4). CRF was negatively associated with component three and positively associated with activity components four and five. The other estimates were not statistically significant.

TABLE 4

Discussion

Understanding children's PA preferences can aid the design of more effective school-based PA interventions, as they can be tailored to the preferences of children. Although guidelines specify the minimum daily level of physical activity for children, there is a knowledge gap about the type of physical activities school children prefer, along with factors that might predict children's PA preferences. Thus, the aim of this study was to investigate children's PA preferences using baseline data from the ASK study (23), which included a large sample of 10-year-old children from 57 elementary schools in Western Norway.

Boys and girls said that soccer and slalom skiing were their two favourite activities and those results were not surprising. Soccer is by far the most popular sport in Norway and Western Norway provides particularly good conditions for winter sports because of easy access to mountains and a long winter season. Consequently, most children are familiar with these activities from a young age. Slalom skiing is difficult to organise for many schools due to the need for equipment and transport. However, we wanted to provide a broad range of activities to determine children's PA preferences as it might provide inspiration for some researchers. For example, schools in Western Norway commonly arrange ski days where most children participate and the school provides transport for all and equipment for those who need it.

Despite the similarities for soccer and slalom skiing, there were distinct gender differences in the children's PA preferences. These centred on eight activities that were preferred more strongly by girls than boys and the strongest differences were for dancing, gymnastics, exercising to music and jumping rope. In contrast, the boys significantly preferred just soccer and strength training, although the differences were much less pronounced. The latter finding was supported by Sherwood et al and Wilson et al (16), who both showed that boys were most interested in soccer and weight lifting, American football and baseball. Also Hulteen et al (8) concluded that soccer was the most popular activity for boys. However, the girls in our study also expressed a high preference for soccer and it should not be viewed as just an activity for boys.

Although examining individual activities is important, it is also interesting to consider similarities among activities, as this may guide the selection of similar activities in other studies. The challenge is to develop groups that reflect the perceptions of children, as these will be more likely to inform our understanding of children's PA preferences rather activities chosen by researchers. To this end, we used PCA to develop different physical activity groupings and this resulted in five categories of activities.

Our analysis revealed that girls had a stronger preference for activity component two than boys, which comprised dancing, gymnastics, exercising to music and climbing. These results reflect findings for adults from the national Norwegian Monitor (28) population survey, which has been carried out every two years for the last 15 years. When the participants were asked what kind of activities they engaged in in their leisure time at least once a month, more than six times as many women (27.3%) as men (4.4%) said that they did gymnastics, jazz ballet or aerobics and nearly four times as many women (15%) as men (3.9%) said that they danced once a month. The activities that were more popular with men than women were were shooting (9.6% versus 1.5%), soccer (16.1% versus 2.3%) and weight lifting (10.6% versus 3.4%). Our study showed strong gender differences for some activities and underlines the fact that these differences were pronounced by 10 years of age. There was one difference between the present data and the national adult data (28). The men and women scored nearly the same on strength training, at 38.2% and 38.7%, respectively (28), but our 10-year-old boys favoured strength training more than the girls in our study.

It was also notable that CRF was positively associated with higher intensity sports in components four and five, such as volleyball, team handball and skiing. In contrast, CRF was negatively associated with the less intense sports in component three, like frisbee, dodgeball and floorball. These data are particularly useful in highlighting the challenges of a standardised one-size-fits-all school-based PA intervention. Activities that might appeal most to children with lower fitness levels, such as dodgeball, might not as well received by children with higher fitness levels. This challenges us to adjust and adapt physical activity programmes as needed to make the intervention as enjoyable as possible for every child. Rather than trying to modify individual sports, it is likely that a mix of activities will be required to maintain high levels of participation across children.

It is interesting that the preferences were not related to abdominal adiposity. This finding was in contrast to previous studies that found BMI - as a measure of child body composition – was associated with children's PA preferences (19). This supports our hypothesis that BMI might have served as a proxy for CRF and, by extension, motor skills. However, while we did have an acceptable range of CRF, the range of abdominal adiposity was narrow. Most children were at a healthy weight and would be considered thin. Future research should provide a more direct comparison of CRF, body composition and motor skill as indicators of children's PA preferences.

These data suggest that different sub-groups, such as low CRF and high CRF and boys and girls, differed in their PA preferences. It is logical that interventions to increase PA in children will be more successful if they reflect these preferences. This perspective is in accordance with the Self-Determination Theory (29), particularly for autonomy and competence motives. The desire for autonomy is a clear source of motivation, as both children and adults want to be active agents in their behaviour (30). Responding to student preferences is likely to result in a greater perception of autonomy and thus increase motivation. In addition, self-determination is based on the fact that that people are motivated to demonstrate competence (30). It is likely that many of the children with low CRF struggled to perform higher intensity activities, which was likely to be a factor in their negative evaluations of soccer and hiking. Moreover, as CRF is associated with motor skills (31), students with low CRF may have been less skilled in sport. If so, they would have felt feel less competent in high skilled sports such as volleyball and team handball. Thus, researchers would do well to consider children's autonomy and feelings of competence when designing PA interventions (32). That said, even high skill and physically intense activities can be presented in a more inclusive manner and, even when choice is not possible, the intervention can be structured so that it successfully reaches most children.

Strength and limitations

The strengths of this study included the large number of children recruited from a normal population sample and the fact that 85% of the 10-year-old children who were invited from one county in Norway agreed to take part. However, this was also limitation with regard to the ability to generalise the findings and the results should be interpreted with caution as the present paper mostly included Caucasian Norwegian children who lived part of the year in cold weather climates. As such, they were more likely to participate and prefer snow sports, such as slalom skiing. We suspect that children who live in warmer climates in Southern Europe, Australia and Africa, would be more likely to participate in, and prefer, other activities. This limitation was mitigated by another strength and that was the use of PCA-derived activity groupings. This allowed for a broader examination of patterns of activity instead of merely comparing each activity in isolation. For example these data allowed us to examine high fitness versus low fitness activities that would allow these data to be adapted other regions and culturally-appropriate activities.

CONCLUSION

This was the first large-scale study to present children's PA preferences in Scandinavia. We observed a distinct gender difference in the children's preferences as there were several where girls showed substantially more interest than boys. The results also suggest that the children's preferences had different associations to CRF. Interestingly, we identified a range of activities that were preferred by children with low CRF that could be used to inform future school-based PA designs that target these children. This is important, as it is these low CRF children who might otherwise be missed by one-size-fits-all school-based physical activity interventions. This highlights the idea that school-based PA intervention researchers need to consider what physical activities interventions should focus on and tailor the PA to the goals of the intervention. Offering girls and boys specific physical activities that they prefer may be an effective way to stimulate regular PA. This line of reasoning reflects a self-determination approach that emphasises autonomy and perceived competency as key sources of motivation (30). For example, if the goal is to promote PA in girls, the activities they prefer, such as dancing, gymnastics, exercising to music and jumping rope skipping in this study, should be included. Children who are less fit could be offered activities such as frisbee, dodgeball and floorball, as these might minimise the differences in skill between them and children with a higher CRF, thereby increasing their sense of enjoyment and avoiding a perceived lack of competence. More importantly, modified activities could be presented that also lessen the advantage that higher skilled students with a high CRF have. Regardless of the approach, this study highlights the need for more studies investigating children's PA preferences so we can improve interventions and understand PA participation better.

Conflict of interest

The authors have no conflicts of interest to declare.

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Table 1. Children's demographic and anthropometric characteristics (Mean, SD)

	Total (n = 1,026)	Boys (n = 529)	Girls (n = 497)	p values for gender
Age (years)	10.2 (0.3)	10.2 (0.3)	10.2 (0.3)	0.707
Body mass (kg)	37.0 (8.0)	37.1 (7.9)	36.9 (8.0)	0.602
Height (cm)	142.8 (6.8)	143.2 (6.7)	142.4 (6.9)	0.055
BMI (kg/m^2)	18.0 (2.9)	18.0 (2.9)	18.1 (3.0)	0.660
Waist circumference	Eivind	Eivind	Eivind	Eivind
Weight status (%)*				
Normal weight	78	79	78	
Overweight	18	18	19	
Obese	3	4	3	
Parent education level (%)				0.924
< University	31	31	32	
University < 4 years	30	30	29	
University ≥ 4 years	39	39	39	
Andersen test (m)	896 (103)	920 (113)	872 (85)	< 0.001

BMI = body mass index; Weight status is based on the criteria by Cole et al (27).

Table 2. Children's physical activity preferences (Median, IQR). The children indicated their preference for activities on a scale from one (lowest preference) to ten (highest preference).

Physical activity	Total			Girls			Boys			P for gender
	n	*Median*	*IQR*	*n*	*Median*	*IQR*	*n*	*Median*	*IQR*	
Dancing	791	6	8	449	9	4	342	2	4	**< 0.001**
Gymnastics	701	7	7	385	9	4	316	4	6	**< 0.001**
Exercising to music	773	7	6	408	8	5	365	5	5	**< 0.001**
Jumping rope skipping	908	4	5	464	6	4	444	3	4	**< 0.001**
Team handball	827	6	6	404	7	5	423	5	5	**< 0.001**
Climbing	795	7	5	399	8	5	396	6	5	**< 0.001**
Swimming/water play	952	8	5	465	9	4	487	8	5	**< 0.001**
Mountain hiking	924	7	4	458	8	5	466	7	5	**< 0.001**
Soccer	997	9	5	480	8	6	517	10	4	**< 0.001**
Strength training	804	6	5	383	5	5	421	7	5	**< 0.001**
Basketball	798	5	4	370	4	4	428	5	4	**0.005**
Floorball	767	6	4	359	6	5	408	6	5	**0.032**
Slalom skiing	739	9	3	354	10	4	385	9	3	0.936
Dodgeball	947	8	4	468	9	4	479	8	4	0.654
Bicycling	945	8	4	462	8	4	483	9	4	0.129
Track and field	819	7	5	403	7	5	416	7	4	0.069
Cross-country skiing	871	7	5	431	7	5	440	7	5	0.709
Baseball	831	7	5	403	7	5	428	7	5	0.218
Jogging	915	6	4	451	6	4	464	6	4	0.974
Volleyball	743	5	4	365	5	4	378	5	4	0.422
Frisbee	815	5	5	394	5	5	421	5	5	0.147

Table 3. Explorative factor analysis with varimax rotation

Activity	1	2	3	4	5
Jogging	**0.78**	0.06	0.13	0.21	-0.3
Strength training	**0.65**	0.03	-0.05	0.48	0.14
Bicycling	**0.53**	0.11	0.43	-0.17	0.18
Track and field	**0.52**	0.27	0.24	0.28	0.16
Dancing	-0.04	**0.84**	0.15	0.05	-0.01
Gymnastics	0.05	**0.77**	-0.05	0.23	0.15
Exercising to music	0.30	**0.67**	0.20	0.07	-0.03
Climbing	0.44	**0.51**	0.22	0.12	0.27
Frisbee	0.10	0.07	**0.71**	0.15	0.00
Dodgeball	0.10	0.07	**0.72**	0.14	0.13
Baseball	0.06	0.22	**0.62**	0.26	0.23
Floorball	0.18	0.14	**0.50**	0.33	0.11
Team handball	-0.01	0.34	0.08	**0.66**	0.20
Volleyball	0.16	0.22	0.29	**0.65**	0.09
Basketball	0.30	-0.06	0.34	**0.62**	-0.08
Slalom skiing	0.03	0.09	0.10	0.17	**0.84**
Cross-country skiing	0.45	0.09	0.19	-0.01	**0.67**
Mountain hiking	**0.75**	0.16	0.16	0.08	0.19
Jumping rope skipping	0.23	0.57	0.42	-0.02	0.13
Soccer	0.25	-0.25	0.03	0.48	.044
Swimming/water play	0.27	0.30	0.42	-0.12	-0.09

Table 4. Linear mixed effect analysis with physical activity preference patterns as the dependent variables.

Variables	Estimate (95% CI)	P-value
Factor 1		
Gender (ref. boys)	-0.12 (-0.40, 0.17)	0.428
Cardiorespiratory fitness (per 2 SD)	0.26 (-0.05, 0.58)	0.097
Abdominal adiposity (per 2 SD)	-0.16 (-0.47, 0.17)	0.343
Factor 2		
Gender (ref. boys)	**1.42 (1.22, 1.63)**	**<0.001**
Cardiorespiratory fitness (per 2 SD)	-0.08 (-0.30, 0.14)	0.468
Abdominal adiposity (per 2 SD)	-0.09 (-0.32, 0.14)	0.444
Factor 3		
Gender (ref. boys)	-0.24 (-0.50, 0.03)	0.087
Cardiorespiratory fitness (per 2 SD)	**-0.33 (-0.63, -0.03)**	**0.029**
Abdominal adiposity (per 2 SD)	-0.06 (-0.37, 0.25)	0.718
Factor 4		
Gender (ref. boys)	-0.02 (-0.29, 0.24)	0.871
Cardiorespiratory fitness (per 2 SD)	**0.44 (0.15, 0.74)**	**0.003**
Abdominal adiposity (per 2 SD)	-0.10 (-0.41, 0.20)	0.503
Factor 5		
Gender (ref. boys)	0.25 (-0.01, 0.52)	0.062
Cardiorespiratory fitness (per 2 SD)	**0.57 (0.27, 0.86)**	**<0.001**
Abdominal adiposity (per 2 SD)	-0.24 (-0.54, 0.06)	0.120

Note. The estimates are adjusted for school site, age, parental education, and the other variables included in the table. The y variables are standardizes into a mean = 0 and 1 SD = 1 with higher scores reflecting higher preferences. Lower parental education was associated with higher scores on factor 3 only (P = 0.003), while age showed no significant associations with any of the factors.