

School-time's contribution to the physical activity level of children and fulfilment of national health recommendations for physical activity in Norway

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Abstract

Physical activity (PA) among children is positively correlated to several positive health outcomes. Although school time constitutes an important arena for children's PA level because it includes all children, research in this area in Nordic countries remains limited. The aim of the present study is to investigate school-time's contribution to both children's total PA and fulfilment of health recommendations for PA. In total, 320 seventh-grade children volunteered to participate in the study, of which 291 provided valid accelerometer data and were included in the analyses. The results show that school time accounts for 30.6% and 26%, respectively, of boys' and girls' total moderate- and vigorous-PA (MVPA) during the week, and for 45.9% and 36.6%, respectively, of the MVPA that children need to fulfil the health recommendations. In addition, boys achieved significantly more MVPA than girls during school time, and school-time's contribution to the fulfilment of the health recommendations for PA was significantly greater among boys than girls. The findings indicate that PA in school time possesses an unrealized potential to substantially increase children's weekly PA. Possible strategies for increasing school-time's contribution to children's PA level, in general, and girls' PA level, in particular, are discussed.

Keywords: *school children; physical activity level; school time; health recommendations; gender*

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Introduction

Research shows definitively that physical activity (PA) level during youth is positively related to several biological and psycho-social health benefits (Janssen & LeBlanc, 2010; Loprinzi et al., 2012). The identified decline in PA during adolescence

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therefore constitutes a major societal concern (Aarnio et al., 2002; Bélanger et al., 2009; Steene-Johannesen et al., 2019). Recent research worldwide has shown that too many young people fail to achieve the recommended minimum of one hour of moderate and vigorous physical activity (MVPA) daily (Kolle et al., 2012; Mikalsen et al., 2020; Steene-Johannesen et al., 2019; WHO, 2018). MVPA represents a level of physical activity with an energy expenditure at least three times higher than that at rest (≥ 3 MET) (Kohl & Cook, 2013). MVPA can be brisk walking or any other activity entailing increased ventilation. Extant literature indicates that PA habits formed during childhood might contribute to a physically active lifestyle that persists into adulthood (Bouchard et al., 2012; Hayes et al., 2019; Rovio et al., 2018). In Norway, from the age of six-years, children spend half of their waking time in school. This organisation of all children's lives gives the school a prominent role in encouraging PA throughout the school years. More knowledge is needed, however, regarding how schools actually provide for their pupils' PA during school time. Our aim in this article is, therefore, to explore the amount of MVPA taking place during school time in children at age 13 in 18 schools in two Norwegian municipalities.

Previous research into school time PA indicates that the level of PA during school time is lower than that outside of school time, and even lower in secondary school than in primary school (Gidlow et al., 2008; Mayorga-Vega et al., 2017). Gidlow et al.'s (2008) study also showed that less than half of children compensated for their low level of PA during school time outside of school. Another investigation from Zimmo et al. (2017) substantiate both the low level of PA during school time, and the decline in school time PA as the children get older.

Studies have reported that two main areas seem to contribute most to children's PA in school: physical education (PE) lessons and breaks (Calahorro-Cañada et al., 2017; Fairclough & Stratton, 2005; Long et al., 2013; McKenzie et al., 2000). However, several studies have shown that PE accounts for a minor part of children's total (weekly) MVPA (Andersen, 2017; Chen et al., 2014; Meyer et al., 2011).

Despite the number of researchers that have identified PE lessons as important in promoting PA in young people, in the Norwegian context, scheduled time for PE is constrained by the Norwegian schools' curricula to approximately 120 minutes per week. In addition, PE usually takes place twice per week (The Education Act, 1998). Gao et al. (2015) have thus claimed that break time at school contributes even more to MVPA, as children have more available break time throughout a week than PE time. Indeed, in Norwegian schools, break time comprises more than 60 minutes every day. On the other hand, other studies have demonstrated that break time does contribute to children's PA, but in a more arbitrary manner (Mota et al., 2005). Acknowledging break time as unorganized time, the existence of arbitrary PE behaviour is not surprising. However, Norwegian studies indicate that pupils' break time PA is dependent on the way that schools design their schoolyards towards making PA more possible and attractive (Haug et al., 2008; Kjølle et al., 2011; Ulleberg, 2006). In order to realise the apparent potential of schools to provide a sufficient

level of PA to all children during school time, it might be productive to argue for a PA-promoting mindset among the school's teachers and management, related to both PE and break time. Knowledge about pupils' actual physical activity behaviour throughout school time is thus considered to constitute an essential point of departure for the present study.

Together with an exploration of the actual amount of MVPA occurring during school time in children at age 13, we also aim to focus on the issue of gender within research on PA. Indeed, studies globally indicate that boys are more physically active than girls, both in and out of school (Andersen, 2017; Gidlow et al., 2008; Lau et al., 2017; Long et al., 2013; Mayorga et al., 2017; Nettlefold et al., 2011; Steene-Johannesen et al., 2019; Walter, 2011).

The aim of this study is therefore to examine the following three research questions:

1. What is the contribution of school time MVPA to the total weekly MVPA level?
2. Are there significant differences between MVPA at school time and leisure time?
3. To what extent does school time MVPA contribute to fulfilling the government's health recommendation of 60 minutes daily MVPA?

All of the research questions will be examined from a gender perspective that inspects pertinent differences between boys and girls.

Methods

Design

To investigate the research questions in this cross-sectional study, we applied accelerometers to measure the 12-13-year-old participants' MVPA. This was divided into school-time MVPA and leisure-time MVPA.

The subjects and their parents were fully informed about the protocol prior to participating in the study. The pupils and their parents provided voluntary and written agreement for participation in the project. Ethical research regulations for research on children were strictly followed, and approval to use the data and conduct the study was granted by both the headmasters of the schools involved and the Norwegian Centre for Research Data (NSD).

Participants

The participants in the study were seventh-grade pupils (i.e., 12–13 years old) from 18 schools in two middle-sized ($\approx 15,000 - 22,000$ inhabitants) municipalities in Mid-Norway. Children from only one small rural school (four children) chose not to participate. 63% came from schools close to a medium-size city, and 37% came from rural schools. The smallest rural school had five seventh-graders (≈ 30 pupils in total), and the largest urban school had 49 seventh-graders (≈ 340 pupils in total). From

this cluster sample, 320 out of 420 children, 161 girls and 159 boys, volunteered to participate.

Measurements and procedures

Measurement of MVPA was conducted during a period of four consecutive weeks in spring (April) 2017. The participants wore the accelerometers on their right hip for seven consecutive days, as recommended by a number of researchers (Addy et al., 2014; Kolle et al., 2012; Trost et al., 2005). The accelerometer was only to be removed for water activities and while sleeping at night. According to the protocol, a daily wear-time of eight hours (480 minutes), for a minimum of two days, was set as a criterion for valid measurement (Kolle et al., 2012). The criterion for valid school-time wear-time was set to 180 minutes of accumulated counts. The activity level was registered as counts per minute (CPM), and the raw data from the accelerometers were measured with 10-second storage intervals (epochs). The average CPM for each valid day was used. In line with Norwegian mapping-studies of PA, the cut-off for MVPA was set with intervals of 2000 counts or more (Steene-Johannesen et al., 2019). Periods of zero registrations for more than 20 minutes were omitted. Timetables showing the start- and end-points of the school day at the 18 schools were acquired from the respective headteachers of the 18 schools, and MVPA in school time and in leisure time at each school were separated using the Actilife program (Actigraph, LLC, Pensacola, FL, U.S.A.).

Analyses

Data from the accelerometers were downloaded to Actilife v6.13.3 (Actigraph, LLC, Pensacola, FL, U.S.A.) and screened according to valid days (Kolle et al., 2012). The assumptions for the use of parametric tests (normality plot, variance, interval level, and independent data) were tested and found to be satisfactory. To address the research questions, descriptive statistics (presented as mean (M) and standard deviation (SD)) and *t*-tests were used. Independent *t*-tests were used to examine statistical differences between boys and girls, while paired *t*-tests were used to examine statistical differences between weekly MVPA in school time and weekly MVPA in leisure time. The significance level was set to $p < 0.05$. Effect sizes were calculated for the gender differences in school-time MVPA, and the fulfilment of the health recommendation of one-hour MVPA daily, using Cohen's *d* (Cohen, 1988). All statistical analyses were carried out in SPSS, Version 25 (IBM, Armonk, NY, U.S.A.).

Results

The results are presented according to the three research questions of this study. From the total sample, 291 participants (51% girls, 49% boys) accumulated valid data (70%). We have no reason to believe that drop-outs were other than completely random.

Contribution of school-time MVPA to total weekly MVPA level

Table 1 presents an overview of mean (M) and standard deviation (SD) for weekly total MVPA, weekly MVPA in school time, and weekly MVPA in leisure time. The table also shows weekly MVPA in school-time’s contribution to total weekly MVPA, and MVPA in school-time’s contribution to weekly health recommendations. Finally, Table 1 presents how the same parameters are distributed between girls and boys separately.

Table 1. Descriptive characteristics of participants’ MVPA (M and SD) and school-time’s contribution to weekly recommended MVPA (%)

	Boys (N = 142)	Girls (N = 149)	Total (N = 291)
Weekly total MVPA (min)	669.4 ± 213.9	612.6 ± 169.8	640.3 ± 193.6
Weekly MVPA school-time (min)	193 ± 69.4	154.9 ± 59.1	173.5 ± 67
Weekly MVPA leisure-time (min)	476.4 ± 194.7	457.7 ± 148.6	466.8 ± 172.6
Daily total MVPA (min)	95.6 ± 30.4	87.5 ± 24.3	91.5 ± 27.7
Daily MVPA school-time (min)	38.6 ± 13.9	31 ± 11.8	34.7 ± 13.5
School-time’s contribution to total MVPA per week (%)	30.6 ± 12.6	26.0 ± 9.4	28.3 ± 11.3
School-time’s contribution to weekly health recommendations (%)	45.9 ± 16.6	36.6 ± 14.2	41.3 ± 16.1

As shown in Table 1, MVPA in school time accounts for 30.6% and 26%, respectively, of boys’ and girls’ total MVPA throughout the week. In addition, the SD indicates that the variation in MVPA is significantly less in school time than in leisure time.

Differences between MVPA at school time and leisure time

In Figure 1, minutes of weekly MVPA in school time, and minutes of weekly MVPA in leisure time, in boys and girls are presented.

Figure 1 shows that weekly MVPA in school time is significantly lower than weekly MVPA in leisure time ($t = -28.4, p < 0.05$). Furthermore, there is a significant difference between the boys and girls in weekly MVPA in school time. Boys spent 39 minutes more in MVPA weekly in school time than did girls, and thereby had a 25% higher level of activity in school time ($t = -5.2, p < 0.05$). Cohen’s *d* effect size is moderate (0.60). There is, however, no significant gender differences in weekly leisure-time MVPA ($t = -0.9, p = 0.385$).

School-time MVPA contribution to fulfilling the government’s health recommendation of 60 minutes daily MVPA

Figure 2 presents the percentage of accumulated weekly MVPA of boys and girls during school time, in relation to the health recommendations.

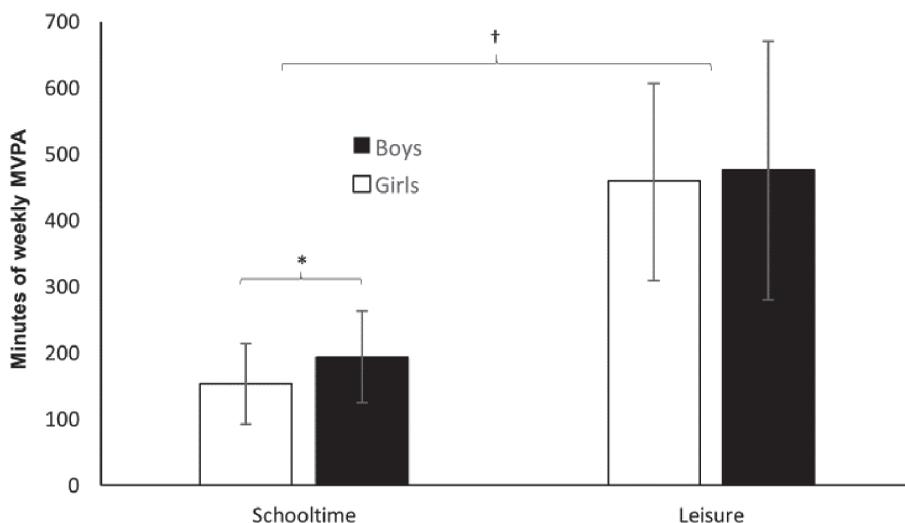


Figure 1. Weekly MVPA in school time and weekly MVPA in leisure time, according to gender. The asterisk (*) indicates a significant difference between boys' and girls' weekly MVPA in school time ($p < 0.05$). The cross (†) denotes a significant difference between weekly MVPA in school time and in leisure time in the total sample ($p < 0.05$).

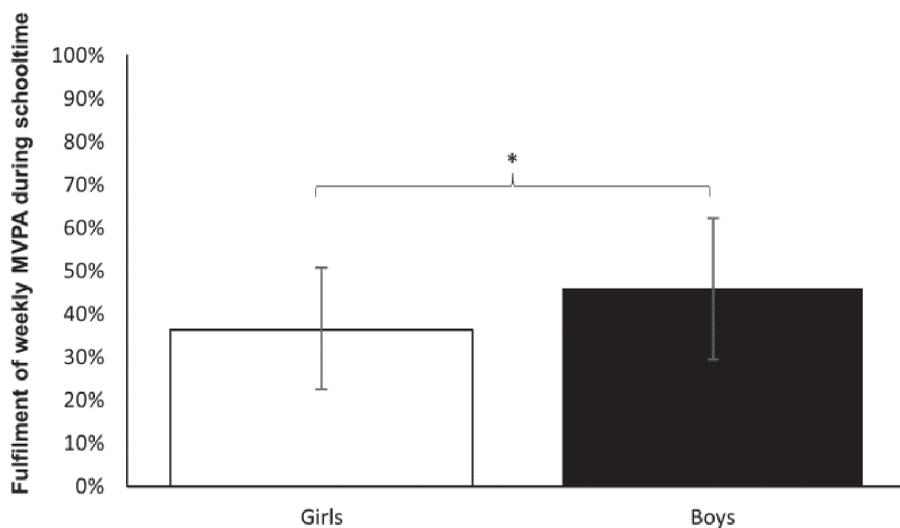


Figure 2. Differences in weekly accumulated school-time MVPA attained by boys and girls. The asterisk (*) indicates a significant difference between boys' and girls' fulfilment of health recommendations for weekly MVPA during school time ($p < 0.001$).

Figure 2 also shows that school-time MVPA amounts to less than half of the recommended MVPA (minimum 60 minutes daily MVPA; The Norwegian Directorate of Health, 2016). Boys and girls accumulate 45.9% and 36.6%, respectively, of the

weekly recommended MVPA level. This gender difference shows that school-time MVPA contributes significantly more to boys than to girls ($t = -5.2, p < 0.05$).

Discussion

Contribution of school-time MVPA to total weekly MVPA level

A main finding is that school-time MVPA accounts for 28.3% of the total samples' weekly MVPA: 30.6% and 26% to boys and girls, respectively. These findings are in accordance with other investigations, such as Gidlow et al. (2008), which found that MVPA in school time accounted for 34% and 23% of total MVPA throughout the week in primary and middle school, respectively.

Harding et al. (2015) determined school-time's contribution to the total weekly activity level to be 34% in British 12-year-olds, and found the same to be 32% among British 15-year-olds. Moreover, among Norwegian 14- to 15-year-olds, Buaas (2013) reported that school-time MVPA contributed to only 20% of the recommended MVPA level. Two other investigations from the U.S.A., which only presented information about MVPA level on weekdays (no information regarding PA during the weekends), found that school-time MVPA accounted for 32% and 39% of total daily MVPA among 13-year-old boys and girls, respectively (Lau et al., 2017), and 43% and 45% among 14-year-old boys and girls, respectively (Long et al., 2013). The higher percentage can be ascribed to the lack of data during the weekends when children are not at school. It is, however, important to point out that comparisons between different studies must be interpreted with caution due to assumed differences in the studies' contexts.

Another main result is that boys have a significantly higher school-time MVPA than girls. The results demonstrate that boys have a 25% higher level of activity in school time than girls. Our findings are supported by several other studies, which show that boys accumulate more minutes of MVPA in school time than girls (Andersen, 2017; Lau et al., 2017; Long et al., 2013; Nettlefold et al., 2011; Walter, 2011).

Differences between MVPA at school time and leisure time

Our results demonstrate that weekly MVPA in school time is significantly lower than weekly MVPA in leisure time. Several other studies support our results by showing that school children are more active in their leisure time than in school time (Harding et al., 2015; Lau et al., 2017; Long et al., 2013). This can be explained by more time spent in leisure than at school, that children sit indoors during most of the school time, and that many children participate in sports with moderate and vigorous intensity level in leisure time. Moreover, in contrast to school time, there were no gender differences in leisure-time MVPA. Only one previous study (Bailey et al., 2012) supports the finding of no gender difference in leisure-time MVPA; whereas, several studies indicate that boys are more physically active in their leisure time than

girls (Gidlow et al., 2008; Lau et al., 2017; Long et al., 2013; Mayorga-Vega et al., 2017). These findings point to a possible challenge for girls, because research shows that children who are not adequately physically active at school do not 'catch up' with those reaching the recommended levels at school (O'Neill et al., 2016). These results also substantiate the importance of promoting children's PA behaviour during school time in general, and girls' PA behaviour in particular. Indeed, according to Long et al. (2013), present school-based policies have failed to provide pupils with adequate opportunities for PA.

School-time MVPA's contribution to fulfilling the government's health recommendation of 60 minutes daily MVPA

Our findings demonstrate that school time accounts for only one-third of all MVPA in 12- to 13-year-old children in mid-Norway, which constitutes 45.9% and 36.6% of the weekly recommended MVPA level for boys and girls, respectively. School time contributes significantly less to girls' fulfilment of health recommendations for weekly MVPA during school time than to boys' fulfilment.

Reducing social differences is an important aim of public-health work in Norway. Accordingly, Norwegian schools are legally required (The Education Act, 1998) to adapt PA to pupils' abilities and requirements. Bearing in mind that children worldwide do not fulfil the health recommendations for MVPA (Belton et al., 2014; Kolle et al., 2012), the present finding highlights the importance of raising the MVPA level in school time, and we argue that significant potential exists within school time for increasing pupils' MVPA, especially girls' MVPA. The school includes all children (in contrast to sports), and is, therefore, a crucial context for establishing a positive relation to being physically active in every child. As investigations have shown that PE accounts for relatively small parts of children's total MVPA, i.e., 12% (Meyer et al., 2011), 2.2% (Chen et al., 2014) and 4.3% (Andersen, 2017), and that break time in school comprises approximately 15%–19% of the PA required for children in the 8–10 year-old age group to reach the recommended weekly level (Andersen, 2017; Mota et al., 2005), we identify both PE and break time as essential PA contexts in school. Indeed, both PA contexts should be recognised as significant contexts for children's exploring and learning how to be physically active and establishing positive PA relations. The contribution from PE and break time is insufficient, however, and it is appropriate to emphasize the importance of making other subjects (i.e., other than PE) more physically active. In total, an average of approximately 360 minutes are available for PA during school hours per day for Norwegian children. Reaching the recommended level of 60 minutes per day at school, or 420 minutes per week, means that 17% or 23% of school time, respectively, should be in MVPA. In fact, this is possible during a day at school. Our results and other research (Bouchard et al., 2012; Hayes et al., 2019; Rovio et al., 2018) indicate that all of the school time should be brought into use

in order to reach an adequate level of MVPA, and allow more children to fulfil the recommended level of PA.

Implications of the study

A main implication of this study is to increase children's PA at school, especially among girls, using several types of strategies. Efforts to increase girls' MVPA level could be directed towards both structural and cultural conditions. Constructing a physical environment which invites especially girls to be involved in PA may, according to extant literature (Hobin et al., 2012; Ulleberg, 2006), be a beneficial strategy. In addition, strengthening an appreciative socio-cultural attitude towards girls' PA, support of girls' competencies beliefs in order to participate, and to achieve significant movement competencies, may constitute another viable strategy (Mikalsen et al., 2020; Timo et al., 2016). Taking the Norwegian context into consideration, with only 120 minutes of PE per week and break time comprising more than 60 minutes every day, promoting PA throughout all school time may be a highly effective strategy.

Several intervention studies have demonstrated that it is possible to increase children's PA at school using several kinds of strategies (Escalante et al., 2014; Ickes et al., 2013; Lonsdale et al., 2013; Sallis et al., 1997). A review study by Escalante et al. (2014) concluded that interventions based on playground markings and physical structures increased school children's PA during break times. Another review study from Ickes et al. (2013) found that strategies related to adding equipment/materials, markings, zones, teacher involvement, active video games, activity of the week, and activity cards increased school PA. The results of both Sallis (1997) and Resaland et al. (2011) point to the importance of including PE teachers in the organization of PA at school time (breaks, PE, and other subjects). They also show that PA level was higher in PE when supervised by highly educated PE teachers, thus highlighting the importance of using expert PE teachers in optimising schools' PA strategies.

Strengths and limitations of the study

A strength of this study is that it includes objective and validated measurements of PA from 291 participants of the same age from 18 different schools. Although the sample was chosen partly for pragmatic reasons, as a cluster sample, it is also considered random according to most children at this age in Norway (Ringdal, 2013), except possibly for children living in the largest cities or the smallest municipalities. The use of accelerometers also makes it possible to compare the results with those from other investigations, as several related studies have also been conducted using accelerometers (i.e., Steene-Johannesen et al., 2019). Moreover, the study had a response rate of 70%, which is relatively high, and the gender balance was 51% girls and 49% boys, which more or less corresponds to the actual distribution in Norwegian primary schools. Furthermore, the entire data collection process was carried out by the same test leader, using the same equipment and the same test procedure at all

18 schools, thus increasing the reliability of the findings. It should also be mentioned that accurate timetables from the 18 participating schools were used to establish accurate activity data for both school time and leisure time. Other studies, such as Long et al. (2016), have used standardised start and finish times for school days.

The present study, however, possesses certain limitations. Although accelerometry is considered to be a preferable measurement when assessing PA in free-living situations, such as school time, it underestimates horizontal activities (i.e., cycling) and does not register water-activities (Pedišić & Bauman, 2015; Trost et al., 2005). In addition, our preference of moderate and vigorous PA could possibly have excluded relevant PA with a low intensity level, which could have potentially impacted future involvement in PA (i.e., motor competence-improving activities). Including low intensity PA in future studies of children's PA behaviour in a health perspective could extend our understanding of the benefits of physical activity behaviour in a long-term perspective.

The interpretation of our accelerometer data was conducted according to cut-off values applied in relevant literature (Kolle et al., 2012; Steene-Johannesen, 2019). Applying similar cut-off values for MVPA enables comparisons of results. Application of different cut-off values make both comparisons and discussions of results more challenging (Pedišić & Bauman, 2014).

Our response rate in the present study was 70%. A higher response rate would, of course, have been preferable for increased representability of the findings. Moreover, a larger sample-size or inclusion of pupils from several geographical and demographic locations would have increased possibilities for generalization of the findings.

Conclusion

The study examines school-time MVPA's contribution to school children's overall level of MVPA, contribution of school-time MVPA to the attainment of national health recommendations, and differences between school-time MVPA and leisure-time MVPA. A main finding is that MVPA in school time accounts for 30.6% and 26% of boys' and girls' total weekly MVPA, respectively, and that accumulated school-time MVPA contributes to less than half of the health-related recommendations of weekly MVPA. Another main result is that boys have a higher school-time MVPA than girls, but no gender differences were found in leisure-time MVPA.

Children's physical behaviour level in school time is thus an important issue. A practical implication related to the findings of the study is that it is necessary to remain aware of gender differences in relation to school-time MVPA. School time accounts for less than half of the MVPA required by the health recommendations, and interventions conducted by qualified and intervention-specific informed resources should be established to raise the level of PA in school time to reduce gender differences in levels of PA.

Author biographies

Fredrik Kristiansen has a master in physical education and sport from Nord University. His research area is related to schooltimes contribution to physical activity level among adolescents.

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