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# The Role of Physical Education Homework to Adolescent Girls' Physical Activity in Finland

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## Abstract

**Introduction:** There is an urgent need for active strategies to promote physical activity (PA) among female adolescents, as they are at greater risk of physical inactivity. In addition to Physical Education (PE) in school, to reach adequate levels of PA, young people need to participate in PA during the school day and/or after-school hours and/or in the before-school period. One week of objectively measured and self-reported information enlightens the status quo of adolescent girls' PA and the role that PE homework plays. **Purpose:** The purpose of this study was to examine girls' objectively measured PA in a lower secondary school as part of the Physical Education Homework Study, a project conducted in Finland. An additional aim was to provide insights into physical education (PE) homework as part of PA. **Methods:** Different levels of PA (i.e., light, moderate, vigorous), sedentary time, number of total steps and running steps were measured using accelerometers among girls in the 7th, 8th and 9th grades, aged between 12 and 15 years ( $n = 88$ ) for a period of 1 week. In addition, self-reported structured diaries were used to gather information about after school activities, including PE homework. An analysis of variance (ANOVA) and Tamhane's post-hoc test was used to compare the different grades on the basis of participants' PA levels and sedentary time. Data from self-reported PE homework frequencies and time spent on PE homework were analysed using the independent-samples t-test. **Results:** The PE homework was a small aspect of the participants' whole-day PA, averaging 34 minutes per week (7th grade girls 20 minutes, 8th grade girls 51 minutes, and 9th grade girls 32 minutes). Half of the girls from the 8th grade reached the 60-minute PA recommendation every day; 38% of all the girls met the recommended levels of PA. For the 7th grade girls, 35% met the recommendation, while 28% of the 9th grade girls reached the PA guidelines. The 7th grade girls recorded an average daily light PA time of 3 hours 28 minutes; this was 34 minutes more than the girls from 8th grade ( $p =$

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0.000) and 30 minutes more than the girls from the 9th grade ( $p = 0.000$ ). **Conclusion:** The PE homework provided a variety of PA for the adolescent girls' after-school hours, even if the role of homework was not time-consuming (20 - 51 minutes per week). A possible way of promoting active time among adolescents during after-school hours is to assign them PE homework, hence, active PE assignments could replace sedentary activities in adolescent girls' lives.

### Keywords

Physical Activity, Adolescent Girls, PE Homework, Accelerometer, Self-Report

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## 1. Introduction

In most countries, physical activity (PA) participation radically decreases during lower secondary school, especially among girls (Currie et al., 2008: pp. 105-107; Ekelund et al., 2012; Haapala et al., 2017). As a result, many adolescents fail to meet the recommended levels of PA (Currie et al., 2008; Pate & O'Neill, 2009; Husu, Vähä-Ypyä, & Vasankari, 2016). According to the Finnish National Physical Activity Recommendations, adolescents should be physically active more than 60 minutes per day (Tammelin & Karvinen, 2008). In Finland, only 10% - 17% of adolescents aged between 13 and 15 attain moderate-to-vigorous levels of PA, with the most radical decline in PA occurring among girls aged between 11 and 15, in their transition from childhood to adolescence (Kokko et al., 2015; Tammelin, Laine, & Turpeinen, 2013). According to Pate & O'Neill (2009), the objectively measured PA of adolescent girls declines at a rate of approximately 4% annually. This means that with time, the level of PA among girls recedes further from current PA guidelines.

Nearly half of young people's total daily PA accumulates after school, although the levels of after-school activity start to decrease gradually during pre-adolescence, while sedentary exposure increases as early as ages 9 to 11 (Wickel, Issartel, & Belton, 2013). Since female adolescents seem to be at greater risk of physical inactivity, there is an urgent need for effective strategies to promote PA among them (Aelterman et al., 2012). The after-school period represents a segment of the day in which adolescents' health-enhancing levels of PA should be promoted (Beets et al., 2009). However, adolescents, particularly girls, accumulate low levels of moderate-to-vigorous physical activity (MVPA) during after-school hours, and their MVPA levels decline at a faster rate (Okely et al., 2011; Pate & O'Neill, 2009). According to Atkin et al. (2008), technology-based sedentary behaviour is the most prevalent activity among adolescents in after-school hours; the sedentary time of girls lasted for 35 minutes per day. Meanwhile, the times spent physically active amounted to 19 minutes for girls per day (Atkin et al., 2008).

School is an important institution for PA promotion, as the vast majority of youths attend school. Thus, physical education (PE), as a structured school activity, has great potential in terms of public-health reach (Scruggs, 2007). There have been calls for schools to expand their efforts to increase PA-related opportunities to obtain higher levels of PA in adolescents, particularly adolescent girls. Even if school PE lessons are well organized and PA levels during these lessons are adequate, PE lessons do not exert a sufficient influence over adolescents' PA and health (Fairclough & Stratton, 2005). MVPA is performed most often during leisure time, while school sports contribute only marginally to MVPA (Pfitzner et al., 2013). In Finland, a great deal of effort has been set into activating school days, for example, the Finnish Schools on the Move (Haapala et al., 2017). In addition to school PE, to reach adequate levels of PA, children and young people need to participate in PA during the school day and/or during after-school hours and/or in the before-school period. A possible way of promoting PA among youths is to assign PE homework (Gabbei & Hamrick, 2001; Williams & Hannon, 2013; Kääpä et al., 2017). Homework assignments could be designed to practise activities learned earlier at school; to be effective, the practicing should take place during after-school hours. Physical homework provides an opportunity for students to apply and practice the skills learnt in PE lessons (Gabbei & Hamrick, 2001; Williams & Hannon, 2013). According to Kääpä et al. (2017), students can find PE homework enjoyable and beneficial. For example, students enjoyed PE homework that included practicing with family member. In addition, it has been found that Finnish students enjoy participating in planning PE homework (Kääpä et al., 2017). The Finnish National Core Curriculum allows and even encourages the use of leisure time to practice skills learnt during lessons (Finnish National Core Curriculum, 2014). PE homework assignments can be implemented in nearby sporting environments or facilities. Becoming familiar with the physical environment and facilities while undertaking PE homework helps to make PA part of one's lifestyle (Williams & Hannon, 2013; Smith & Claxton, 2003).

The purpose of this study was to examine the objectively measured PA levels of adolescent girls in a lower secondary school in Finland and provide insights into the role of PE homework as part of adolescent girls' PA. The participants' MVPA, sedentary time, and the number of total steps and running steps were reported, and compared to PE homework-participation. Using both types of steps and the MET values add variety and reliability to the results and enable comparison between the step-based studies as well.

## 2. Materials and Methods

### 2.1. Design of the Study

This study is part of the Physical Education Homework Study, a project that began in Finland in 2015. The purpose of the study was to attempt to increase adolescents' PA time by giving them active PE homework during PE lessons (Kääpä

et al., 2017). This week-long cross-sectional study, conducted in autumn 2016, concentrated on gathering information about adolescent girls' PA and the role of PE homework by using objective measurements and self-reported methods.

## 2.2. Participants

The participants for this study were girls in the 7th, 8th and 9th grades in a lower secondary school in central Finland. The girls were aged between 12 and 15 years. The half of the girls live near the school and half of them commute to school by buss. From a total of 124 girls, 105 (84.7%) agreed to participate in the study. Girls and their parents were informed about the study beforehand, and informed consent was obtained from the parents/guardians. According to the layer of the University Ethical Board, this protocol covers needed ethical permissions concerning this type of research. The study consisted of week-long objective PA measures using accelerometers and structured self-report diaries during the measurement week. There were missing data from 17 participants as a result of students (12) who were absent from school during the measurement week, and some accelerometer problems that were encountered. The actual study data consists of information from participants who had at least 4 days of accelerometer data ( $n = 88$ ) and questionnaires concerning their self-report diaries ( $n = 81$ ). In self-reported data, the division was 28 girls from the 7th grade, 26 girls from the 8th grade and 27 girls from 9th grade. In the objectively measured data analysis, to get the most comprehensive overview about the adolescents' physical activity, all of the participants acceptable (at least 4 days, 10 h minimum/day) accelerometer data were used ( $n = 513$ ). For this reason, the measurement days consisted of 190 days of data from the 7th grade girls, 152 days of data from the 8th grade girls and 171 days of data from the 9th grade girls. Girls' who had both objectively measured and self-reported data were included in analyses of compound measurement results (No PE homework  $n = 238$ , PE homework twice a week or more  $n = 248$ ).

## 2.3. Setting

In Finland, the school day usually begins at 8:00 am and ends at 3:00 or 4:00 pm. The normal school-day structure consists of 7 to 8 lessons lasting for 45-minute each, with a 15-minute break between the lessons and a 30-minute lunch break at noon. The Finnish Schools on the Move program has concentrated on activating students during the school day and using the breaks in an active way (Haapala et al., 2017). The PE Homework Study focuses on activating after-school hours (Käätä et al., 2017). During the study period, the lower secondary school students had  $2 \times 45$  mins PE lessons in a row (lasting 90 minutes) once a week. In Finland, this double classes one day a week is normal national standard. In Finland, organized after-school sport activities for adolescents usually take place in sport clubs and in teams. According to Blomqvist et al. (2015), over half (53%) of the Finns in their study aged between 9 and 15 took

part in sports-club activities at least once a week. Their participation declined as they aged, with low levels of participation among 15-year-old (Blomqvist et al., 2015).

The PE teacher (first author) had occasionally given the girls in the lower secondary school PE homework in past years; thus, the concept of PE homework was familiar to them. PE homework was an aspect of PE that was undertaken by all of the girls. Homework assignments followed PE requirements, and they were given to all students in every PE lesson once a week during the study year. This meant that PE homework was given between 30 and 40 times per school year. PE homework assignments often consisted of body-conditioning exercises such as push-ups, squats or ab crunches; jogging with a family member or friend; stretching; or some skill or activity from the PE lesson. An example of PE homework is balance practices, where the student stands on their right foot in the morning while brushing their teeth and on their left foot at night while brushing their teeth. PE skill practices consisted of tasks practiced in PE lessons that they had to practice for PE homework (e.g., throwing and catching a ball). An example of PE homework combining skill practice and parental involvement is teaching the correct performance of squats to a family member. Involving the students in planning their PE homework was sometimes part of the PE lessons' "cooling-down" session. Often, the students could choose the scale or complexity of the homework themselves and they had an influence on the activity. Improving the girls' autonomy and self-determination was the main goal in involving them in planning, choosing the scale and deciding on the amount of PE homework (Deci & Ryan, 2000). Girls participated in their PE homework assignments actively, 89.7% of the girls always completed their PE homework (Käätä et al., 2017).

#### 2.4. Self-Reported Data

The students' self-reported PA was assessed using a structured diary questionnaire. The aim was to identify the frequency and type of PA that girls engaged in. The diary questionnaire consisted of categorized structures where students marked their activity frequency, level of self-initiated PA, organized sport activities, occupational activities and PE homework in which they participated within the study week. In addition, they estimated the time spent on PE homework. In this study, only self-reported PE homework reports were used. Girls this age are expected to be able to fill out this kind of structured diary that does not require a lot of creativity or writing. Self-reported data supplements the objectively measured data identifying the context of physical activity.

#### 2.5. Accelerometer Data

A tri-axial accelerometer, UKK RM42 (UKK-Institute, Tampere, Finland), was selected because of its small-sized and light monitor. It can easily be worn for 24 hours a day and can collect and store data over the course of a week without

needing to be charged. These accelerometers measure accurate information concerning the duration, intensity and pattern of PA and inactive periods, posture and postural changes and the number of total and running steps and enable the comparison of accelerometer results between different studies also in adolescents (Aittasalo et al., 2015). The ability of accelerometers to also record incidental PA is important, as this might be difficult to recall in self-reports, especially for children and adolescents. The accurate information on the metabolic equivalent (MET)-values of PA levels broadens the results from the pedometer's step counts (Vähä-Ypyä et al., 2015a, 2015b). The time spent standing still, sitting and lying, PA levels and the number of daily steps and running step were categorized separately. The total number of steps includes walking and running steps. Using both types of steps along with the MET values adds variety and reliability to the results.

## 2.6. Procedures

The accelerometer- and diary-based measurements were implemented in November 2016, 3 months following the beginning of the semester, meaning that several PE homework assignments had already been completed. The teacher delivered the devices during PE lessons and instructed the girls to wear the flexible (elasticated) belt with the accelerometer around their waist, placing the monitor on the right hip. The teacher gave oral instructions, and written instructions were attached to the diary questionnaire, which was delivered during the same lesson. The girls were instructed to wear the belt for seven consecutive days during their waking hours, apart from during water-based activities such as showering or swimming. The girls started the monitoring straight away and tested the accelerometers; if a malfunction was detected, the device was replaced immediately.

The girls returned the accelerometers and their self-report diaries a week later, during their following PE lesson, fulfilling instructed seven consecutive days requirement. To obtain a comprehensive overview, only the data from the participants who used the accelerometer for at least 4 days during the week and at least 10 hours each day were accepted for the study, and the data were analysed in 6-second epochs (Troiano et al., 2008). In studies with large sample, reliability can be achieved with 3 days of recording. Studies with smaller sample sizes like this, it is recommended to measure a greater number of days to improve measurement precision (Mattocks et al., 2008). Monitoring is also recommended to be performed over an entire day (Trost et al., 2000). The average measurement time was 14 hours 30 minutes per day; the minimum time was 12 hours 8 minutes, while the maximum was 19 hours 47 minutes. PE homework was given when the group had their PE lesson; the time period for completing the assigned task was a week. PE homework assignments could be performed at any time during girls' leisure time, on account of this, the weekdays or weekends were not separated.

## 2.7. Analysis

The tri-axial acceleration data, collected at a 100 Hz sample rate in raw mode (in g-units), were uploaded and stored, and a statistician from the UKK -institute transferred the data into Excel spreadsheet for further analysis. 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). Further, the measured MAD values were converted to MET values in a validated way (Vähä-Ypyä et al., 2015a). MET values were used to categorize PA into different intensity levels: Light PA was defined as activity corresponding to 1.5 - 2.9 METs, moderate activity as 3.0 - 6.0 METs and vigorous activity was more than 6 MET. Body posture was classified as standing, sitting or lying for epochs of low movement intensity (<1.5 MET). The classifications were based on the Angle for Posture Estimation (APE) algorithm, which compares the accelerometer orientation in relation to an identified upright position at the end of each 6-second epoch (Vähä-Ypyä et al., 2018).

The analyses were implemented using SPSS software. The recorded PA levels and sedentary time of each girl from the measurement days were compared. Means and standard deviations in light, moderate, vigorous and MVPA MET values, along with standing and sedentary behaviour (i.e., sitting and lying) were analysed using analysis of variance (ANOVA) and Tamhane's post-hoc test. The MET values were smoothed by calculating a 1-minute exponential moving average for each epoch; the peak hourly MET value was analysed from the smoothed MET values. In addition, the mean values and standard deviations from the number of average total and running steps per day of the girls from the 7th, 8th and 9th grades were compared by means of ANOVA and Tamhane's post-hoc test. An ANOVA and Tamhane's post-hoc test were used to compare the 7th, 8th and 9th graders in terms of their self-reported data on the frequency and time spent doing their PE homework. The girls were further divided into 2 PE homework groups: Those who did not do PE homework at all or did it only once a week and those who did it at least twice a week. Independent-sample T-tests were used to compare two groups' daily running and total steps with the objectively measured PA levels. For the independent-samples t-tests, Cohen's *d* was determined by calculating the mean difference between the two groups and then dividing the result by the pooled standard deviation. Cohen's *d* is the appropriate effect -size measure when 2 groups have similar standard deviations and are of similar size, as in these data. The significance level was set at  $p < 0.05$ .

## 3. Results

### 3.1. Physical Activity Levels

The participants' objectively measured and combined light, moderate and vigorous average PA time of the participants was 4 hours 18 minutes (SD  $\pm$  1 hours 6 minutes). The light PA coverage of 3 hours 8 minutes ( $\pm$ 40 minutes) was transcendent compared to a moderate-to-vigorous coverage of 1 hour 2 minutes



( $\pm 20$  minutes) and 8 minutes ( $\pm 6$  minutes) of vigorous PA per day (Table 1). The average measurement time per day was comprehensive, 14 hours 30 minutes, and the average sedentary time was 7 hours 37 minutes ( $\pm 1$  hour 52 minutes), representing 52% of the total measurement time. The participants spent an average of 2 hours 41 minutes ( $\pm 55$  minutes) standing still, 6 hours 29 minutes ( $\pm 1$  hour 5 minutes) sitting and 1 hour 8 minutes ( $\pm 1$  hour 5 minutes) lying down on each measurement day.

The 7th graders recorded greater levels of daily light PA than those from other grades. The 7th grade girls recorded an average daily light PA time of 3 hours 28 minutes ( $\pm 32$  minutes); this is 34 minutes more than the girls from 8th grade ( $p = 0.000$ ) and 30 minutes more than the girls from the 9th grade ( $p = 0.000$ ). Regarding daily moderate PA, there was a significant difference between the girls from the 7th and 8th grades ( $p = 0.017$ ), with a 6-minute time differential benefitting the 8th graders. The half of the girls from the 8th grade reached the Finnish 60-minute PA recommendation; 38% of all girls met the recommended levels of PA. For the 7th grade girls, 35% met the recommendations, while 28% of the 9th grade girls reached the 60-minute PA recommendations every day.

The 9th grade girls spent more time standing than others. There was a significant difference in time spent standing between the girls from the 7th and 9th grades ( $p = 0.038$ ), with a 12-minute differential between these grades.

Regarding sedentary behaviour (i.e., sitting and lying), the girls from the 8th

**Table 1.** Participants' daily average time (hours and minutes) spent in different physical activity (PA) levels, including combined level of moderate and vigorous physical activity (MVPA), by grades (mean, std. deviation, ANOVA  $p$ -value and Tamhane's post-hoc test).

	7th grade (190 days)	8th grade (152 days)	9th grade (171 days)	All (513 days)	All ANOVA $p$ -value	7-8th grade	7-9th grade	8-9th grade
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)				
Light PA (1.5 - 2.9 MET)	3:28 (0:32)	2:54 (0:36)	2:58 (0:42)	3:08 (0:40)	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	0.834
Moderate PA (3 - 6 MET)	0:59 (0:16)	1:05 (0:23)	1:03 (0:21)	1:02 (0:20)	<b>0.016</b>	<b>0.016</b>	0.193	0.656
Vigorous PA (over 6 MET)	0:08 (0:07)	0:09 (0:06)	0:08 (0:06)	0:08 (0:06)	0.110	0.317	0.937	0.098
MVPA	1:08 (0:40)	1:15 (0:43)	1:11 (0:40)	1:11 (0:41)	0.283	0.315	0.864	0.755
Time spent standing	2:36 (0:47)	2:38 (1:02)	2:50 (0:57)	2:41 (0:55)	<b>0.041</b>	0.915	<b>0.030</b>	0.287
Time spent sitting	6:30 (1:05)	6:31 (1:07)	6:25 (1:04)	6:29 (1:05)	0.667	10.000	0.782	0.864
Time spent lying	1:19 (1:13)	0:41 (0:35)	1:20 (1:08)	1:08 (1:05)	<b>0.000</b>	<b>0.000</b>	10.000	<b>0.000</b>
Total sedentary (sitting and lying)	7:51 (2:01)	7:11 (1:18)	7:45 (2:02)	7:37 (1:52)	<b>0.003</b>	<b>0.001</b>	0.970	<b>0.008</b>

grade recorded the shortest time. The time spent sedentarily by the 7th grade girls' (7 hours 50 minutes) was 38 minutes more than that spent by the girls in 8th grade (7 hours 12 minutes) ( $p = 0.002$ ). Moreover, the girls in the 9th grade recorded a sedentary time of 33 minutes more than that of the girls in the 8th grade ( $p = 0.012$ ). There was a significant difference in time spent lying down: The 8th graders spent 38 minutes less lying down than the 7th graders ( $p = 0.000$ ) and 33 minutes less than the grade 9th graders ( $p = 0.000$ ).

### 3.2. Steps per Day

The girls averaged 8535 steps per day (Table 2), and the average number of running steps per measurement day was 730. The number of total steps per day varied from a minimum of 4645 steps to a maximum of 14,089 steps. One-third (32%) of the girls reached the average 10,000-step recommendation per day (Tudor-Locke et al., 2011; Adams, Johnson, & Tudor-Locke, 2013). The differences between the girls from the different grades were prominent, especially in terms of running steps. The average daily running steps recorded for the 9th grade girls was the lowest (547) among the grades; the 7th grade girls recorded an average of 843 daily running steps ( $p = 0.000$ ), while the 8th grade girls recorded an average of 796 daily running steps ( $p = 0.000$ ). The girls from 8th grade recorded the highest number of total steps (9036), and over 44% of them reached the average recommendation of 10,000 steps. The girls from the 7th grade averaged 8054 steps. The difference in the total number of steps between the 7th and 8th graders was almost 1000 (982) steps ( $p = 0.001$ ).

### 3.3. Self-Reported PE Homework

The 7th and 8th graders did their PE homework more than twice a week on average, 7th grade girls' homework frequency was  $2.17 \pm 1.81$  and 8th grade girls'  $2.12 \pm 1.66$  occasions per week. Meanwhile, the 9th graders reported a frequency of  $1.5 \pm 1.01$  occasions a week (Table 3). PE homework added on average 34 minutes active time to the girls' week. The girls from 8th grade spent an average of 51 minutes per week on PE homework, while the girls from 7th grade spent 20 minutes and the girls from 9th grade spent 32 minutes. The difference between the girls from the 7th and 8th grades was significant ( $p = 0.027$ ) in terms of total time spent on PE homework per week.

**Table 2.** Average total steps and running steps per day by grade (mean, std. deviation, ANOVA  $p$  value with Tamhane's post-hoc test).

	7th grade ( $n = 190$ )	8th grade ( $n = 152$ )	9th grade ( $n = 171$ )	All ( $n = 513$ )	ANOVA	Post-hoc		
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	$p$ value	7 - 8th grade	7 - 9th grade	8 - 9th grade
Total steps	8054 (2156)	9036 (2618)	8625 (2421)	8535 (2418)	<b>0.001</b>	<b>0.001</b>	0.057	0.369
Running steps	843 (624)	796 (529)	547 (417)	730 (549)	<b>0.000</b>	0.856	<b>0.000</b>	<b>0.000</b>

**Table 3.** Self-reported PE homework frequency/week and minutes/student/week: Comparisons between the 7th, 8th and 9th grades using ANOVA *p* values and Tamhane's post-hoc test.

	7th grade <i>n</i> = 28 Mean (SD)	8th grade <i>n</i> = 26 Mean (SD)	9th grade <i>n</i> = 27 Mean (SD)	All <i>n</i> = 81 Mean (SD)	ANOVA <i>p</i> value	Post-hoc 7 - 8th grade	7 - 9th grade	8 - 9th grade
PE homework (frequency/week)	2.17 (1.81)	2.12 (1.66)	1.52 (1.01)	1.94 (1.55)	0.228	0.999	0.271	0.326
PE homework (minutes/student/week)	20 (19)	51 (53)	32 (38)	34 (40)	<b>0.017</b>	<b>0.027</b>	0.415	0.365

Those who did PE homework twice or more per week had 371 more daily running steps ( $p = 0.000$ ) and 1067 more total daily steps ( $p = 0.107$ ) than those who did not do homework as often (Table 4).

The difference in objectively measured average vigorous daily PA between the groups who did PE homework more often and those who did not was statistically significant ( $p = 0.000$ ) (Table 5). The differences comprised an average of 3 to 7 minutes, but the difference favoured the group who did more PE homework.

#### 4. Discussion

As a part of the Physical Education Homework Study, adolescent girls' objectively measured PA and self-reported PE homework were examined. The girls were more active compared to those in other PA studies (Ruiz et al., 2011; Cohen, Ghosh-Dastidar, & Lytle, 2014; Marques et al., 2015); 38% of the girls reached the 60-minute MVPA recommendations (Currie et al., 2008). The PE homework comprised an average of 34 minutes of active time per week. As a whole, those who did PE homework at least twice per week were more physically active than those who did less PE homework. There was a statistically significant difference in vigorous PA and running steps between the PE homework groups.

On average, girls spent 1 hour 2 minutes daily on moderate PA (3 - 6 MET) and 8 minutes on vigorous PA (over 6 MET), with MVPA averaging 1 hour and 11 minutes. Comparing these results to those of a 9-country international study (Ruiz et al., 2011), the amount of MVPA was higher in this study than in others. According to Ruiz et al. (2011), European adolescent girls' (aged 12.5 - 17.5 years) MVPA was 49 minutes per day. In the study of the 9 European countries, 27.5% of girls met the current MVPA recommendations (over 60 minutes per day). In the present study, 35% of girls from 7th grade, 50% of girls from 8th grade and 28% of girls from 9th grade reached the 60-minute recommendation, even if MVPA was on average 1 hour and 11 minutes. The differences between the grades in MVPA comprised a few minutes, but the 7th-grade girls were the most active when light, moderate and vigorous activities were compounded. Particularly with light PA, there were significant differences between the 7th graders and the other grades. The girls in this study were more active than in the study of Cohen, Ghosh-Dastidar, & Lytle (2014) and in that of Marques et al. (2015). In the present study, the average MVPA of the 8th-grade girls was 75

**Table 4.** Differences in self-reported homework frequency and daily steps and running steps by independent sample t-test.

	No PE homework or just once <i>n</i> = 238	PE homework twice or more <i>n</i> = 248	<i>p</i> value	Cohen's <i>d</i> effect size
Total steps mean (SD)	8061 (2321)	9128 (2260)	0.107	0.465796
Running steps mean (SD)	559 (372)	930 (630)	<b>0.000</b>	0.717128

**Table 5.** Differences in self-reported homework frequency and in MET-values in Light, Moderate and Vigorous activity levels by independent-sample t-test.

	No PE homework or just once <i>n</i> = 238	PE homework twice or more <i>n</i> = 248	<i>p</i> value	Cohen's <i>d</i> effect size
Light PA (1.5 - 3 MET) mean hour and minute (SD)	3:05 (0:39)	3:09 (0:40)	0.796	0.101258
Moderate PA (3 - 6 MET) mean hour and minute (SD)	0:59 (0:19)	1:06 (0:20)	0.341	0.358856
Vigorous PA (>6 MET) mean hour and minute (SD)	0:07 (0:05)	0:10 (0:07)	<b>0.000</b>	0.491553

minutes, while in Cohen, Ghosh-Dastidar, & Lytle (2014) study, their average was 22.2 minutes per day. The study of Marques et al. (2015) had the same continuum in their results: Girls aged between 10 and 18 recorded an average MVPA of 34 minutes per day, with sedentary time being 9 hours 8 minutes. In the present study, the average sedentary time was 7 hours 37 minutes, which is less than in other studies. Even if the MVPA in this study is higher than in others, the most revealing element remains the low time recorded for sedentary behaviour. What is noteworthy is that the 8th-grade girls recorded only 7 hours 12 minutes of sedentary time. In a study by Okely et al. (2011), which investigated 1518 adolescent girls, only 1.5% met the current PA recommendations; the girls spent less than 5% of their waking hours in MVPA and 60% spent time being sedentary. In this study, PA levels during school hours might be partly due to the policy of the school. It is mandatory to go outdoors during every recess, which means that even the most sedentary students engage in light activity during breaks when moving outside and then back to their classes for the next lesson.

According to methodology and research, there is a great range of variation in step-count guidelines for adolescents: Numbers vary from 9000 to 16,000 steps per day (Silva et al., 2015). The guidelines of Tudor-Locke et al. (2011) are well known and recommendations are directed to adolescent girls. To maintain an adolescent's health, the minimal recommendation of 60 minutes of MVPA is associated with the advocated 10,000 - 11,700 steps per day for adolescents (Tudor-Locke et al., 2011), which was reached by 31.6% of the girls in this study. The average number of steps per day was 8,535, which was clearly less than in MacDonald et al.'s (2017) study, where the mean daily step count for adolescent girls (aged 12 to 15) was 10,287. In this study, the difference between the mini-

imum of 4645 steps and the maximum of 14,089 steps was extensive, which might explain the lower number of average total steps.

On average, the frequency of the participants' PE homework was twice weekly. The time spent on PE homework varied from 20 minutes to 51 minutes among the different grades. The PE homework added averaging 34 minutes active time per week to the girls' after-school hours. PE homework might lower the accumulation of sedentary time throughout the afternoon by turning sedentary behaviour into more active behaviour. Moreover, some PE homework assignments required activating other persons, preferably family members. Getting parents to participate in PE homework gives them an opportunity to familiarize themselves with the content and tasks of PE (Williams & Hannon, 2013). Parents' perceptions of PE can be sometimes outdated; thus, PE homework could provide them an overview of the current contents of PE. In addition, PE skills-practice may have been extended during after-school hours through PE homework (Gabbei & Hamrick, 2001; Williams & Hannon, 2013). PE homework is also valued in terms of involving students in planning, increasing their autonomy and increasing positive PA experiences (Deci & Ryan, 2000). The study of Behrens et al. (2015), found that the teacher's supportive interaction with participants appear to be important aspect in generating an increase in PA. In their study, when teachers promoted PA, a positive relationship with MVPA was noted (Behrens et al., 2015). If the teacher's interactions and promotions can reach students in daily life (e.g., in the form of PE homework), it could increase their PA levels.

### Strengths and Limitations

The strength of this study is the combined use of an objective assessment tool and a self-reported diary questionnaire. The use of accelerometers increases the verifiability of high-quality objective data concerning the quantity and type of PA being performed. Previous studies have confirmed that the accelerometer records all ambulatory activity and that accelerometers are reliable in assessing gait parameters in children and adolescents (Ekelund, Tomkinson, & Armstrong, 2011). For example, it is more reliable to make conclusions about the predictors and health impacts of intensity-specific PA using accelerometer methods (Aittasalo et al., 2015; Brandes et al., 2006). However, self-reported PA data provide a source of information that cannot be reached by accelerometers. On the other hand, the outcome from self-reported diaries might have been affected by biases such as problems with recall, social desirability, over-reporting of frequencies or over-reporting of time spent doing PE homework. A combination of contextual self-reported data and accelerometer-assessed PA is a desirable surveillance mechanism for collecting data concerning adolescents' PA during after-school hours; these sources allow researchers to provide meaningful findings.

The classification used in this study was the APE algorithm, which compares the accelerometer orientation in relation to the identified upright position at the

end of each 6-second epoch (Vähä-Ypyä et al., 2018). This 6-second epoch calculates more moving data compared to, for example, values measured at the end of each 1-minute epoch. In comparison with other studies, this is something to be considered. The excitement of participating in the study and wearing the accelerometer might add to the girls' PA. In this study, the predicted decline in PA did not occur: The 8th grade girls' moderate PA and MVPA were higher than the PA of girls in the other grades. Comparing the PA research results from Finland to other countries is tough to make as Finland has different approach to PA during school breaks.

Comparing those who did more PE homework with those who did less requires addressing. Those who participated more in PE homework might be more active and more physically competent in the first place. However, PE homework added PA time, at least a small amount, to those who did more homework and to those who did them less.

The small sample could be a limitation and might preclude the detection of significance; however, this selected sample only contained girls from one lower secondary school in Finland. The question of transferability regarding all aspects is relevant. In Finland, schools and PE are quite similar nationwide. In addition, in the Western world, PE and teaching styles are comparable. As such, the replication of the study is possible in other schools. There were no withdrawals or dropouts during the study. This could be due to the school structure and the influence schools and teachers have on girls of this age (Kohl II & Cook, 2013).

Studies, in which the students' own teacher conducts the research, imply both advantages and disadvantages. It is possible that granting the consent to participate in a study leads to heightened awareness of targeted behaviours (Beets et al., 2009). Students might also exaggerate their PA behaviour in diaries, with the desire to impress their PE teacher. However, a familiar and confidential relationship between the teacher/researcher and the participants might encourage students to take the study seriously.

## 5. Conclusion

Promoting a physically active lifestyle requires reaching beyond the PE lessons. In this study, PE homework provided an opportunity to embed active assignments into the adolescent girls' daily lives replacing sedentary activities. In addition, homework requirements were used to engage families, add knowledge about the content of the PE targets and increase the time spent practicing various skills. Referring to the results of this study, adding active PE homework to the content of PE is recommended. Future studies should target the additional facilitators of active PE assignments to more thoroughly understand the role of PE homework.

This study aimed to determine the influence of organizational and pedagogical changes in school by using PE homework as a tool to influence the PA of adolescent girls. Increasing PA outside of PE has implications also for public

health policies, the makers of which could participate in the discussion regarding the use of this practice on a wider scale. Educational policy-makers and school administrators can use these findings to guide curriculum planning and development, as schools are the focal point for interventions designed to incorporate health-enhancing PA in after-school hours.

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### Conflicts of Interest

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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