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REGULAR ARTICLE

Organised physical activity during leisure time is associated with more objectively measured physical activity among Swedish adolescents

Andreas Fröberg¹  | Anna-Karin Lindroos^{2,3} | Örjan Ekblom⁴ | Gisela Nyberg^{4,5} 

¹Department of Food and Nutrition and Sport Science, University of Gothenburg, Gothenburg, Sweden

²Swedish Food Agency, Uppsala, Sweden

³Department of Internal Medicine and Clinical Nutrition, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

⁴The Swedish School of Sport and Health Sciences, Stockholm, Sweden

⁵Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden

Correspondence

Andreas Fröberg, Department of Food and Nutrition and Sport Science, University of Gothenburg, Pedagogen, Hus C, Läroverksgatan 5, PO Box 300, SE-405 30, Gothenburg, Sweden.

Email: andreas.froberg@gu.se

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Abstract

Aim: The aim of this study was to investigate associations between participation in organised physical activity (PA), such as sport and exercise during leisure time, and objectively measured PA and sedentary time in a large representative sample of Swedish adolescents.

Methods: This study was part of the school-based cross-sectional Swedish national dietary survey Riksmaten Adolescents 2016-17. Data from 3477 adolescents aged 11-12, 14-15 and 17-18 years were used in the analyses. Participation in organised PA and parental education were reported in questionnaires. PA and sedentary time were objectively measured through accelerometry during seven consecutive days.

Results: Adolescents who participated in organised PA had significantly higher total PA (14%, $P < .001$), more time spent on moderate-to-vigorous PA (MVPA) (8 minutes, $P < .001$) and had less sedentary time (15 minutes, $P < .001$). Those who participated in organised PA were more likely to reach recommended PA levels. Total PA and MVPA did not differ by parental education among those who participated in organised PA.

Conclusion: Adolescents who participated in organised PA were more physically active, less sedentary and more likely to reach PA recommendations than those who did not.

KEYWORDS

adolescent health, exercise, physical activity, sedentary behaviour, socio-economic, sports

1 | INTRODUCTION

Convincing evidence shows associations between physical activity (PA) and health benefits among children and adolescents.¹ Some researchers have also begun to acknowledge the potential negative health consequences of sedentary time.²

Despite the well-established health benefits of PA, most children and adolescents do not reach the 60 or more daily minutes of moderate-to-vigorous PA (MVPA) recommended by the World Health Organization.³ In a large representative sample of Swedish adolescents, 32% reached the PA recommendation with 43% and 23% of boys and girls, respectively.⁴ Studies measuring PA with objective methods

Abbreviations: MVPA, moderate-to-vigorous physical activity; PA, physical activity.

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such as accelerometers also suggest that children and adolescents spend most waking hours sedentary.⁵ In addition, PA decreases and sedentary time increases throughout childhood and adolescence³ and the decrease in PA might be more profound during adolescent years.⁶ For example, a 9-year follow-up study involving Swedish participants showed that MVPA decreased with approximately 30 minutes per day from childhood to adolescence.⁷ Also, a previous study from Sweden showed that boys are more physically active than girls.⁸

Clearly, effective PA interventions for children and adolescents are urgently needed. Systematic reviews and meta-analyses of PA interventions published during the last decade generally show small to negligible effects on PA among children and adolescents.⁹⁻¹² Many children and adolescents participate in organised PA such as sport and exercise during leisure time. According to results from the 2016 Report Card on Physical Activity for Children and Youth, approximately 75% of Swedish adolescents aged 11-15 participate in organised sport twice or more weekly.¹³ Organised PA is therefore often regarded as a promising intervention strategy to increase PA.¹⁴ Recent systematic reviews also demonstrate more MVPA among children and adolescents who participate in sports and exercise than among those who do not.^{15,16} Most of the reviewed studies assessed PA by self-report measures^{15,16} but some studies using objective methods such as accelerometry have also reported positive associations between participation in sport and exercise and PA.¹⁷⁻¹⁹

However, less is known about how organised PA is associated with sedentary time. For example, Marques et al found that children and adolescents who participated in organised sports spent more time in objectively measured moderate PA, vigorous PA and MVPA than those who did not, yet no difference was observed for sedentary time.¹⁹

In Sweden, no nationally representative study has yet investigated the associations between participation in organised PA and objectively measured PA and sedentary time among adolescents. Such studies are important because they might contribute with background information when developing intervention strategies to increase PA among adolescents, or at least counteract the age-related decrease commonly observed during adolescent years. Therefore, this study aimed to investigate associations between participation in organised PA, such as sport and exercise during leisure time, and objectively measured PA and sedentary time in a large representative sample of Swedish adolescents.

2 | METHODS

This study was part of the national, cross-sectional, dietary survey Riksmaten Adolescents 2016-17 conducted by the Swedish Food Agency in Sweden between September 2016 and May 2017. School classes in grades 5 (11-12 years), 8 (14-15 years) and 11 (17-18 years) were recruited to be representative of these grades in Sweden, and the students in the selected classes were invited to take part. In addition to information on dietary intake, which was the main focus of the survey, information on organised physical activity was collected through web questionnaires. PA and sedentary time were

Key notes

- In Sweden, no nationally representative study has investigated the associations between participation in organised physical activity (PA), such as sport and exercise during leisure time, and objectively measured PA among adolescents
- Adolescents who participated in organised PA were more physically active, less sedentary and more likely to reach PA recommendations than those who did not.
- The study results might contribute with background information when developing interventions to increase PA among adolescents.

also objectively measured. Trained field staff from the Swedish Food Agency visited during school hours to inform the students about the study and the web questionnaires. They also distributed accelerometers and measured body height and body weight. The study design, methods and participation are described in detail elsewhere.²⁰

2.1 | Recruitment of participants

Statistics Sweden selected schools based on type of municipality, school organisation (public or independent) and geographical location. In total, 619 schools, approximately 200 from each school grade, were invited to take part via e-mails addressed to the principal.

A total of 131 schools agreed to take part, and one or two classes per school were selected to participate in the survey. The schools selected 1-2 classes in a given school grade, and all students ($n = 5145$) in these classes were invited to participate. Exclusion criteria were not being able to read and write Swedish. A total of 3477 students participated in at least one part of the survey. The participants were overall considered to be representative for the population with regard to socio-economic background and school (public or independent), and schools were distributed throughout Sweden with all types of municipalities represented.²⁰

The Regional Ethical Review Board in Uppsala approved the study (No. 2015/190). Before study start, information letters were sent to all students and their parents. From schools with biological sampling, written consent was required from all participants and both parents of adolescents younger than 16 years. In schools without biological sampling, opt-out consents were used and approved by the ethics committee.

2.2 | Data collection

The participants were asked whether they were active in any organisation or club, such as soccer, swimming, dance and scouts

with the responses being yes or no. A follow-up question was which organisation or club they participate in and what kinds of activities that were included. This question had an open response alternative, and participants could provide multiple responses. These responses were manually reviewed, and activities involving PA such as soccer, floorball, dance and martial arts were considered as organised PA, thus excluding activities such as playing musical instruments and theatre. To assess frequency of participation in organised PA, the participants provided information about how many times per week they participate in their activities. This question was answered using the categories once per week, twice per week, three times per week, four times per week, or five or more times per week.

Accelerometers from ActiGraph models GT3X and GT3X+ (ActiGraph LLC) were used to objectively measure PA and sedentary time. The Swedish Food Agency field staff distributed the accelerometers during school visits. The participants were instructed to wear the accelerometer on the right hip with an elastic belt for seven consecutive days including five weekdays and two weekend days except while asleep and during water-based activities such as swimming and showering. The class teacher collected the monitors after 7 days and sent them back to the Swedish Food Agency in a pre-paid envelope.

The accelerometers were set to sample at 30 Hz and aggregate the raw data into 5-second epochs. The data were processed using ActiLife version 6.13.3. The non-wear time filter was set to remove all sequences of at least 60 consecutive minutes of zero counts (no tolerance), and at least 500 minutes of wear time was required for a day to be considered valid. A time filter was set between 06:00 and 22:59 for those aged 11-12 and 14-15 and 06:00 and 23:59 for those aged 17-18. Participants with at least

three valid days (two weekdays and one weekend day) were included in the analysis. Total PA was estimated by using the sum of the vertical axis (v) activity counts divided by recorded minutes (counts per minute). Cut-points were used to estimate MVPA (≥ 2296 counts per minute) and sedentary time (≤ 100 counts per minute).^{21,22}

Parents' educational attainment was reported in a web questionnaire for the parents. The highest level of education attained by either of the parents was used, and the responses were dichotomised into low parental education (≤ 12 years of schooling) and high parental education (> 12 years of schooling).

The participants reported which country they were born in. Based on this information, country of birth was dichotomised into Sweden or outside Sweden.

Information on municipality was based on the participants' schools. The municipalities were categorised into one of five groups based on the Swedish municipality classification 2011. The first three groups were metropolitan municipalities, suburbs surrounding metropolitan areas, and larger cities and surrounding suburbs. These three groups were categorised as urban areas. The other two were densely populated municipalities and other municipalities, such as commuter municipalities, tourism and travel industry municipalities, manufacturing municipalities, sparsely populated municipalities and municipalities in sparsely populated regions. These two groups were categorised as rural areas.

Trained staff from the Swedish Food Agency measured body height and weight by standardised methods in schools. Body height (nearest 0.1 cm) and weight (nearest 0.1 kg) were measured by SECA 213 portable stadiometers (SECA Weighing and Measuring Systems) and SECA 862 or 899 digital weighing scales (SECA Weighing and Measuring Systems), respectively. Body mass

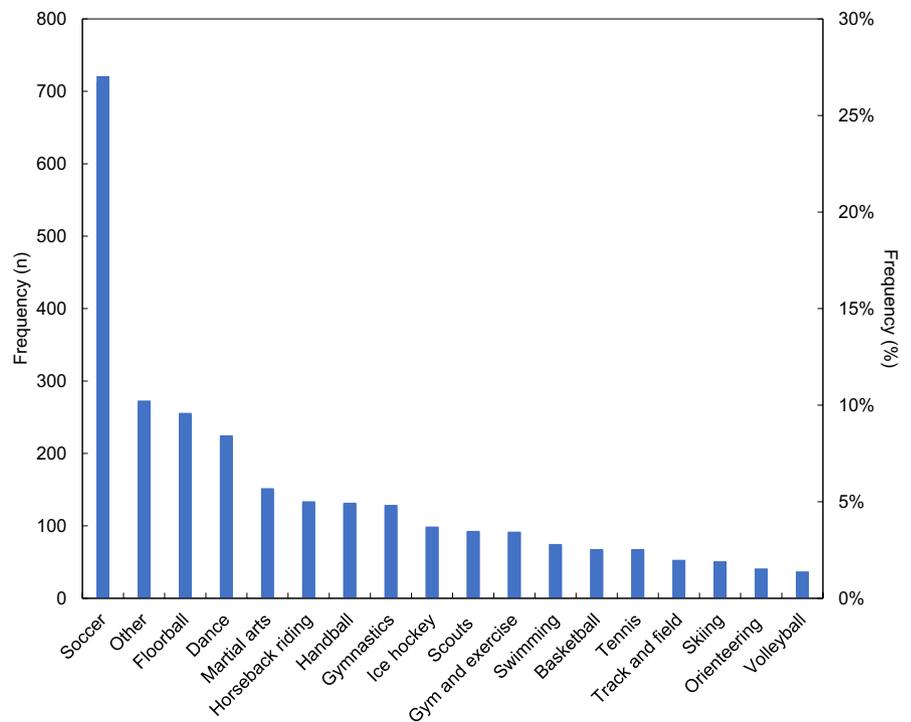
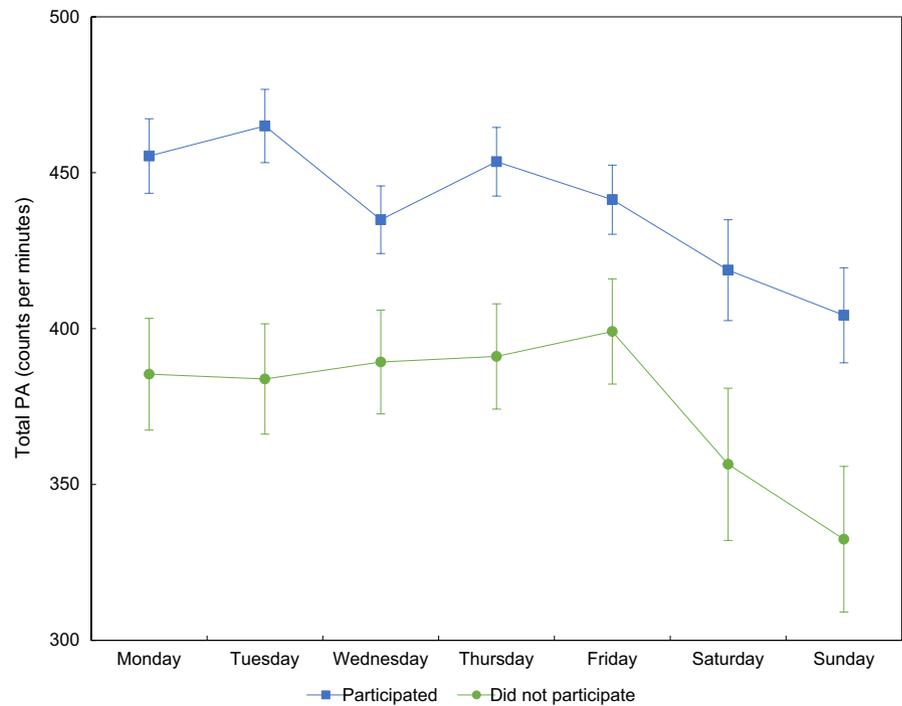


FIGURE 1 Types of organised PA reported by the participants presented as frequency in descending order. The category other includes organised PA such as badminton, bandy, baseball, cycling, figure skating, golf and table tennis

FIGURE 2 Total PA each day of the week among those who participated in organised PA and those who did not. Adjusted for sex, age group, parental education, country of birth and type of municipality (presented as mean with 95% CI)



those who participated in organised PA were also more likely to wear the accelerometers for at least three days (all $P < .001$). No significant difference was observed for type of municipality ($P = .07$).

In total, 2146 adolescents both responded to the question regarding organised PA, had at least three days of accelerometer data and provided information on the variables controlled for. Of these, 1478 participated in organised PA (69%) and 668 (31%) did not. Those who participated in organised PA reported the following frequency per week: 16% reported once, 22% said twice, 24% three times, 20% four times and 19% five times or more.

The mean (SD) accelerometer wear time was 809 (76) and 810 (77) minutes per day among those who participated in organised PA and those who did not, respectively ($P = .98$).

3.1 | Physical activity and sedentary time

Figure 2 shows adjusted analyses for total PA (counts per minutes) from Monday to Sunday among those who did or did not participate in organised PA (differences between the two groups $P < .001$ all days). Those who participated in organised PA had higher weekly average total PA, spent more time in MVPA and had less sedentary time than those who did not (Table 2). For example, those who participated in organised PA had approximately eight more minutes of MVPA and 15 minutes less sedentary time per day.

Total PA, MVPA and sedentary time all differed ($P < .001$) depending on weekly frequency of participation in organised PA. As shown in Figure 3, total PA and MVPA increased, whereas sedentary time decreased, with higher frequency of participation in organised PA.

In the total sample, 37% of those who participated in organised PA reached the PA recommendations versus 20% of those who did not ($P < .001$) (Table 2). Those who participated in organised PA were 2.2 (95% CI: 1.8-2.8) times more likely to reach the PA recommendations. Results were similar for boys and girls (Table 3).

3.2 | Age group

Adjusted analyses stratified by age group revealed that those who participated in organised PA had more total PA and MVPA relative to those who did not. These results were observed across all age groups. Further stratification by sex within each age group gave similar results, except for boys aged 17-18. Generally, weaker associations were found for sedentary time. Sedentary time did not differ between those who participated in organised PA and those who did not among boys and girls aged 11-12 and girls aged 14-15, and boys and girls aged 17-18 (Table 2).

More of those who participated in organised PA reached the PA recommendations except for boys aged 14-15 and 17-18 years (Table 2). Those aged 11-12, 14-15 and 17-18 years who participated in organised PA were 2.6 (95% CI: 1.7-3.8), 2.8 (95% CI: 1.8-4.5) and 1.9 (95% CI: 1.2-2.7) times more likely to reach the PA recommendations, respectively (Table 3).

3.3 | Parental education

Total PA and MVPA did not differ by parental education among those who participated in organised PA (both $P > .05$). Figure 4 shows total

TABLE 2 Total PA, MVPA and sedentary time among those who participated in organised PA and those who did not in the total sample and stratified by boys and girls and age group

All									
Participated in organised PA	Total			Boys			Girls		
	Yes	No	P	Yes	No	P	Yes	No	P
Weekly average	n = 1478	n = 668		n = 627	n = 258		n = 851	n = 410	
Total PA, CPM/day (Mean (SE))	438 (4.0)	381 (6.1)	<.001	465 (6.6)	417 (10.4)	<.001	419 (5.0)	356 (7.4)	<.001
MVPA, min/day (Mean (SE))	55 (0.5)	47 (0.8)	<.001	59 (0.9)	53 (1.4)	<.001	52 (0.6)	43 (0.9)	<.001
Sedentary time, min/day (Mean (SE))	616 (2.0)	631 (3.0)	<.001	604 (3.1)	623 (4.9)	.002	625 (2.6)	636 (3.8)	.02
Reaching the PA recommendation (%)	37	20	<.001	48	32	<.001	29	13	<.001
11-12 y									
Participated in organised PA	Total			Boys			Girls		
	Yes	No	P	Yes	No	P	Yes	No	P
Weekly average	n = 669	n = 154		n = 297	n = 77		n = 372	n = 77	
Total PA, CPM/day (Mean (SE))	513 (6.8)	451 (14.4)	<.001	530 (10.1)	481 (20.1)	.03	498 (9.2)	426 (20.7)	.002
MVPA, min/day (Mean (SE))	60 (0.7)	51 (1.5)	<.001	66 (1.2)	57 (2.4)	.002	56 (0.9)	46 (1.9)	<.001
Sedentary time, min/day (Mean (SE))	581 (2.8)	591 (6.0)	.13	578 (4.3)	584 (8.5)	.52	584 (3.7)	597 (8.4)	.16
Reaching the PA recommendation (%)	46	27	<.001	58	38	.001	36	15	<.001
14-15 y									
Participated in organised PA	Total			Boys			Girls		
	Yes	No	P	Yes	No	P	Yes	No	P
Weekly average	n = 523	n = 197		n = 227	n = 69		n = 296	n = 128	
Total PA, CPM/day (Mean (SE))	405 (5.8)	334 (9.4)	<.001	445 (10.2)	362 (18.5)	<.001	376 (6.6)	316 (10.2)	<.001
MVPA, min/day (Mean (SE))	52 (0.8)	43 (1.3)	<.001	56 (1.4)	48 (2.6)	.004	48 (0.9)	40 (1.4)	<.001
Sedentary time, min/day (Mean (SE))	626 (3.2)	649 (5.2)	<.001	606 (5.0)	642 (9.1)	.001	641 (4.1)	655 (6.3)	.07
Reaching the PA recommendation (%)	31	15	<.001	42	31	.066	22	6	<.001
17-18 y									
Participated in organised PA	Total			Boys			Girls		
	Yes	No	P	Yes	No	P	Yes	No	P
Weekly average	n = 286	n = 317		n = 103	n = 112		n = 183	n = 205	
Total PA, CPM/day (Mean (SE))	379 (7.8)	327 (7.4)	<.001	380 (15.0)	357 (14.4)	.27	378 (8.9)	311 (8.4)	<.001
MVPA, min/day (Mean (SE))	50 (1.2)	45 (1.1)	<.001	51 (2.1)	48 (2.1)	.44	50 (1.4)	43 (1.3)	<.001
Sedentary time, min/day (Mean (SE))	652 (4.7)	665 (4.4)	.06	649 (8.3)	664 (8.0)	.20	655 (5.6)	665 (5.3)	.20
Reaching the PA recommendation (%)	29	20	.007	35	28	.249	26	16	.013

Note: Analyses of covariance were adjusted for sex and age group (when not stratified), parental education, country of birth and type of municipality (presented as mean with standard error).

Abbreviation: CPM, counts per minute; MVPA, moderate-to-vigorous physical activity; PA, physical activity; SE, standard error.

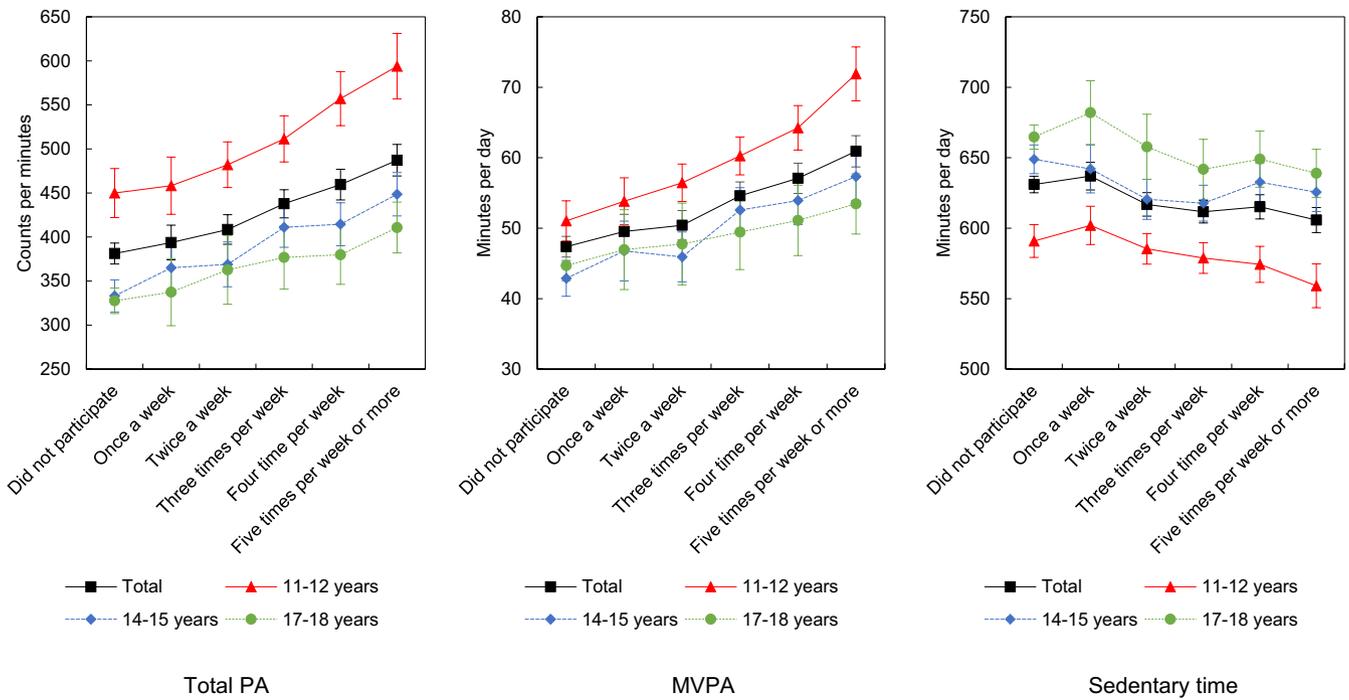


FIGURE 3 Total PA, MVPA and sedentary time among those who did not participate in organised PA and those who did according to frequency per week in the total sample and stratified by age group. Adjusted for sex, age group (when not stratified), parental education, country of birth and type of municipality (presented as mean with 95% CI)

TABLE 3 Binary logistic regression representing the likelihood of reaching the PA recommendations among those who participated in organised PA with those who did not stratified by boys and girls and age group

	Total	Boys	Girls
All	2.2 (1.8-2.8)	2.0 (1.4-2.8)	2.5 (1.7-3.5)
11-12 y	2.6 (1.7-3.8)	2.4 (1.4-4.1)	2.9 (1.5-5.6)
14-15 y	2.8 (1.8-4.5)	2.0 (1.1-3.7)	4.1 (1.9-8.9)
17-18 y	1.9 (1.2-2.7)	1.7 (0.9-3.2)	1.9 (1.1-3.2)

Note: Adjusted for sex and age group (when not stratified), parental education, country of birth and type of municipality (presented as odds ratio with 95% CI).

PA each day of the week among those who did/did not participate in organised PA and whose parents had low/high education levels.

4 | DISCUSSION

The main finding of this study was a positive association between organised PA and objectively measured PA in a representative sample of Swedish adolescents. The results were similar for boys and girls across all age groups, with the exception of boys aged 17-18. Those who participated in organised PA were more likely to reach the PA recommendations than those who did not participate in organised PA. However, the results for participation in organised PA and sedentary time were less clear.

Overall, our findings align with conclusions from previous systematic reviews of studies mainly using self-reported measures of PA^{15,16} as well as recent studies that have used objective methods to assess PA.¹⁷⁻¹⁹ For example, Hebert et al, who analysed accelerometer data from 1124 Danish children (mean age 8 years), reported that participation in organised sports such as soccer and handball were associated with 5-20 additional minutes of MVPA and 3-15 times increased likelihood of reaching PA recommendations.¹⁷ Another study including children and adolescents aged 10-18 years found that organised PA was associated with more MVPA and increased likelihood of reaching PA recommendations.¹⁹

Our study also showed that those who participated in organised PA five times per week or more had the highest total PA and MVPA, and the lowest sedentary time. Although we did not specifically assess duration per session of organised PA, these results align with those of a study in which Dalene et al analysed accelerometer data from Norwegian children and adolescents aged 9 and 15 years and found that those who participated in organised sports or exercise 8 hours or more per week had approximately 15-18 minutes more MVPA per day than those who reported 2 hours or less.¹⁸

Moreover, compared with non-participants, those who participated in organised PA five times per week or more spent approximately 15 more minutes per day in MVPA in the total sample and 8 more minutes among adolescents aged 17-18 years. In addition, the likelihood of reaching the PA recommendations doubled to quadruple depending on sex and age group: 37% of those participating in organised sports reached the recommendations vs 20% among non-participants. Our results, although cross-sectional, might

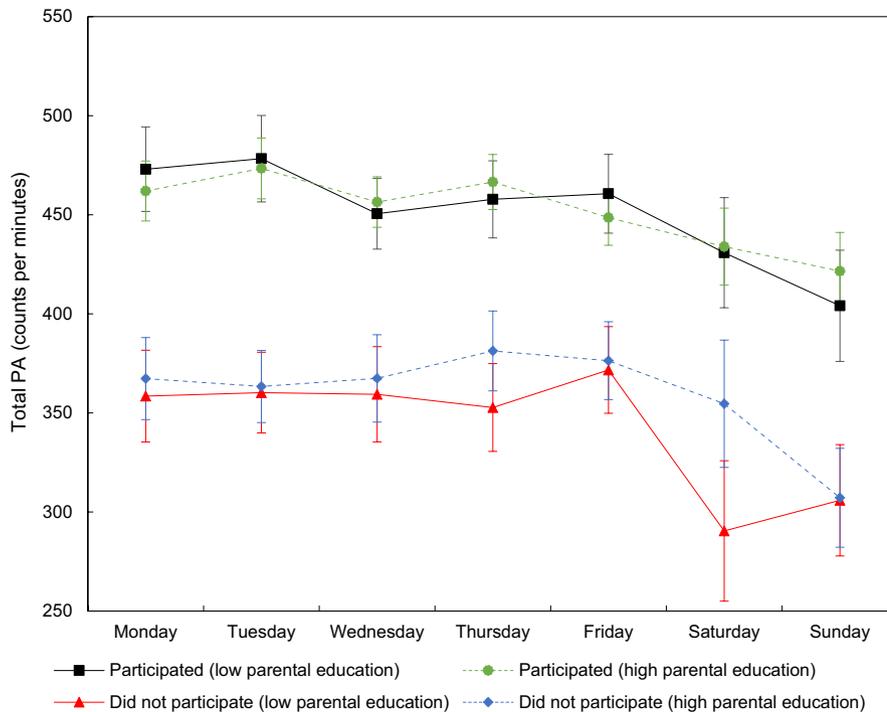


FIGURE 4 Total PA each day of the week among those who did/did not participate in organised PA and whose parents had low/high education levels. Adjusted for sex, age group, country of birth and type of municipality (presented as mean with 95% CI)

contribute with background information when developing interventions to increase PA among adolescents. Besides getting more PA, children and adolescents who participate in sports appear to reap social and psychological health benefits such as social skills, self-esteem, confidence and competence.²⁴

Our results must also be interpreted with some caution. We lack data on how PA patterns change when adolescents begin to participate—or increases participation—in organised PA. Further, from a public health perspective, the higher prevalence of overweight and obese among non-participants, compared with participants, might not necessarily be interpreted as an effect of exercise, as the association between PA and overweight and obesity has been shown to be modest or weak.²⁵ Rather, adolescents with overweight or obesity might experience that they do not fit in organised PA such as sports and therefore do not participate. However, previous lifestyle-based interventions including PA to prevent overweight and obesity have demonstrated some effectiveness among adolescents.²⁶ Therefore, interventions to increase participation in organised PA among adolescents might be efficient, especially if clubs would be able to make the participation sustainable.

Furthermore, not all analyses showed associations between participation in organised PA and sedentary time. The associations observed for the total sample, and when stratified by boys and girls, disappeared after further stratification by age group for those aged 11–12 and 17–18 years. These results resemble those reported by Marques et al and suggest that participation in organised PA is associated with more total PA and MVPA but not necessarily less sedentary time.¹⁹

Organised PA was associated with higher total PA and more time spent in MVPA regardless of parental education level, but fewer adolescents from the low parental education group participated in organised PA. This is an important finding since some studies indicate

that adolescents from low socio-economic status groups, such as those from families with low parental education, generally have less PA than those from high socio-economic status groups.²⁷ This might be due to economic factors as organised PA might require financial outlay to cover, for example, sports equipment and membership fees. For example, a previous systematic review suggested that financial resources were one key barrier to participate in organised sport among children and adolescents.²⁸ According to Martins et al, this might be specific for adolescents in low socio-economic areas.²⁹ In line with this, lack of financial support was identified as a barrier to participate in organised PA among adolescents in a Swedish low socio-economic status area.³⁰

4.1 | Strengths and limitations

This was the first study to investigate the association between participation in organised PA and objectively measured PA and sedentary time among adolescents using data from a nationally representative Swedish study. Major strengths included the large sample size and the use of accelerometry to objectively measure PA and sedentary time.

Limitations included the cross-sectional design, which precluded conclusions about causality. This is important given that one previous study has shown cross-sectional associations between participation in organised sport and objectively measured PA among children and adolescents aged nine and 15 years but no prospective association from age nine to 15 when a sub-sample was analysed.¹⁸

Furthermore, more of those who participated in organised PA wore the accelerometers for at least 3 days. Since there were significant differences between adolescents wearing and not wearing accelerometers, there might have been an overestimation regarding

absolute PA level and thus the number of adolescents reaching the PA recommendations. However, differences between organised and non-organised adolescents regarding PA level might have been less affected by this.

Finally, accelerometers have inherent limitations including an inability to adequately measure PA such as cycling (as they were worn on the hip by the participants of this study) and water-based activities such as swimming. Also, accelerometers might be deemed less feasible to wear during contact sports due to, for example, safety concerns.

5 | CONCLUSION

The study showed that adolescents who participated in organised PA were more physically active, less sedentary and more likely to reach PA recommendations than those who did not participate. The study results might contribute with background information when developing interventions to increase PA among adolescents.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ORCID

Andreas Fröberg  <https://orcid.org/0000-0002-3352-6661>

Gisela Nyberg  <https://orcid.org/0000-0003-0004-8533>

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