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## Organized Youth Sports Trajectories and Adult Health Outcomes - The Young Finns Study

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## ABSTRACT

**Introduction:** This study identified trajectories of organized youth sports (OYS) over 9 years in youths 9–18 years and examined whether the trajectories predicted physical activity (PA), sedentary behavior (SB), and obesity in midlife.

**Method:** Self-reported OYS trajectories were identified for participants between 1980–1989 (n=3,474). Accelerometer-derived PA was quantified for participants (n=1,349) in 2018–2020. Sociodemographic, PA, and TV viewing data were collected through questionnaires either at baselines or follow-up. Adult BMI was calculated to clarify obesity. Associations of OYS trajectories with adult PA, SB, and obesity were evaluated using mixture models, which were stratified by sex and conducted in 2022.

**Results:** Three OYS trajectories were identified for boys and girls (sustained high-sports participation, 12.0%/7.5%; sustained moderate-sports participation, 14.0%/13.3%; and low-sports/non-participation, 74.0%/79.2%). Boys sustaining both moderate- and high-sports participation had higher levels of adult self-reported PA ( $\beta=0.59$ ,  $p=0.007$ ;  $\beta=0.69$ ,  $p<0.001$ ) than low-sports/non-participating boys. Girls sustaining both moderate- and high-sports participation accumulated more total PA ( $\beta=113.4$ ,  $p=0.009$ ;  $\beta=144.3$ ,  $p=0.002$ ), MVPA ( $\beta=7.86$ ,  $p=0.016$ ;  $\beta=14.01$ ,  $p<0.001$ ), step counts ( $\beta=1020$ ,  $p=0.003$ ;  $\beta=1045$ ,  $p=0.005$ ), and self-reported PA ( $\beta=0.79$ ,  $p<0.001$ ;  $\beta=0.63$ ,  $p=0.003$ ) in midlife compared to their low-sports/non-participating counterparts. Girls sustaining moderate-sports participation accumulated more light-intensity PA ( $\beta=19.79$ ,  $p=0.012$ ) and less sedentary time ( $\beta=-27.65$ ,  $p=0.002$ ) and they sustaining high-sports participation had lower obesity prevalence (OR=0.41,  $p=0.009$ ) 40-years later than low-sports/non-participating girls.

**Conclusions:** Sustained participation in OYS is independently predictive of PA patterns, sedentary time, and obesity in midlife, especially in girls, and thus contribute to the development of a healthy and active lifestyle across the life-course.

**Key words:** Accelerometer, youth sport, physical activity, sedentary behavior, body mass index, trajectory

## INTRODUCTION

Participation in organized youth sports (OYS) is important for children and adolescents to meet the recommended levels of physical activity (PA), that is,  $\geq 60$  minutes of moderate-to-vigorous PA (MVPA) per day.<sup>1,2</sup> A recent systematic review has shown that intensive participation in OYS predicts higher PA levels in adulthood, particularly among those involved in OYS at least for 3 years.<sup>3</sup> Sustained OYS participation has also been found to predict later health outcomes in terms of reduced obesity and metabolic syndrome,<sup>4,5</sup> better cardiometabolic health,<sup>6</sup> and healthy habits.<sup>7</sup> Most evidence regarding the associations of participation in OYS with adult PA and health outcomes is based on the assessment of OYS between two time points.

In epidemiological research, trajectory modeling has been applied to identify homogeneous subgroups within a given population, rather than to assume the existence of subgroups at two different intervals.<sup>8</sup> A recent systematic review was conducted to identify distinct trajectories of PA and related factors during the life course.<sup>9</sup> In this review, only 3 of the 27 studies reported the impact of group-based OYS on health profiles in young adulthood such as less smoking,<sup>10</sup> decreased TV viewing,<sup>11</sup> lower BMI and better physical health,<sup>12</sup> and cardiometabolic and mental health profiles.<sup>13</sup> However, some studies found no clear patterns of association between OYS and obesity in cross-sectional designs<sup>14</sup> and long-term prospective studies.<sup>15,16</sup> These mixed results could be due to contextual differences between studies or the lack of repeated longitudinal data in the analysis.

Despite the increased interest in the trajectories of OYS as it relates to obesity and TV viewing in young adulthood, there are a lack of cohort studies of this kind that have assessed such associations in midlife using a longitudinal design. Of various sedentary behavior (SB), watching TV remains the most prevalent in Finland despite the proliferation of other electronic devices.<sup>21</sup> Understanding the associations of OYS trajectories in youth with PA, SB, and obesity in midlife is important for assessing the significance of OYS behavior for physical health, especially from a preventive point of view, as adherence to a healthy

lifestyle is a central target for prevention efforts. Thus, the present study identified OYS trajectories and examined their associations with accelerometer-derived and self-reported PA, SB (i.e., sedentary time and TV viewing), and obesity in midlife, taking into account the baseline and follow-up characteristics of participants in the Young Finns Study (YFS). Since a few studies previously found that OYS trajectories were associated with adult health profiles in a relatively short period,<sup>10-12</sup> this study specifically analyzed the associations of OYS trajectories with three distinct adult health outcomes over a longer period. It was hypothesized that children and adolescents who participated in OYS over 9 years would have higher levels of PA and lower levels of SB and obesity in midlife, compared to low-sports/non-participants.

## **METHODS**

### **Study Population**

Data were obtained from the YFS of children and adolescents aged 3 to 18 years with six age-cohorts in 1980.<sup>17</sup> From 1980 to 1992, 3,596 participants have been remeasured triennially, and then followed up in 4- to 9-year intervals from 1992 to 2011<sup>18</sup> and 2018–2020.<sup>19</sup> Participants were randomly selected from the five Finnish university cities with medical schools (Helsinki, Kuopio, Oulu, Tampere, and Turku) and their surrounding rural communities. For this study, participants (n=3,474) who had at least one non-missing measure of OYS over time were included in trajectory analyses. Adult participants (n=1,349) who wore an accelerometer were included in regression analyses. The study was evaluated by the local ethics committees and written informed consent was obtained from all participants in accordance with the Helsinki Declaration.

### **Measures**

Self-reported OYS was assessed in youth aged 9-18 years in 1980, 1983, and 1986 as well as 12-18 years in 1989. The youngest 9-year-old children were instructed to ask the assistance of their parents if needed.

Between 1980–1989, three of the questions were used to measure OYS.<sup>20</sup> The first question was “How many times per week do you usually engage in training sessions of a sport club?”. The response alternatives were recoded into four scales: 1=no participation, 2=less than once a week, 3=once a week, and 4=many hours and times per week. The second question was “How heavily do you breath and sweat when you engage in physical activity and sport?” The responses to the question were 1=not at all, 2=moderately, and 3=a lot. The third question asked “Do you participate in sport competitions in (a) sports clubs, (b) at the regional level, and (c) at the national level?” These were simple yes–no (1–2) responses for each item, which were combined into a sport competition scale from 1 to 4. All questions were then summed to create a OYS index ranging from 3 to 11, with higher scores indicating higher levels of sports participation. Details of the reliability and validity of the PA index including OYS have been reported elsewhere.<sup>20</sup>

PA in adulthood was measured with a self-administered questionnaire in 2018 and consisted of the intensity of PA, frequency of vigorous PA, hours spent on vigorous PA, average duration of a PA session, and participation in organized PA, all with acceptable to good internal consistency (Cronbach’s  $\alpha=0.73$ ). The items were based on the average number of hours/times per week. Each item was coded from 1=low to 3=high and summed to generate a PA index ranging from 5 to 15.<sup>18</sup> The PA index has been found to be reliable and valid to measure PA across the lifespan.<sup>18,20</sup> Simultaneously, the participants were asked to report how much time on average they spent daily on TV viewing. The daily TV viewing was measured in minutes separately for weekdays and weekend days, and those self-reports were calculated by  $(5 \times \text{weekday} + 2 \times \text{weekend}) / 7$  as a mean daily TV viewing.<sup>21</sup>

PA and sedentary time in adulthood were also objectively measured using a triaxial accelerometer (ActiGraph GT3X+ and wGT3X+, FL, USA) in 2018–2020. Briefly, participants were instructed to wear the accelerometer for seven consecutive days and nights, but to remove it for bathing and water activities.

Data were collected at a 60Hz sample rate using normal filter and later averaged to 60s epochs. Individual-level data from at least  $\geq 10$  hours for  $\geq 4$  days during awake time were required for inclusion in analysis. 60 minutes of consecutive zero counts were defined as non-wearing time and excluded from data. The accelerometer measures have been recently described in detail elsewhere.<sup>19</sup> For this study, the outcome variables included average vector magnitude counts per minute (cpm) as an index of total PA, steps/day, time spent on sedentary, light-intensity PA, and MVPA. Cut-points of  $\leq 150$  cpm for vertical axis were defined as sedentary time,<sup>22</sup> while cut-points of  $> 2,690$  cpm for vector magnitude were defined as MVPA.<sup>23,24</sup>

The participants' height and weight were measured at the baseline and follow-up study visits and BMI was calculated as  $\text{weight}(\text{kg})/\text{height}(\text{m}^2)$ . Adult BMI was categorized as follows: normal weight ( $< 25$   $\text{kg}/\text{m}^2$ ), overweight ( $\geq 25$  and  $< 30$ ), and obese ( $\geq 30$ ).

### **Statistical Analyses**

Descriptive characteristics are expressed as mean (standard deviation) for continuous variables and as percentages for categorical variables. Sex differences in all variables were analyzed using independent  $t$  tests or  $\chi^2$  tests. Latent profile analysis (LPA) with 2 to 6 classes was fitted on boys' and girls' OYS based on the data in the first four phases, which were synchronized using at least one OYS observation at successive ages 9–18. The flexibility of LPA approach enables the classification of incompletely observed indicators. Classification of OYS was conducted by adjusting for baseline age, BMI, residential place, having siblings, and parental PA, education, and occupation.<sup>25</sup> Several measures of model fit, including information theoretic criteria (AIC, BIC, ABIC), likelihood ratio-based tests (VLMR, LMR, BLRT), entropy values, and average posterior probabilities describing the classification uncertainty were calculated and evaluated to determine the optimal number of classes. To select the most parsimonious adequate model, the lowest values of information criteria, specifically ABIC, were favored within the

range of class sizes suggested by likelihood ratio tests.<sup>26</sup> Also, class sizes with less than 5% of the total sample were not accepted. In the post hoc analysis, linear regressions were used for all outcome variables representing unstandardized  $\beta$ -coefficients (95% CI). Logistic regressions were used to estimate OR (95% CI) for obesity (category). Both unadjusted and adjusted models were estimated, adjusting for adult participants' age, having children, and own education and income. Models for accelerometer-derived PA were additionally adjusted for wear time. All analyses were conducted in R environment<sup>27</sup> and Mplus Version 7.0<sup>28</sup> via R software package MplusAutomation,<sup>29</sup> in 2022. Missing data were assumed to be missing at random (MAR) and were considered missing as a function of observed covariates and observed outcomes.<sup>28</sup> Full information maximum likelihood estimation with robust standard errors was used to handle the MAR assumption to reduce potential bias in the parameter estimates and statistical power to detect statistically significant effects.

## RESULTS

Of the 3,474 participants (48.8% males), 10.7% completed all four OYS assessments, 26.6% completed three, 35.8% completed two, and 26.9% completed one. In youth, boys were younger ( $p=0.004$ ) and had higher OYS at all study phases (all  $p<0.001$ ) than girls (Table 1). In adulthood, males engaged more in total PA ( $p=0.005$ ) and MVPA ( $p<0.001$ ), had higher income ( $p<0.001$ ), spent more time watching TV ( $p=0.006$ ), had higher BMI ( $p=0.048$ ), had lower levels of light-intensity PA ( $p=0.001$ ), and were less educated ( $p<0.001$ ) than females. Fathers had higher PA ( $p<0.001$ ) and manual work ( $p<0.001$ ) and lower educational attainment ( $p=0.007$ ) than mothers. No other sex differences were observed.

The 3-class model of boys' and girls' OYS was the most appropriate model according to the goodness-of-fit criteria (Table 2). VLMR and LMR were significant (all  $p<0.0001$ ) and the highest entropy values were displayed ( $\geq 83\%$ ) in both sexes. Three trajectory groups were identified for boys and girls: *sustained high-sports participation* (12.0%/7.5%) subjects generally participated in high-intensity

training several hours and times a week and competitions at regional and/or national levels; *sustained moderate-sports participation* (14.0%/13.3%) subjects typically participated in moderate-intensity training at least once a week and competitions at local sport-club level; and *low-sports/non-participation* (74.0%/79.2%) subjects were either nonparticipants (those not participating in sports at all for the study period), occasional participants (those participating in sports less than once a week), or dropouts/decreasers (those quitting organized sports after the first two phases). Boys and girls had age-related increases in the levels of OYS in high- and moderate-sports participation classes from childhood to adolescence (Figure 1a–b).

Sustained moderate- and high-sports participation were associated with higher levels of adult self-reported PA compared with low-sports/non-participation in boys ( $\beta=0.59$ ,  $p=0.007$ ;  $\beta=0.69$ ,  $p<0.001$ ) and girls ( $\beta=0.79$ ,  $p<0.001$ ;  $\beta=0.63$ ,  $p=0.003$ )(Table 3). Girls sustaining both moderate- and high-sports participation accumulated more daily MVPA ( $\beta=7.86$ ,  $p=0.016$ ;  $\beta=14.01$ ,  $p<0.001$ ), step counts ( $\beta=1020$ ,  $p=0.003$ ;  $\beta=1045$ ,  $p=0.005$ ), and total PA ( $\beta=113.4$ ,  $p=0.009$ ;  $\beta=144.3$ ,  $p=0.002$ ) 40-years later than their low-sports/non-participating counterparts. Compared to those who maintained low-sports/non-participation, girls who maintained high-sports participation were also 59% lower odds of obesity (OR=0.41,  $p=0.009$ ) and those who maintained moderate-sports participation had higher light-intensity PA ( $\beta=19.79$ ,  $p=0.012$ ) and lower sedentary time ( $\beta=-27.65$ ,  $p=0.002$ ) in midlife. These associations were independent of covariates. High- or moderate-sports participating girls had less TV viewing time or lower overweight rates in midlife than low-sports/non-participating girls but disappeared after multivariable adjustments.

## DISCUSSION

This study is the first to examine the association of distinct trajectories of OYS with accelerometer-derived and self-reported PA, SB, and obesity in midlife. Three OYS trajectory classes (sustained high-

sports participation, sustained moderate-sports participation and low-sports/non-participation) were identified for boys and girls. The present study found that OYS trajectory classes over 9 years were differentially associated with PA, SB, and obesity prospectively. However, no associations were found between OYS trajectories and adult TV viewing in either sex.

The results indicated that the proportion of boys and girls sustaining both moderate- and high-sports participation over 9 years was 26.0% and 20.8%, which was lower than that of boys (55.2%) and girls (47.5%) in prior research.<sup>12</sup> Changes in OYS over time were also found in prior research<sup>10-12</sup> but not in this study. There are several methodological aspects that may explain this seemingly inconsistent finding. The first is that this study used the three items to create an index for OYS, especially sports competitions, which may affect the form of the OYS trajectories. The results, combined with previous studies,<sup>10-12</sup> may provide additional information on OYS trajectories for future investigations. This study confirms previous findings that intensive training and competitive sports in youth tend to increase with age, although the number of participants decreases gradually over time.<sup>30</sup> Second, the LPA approach was used to divide participants into homogenous classes, classification was based on the level of the index on four occasions. Most of these participants engaged in OYS on some occasions or even all occasions, but their indices still tended to be low. In this case, the most probable class in the 3-class solution could be the low-sports/non-participation. Further research is needed to determine the best method for integrating data from multiple OYS for trajectory evaluation. Finally, this study identified OYS trajectories over relatively longer periods compared to prior tracking<sup>3-7</sup> and trajectory<sup>10-12</sup> research. This may emphasize the importance of paying attention to the analytical approach used in this study when analyzing trajectories of sport-specific participation over a longer time.

The findings are not in line with previous studies in which the dropout class was identified (e.g., those who initially participated in OYS and then chose to withdraw from the sport during follow-up

periods).<sup>11,12</sup> Although the 4-class model of OYS displayed a dropout trajectory for both sexes, it was dismissed because of its non-significance in both VLMR and LMR. This led to the selection of the 3-class solution for OYS, which may attenuate some relevant relationships between classification and the outcomes, as the actual dropouts were grouped into the low-sports/non-participation class. It is therefore possible that dropout from OYS is commonly seen as the result of a long-term process of low-intensity PA or disengagement. Given its importance, future studies should consider the multivariate statistical methods to model and evaluate the assessment of a single sport participation in youth, by highlighting the interaction of frequency, intensity, and length of time across subgroups during the transition to young adulthood.

The results supported the hypothesis that the sustained moderate- and high-sports participation classes were associated with higher levels of adult self-reported PA compared with the low-sports/non-participation class in both sexes. Girls sustaining moderate- and high-sports participation accumulated more total PA, MVPA, step counts, and light-intensity PA after 40-years than their low-sports/non-participating counterparts. These results are consistent with findings of previous research that found high-intensity exercise and competitions in youth to be associated with higher levels of PA in adulthood.<sup>3</sup> However, not all studies support this point. Some studies revealed that consistent sports participation was not significantly associated with the maintenance of MVPA in young adulthood,<sup>11</sup> and found no significant association for females.<sup>12</sup> The differing findings may partially be explained by different samples, the assessments of sports participation, length of follow-up time, and different statistical methods. Another possible explanation could be that girls sustaining OYS participation may have favored accelerometer to improve the accuracy of daily PA in midlife.

The current study did not observe any association of OYS trajectories with adult TV viewing, in contrast to previous research, which has found that the consistently active trajectory is associated with low TV

viewing over time.<sup>11</sup> However, the study found that girls sustaining moderate-sports participation accumulated less sedentary time in midlife than their low-sports/non-participation counterparts. One explanation for this may be that TV viewing is a marker of sedentary activity that may not adequately reflect total sedentary time in adults.<sup>31,32</sup> This suggests that sustained moderate-sports participation in youth, particularly in girls, should be considered a basis for total sedentary time prevention later in life.

This prospective study found an inverse association between sustained high-sports participation and BMI in females but not in males. It is plausible that athletic activity increases muscle mass, and athletes with intensive training and competitions may have increased relative weight due to increased muscle mass, particularly in male athletes. This is because BMI did not distinguish between fat mass and fat-free mass in youth athletes. For example, Etchison et al.<sup>33</sup> reported that 13.31% of the 33,896 student-athletes (aged 11–19) were classified as obese, while only 5.95% were classified as obese using skinfold measures. More research is needed to provide an adjustment method for BMI<sup>34</sup> and additional insight into body composition assessment in athletes.<sup>35</sup>

### **Limitations**

This study had several potential limitations. First, the study assessed trajectories of the index of frequency, intensity, and competition levels of sports participation, but sports specialization was not included in the study due to incomplete data. Further YFS examinations including the type of sports and years of training would enable us to explore the metabolic equivalent task, which is utilized to quantify sports activities in different competitive levels. Second, although the assessments of PA were not comparable between the accelerometer-derived and self-reported methods,<sup>36</sup> the data have demonstrated a modest positive association between the two assessments in adults. Third, the study included only TV viewing during leisure time but did not capture domain-specific (i.e., occupational, transport-related, and domestic) sitting time and other leisure sitting activities. Future studies should take into account a wide range of

SBs assessed by accelerometry and self-report. Fourth, the study opted to use classification thresholds for MVPA (>2,690 cpm) and sedentary time ( $\leq 150$  cpm). These cut-points might influence the amount of MVPA and sedentary time, which in turn could potentially affect the outcomes of the LPA approach. Finally, the trajectory models did not address the change of OYS in both sexes over a 9-year follow-up, which might misclassify the participants that dropped out of sport or decreased sports activities with those who were actually part of the non-participation. The dropout/decreasing experiences may either enhance or undermine the influence of compliance with PA, SB, and obesity on adult's health.

## **CONCLUSIONS**

This study identified multiple patterns of OYS from childhood to adolescence over 9 years in both sexes. Sustained moderate- and high-sports participation may contribute to the development of a healthy, physically active lifestyle from childhood to adulthood, particularly in girls. The implication of this finding is that parents, teachers, trainers, health professionals, and policymakers should strive to not only enhance children's athletic experience, but also optimize environmental variables toward increasing children's sports participation. More evidence is needed regarding children's involvement in different sport contexts.

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Figure legend:

Figure 1. Mean profile lines for latent organized youth sports classes (C = 3) of boys (a) and girls (b)

<b>Table 1.</b> Comparison of participant characteristics by sex				
<b>Variable</b>	<b>All (n = 1,349)</b>	<b>Male offspring (n =544)</b>	<b>Female offspring (n = 805)</b>	<b>p-value</b>
Mean and standard deviation				
Youth age (years)	10.9 (5.1)	11.0 (5.2)	10.9 (5.0)	0.716
Adult age (years)	48.9 (5.1)	49.0 (5.2)	48.9 (5.0)	0.716
Youth body mass index (kg/m <sup>2</sup> )	17.9 (3.0)	18.1 (3.1)	17.8 (2.9)	0.163
Organized youth sports (index)				
1980	5.1 (1.5)	5.4 (1.6)	4.9 (1.5)	<0.001
1983	5.2 (2.0)	5.6 (2.2)	5.0 (1.9)	<0.001
1986	5.2 (1.9)	5.5 (2.0)	5.0 (1.8)	<0.001
1989	5.1 (1.9)	5.4 (2.0)	5.0 (1.8)	<0.001
Adult accelerometer PA				
Total PA (cpm)	1034.5 (395.2)	1072.1 (431.8)	1009.0 (366.4)	0.005
MVPA (min/day)	54.9 (32.0)	63.0 (36.0)	49.4 (27.6)	<0.001
MVPA <sub>10 min</sub> (min/day)	16.7 (17.6)	16.9 (17.3)	16.5 (17.8)	0.723
Light-intensity PA (min/day)	265.1 (72.8)	257.3 (73.4)	270.3 (72.1)	0.001
Sedentary time (min/day)	699.3 (96.0)	699.6 (103.1)	699.2 (91.0)	0.939
Sedentary time <sub>30 min</sub> (min/day)	187.3 (68.2)	193.6 (70.8)	182.9 (66.1)	0.005
Total steps (step/day)	8527 (2957)	8520 (3033)	8532 (2907)	0.943
Wear time (min/day)	1019 (76)	1020 (82)	1019 (72)	0.821
Adult PA index	9.1 (1.9)	9.1 (2.0)	9.1 (1.9)	0.702
Adult TV viewing (min/day)	116.8 (67.4)	124.6 (71.1)	111.6 (64.3)	0.001
Adult body mass index (kg/m <sup>2</sup> )	27.4 (5.2)	27.6 (4.5)	27.2 (5.6)	0.209
Place of residence (%)				
Urban	53.3	53.4	53.2	0.993
Rural	46.7	46.6	46.8	
Having siblings (%)	87.5	86.3	88.3	0.327
Adult education (year) (%)				
Low (≤13)	25.1	33.2	19.7	<0.001
High (>13)	74.9	66.8	80.3	
Adult income (annual) (%)				
<€25,000	15.7	13.5	17.3	<0.001
€25,000–45,000	46.5	34.9	54.4	
>€45,000	37.8	51.6	28.3	
Having children (%)	48.8	50.6	47.6	0.326
Parental PA (%)	All	Fathers	Mothers	
A little	26.0	22.0	29.6	<0.001
Occasionally	54.6	55.7	53.7	
Regular	19.4	22.3	16.7	
Parental education (year) (%)				
Low (≤9)	53.3	56.3	50.5	0.007
Moderate (10–12)	25.6	23.1	27.9	
High (>12)	21.1	20.6	21.6	
Parental occupation (%)				
Manual	35.8	40.6	31.4	<0.001
Lower non-manual	28.4	18.0	38.0	
Upper non-manual	35.8	41.4	30.6	

Note: Boldface indicates statistical significance ( $p < 0.05$ ). p-value from Student's  $t$  test or  $\chi^2$  test. cpm, counts per minute; PA, physical activity; MVPA, moderate-to-vigorous intensity PA.

<b>Table 2.</b> The model goodness of fit indices of latent profile analysis for organized youth sports								
<b>Class</b>	<b>AIC</b>	<b>BIC</b>	<b>ABIC</b>	<b>VLMR</b>	<b>LMR</b>	<b>BLRT</b>	<b>Entropy</b>	<b>Class sizes</b>
Boys ( <i>n</i> = 544)								
2	4643	4703	4659	<0.001	<0.001	0	0.82	77.9%, 22.1%
<b>3</b>	<b>4491</b>	<b>4577</b>	<b>4513</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>0</b>	<b>0.86</b>	<b>73.5%, 14.0%, 12.5%</b>
4	4460	4572	4489	0.139	0.148	0	0.79	64.2%, 13.3%, 12.4%, 10.1%
5	4427	4564	4463	0.548	0.557	0	0.79	57.5%, 16.3%, 10.8%, 8.1%, 7.3%
6	4391	4554	4433	0.216	0.221	0	0.79	57.7%, 16.3%, 8.3%, 8.0%, 5.1%, 4.6%
Girls ( <i>n</i> = 805)								
2	6687	6753	6709	<0.001	<0.001	0	0.84	82.9%, 17.1%
<b>3</b>	<b>6481</b>	<b>6574</b>	<b>6511</b>	<b>0.002</b>	<b>0.003</b>	<b>0</b>	<b>0.85</b>	<b>77.8%, 12.4%, 9.8%</b>
4	6377	6499	6417	0.154	0.161	0	0.81	69.6%, 11.8%, 10.1%, 8.5%
5	6314	6464	6362	0.349	0.357	0	0.83	69.2%, 10.8%, 9.9%, 8.3%, 1.8%
6	6242	6421	6300	0.124	0.127	0	0.82	65.6%, 10.8%, 10.1%, 7.1%, 4.9%, 1.5%
<p>Note: Boldface indicates statistical significance (<math>p &lt; 0.05</math>) and the best model. Final models were adjusted for baseline age, BMI, place of residence, having siblings, parental physical activity, education and occupation.</p> <p>AIC, Akaike's Information Criterion; BIC, Bayesian Information Criterion; ABIC, Sample-size adjusted Bayesian Information Criterion; VLMR, Vuong-Lo-Mendell-Rubin likelihood ratio test; LMR, Lo-Mendell-Rubin adjusted likelihood ratio test; BLRT, Parametric bootstrapped likelihood ratio test.</p>								

**Table 3.** Regression coefficients of organized sports trajectories in youth on physical activity, sedentary behavior and obesity in midlife

Outcome measures	Unadjusted model <sup>a</sup>		Adjusted model <sup>ab</sup>	
	Sustained high-intensity sports ( <i>n</i> = 71 boys/74 girls)	Sustained moderate-intensity sports ( <i>n</i> = 66 boys/79 girls)	Sustained high-intensity sports ( <i>n</i> = 71 boys/74 girls)	Sustained moderate-intensity sports ( <i>n</i> = 66 boys/79 girls)
	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)
<i>Males</i>				
Total PA (cpm)	56.03 (-53.95, 166.0)	-1.58 (-115.0, 111.9)	100.4 (-14.83, 215.5)	-7.66 (-124.5, 109.2)
MVPA (min/day)	3.21 (-5.85, 12.26)	-4.42 (-13.76, 4.92)	6.97 (-2.52, 16.46)	-6.06 (-15.71, 3.60)
MVPA <sub>10-min</sub> (min/day) <sup>c</sup>	1.64 (0.98, 2.77)	1.07 (0.63, 1.80)	1.42 (0.82, 2.49)	0.94 (0.54, 1.65)
Light-intensity PA (min/day)	-1.17 (-18.86, 16.53)	6.92 (-11.33, 25.17)	11.46 (-6.47, 29.40)	12.10 (-6.14, 30.34)
Sedentary time (min/day)	-2.04 (-24.92, 20.84)	-2.50 (-26.10, 21.11)	-18.43 (-41.96, 5.09)	-6.04 (-29.97, 17.88)
Sedentary time <sub>30-min</sub> (min/day)	2.71 (-14.87, 20.30)	2.28 (-15.86, 20.42)	-2.17 (-20.05, 15.72)	-6.82 (-25.01, 11.37)
Total steps (step/day)	357.2 (-408.9, 1123)	-259.1 (-1049, 531.1)	540.7 (-271.2, 1353)	-413.5 (-1239, 412.1)
Self-reported PA (score)	<b>0.90 (0.40, 1.39)</b>	<b>0.61 (0.09, 1.14)</b>	<b>0.56 (0.05, 1.07)</b>	<b>0.55 (0.01, 1.08)</b>
TV viewing (min/day)	1.69 (-16.54, 19.92)	-2.44 (-21.25, 16.36)	13.93 (-5.10, 32.95)	-8.34 (-27.65, 10.97)
Overweight <sup>c</sup>	1.02 (0.57, 1.89)	1.30 (0.67, 2.62)	1.10 (0.58, 2.12)	1.01 (0.50, 2.10)
Obese <sup>c</sup>	0.89 (0.43, 1.82)	1.67 (0.81, 3.54)	1.08 (0.50, 2.35)	1.45 (0.67, 3.17)
<i>Females</i>				
Total PA (cpm)	<b>138.8 (50.65, 227.0)</b>	62.38 (-23.28, 148.0)	<b>132.8 (43.06, 222.5)</b>	<b>91.19 (3.54, 178.8)</b>
MVPA (min/day)	<b>13.73 (7.18, 20.29)</b>	5.00 (-1.38, 11.38)	<b>12.48 (5.74, 19.22)</b>	<b>6.81 (0.20, 13.42)</b>
MVPA <sub>10-min</sub> (min/day) <sup>c</sup>	1.20 (0.74, 1.96)	1.26 (0.79, 2.03)	1.04 (0.63, 1.73)	1.35 (0.82, 2.24)
Light-intensity PA (min/day)	-2.56 (-19.03, 13.90)	<b>18.33 (2.29, 34.36)</b>	1.86 (-14.49, 18.22)	<b>19.71 (3.67, 35.74)</b>
Sedentary time (min/day)	-11.17 (-29.85, 7.51)	<b>-23.33 (-41.52, -5.13)</b>	-14.34 (-33.17, 4.49)	<b>-26.52 (-44.98, -8.06)</b>
Sedentary time <sub>30-min</sub> (min/day)	-4.14 (-19.78, 11.49)	-6.43 (-21.65, 8.80)	-5.14 (-20.83, 10.55)	-9.17 (-24.54, 6.21)
Total steps (step/day)	<b>953.2 (259.3, 1647)</b>	660.3 (-15.43, 1336)	<b>930.2 (212.4, 1648)</b>	<b>786.5 (82.94, 1490)</b>
Self-reported PA (score)	<b>0.82 (0.36, 1.28)</b>	<b>0.66 (0.21, 1.11)</b>	<b>0.70 (0.23, 1.17)</b>	<b>0.78 (0.32, 1.24)</b>
TV viewing (min/day)	-11.14 (-26.77, 4.48)	7.55 (-7.80, 22.90)	-0.64 (-16.32, 15.05)	<b>2.73 (-12.69, 18.15)</b>
Overweight <sup>c</sup>	0.72 (0.41, 1.22)	0.79 (0.44, 1.38)	0.91 (0.51, 1.61)	0.74 (0.40, 1.35)
Obese <sup>c</sup>	<b>0.46 (0.22, 0.88)</b>	1.01 (0.57, 1.77)	<b>0.48 (0.22, 0.96)</b>	1.00 (0.54, 1.81)

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>The sustained low-active/nonparticipation for boys ( $n = 382$ ) and girls ( $n = 615$ ) serves as the reference group for each.

<sup>b</sup>Adjusted for participants' adult age, having children, own education and income, as well as accelerometer wear time (special for the device).

<sup>c</sup>Presented as an odds ratio and 95% confidence interval. MVPA<sub>10-min</sub> was dichotomized as high (at and above median) and low (below median). Obesity was defined as BMI of normal weight (18.5–25 kg/m<sup>2</sup>), overweight (between >25 and <30) or obese ( $\geq 30$ ), the reference group was normal weight.

$\beta$ , beta coefficients; CI, confidence interval, PA, physical activity; MVPA, moderate-to-vigorous intensity PA.



Figure 1. Mean profile lines for latent organized youth sport classes ( $C = 3$ ) of boys (A) and girls (B)

