

**This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.**

**Author(s):** Kääpä, Mari; Palomäki, Sanna; Vähä-Ypyä, Henri; Vasankari, Tommi; Hirvensalo, Mirja; Fedewa, Alicia

**Title:** Finnish Adolescent Girls' Activity Patterns and The Effects of an Activity-Based Homework Intervention on Their Physical Activity

**Year:** 2021

**Version:** Published version

**Copyright:** © 2021 the Authors

**Rights:** CC BY 4.0

**Rights url:** <https://creativecommons.org/licenses/by/4.0/>

**Please cite the original version:**

Kääpä, M., Palomäki, S., Vähä-Ypyä, H., Vasankari, T., Hirvensalo, M., & Fedewa, A. (2021). Finnish Adolescent Girls' Activity Patterns and The Effects of an Activity-Based Homework Intervention on Their Physical Activity. *Physical Activity and Health*, 5(1), 1-14.  
<https://doi.org/10.5334/paah.73>

## RESEARCH

# Finnish Adolescent Girls' Activity Patterns and The Effects of an Activity-Based Homework Intervention on Their Physical Activity

Mari Kääpä<sup>1</sup>, Sanna Palomäki<sup>1</sup>, Henri Vähä-Ypyä<sup>2</sup>, Tommi Vasankari<sup>2</sup>, Mirja Hirvensalo<sup>1</sup> and Alicia Fedewa<sup>3</sup>

<sup>1</sup> University of Jyväskylä, FI

<sup>2</sup> UKK Institute Promoting Health-enhancing Physical Activity, FI

<sup>3</sup> University of Kentucky, US

Corresponding author: Mari Kääpä ([mari.p.kaapa@jyu.fi](mailto:mari.p.kaapa@jyu.fi))

---

**Purpose:** The insufficient physical activity (PA) of adolescents is a global challenge, and there is a need to find opportunities to engage youth in active lifestyles. The majority of adolescents do not meet the recommended guidelines of physical activity, and especially females have low levels of activity as they approach adolescence. The goal of this study was to obtain insight into Finnish adolescent girls' objectively measured physical activity by evaluating the effects of an activity-based homework intervention on low, medium, and high-active girls during after-school hours.

**Method:** A physical activity homework intervention was put into place for female adolescent girls. Physical activity was measured by accelerometers and a self-reported diary from 87 girls aged 13 to 15 years.

**Results:** Results indicated that high-active girls maintained their activity until the last measurement hour (10 pm), while the moderate- and low-active girls' activity declined towards the evening hours. The high-active girls participated the most frequently in organized sports activities, and the low-active girls were the most active in participating in household chores. The PE homework intervention increased girls' activity time an average of 34 minutes per week.

**Conclusion:** This study offers a picture of the diverse nature of the physical activity that adolescent girls engage in during after-school hours and shows the potential of PE homework assignments to reduce sedentary time and thereby increase physically active time during after-school hours.

---

**Keywords:** physical activity; after-school; lower secondary school girl students; Physical Education homework intervention

---

## Introduction

Global recommendations state that adolescents should engage in 60 or more minutes of moderate-to-vigorous physical activity (MVPA) each day (ACSM, 2018). In addition, recommendations suggest that youth should regularly engage in specific physical activities, such as aerobic-based activity, resistance training, and stretching and flexibility exercises. In Finland, similar to the United States, only one-third of children and adolescents meet these global standards; Finnish adolescents in particular spend more than half of their waking hours engaged in sedentary activities (Husu et al., 2019; Kokko et al., 2016; Tammelin et al., 2007). Globally, including in Finland, girls are particularly at risk of falling short of the guidelines (ACSM, 2018; Hallal et al., 2012; Husu et al., 2019; Pate et al., 2009). Adolescence is a particularly vulnerable time, as this transition marked with biological changes coincides with a significant decrease in physical activity for youth, especially girls (Abdelghaffar et al., 2019; Martins et al., 2015). There is a considerable amount of research to date that suggests

girls are at particular risk of physical inactivity (Judice et al., 2017; Ruiz et al., 2011). Given that physical activity is an important determinant of health and that health-enhancing habits of an active lifestyle are established in youth (Atkin et al., 2015; Pardo et al., 2014), adolescence is a critical time to intervene to prevent the sharp decline in physical activity that occurs during this developmental period.

### ***After-School Activities***

Despite the relationship between physical activity and increased academic achievement in youth (Fedewa & Ahn, 2011), the reduction of physical activity opportunities, including recess and physical education, have been replaced in most countries with increased academic instructional time (U.S. Department of Health and Human Services, 2012). Thus, since many activities during the school day do not reach the recommended levels of physical activity (Grao-Cruces et al., 2019), after-school activities are an effective means of accumulating the daily recommended 60 minutes of activity (Beets et al., 2009; Mears & Jago, 2016; Pate & O'Neill, 2009). In the United States, approximately a quarter of school-aged youth participate in after-school activities (After School Alliance, 2014). In Finland, half of Finnish youth between the ages of 9 and 15 engage in sports club activities at least once a week (Blomqvist et al., 2019). Given that opportunities to be active are insufficient during school hours, after-school activities to promote physically active behaviours among youth are increasingly more important (Society of Health and Physical Educators, 2016) and make a significant contribution to children's overall daily physical activity levels, particularly as children reach adolescence (Arundell et al., 2016).

Research suggests that after-school activity types, however, differ between low- and high-active girls (Koorts et al., 2011; Taverno Ross et al., 2013; Trilk et al., 2012; Zimmermann-Sloutskis et al., 2010). In Taverno Ross et al. (2013), high-active adolescent girls reported more physical activity outside of school in team sports and individual sports than low-active girls. The low-active girls reported engaging in leisure time and educational sedentary activities more than high-active girls (Taverno Ross et al., 2013). Koorts et al. (2011) found that the more active adolescents reported activities such as outdoor games and sports, which is likely how these youth achieved their higher activity levels. Even if sport club membership has a strong effect on moderate physical activity in both boys and girls (Trilk et al., 2012; Zimmermann-Sloutskis et al., 2010), it is important to note that research has found that girls often accumulate their activity through different means, particularly through leisure-time physical activity such as performing occupational and household tasks (Pardo et al., 2014).

### ***Evidence for Activity Homework Interventions***

The use of homework in physical education (PE) is relatively uncommon compared to academic homework, and for this reason, the evidence of PE homework assignments is relatively limited (Hill, 2018). There are few studies concerning homework in PE, and in those studies, it is clear that active homework assignments can be effective in increasing levels of physical activity (Claxton & Wells, 2009; Duncan et al., 2011; Duncan et al., 2019; Fairclough et al., 2013; Kriemler et al., 2011). Some physical educators have suggested that homework assignments could be used as a way to meet PE curriculum learning objectives and recommendations for maintaining an active lifestyle (Hill, 2018). Homework might allow teachers to reach students' after-school time with physically active assignments and focus on skill development outside of instructional time. Teachers, therefore, might be able to use homework as a tool to add skill practice outside of school hours and increase parents' knowledge about PE learning objectives and practices (Hill, 2018). The multicomponent school-based interventions that include families such as PE homework are the most promising and effective strategies for increasing overall physical activity (Kriemler et al., 2011).

### ***Purpose of Present Study***

Although adolescent physical activity has been examined in the literature, less attention has been paid to the physical activity levels of youth during after-school hours and, in particular, how the specific activities vary among adolescents by gender. This is important because adolescence is a time when health behaviours, such as physical activity, are established and then maintained into later adolescence and even adulthood (Atkin et al., 2015; Pardo et al., 2014). It is important to understand physical activity behaviours among this crucial age group so that effective interventions can be put in place, particularly given the significant decline in activity among adolescent females. All adolescents participate in school and physical education, a situation that provides tremendous potential to influence physical activity and youth attitudes toward physical activity. School-based multicomponent interventions could therefore be the most effective way to change the physical activity of adolescent girls in a positive direction (Okely et al., 2011; Owen et al., 2017).

The present study was conducted as a part of the PE Homework Study project in Finland, where lower secondary school girls' physical activity was studied and promoted by PE homework (Kääpä et al., 2017). The study focused on the patterns and types of physical activity of adolescent girls during after-school hours. The study had two guiding aims: (a) to evaluate the timing and variety of physical activity patterns of adolescent females with low, medium, and high activity levels during after school hours and (b) to determine whether a PE homework intervention increased the level of physical activity for youth after school hours.

## Methods

### *Procedures*

This study was conducted in a moderate-sized lower secondary school in Central Finland. All of the girls attending grades 7 to 9 (ages 13 to 15) in this school were invited to participate ( $N = 124$ ). Participants and their parents were informed about the study beforehand, and informed consent was obtained from the parents/guardians. Participation in the study was voluntary. Of the total of 124 pupils, 105 (84.7%) agreed to participate in the study project. According to the Ethical Committee of the University of Jyväskylä, the study protocol met the required ethical permissions established by the Helsinki Declaration concerning this type of research.

The study consisted of 1 week of objective physical activity measures with accelerometers and a half-structured self-reported diary. Altogether, out of 124 youth, 87 girls had complete accelerometer data. The accelerometers measure accurate information on the duration, intensity, and pattern of PA and inactive periods, posture and postural changes, and the number of steps on the metabolic equivalent (MET) – values of PA levels (Aittasalo et al., 2015; Vähä-Ypyä et al., 2015a, 2015b). Physical activities are frequently classified by their intensity, using MET as an indicator of exertion, a practice that was also followed in the present study. MET refers to metabolic equivalent, and 1 MET is the rate of energy expenditure while sitting at rest. Hence, activities that do not significantly increase resting energy expenditure are classified as sedentary behaviours. The conventional energy expenditure is an oxygen uptake of 3.5 millilitres per kilogram of body weight per minute. MET values express the energy cost of physical activities as a multiple of the resting metabolic rate and were used as the metric for the present study (Pate et al., 2008). The participants were divided into three activity groups ( $n = 29$  in each group) according to their objectively measured mean MET values. In total mean MET values, there were daily peak MET values from the measurement week, and those total mean MET values of the groups were as follows: 57.2 to 73.4 for low-active girls, 74.2 to 81.7 for moderately active girls, and 82.1 to 97.2 for high-active girls (**Table 1**). The variety of activities during after-school hours was studied according to these three activity groups.

The measurements were implemented in November 2016. Both accelerometers and diary questionnaires were delivered during the PE lessons with oral and written instructions and were returned 1 week later. The data in the study were from participants who had used the accelerometer for at least 4 days during the week, at a minimum of 10 hours per day (Mattocks et al., 2008; Troiano et al., 2008), with 82 completed self-reported diaries. In Finland, the duration of the school day is usually 6 to 8 hours starting between 8:00 am and 9:00 am and ending between 2:00 pm and 4:00 pm. Note that students may have different schedules, and a few students might have class after 2:00 pm. However, in this study, the after-school time period was defined as starting at 2:00 pm and ending at 10:00 pm.

### *Self-Reported Physical Activity*

The information on girls' after-school activities was obtained by a half-structured, self-reported diary questionnaire developed by the teacher-researcher and tested in two different lower secondary schools in Central Finland. The diary questionnaire has shown to produce adequate test-retest coefficients ranging from .690–.996. The participants reported the type (e.g., dance lesson, walking, cleaning) and the frequency of activities in organized sports, self-initiated activities, household activities, and PE homework. In addition, the participants estimated the time spent in organized sports and PE homework during the week. Focusing on these two behaviours was pre-determined based on previous research of Finnish adolescent activity preferences, as many girls participate in organized sport activities (Paakkari et al., 2017; Tammelin et al., 2016), which are usually held at the same time every week for the same duration. In organized sport activities and self-initiated sport activities, participants responded to open-ended questions, in contrast to the PE homework assignments and household activities, which were structured. Each specific activity type reported was recorded as one occasion of activity. The survey answers of students across the two schools were compared with a  $t$ -test to ensure that frequency and time used in PE homework did not differ, which was the case ( $p = 0.656$  and  $p = 0.655$ ), indicating that the PE homework questions could be used in a transferable manner.

**Table 1:** Percentage of low-, middle- and high-active girls' physical activity levels (light, moderate and vigorous) during waking hours; standing and sedentary behaviour, variance by ANOVA, Tukey and Tamhane post hoc tests. Mean daily values in proportion to daily measurement time.

	<b>Low-Active Girls</b>	<b>Middle-Active Girls</b>	<b>High-Active Girls</b>	<b>Total</b>	<b>p Value Low-Middle</b>	<b>p Value Middle-High</b>	<b>p Value Low-High</b>
Total mean peak MET value	57.2–73.4	74.2–81.7	82.1–97.2				
	<i>N</i> = 29 (SD)	<i>N</i> = 29 (SD)	<i>N</i> = 29 (SD)	<i>N</i> = 87 (SD)			
	%	%	%	%			
Total daily	67.2	78.0	87.5	77.6	<b>.000</b>	<b>.000</b>	<b>.000</b>
(SD)	(5.1)	(2.4)	(4.5)	(9.3)			
After-school	30.8	36.3	40.3	35.8	<b>.005</b>	.253	<b>.000</b>
(SD)	(4.6)	(7.4)	(10.2)	(8.6)			
Light PA (1.5–2.9 MET)	12.7 (2.9)	13.3 (2.4)	15.8 (2.6)	13.9 (2.9)	.662	<b>.002</b>	<b>.000</b>
Moderate PA (3–6 MET)	8.3 (2.3)	9.8 (2.5)	11.6 (2.0)	9.9 (2.6)	<b>.047</b>	<b>.008</b>	<b>.000</b>
Vigorous PA (<6 MET)	0.6 (0.4)	1.6 (0.8)	1.8 (0.7)	1.3 (0.9)	<b>.000</b>	.384	<b>.000</b>
MVPA	8.9 (2.19)	11.3 (2.83)	13.4 (2.02)	11.2 (2.97)	<b>.001</b>	<b>.004</b>	<b>.000</b>
standing	17.4 (6.0)	16.7 (5.1)	17.1 (5.0)	17.1 (5.3)	.850	.940	.977
sitting	50.4 (4.9)	46.3 (6.1)	46.0 (5.0)	47.6 (5.7)	<b>.012</b>	.980	<b>.007</b>
lying	10.6 (6.2)	12.5 (8.4)	7.7 (4.7)	10.2 (6.8)	.700	<b>.033</b>	.152
sedentary = sitting & lying	61.0 (6.6)	58.7 (6.8)	53.7 (5.9)	57.8 (7.1)	.386	<b>.011</b>	<b>.000</b>

**Organized sports activities** were activities led by coaches or instructors. Participants were asked to report the activity types per week they engaged in during after-school hours. The time spent in organized sports activities during the week was reported in minutes as well. **Household activities** were duties related to the home environment, such as babysitting younger siblings or performing household chores. The household activities included optional household chores to choose from: cleaning, walking the dog, taking care of siblings, and other chore-related activities around the house. In the “other” category, participants reported activities they performed such as shovelling snow, delivering newspapers, or raking leaves. **Self-initiated sports activities** included non-organized leisure time activities that girls performed in without supervision. Participants were asked to report the activity types per week they engaged in during after-school hours.

### **PE Homework**

PE homework included physically active assignments given by a PE teacher related to the content of PE lessons. The assignments had different tasks, such as practicing motor skills, involving parents in the activities, adding students' own decision making and self-determination, and varying exercises that included endurance and moderate to intense physical activities (Kääpä et al., 2019). The PE homework was part of the PE undertaken by all the girls; homework assignments were given to all students in each PE lesson. Even if the PE homework was not mandatory, most of the students (89.7%) did the assignments (Kääpä et al., 2017). The PE homework assignments often involved strength training such as squats or abdominal crunches, jogging with a family member, or a sport skill such as throwing a tennis ball against the wall. For the PE homework, participants reported the frequencies and time spent doing PE assignments in minutes.



### **Accelerometer Data**

The participants wore a tri-axial accelerometer UKK RM42 (Urho Kekkonen Fitness Institute Foundation; Tampere, Finland) for 7 consecutive days. The UKK RM42 is easy to use because it is small and lightweight and has shown to produce accurate estimates of youth activity levels (Vähä-Ypyä et al., 2017). A comparison between accelerometer brands (Hookie and Actigraph) showed excellent agreement and assured reliable use in studies of adolescents' physical activity and sedentary behaviour as well (Aittasalo et al., 2015). In addition, this accelerometer can be used for over a week without recharging.

### **Analysis**

The tri-axial accelerometer data were uploaded and stored. After the data were uploaded, a statistician from the UKK Institute transferred the data into Excel form. The collected data were analysed in 6-second epochs, and the mean amplitude deviation (MAD) of the resultant acceleration signal was calculated for each epoch (Vähä-Ypyä et al., 2015b). Furthermore, the measured MAD values were converted to metabolic equivalents (MET) in a method established in prior literature (Vähä-Ypyä et al., 2015b). The amounts of time spent standing still, sitting, and lying, as well as physical activity levels, were separated into unique variables; in addition, the number of daily steps was separately calculated. The classifications were based on the angle for posture estimation (APE) algorithm, comparing the accelerometer orientation in relation to an identified upright position at the end of each 6-second epoch (Vähä-Ypyä et al., 2018).

The reported data from the self-reported diaries complemented the accelerometer data. All the data were analysed using SPSS software. The total daily measurement time varied between activity groups (low-active girls 13 hours 53 minutes, moderately active girls 15 hours 5 minutes, and high-active girls 14 hours 37 minutes). To compare METs between activity groups, the total MET values are presented in proportion to the participants' daily measurement time. Proportioned MET values in light, moderate, vigorous physical activity and MVPA, along with standing and sedentary behaviour (sitting and lying), were compared between the low, medium, and high activity groups using analysis of variance (ANOVA) with Tukey and Tamhane post-hoc tests. The mean frequencies per week of organized sport activities and self-initiated activities were compared using ANOVA with Tamhane post hoc test between the low, medium, and high activity groups. An independent-samples Kruskal-Wallis test with a Bonferroni post-hoc test was used to compare the small sample sizes in the frequencies by type: organized sport and self-initiated type.

## **Results**

### **Daily Total Physical Activity**

Individual daily total MET values varied between 43.8 and 158.6 METs, and average values were found to be 67.2 METs for the low-active girls' group, 78.0 METs for the moderately active group, and 87.5 METs for the high-active girls' group (see **Table 1**). Participants spent most of their physically active time at a light activity level. The light activity accounted for 13.9% of their total waking hours, while moderate-to-vigorous physical activity (MVPA) accounted for 11.2% of their total waking hours. The participants were divided into activity groups according to their total mean MET values. Significant differences between the groups' physical activity levels were evident. The high-active girls were more active in all intensity levels and had the lowest percentage of time in sedentary behaviour. The high-active girls had significantly more light intensity physical activity than the other groups of girls (moderate-high  $p = 0.002$ , low-high  $p < 0.001$ ). At the vigorous intensity level, the group of low-active girls had significantly lower values than the moderate and high-active groups ( $p < 0.001$ ). In total MVPA, all the groups significantly differed from each other. For example, the low-active girls' MVPA was 8.9% of daily measurement time compared to 13.4% ( $p < 0.001$ ) of the high-active girls' measured time.

### **After-School Physical Activity**

Approximately 46% of daily activity was accumulated during after school hours. During after-school hours, the participants' METs varied between 12.9 and 55.1; the average values of the low, moderate, and high active groups were 30.8, 36.3, and 40.3 METs, respectively (see **Table 1**). Altogether, the mean hourly afternoon MET value was an average of 4.2 METs per after-school hour. On average, the participants' physical activity intensity after school was spent at a moderate level (3–6 METs) (see **Figure 1**). The high-active girls averaged 4.7 METs during after-school hours, while the moderately active girls' average was 4.3 METs, and the low-active girls averaged 3.6 METs (high-moderate  $p = 0.253$ , moderate-low  $p = 0.005$ , low-high  $p < 0.001$ ).

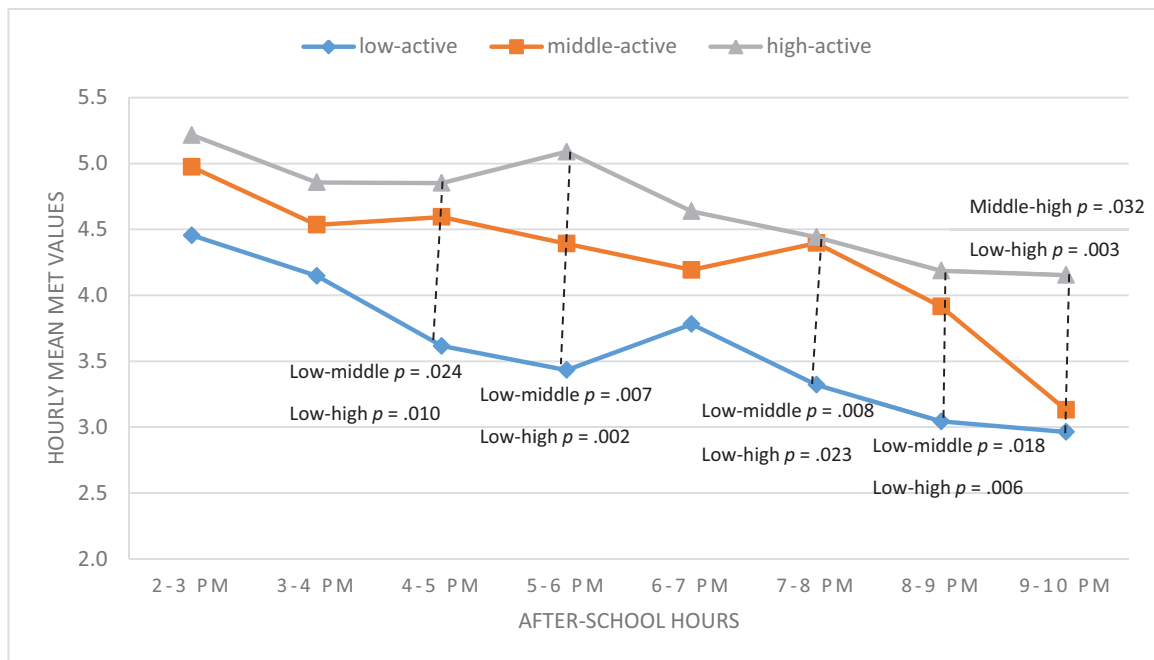
In total, the first after-school hours were the most active ones for all participants. The low-active group's physical activity declined below 4 METs as early as at 4 pm and stayed low for the remainder of the evening, reaching its lowest intensity level (2.96 METs) at 9 pm. The low active girls had only one peak during the

afternoon hours, from 6:00 pm to 7:00 pm, reaching 3.78 METs. The METs of participants in the low-active group were significantly lower than the values of participants in the other two groups during several afternoon hours: 4:00 pm to 6:00 pm and 7:00 pm to 9:00 pm. The moderately active girls' activity level remained steady between 4 and 5 METs during afternoon hours, and their MET values declined below 4 METs after 8:00 pm. The high-active girls' peak MET value was from 2:00 pm to 3:00 pm (5.22 METs), then declined slightly, but increased again at 5:00 pm to 6:00 pm (5.09 METs). The high-active girls' physical activity level stayed over 4 METs during the entire evening.

### Self-Reported Physical Activity

The participants' after-school physical activity in different activity patterns (organized sport activities, household activities, self-initiated activities, PE homework) varied, depending on the activity group (see **Table 2**). **Organized sports** frequencies varied from the high-active girls' 3.02 occasions/girl/week to the low-active girls' 2.02 occasions/girl/week, reflecting significant differences in sport involvement between the high-active group compared to the other two groups ( $p \leq 0.004$ ).

Among all participants, football, dance and dance-related sports, gymnastics, and "other ballgames" were the most popular after-school **organized sports** activities (**Figure 2**). The high-active girls were mainly represented in football and dance, moderately active girls in other ball games (floorball, basketball, volleyball, and Finnish baseball), and low-active girls in the "no activities" section. In addition, the low-active



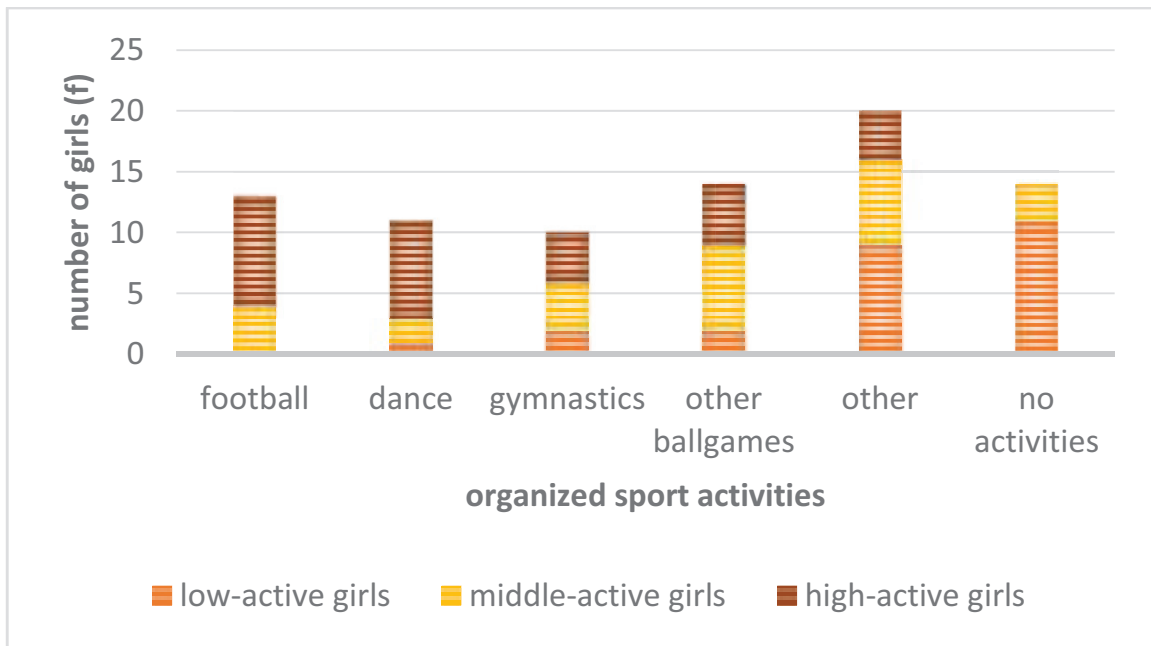
**Figure 1:** Comparison with Tamhane post hoc test of mean MET values during after-school hours among high-, middle-, and low-active girls'. Significant differences are included in the figure.

**Table 2:** After-school activities (frequency, f) /girl/week and standard deviation, SD according to activity groups with a Tamhane post hoc test.

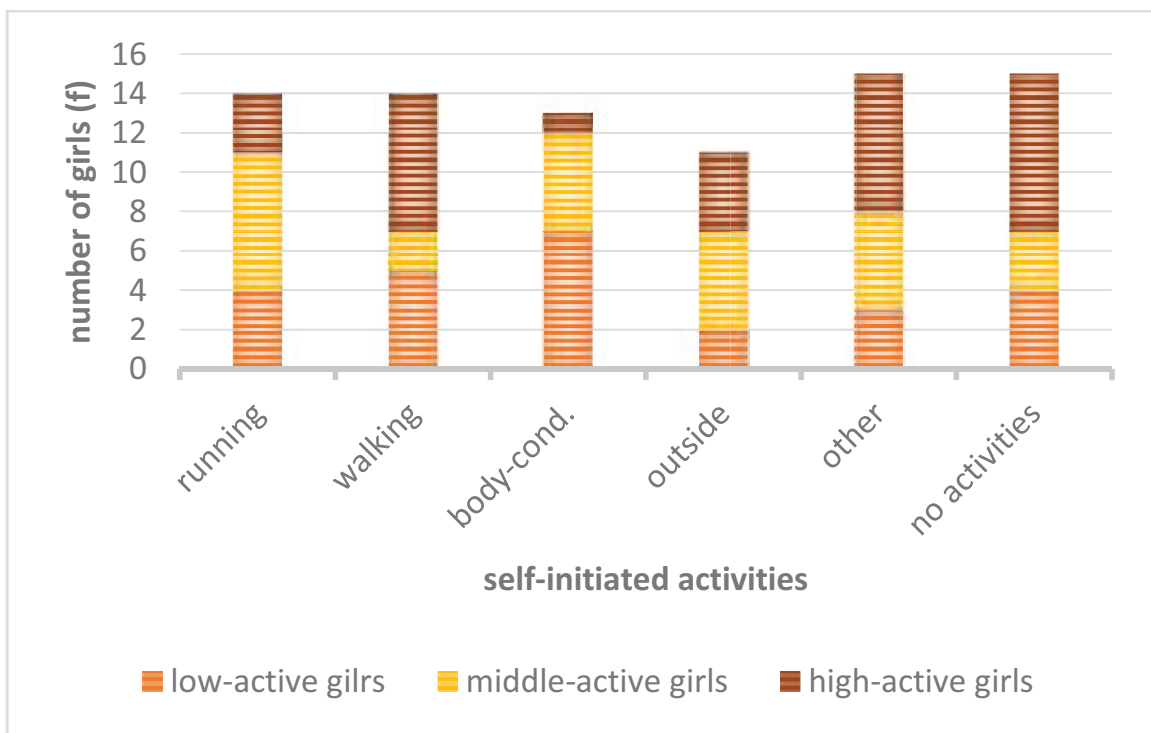
	High-Active Girls (n = 29) F	Middle-Active Girls (n = 27) F	Low-Active Girls (n = 26) F	Total (N = 82) f	p Value High-Middle	p Value High-Low	p Value Middle-Low
organized sports activities (SD)	3.02 (1.61)	2.36 (1.84)	2.02 (2.07)	2.47 (1.89)	<b>.004</b>	<b>.000</b>	.331
household activities (SD)	2.82 (2.62)	3.24 (2.64)	3.58 (2.71)	3.21 (2.67)	.465	<b>.029</b>	.738
self-initiated activities (SD)	2.87 (2.5)	2.59 (2.22)	2.45 (2.06)	2.64 (2.27)	.784	.296	1.000
PE homework (SD)	1.97 (1.49)	1.96 (1.56)	1.77 (1.33)	1.9 (1.46)	1.000	.654	.770

girls were well represented in the category of “other,” which included sports such as horseback riding, body-conditioning exercises, swimming, martial arts, strength training, and skating.

For the **self-initiated activities**, the high-active girls showed the highest frequency of involvement (2.87 occasions/girls/week) and had the most different types of activities compared to the girls in the other groups. Although the differences were not statistically significant, the high-active girls were the ones who sought out additional activities that were physically demanding. In **self-initiated activities**, the most frequent reported choices were running or jogging, walking, body-conditioning exercises, and playing outside (see **Figure 3**). The high-active girls were most represented in the categories of walking, “other”, and no activities. The moderately active girls were the biggest group in running/jogging and in playing outside. The low-active



**Figure 2:** Organized sports (f) by activity group.



**Figure 3:** Self-initiated activities (f) by activity group.



girls were most represented in body-conditioning exercises. The most frequent activity behaviour in total was **household activities** (3.21 occasions/girl/week); frequencies varied from the low-active girls' 3.58 occasions/girl/week to the high-active girls' 2.82 occasions/girl/week ( $p = 0.029$ ). The most common household chore in all activity groups was cleaning, followed by taking the dog out and taking care of siblings.

The total activity frequency of doing **PE homework** was 1.9 occasions per girl each week. In this behaviour, the frequencies for the girls' activity groups were close to one other. In terms of duration, girls' PE homework time was, on average, 34 minutes per week for each girl. The low-active girls' weekly PE homework time was, on average, 26 minutes per week. For the moderately active girls, it was 33 minutes per week, and for the high-active girls, it was 41 minutes per week. The differences between the groups were not significant but indicate that the high-active girls spent the most time on average engaging with the PE homework.

## Discussion

The present study sought to understand the physical activity patterns of adolescent girls during after-school hours, as well as the effects of a PE homework intervention to increase girls' activity levels. During the after-school hours, the timing and variety of activities differed considerably between the low-active, moderately active, and high-active girls. Thus, this study brings new information about girls' physical activity timing and types in different activity groups for the promotion of physical activity.

### **After-School Activity Patterns**

It was clear that after parsing out the data, the high-active adolescent girls had the greatest intensity of activity that also remained fairly stable throughout the after-school period. During the last hour of measurement, the high-active girls were still significantly more active than the others were, likely due to participation in organized sports, commuting back home, doing some active chores around the house, and taking care of their evening tasks, for example showering. For the low and moderately active youth, however, the level of activity dropped considerably; the most significant MET value differences occurred from 4 pm to 6 pm and 7 pm to 9 pm. This is likely due to the differences across groups in organized sports participation given that practices and games can last until the evening hours (Koorts et al., 2011; Taverno Ross et al., 2013). Thus, it might be late when students commute back home and complete their necessary evening tasks, such as chores and showering. Getting to and from activities are factors that may moderate adolescent girls' physical activity (Lytle et al., 2009). Lytle et al. (2009) suggested that addressing the barrier of getting to and from activities by making them easily accessible could increase levels of physical activity for low active youth when the barrier to participation could be accessibility to the organized sport.

In the after-school period, the first after-school hours were the most active ones for all three activity groups. Active commuting from or school and some late afternoon PE lessons likely had an effect on the increase in after-school hours of physical activity. In Finland, physically active commuting home is common, even during the wintertime when over half of school aged children or adolescents (52 %) choose active school transportation (walking or cycling) over motorized non-active transportation (Mehtälä et al., 2020). Active transport in youth has been observed to predict health benefits, such as lower weight status and higher adult physical activity, especially in early midlife (Yang et al., 2014). Investing in sidewalk networks near the homes and schools of youth as well as developing transport infrastructures that attract youth to take part in active transport would also serve as key catalysts to increasing activity in children and adolescents (Mehtälä et al., 2020).

In terms of total MET values during the day, MVPA comprised 11.2% of the girls' day, which is higher than prior international studies have found (Graham et al., 2014; Júdice et al., 2017; Klinker et al., 2014; Kokko et al., 2018). According to Graham et al. (2014), American adolescent girls engaged in 5 hours/week (43 minutes/day) of MVPA. In Klinker et al. (2014), Danish adolescent girls' proportion of time spent daily in MVPA was 6.7%. Sitting took most of the participants' time (47.57% of the day). Although the time spent being sedentary is more than the World Health Organization recommendations (Currie et al., 2008), this appears lower than other countries, which have found rates as high as 61% in adolescents (Okely et al., 2011). The analysis of individual low-active girls showed that some adolescent girls were sedentary for the entire after-school period. To support a healthy lifestyle and physical activity for those girls who are not interested in or do not have access to sports activities, efforts to promote self-initiated and household activities are particularly important. According to a study by Corder et al. (2013), among adolescents, the familiarity of an environment for physical activity might be important, and the most common activities take place at home or in a neighbourhood setting. The self-initiated activities (2.64 occasion/girl/week) or household activities (3.21 occasion/girl/week) were frequently mentioned in this study for low-active youth.

These unstructured and informal exercises may represent a less threatening alternative for adolescents who lack athletic competence (Lawler et al., 2017) and encourage adolescent girls to be more active outside of school and in the home environment (He et al., 2013).

### ***PE Homework Effectiveness***

Although not surprising to note that low and moderately active youth did not engage in as much after-school activity as the high-active group, it is important to note that the PE homework intervention *did* increase the amount of physical activity each girl engaged in during after-school hours. This is one of the few studies to suggest that PE homework in adolescent girls could increase the amount of physical activity time they accumulate each day. PE homework added an average of 34 minutes per week to the physical activity of each girl during after-school hours and has been shown in prior research to increase daily step counts for youth as well (Duncan et al., 2011). Because the results are from self-reported diaries, the intensity of PE homework is unknown. Adding PE homework to girls' after-school lives could lead to some sedentary behaviours being replaced by more active and productive activities, however. For the low-active girls, PE homework added on average 26 minutes of activity time in a week. Replacing at least 10 minutes of daily sedentary time with physical activity appears to be a minimal starting point to combat declining physical activity in youth (Corder et al., 2015). In an earlier study from the United States, Trilk et al. (2016) found that girls who participated in homework had a higher average of daily minutes of physical activity and less of a decline in physical activity from grades 6 to 8. Learned habits of completing homework may help to sustain at least light physical activity during adolescence. Creating functional knowledge and teaching adolescents how to be active on their own might result in lifelong healthy behaviour (Duncan et al., 2011); PE homework may be one such way to improve daily physical activity habits in adolescents and thereby increase healthy behaviours over the lifespan.

In the present study, PE homework assignments were related to the Finnish national PE curriculum (Finnish National Core Curriculum, 2014). Due to the relatively short school days in Finland, homework is a common way of adding practice time in many school subjects, but assignments in PE are rare. However, when they are given such assignments, students in Finland complete them with a high degree of compliance (89%; Kääpä et al., 2017). In the present study, the pupils participated in decision-making concerning the content of PE homework assignments, and they could decide the amount and intensity level of the activity in the assignment themselves (Kääpä et al., 2017). Fostering perceptions of ownership over participation in physical activity and creating opportunities for decision-making may enable girls to be active in a way they choose (Corder et al., 2013; Deci & Ryan, 2000; Lawler et al., 2017). Reinforcement by influential adults, such as PE teachers and coaches, may support pupils' involvement in sporting activities (Trilk et al., 2012). By including popular sports in PE homework, the PE teacher can advocate for sports participation outside of school and add skill practice outside of the class to lower the threshold for participation in sports as well. Introducing active homework activities into existing curriculum is a cost-effective way to utilize the expertise of trained teachers (Duncan et al., 2011). The curriculum-based assignments also enable teachers to effectively deliver health-related educational material without sacrificing their formal teaching obligations and learning objectives (Duncan et al., 2011).

### ***Types of After-School Activities***

In organized sports activities, the frequencies of the high-active girls were clearly higher compared to other groups. In terms of specific sports, the high-active girls were mainly represented in football and dance, moderately active girls in other ball games, and low-active girls were the main group in the no activities section. Encouraging female youth to engage in the more popular organized activities among adolescents might help those youth who do not like sports, are less skilled, or perhaps not motivated at competitive sports to be more physically active. In addition, increasing adolescent girls' participation in organized sport activities might help to better sustain physical activity levels over time (Bélanger et al., 2009; Pate et al., 2010). The most popular self-initiated sports activities were jogging, walking, body-conditioning exercises, playing games outside, stretching, and dancing with video games. Many of these behaviours are typically done at a low-intensity level, spontaneous and unstructured, and they might attract girls who are not interested in high-intensity activities or competitive sports. The special abilities or skills that are often required for organized sport activities or team sports are less necessary for taking part in self-initiated physical activity such as walking, jogging, or non-competitive pursuits. It is possible that some older girls substituted organized sport activities for spontaneous activities (such as walking, running, or body-conditioning exercises). Interest in a healthy lifestyle, including physical activity, might be attributed to heightened body awareness during

adolescence (Sand et al., 2015). The increase in the number of gyms, knowledge about the health benefits of training, and concern with one's body may be important factors regarding adolescents' preference for certain types of activities (Coll et al., 2014; Koorts et al., 2011). Identifying the adolescent girls' preferred types of physical activity may help influential adults to offer activities the adolescents enjoy. In addition, earlier studies have shown that low-intensity physical activities such as walking are more sustainable than forms of MVPA throughout adolescence (Pate et al., 2010; Trilk et al., 2012). The girls from all activity groups participated in self-initiated activities, which are easy to access. The selection of different self-initiated activities was the most diverse in the high-active group of girls, and thus, an effective strategy for increase MVPA among low and moderately active youth might be to offer a more diverse repertoire of choices to increase physical activity during leisure time.

The frequency of the low-active girls was the highest in household activities. Cleaning, taking the dog out, and taking care of siblings were the most popular household activities. Duties related to the home environment are usually occupational and more or less obligatory; due to this, these activities do not usually decrease over time. However, these duties might reduce the time and opportunities to participate in organized sport or self-initiated activities that would allow adolescents to increase the amount of time spent in MVPA. It is important to note that low-active girls have shown lower odds of active transportation (Mehtälä et al., 2020). Thus, one implication from the present study would be to add active transportation as a PE homework assignment given the sharp drop in activity that occurred for the low-active girls after school. Further, in Finland, physical activity during school hours (particularly at recess) has been a target of national interventions (Haapala et al., 2014). According to Haapala et al. (2014) and the *Finnish Schools on the Move* study, organized recess activities, student recess activators, equipment provision, the development of sports facilities, and gender-specific physical activities have all contributed to significant gains in youth activity. A 15-minute break after every 45-minute lesson in Finland also provides youth with consistent opportunities to be active during the school day. In the schools from the present study, it is mandatory to go outside to the schoolyard during recess breaks. This could likely activate even the low-active girls during school hours and can be a further target of intervention to increase activity among low-active youth.

### **Strengths and Limitations**

This study incorporated several sources of data, providing a broader view of adolescent after-school physical activities (Ekelund et al., 2011; Pate & O'Neill, 2009). Objectively measured physical activity data and the self-reported physical activity measure allow for accurate intensity, frequency, and duration data for physical activity, while the self-report measure provides a rich context for understanding adolescents' activities during after-school hours. However, the cross-sectional nature of the case study is a limitation and precludes conclusions being made about the direction of effects between adolescent girls' physical activity and the behaviours of physical activity participation. Because of the small sample size, the data cannot be considered globally representative. However, given similar Westernized practices and schooling, it is likely that the physical activity patterns and types are reflective of those of Finnish lower secondary school girls across the country.

### **Conclusion**

This study offers a picture of the diverse nature of the physical activity of secondary school girls and identifies the variety of behaviours and types of physical activity that girls perform during after-school hours. Utilizing these results can help influential adults encourage girls—especially low-active girls—to be active in a way they choose to be, as well as improve offerings for an array of activities that girls may be more motivated to engage with in the future. An effective approach to promoting physical activity could be to experiment with school-based programs that target girls in after-school hours with the types of physical activity they prefer. It is important that researchers and policymakers recognize the school environment as a vehicle for changing girls' physical activity levels during after-school hours. School reaches all adolescents, so it can play a central role in delivering effective physical activity programming. As demonstrated in this study, PE homework assignments may have the potential to replace sedentary time and thereby increase physically active time for female youth.

### **Competing Interests**

The authors have no competing interests to declare.

## References

- Abdelghaffar, E. A., El Kazdough, H., Bouftini, S., El Fakir, S., & El Achhab, Y.** (2019). Perspectives of adolescents, parents, and teachers on barriers and facilitators of physical activity among school-age adolescents: A qualitative analysis. *Environmental Health and Preventative Medicine*, *24*(1), 21–13. DOI: <https://doi.org/10.1186/s12199-019-0775-y>
- Afterschool Alliance.** (2014). *America after 3pm: Afterschool programs in demand*. [http://www.afterschoolalliance.org/documents/AA3PM-2014/AA3PM\\_National\\_Report.pdf](http://www.afterschoolalliance.org/documents/AA3PM-2014/AA3PM_National_Report.pdf)
- Aittasalo, M., Vähä-Ypyä, H., Vasankari, T., Husu, P., Jussila, A. M., & Sievänen, H.** (2015). Mean amplitude deviation calculated from raw acceleration data: a novel method for classifying of adolescents' physical activity irrespective of accelerometer brand. *BMC Sports Science, Medicine & Rehabilitation*, *7*(1), 18. DOI: <https://doi.org/10.1186/s13102-015-0010-0>
- American College of Sports Medicine Position Standard.** (2018). *Physical Activity Guidelines for Americans*. 2<sup>nd</sup> edition. <https://health.gov/our-work/physical-activity/current-guidelines>
- Arundell, L., Fletcher, E., Salmon, J., Veitch, J., & Hinkley, T.** (2016). A systemic review of the prevalence of sedentary behavior during the after-school period among children aged 5–18 years. *International Journal of Behavioral Nutrition and Physical Activity*, *13*, 93. DOI: <https://doi.org/10.1186/s12966-016-0419-1>
- Atkin, A., Corder, K., Goodyer, I., Bamber, D., Ekelund, U., Brage, S., Dunn, V., & Van Sluijs, E. M. F.** (2015). Perceived family functioning and friendship quality: Cross-sectional associations with physical activity and sedentary behaviours. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 23. DOI: <https://doi.org/10.1186/s12966-015-0180-x>
- Beets, M. W., Beighle, A., Erwin, H. E., & Huberty, J. L.** (2009). After-school program impact on physical activity and Fitness. *American Journal of Preventive Medicine*, *36*, 527–537. DOI: <https://doi.org/10.1016/j.amepre.2009.01.033>
- Bélanger, M., Gray-Donald, K., O'Loughlin, J., Gilles, P., & Hanley, J.** (2009). When adolescents drop the ball: Sustainability of physical activity in youth. *American Journal of Preventive Medicine*, *37*(1), 41–49. DOI: <https://doi.org/10.1016/j.amepre.2009.04.002>
- Blomqvist, M., Mononen, K., Koski, P., & Kokko, S.** (2019). Participation in sport club activities. [Urheilu ja seuraharrastaminen.] In *The physical activity behaviours of children and adolescents in Finland; results of the LIITU study 2018*. [Lasten ja nuorten liikuntakäyttäytyminen Suomessa. LIITU-tutkimuksen tuloksia 2018.], edited by: Kokko, S. & L. Martin. Helsinki, Finland: State Sport Council Publications, *1*, 47–55.
- Claxton, D., & Wells, G. M.** (2009). The effect of physical activity homework on physical activity among college students. *Journal of Physical Activity and Health*, *6*(2), 203–210. DOI: <https://doi.org/10.1123/jpah.6.2.203>
- Coll, C. V., Knuth, A. G., Bastos, J. P., Hallal, P. C., & Bertoldi, A. D.** (2014). Time trends of physical activity among Brazilian adolescents over a 7-year period. *Journal of Adolescent Health*, *54*(2), 209–213. DOI: <https://doi.org/10.1016/j.jadohealth.2013.08.010>
- Corder, K., Atkin, A. J., Ekelund, U., & Van Sluijs, E. M. F.** (2013). What do adolescents want in order to become more active? *BMC Public Health*, *13*(1), 718, 1–10. DOI: <https://doi.org/10.1186/1471-2458-13-718>
- Corder, K., Sharp, S. J., Atkin, A. J., Griffin, S. J., Jones, A. P., Ekelund, U., & Van Sluijs, E. M. F.** (2015). Change in objectively measured physical activity during the transition to adolescence. *British Journal of Sports Medicine*, *49*(11), 730–736. DOI: <https://doi.org/10.1136/bjsports-2013-093190>
- Currie, C., Gabhainn, S. N., Godeau, E., Roberts, C., Smith, R., Currie, D., Pickett, W., Richter, M., Morgan, A., & Barnekow, V.** (2008). Inequalities in young people's health: HBSC international report from the 2005/06 survey. In *Health Policy for Children and Adolescents*, 105–107.
- Deci, E. L., & Ryan, R. M.** (2000). The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, *11*(4), 227–268. DOI: [https://doi.org/10.1207/S15327965PLI1104\\_01](https://doi.org/10.1207/S15327965PLI1104_01)
- Duncan, S., McPhee, J. C., Schluter, P. J., Zinn, C., Smith, R., & Schofield, G.** (2011). Efficacy of a compulsory homework program for increasing physical activity and healthy eating in children: The healthy homework pilot study. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 127, 1–10. DOI: <https://doi.org/10.1186/1479-5868-8-127>
- Duncan, S., Stewart, T., McPhee, J., Borotkanics, R., Prendergast, K., Zinn, C., & Schofield, G.** (2019). Efficacy of a compulsory homework programme for increasing physical activity and improving nutrition in children: A cluster randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(80), 1–12. DOI: <https://doi.org/10.1186/s12966-019-0840-3>



- Ekelund, U., Tomkinson, G. R., & Armstrong, N.** (2011). What proportion of youth are physically active? Measurement issues, levels and recent time trends. *British Journal of Sports Medicine, 45*(11), 859–886. DOI: <https://doi.org/10.1136/bjsports-2011-090190>
- Fairclough, A. J., Hackett, A. F., Davies, I. G., Gobbi, R., Warburton, G. L., Stratton, G., Van Sluijs, E. M. F., & Boddy, L. M.** (2013). Promoting healthy weight in primary school children through physical activity and nutrition education: A pragmatic evaluation of the CHANGE! Randomised intervention study. *BMC Public Health, 13*, 626. DOI: <https://doi.org/10.1186/1471-2458-13-626>
- Fedewa, A. L., & Ahn, S.** (2011). The effects of physical activity and physical fitness on children's cognitive outcomes: A meta-analysis. *Research Quarterly for Exercise and Sport, 82*(3), 521–535. PMID:21957711. DOI: <https://doi.org/10.1080/02701367.2011.10599785>
- Graham, D. J., Wall, M. M., Larson, N., & Neumark-Sztainer, D.** (2014). Multicontextual correlates of adolescent leisure-time physical activity. *American Journal of Preventive Medicine, 46*(6), 605–616. DOI: <https://doi.org/10.1016/j.amepre.2014.01.009>
- Grao-Cruces, A., Swgura-Jimenez, V., Conde-Caveda, J., Garcia-Cervantes, L., Martinez-Gomez, D., Keating, X. D., & Castro-Pinero, J.** (2019). The role of school and adolescents reach the physical activity recommendations: The UP & DOWN study. *Journal of School Health, 89*(8), 612–618. DOI: <https://doi.org/10.1111/josh.12785>
- Haapala, H., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Lintunen, T., & Tammelin, T. H.** (2014). Adolescents' physical activity at recess and actions to promote a physically active school day in four Finnish schools. *Health Education Research, 29*(5), 840–852. DOI: <https://doi.org/10.1093/her/cyu030>
- Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U.** (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *Lancet, 380*(9838), 247–257. DOI: [https://doi.org/10.1016/S0140-6736\(12\)60646-1](https://doi.org/10.1016/S0140-6736(12)60646-1)
- He, L., Ishii, K., Shibata, A., Adachi, M., Nonoue, K., & Oka, K.** (2013). Patterns of physical activity outside of school time among Japanese junior high school students. *Journal of School Health, 83*, 623–630. DOI: <https://doi.org/10.1111/josh.12074>
- Hill, K.** (2018). Homework in physical education? A review of physical education homework literature. *Journal of Physical Education, Recreation & Dance, 89*(5), 58–63. DOI: <https://doi.org/10.1080/07303084.2018.1440263>
- Husu, P., Jussila, A. M., Tokola, K., Vähä-Ypyä, H., & Vasankari, T.** (2019). Objectively measured physical activity, sedentary time, and sleeping time. *The physical activity behaviours of children and adolescents in Finland; results of the LIITU study 2018. Helsinki, Finland: State Sport Council Publication, 1*, 26–40.
- Júdice, P. B., Silva, A. M., Berria, J., Petroski, E., Ekelund, U., & Sardinha, L.** (2017). Sedentary patterns, physical activity and health-related physical fitness in youth: cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 14*(25), 1–10. DOI: <https://doi.org/10.1186/s12966-017-0481-3>
- Kääpä, M., Hirvensalo, M. H., Palomäki, S., & Valleala, U. M.** (2017). Liikuntatehtäviä kotiläksyinä: Koulun ulkopuolella tapahtuva oppiminen opetuksen tukena tyttöjen liikunnassa. [Physical active assignments as physical education homework: Adolescent girls learning PE outside of the school PE lessons.] *Liikunta & Tiede, 54*, 74–82.
- Kääpä, M., Palomäki, S., Vähä-Ypyä, H., Vasankari, T., & Hirvensalo, M.** (2019). The role of physical education homework to adolescent girls' physical activity in Finland. *Advances in Physical Education, 9*(4), 223–239. DOI: <https://doi.org/10.4236/ape.2019.94016>
- Klinker, C. D., Schipperijn, J., Christian, H., Kerr, J., Erball, A. K., & Troelsen, J.** (2014). Using accelerometers and global positioning system devices to assess gender and age differences in children's school, transport, leisure and home-based physical activity. *International Journal of Nutrition and Physical Activity, 1*(8), 1–10. DOI: <https://doi.org/10.1186/1479-5868-11-8>
- Kokko, S., Mehtälä, A., Villberg, J., Ng, K., & Hämylä, R.** (2016). Self-reported physical activity, sitting and screen time and equipment for measuring physical activity. *The physical activity behaviours of children and adolescents in Finland: Results of the LIITU study. Helsinki, Finland: State Sport Council Public, 4*, 10–15.
- Koorts, H., Mattocks, C., Ness, A. R., Deere, K., Blair, S. N., Pate, R. R., & Riddoch, C.** (2011). The association between the type, context, and levels of physical activity amongst adolescents. *Journal of Physical Act & Health, 8*(8), 1057–1065. DOI: <https://doi.org/10.1123/jpah.8.8.1057>
- Kriemler, S., Meyer, U., Martin, E., Van Sluijs, E. M. F., Anderson, L. B., & Martin, B. W.** (2011). Effect of school-based interventions on physical activity and fitness in children and adolescents: A review of reviews and systematic update. *British Journal of Sports Medicine, 45*(11), 923–930. DOI: <https://doi.org/10.1136/bjsports-2011-090186>

- Lawler, M. C., Heary, C., & Nixon, E.** (2017). Variation in adolescents' motivational characteristics across gender and physical activity patterns: A latent class analysis approach. *BMC Public Health*, *17*(1), 1–13. DOI: <https://doi.org/10.1186/s12889-017-4677-x>
- Lytle, L. A., Murray, D. M., Evenson, K. R., Moody, J., Pratt, C., Metcalfe, L., & Parra-Medina, D.** (2009). Mediators affecting girls' levels of physical activity outside of school: Findings from the Trial of Activity in Adolescent Girls. *Annals of Behavior Medicine*, *38*(2), 124–136. DOI: <https://doi.org/10.1007/s12160-009-9127-2>
- Martins, J., Marques, A., Saramento, H., & Carreiro da Costa, F.** (2015). Adolescents' perspectives on the barriers and facilitators of physical activity: A systematic review of qualitative studies. *Health Ed Research*, *30*(5), 742–755. DOI: <https://doi.org/10.1093/her/cyv042>
- Mattocks, C., Ness, A., Leary, S., Tilling, K., Blair, S. N., Sheild, J., Deere, K., Saunders, J., Kirkby, J., Smith, G. D., Wells, J., Wareham, N., Reilly, J., & Riddoch, C.** (2008). Use of accelerometers in large field-based study of children: Protocols, design issues, and effects on precision. *Journal of Physical Activity & Health*, *5*(1), 98–111. DOI: <https://doi.org/10.1123/jpah.5.s1.s98>
- Mears, R., & Jago, R.** (2016). Effectiveness of after-school interventions at increasing moderate-to-vigorous physical activity levels in 5- to 18-year olds: A systematic review and meta-analysis. *British Journal of Sports Medicine*, *50*(21), 1315. DOI: <https://doi.org/10.1136/bjsports-2015-094976>
- Mehtälä, A., Villberg, J., Blomqvist, M., Huotari, P., Jaakkola, T., Koski, P., Lintunen, T., Mononen, K., Ng, K., Palomaki, S., Saakslähti, A., Tammelin, T., Vasankari, T., & Kokko, S.** (2020). Individual- and environmental-related correlates of moderate-to-vigorous physical activity in 11-, 3-, and 15-year-old Finnish children. *PLoS ONE* *15*(6), e0234686. DOI: <https://doi.org/10.1371/journal.pone.0234686>
- Okely, A. D., Cotton, W. G., Lubans, D. R., Morgan, P. J., Puglisi, L., Miller, J., Wright, J., Batterham, M. J., Peralta, L. R., & Perry, J.** (2011). A school-based intervention to promote physical activity among adolescent girls: Rationale, design, and baseline data from the Girls in Sport group randomised controlled trial. *BMC Public Health*, *11*, 658. DOI: <https://doi.org/10.1186/1471-2458-11-658>
- Owen, M. B., Curry, W. B., Kerner, C., Newson, L., & Fairclough, S. J.** (2017). The effectiveness of school-based physical activity interventions for adolescent girls: A systematic review and meta-analysis. *Preventive Medicine*, *105*, 237–249. DOI: <https://doi.org/10.1016/j.ypmed.2017.09.018>
- Paakkari, L., Kokko, S., Villberg, J., Paakkari, O., & Tynjälä, J.** (2017). Health literacy and participation in sport club activities among adolescents. *Scandinavian Journal of Public Health*, *45*(8), 854–860. DOI: <https://doi.org/10.1177/1403494817714189>
- Pardo, A., Román-Vilñas, B., Ribas-Barba, L., Roure, E., Vallbona, C., & Serra-Majem, L.** (2014). Health-enhancing physical activity and associated factors in a Spanish population. *Journal of Science and Medicine in Sport*, *17*(2), 188–194. DOI: <https://doi.org/10.1016/j.jsams.2013.04.002>
- Pate, R. R., & O'Neill, J. R.** (2009). After-school interventions to increase physical activity among youth. *British Journal of Sports Medicine*, *43*(1), 14–18. DOI: <https://doi.org/10.1136/bjism.2008.055517>
- Pate, R. R., O'Neill, J. R., & Lobelo, F.** (2008). The evolving definition of “sedentary”. *Exercise Sport Science Reviews*, *36*(4), 173–178. DOI: <https://doi.org/10.1097/JES.0b013e3181877d1a>
- Pate, R. R., Sallis, J. F., Ward, D. S., Stevens, J., Dowda, M., Welk, G. J., Young, D. R., Jobe, J. B., & Strikmiller, P. K.** (2010). Age-related changes in types and contexts of physical activity in moderate school girls. *American Journal of Preventive Medicine*, *39*(5), 433–439. DOI: <https://doi.org/10.1016/j.amepre.2010.07.013>
- Pate, R. R., Stevens, J., Webber, L. S., Dowda, M., Murray, D. M., Young, D. R., & Going, S.** (2009). Age-related change in physical activity in adolescent girls. *Journal of Adolescent Health*, *44*(3), 275–282. DOI: <https://doi.org/10.1016/j.jadohealth.2008.07.003>
- Perusopetuksen Opetussuunnitelman Perusteet (Finnish National Core Curriculum).** (2014). *Finnish National Agency for Education, Regulations and Guidelines*, 433–437.
- Ruiz, J. R., Ortega, F. B., Martínez-Cómez, D., Labayen, I., Moreno, L. A., De Bourdeaudhuij, I., Manios, Y., Gonzalez-Gross, M., Mauro, B., Molnar, D., Widhalm, K., Marcos, A., Beghin, L., Castillo, M. J., & Sjostrom, M.** (2011). Objectively measured physical activity and sedentary time in European adolescents: The HELENA study. *American Journal of Epidemiology*, *174*(2), 173–184. DOI: <https://doi.org/10.1093/aje/kwr068>
- Sand, A. S., Emaus, N., & Lian, O.** (2015). Overweight and obesity in young adult women: A matter of health or appearance? The Tromsø study: Fit futures. *International Journal of Qualitative Studies on Health and Well-Being*, *10*(1), 1–13. DOI: <https://doi.org/10.3402/qhw.v10.29026>




- Society of Health and Physical Educators.** (2016). *2016 Shape of the nation: Status of physical education in the USA*. [https://shapeamerica.org/uploads/pdfs/son/Shape-of-theNation-2016\\_web.pdf](https://shapeamerica.org/uploads/pdfs/son/Shape-of-theNation-2016_web.pdf)
- Tammelin, T. H., Aira, A., Hakamäki, M., Husu, P., Kallio, J., Kokko, S., Laine, K., Lehtonen, K., Mononen, K., Palomaki, S., Stahl, T., Saakslähti, A., Tynjala, J., & Kamppi, K.** (2016). Results from Finland's 2016 report card on physical activity for children and youth. *Journal of Physical Activity & Health, 13*(11), 157–164. DOI: <https://doi.org/10.1123/jpah.2016-0297>
- Tammelin, T., Ekelund, U., Remes, J., & Näyhä, S.** (2007). Physical activity and sedentary behaviors among Finnish Youth. *Medicine & Science in Sports Exercise, 39*(7), 1067–1074. DOI: <https://doi.org/10.1249/mss.0b13e318058a603>
- Taverno Ross, S. H., Dowda, M., Beets, M. W., & Pate, R. R.** (2013). Physical activity behavior and related characteristics of high active eighth-grade girls. *Journal of Adolescent Health, 52*(6), 745–751. DOI: <https://doi.org/10.1016/j.jadohealth.2012.12.003>
- Triik, J. L., Pate, R. R., Pfeiffer, K. A., Dowda, M., Addy, C. L., Riblisl, K. M., Neumark-Sztainer, D., & Lytle, L. A.** (2012). Cluster analysis of physical activity and sedentary behavior patterns in moderate school girls. *Journal of Adolescent Health, 51*(3), 292–298. DOI: <https://doi.org/10.1016/j.jadohealth.2011.12.021>
- Troiano, P. R., Berrigan, W. D., Dodd, C. K., Mâsse, C. L., Tilert, C. T., & Mcdowell, C. M.** (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports Exercise, 40*(1), 181–188.
- U.S. Department of Health and Human Services.** (2012). Physical activity guidelines for Americans midcourse report: Strategies to increase physical activity among youth. U.S. Department of Health and Human Services. <http://health.gov/paguidelines/midcourse/pag-mid-course-report-final.pdf>. DOI: <https://doi.org/10.1249/mss.0b013e31815a51b3>
- Vähä-Ypyä, H., Husu, P., Suni, J., Vasankari, T., & Sievänen, H.** (2017). Reliable recognition of lying, sitting, and standing with a hip-worn accelerometer. *Scandinavian Journal of Medicine & Science in Sports, 28*(3), 1092–1102. DOI: <https://doi.org/10.1111/sms.13017>
- Vähä-Ypyä, H., Vasankari, T., Husu, P., Mänttari, A., Vuorimaa, T., Suni, J., & Sievänen, H.** (2015b). Validation of cut-points for evaluating the intensity of physical activity with accelerometry-based mean amplitude deviation (MAD). *PLoS One, 10*(8), e0134813. DOI: <https://doi.org/10.1371/journal.pone.0134813>
- Vähä-Ypyä, H., Vasankari, T., Husu, P., Suni, J., & Sievänen, H.** (2015a). A universal, accurate intensity-based classification of different physical activities using raw data of accelerometer. *Clinic Physiology and Functional Imaging, 35*(1), 64–70. DOI: <https://doi.org/10.1111/cpf.12127>
- Yang, X., Telama, R., Hirvensalo, M., Tammelin, T., Viikari, J. S., & Raitakari, O. T.** (2014). Active commuting from youth to adulthood and as a predictor of physical activity in early midlife: The young Finns study. *Preventive Medicine, 59*, 5–11. DOI: <https://doi.org/10.1016/j.ypmed.2013.10.019>
- Zimmermann-Sloutskis, D., Wanner, M., Zimmermann, E., & Martin, B. W.** (2010). Physical activity levels and determinants of change in young adults: A longitudinal panel study. *International Journal of Behavioral Nutrition and Physical Activity, 7*(2), 1–14. DOI: <https://doi.org/10.1186/1479-5868-7-2>

**How to cite this article:** Kääpä, M., Palomäki, S., Vähä-Ypyä, H., Vasankari, T., Hirvensalo, M., & Fedewa, A. (2021). Finnish Adolescent Girls' Activity Patterns and The Effects of an Activity-Based Homework Intervention on Their Physical Activity. *Physical Activity and Health, 5*(1), pp. 1–14. DOI: <https://doi.org/10.5334/paah.73>

**Submitted:** 04 December 2020    **Accepted:** 24 December 2020    **Published:** 21 January 2021

**Copyright:** © 2021 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC-BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. See <http://creativecommons.org/licenses/by/4.0/>.

 *Physical Activity and Health* is a peer-reviewed open access journal published by Ubiquity Press.

**OPEN ACCESS** 