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EDITED BY
Danping Wang,
The University of Auckland,
New Zealand

REVIEWED BY
Birute Strukcinskiene,
Klaipėda University, Lithuania
Ove Østerlie,
Norwegian University of Science
and Technology, Norway

*CORRESPONDENCE
Hilde Kristin Mikalsen
Hilde.k.mikalsen@nord.no

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School's outdoor area as an educational and health-promoting resource for young teenagers

Hilde Kristin Mikalsen*, Guro Ninive and Pål Lagestad

Faculty of Teacher Education and Arts and Culture, Nord University, Levanger, Norway

Regular physical activity (PA) is positive for the health of young people, but previous research has indicated that the proportion of the population attaining recommended levels of activity decreases with age. Several studies indicate that the PA pupils get during school hours represents an important part of their total PA. The purpose of this study was to examine the relation between the size of the school's total outdoor area and pupils' PA behavior during schooltime. ActiGraph GT1M accelerometers were used to measure objectively 12–13-year-old schoolchildren's minutes of moderate-to-vigorous PA (MVPA) during schooltime. The pupils (***n*** = 300, 155 girls and 145 boys) came from 18 primary schools in two medium-sized municipalities in mid-Norway. Linear regression analysis was used to examine the relationship between the schools' total outdoor area and outdoor area per pupil in relation to pupils' weekly minutes of MVPA during schooltime. The results show no association with either the schools' total outdoor area or the outdoor area per pupil, and the pupils' weekly minutes of MVPA during schooltime. This finding indicates that there are probably factors in the school environment affecting young people's level of activity during schooltime, other than the size of the schools' outdoor area.

KEYWORDS

MVPA, accelerometer, schooltime, outdoor area, children, health promotion

Introduction

Regular physical activity (PA) is important for children and young people to achieve normal growth and development, and good physical and mental health (Anderssen et al., 2007; Ortega et al., 2008; Loprinzi et al., 2012; The Norwegian Directorate of Health, 2019). International and national health authorities, therefore, recommend a minimum of 60 min of moderate-to-vigorous PA (MVPA) daily for children and adolescents (The Norwegian Directorate of Health, 2019; World Health Organization, 2019). Studies worldwide over the past decade, however, show that the proportion of the population attaining recommended levels of activity decreases with age (Telama and Yang, 2000; Riddoch et al., 2004; Kolle et al., 2012; World Health Organization, 2018;

Steene-Johannesen et al., 2019). In many countries, therefore, PA has arised as a substantial risk factor for public health (Kohl et al., 2012; Sallis et al., 2016; World Health Organization, 2019). Tracking studies suggest that PAs when young and later in life are related. Such studies affirm the importance of providing day-to-day circumstances contributing to comprehensive and sufficient PA among children and young people (Kjønniksen et al., 2008; Evans et al., 2009; Howie et al., 2016).

All children and adolescents spend a large part of their waking day at school (Naylor and McKay, 2009; Norwegian Directorate for Education and Training, 2019). The point is often made, therefore, that school has great potential for undertaking health-promoting work and for increasing daily participation in PA (Story et al., 2006; Van Sluijs et al., 2007). Moreover, through the curriculum, the school has a wide-ranging responsibility to order school life so that pupils' health is provided for (Education Act §9 A-7, 2017). In addition, in 2009, a provision was made for extra time to be made available for a more varied and active school day outside of physical education (PE) lessons for children in grades 5–7 (§1-1a; Norwegian Directorate for Education and Training, 2009). A recent Norwegian study (Kristiansen et al., 2020) found that schooltime accounted for 45.9 and 36.6%, respectively, of 13-year-old boys' and girls' daily recommended 60 min of MVPA. Other studies have further shown that the greatest part of the total amount of MVPA in schooltime takes place during recess (Mota et al., 2005; Dessing et al., 2013; Andersen, 2017). Relating to the weekly level of physical activity in pupils, PE's contribution is smaller (Meyer et al., 2013; Chen et al., 2014; Andersen, 2017).

Furthermore, O'Neill et al. (2016) discovered a tendency for children who were less active during schooltime, to not compensate for this through greater involvement in physical activity out of school. These studies, therefore, bolster our understanding of school and schooltime's impact on PA behavior among children and adolescents. Optimization of opportunities for both organized and self-organized PAs for all the pupils in school can, therefore, be seen as an important strategy for promoting a physically active population.

The Directorate of Health's guidance (2014) concerning its regulations regarding the importance of the environment to good health in schools indicates that "good practice in school" involves outdoor areas well adapted to varied PA. Given that it is a widespread, unwritten rule that pupils in Norwegian primary schools should be outdoors during recess, the school's outdoor area appears to be a central promoter of pupils' PA.

Over the past few years, in various contributions to the literature, the concept of "affordances" has come into use in connection with the relationship between environment and PA behavior (Lundhaug and Neegaard, 2013; Sæther and Hagen, 2014; Vingdal, 2014). The term has its origin in Gibson's (1979) theory of affordances, in which he proposed that all variations in the environment each, in their own way, invite different ways of engaging with it. Gibson (1979, p. 127) stated as follows:

The affordance of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment.

In other words, according to Gibson, environmental conditions can be understood as properties or affordances, having the potential to actively promote certain actions. The individual's activity arises from direct perception-action, in and with the environmental conditions. Gibson's theory has, however, led to an ontological debate about the environment as something that just is and which controls the individual's actions, or as a constructed basis for actions in interaction with the individual. A review article by Dotov et al. (2012) referred to Gibson himself, who in a kind of compromise between affordances as objective quantities, and affordances as subjectively constructed conditions, claims that: "An affordance is neither an objective property nor a subjective property; or it is both if you like." (Gibson, 1979 in Dotov et al., 2012: 35). In this study, good school outdoor areas are therefore considered as sufficiently large, varied outdoor areas inviting pupils to interact with a wide range of organized and self-organized PAs. At the same time, the individuals' perceptions and interactions with the environment are dependent on the individuals' mental and physical abilities to perceive and interact. Good school outdoor areas may thus represent an inherent educational potential for developing physical, mental, and social health in young people.

Against the background of this introduction, this study will investigate the school's outdoor area as a resource for pupils' MVPA during schooltime. Because of available data, we will examine the extent to which the size of the school's outdoor area affects pupils' minutes of MVPA during schooltime.

None of the Nordic countries has a national standard for the size of the outdoor areas of schools. Norway, however, applies a general recommendation of a minimum of 30 m^2 per pupil in primary schools' outdoor areas. Other Nordic countries recommend 10–20 m^2 per pupil (Finland) or 30 m^2 (Sweden) (Thorén et al., 2019). There is a lack of information about the relationship between the size of the outdoor area and the health of pupils (Thorén et al., 2019). Certain studies, however, do indicate that a greater area per pupil does contribute to a higher level of activity (Harten et al., 2007; Ozdemir and Yilmaz, 2008; Dowda et al., 2009; Escalante et al., 2012; Delidou et al., 2016; Thorén et al., 2019). According to Dowda et al. (2009), children used more minutes in MVPA in nurseries having a larger outdoor area. Although this study concerned nurseries, parallels can be drawn to schools based on studies suggesting that greater accessibility and proximity of the outdoor area are related to a higher level of physical activity in both young

and older people (Duncan et al., 2005; Ding et al., 2011; Van Cauwenberg et al., 2018).

On the contrary, Thorén et al. (2019) concluded that the school's outdoor area has a negative effect on pupils' health if it offers less than 20 m^2 per child. Lots of pupils in a small area will reduce access to the different facilities for PA, the play equipment and the special activity areas of the playground. Access to facilities and special areas contributes, according to Thorén et al. (2019), to increased activity in the playground. Kolle et al. (2012) addressed Thorén's (2003) earlier proposal of a minimum of 50 m^2 per pupil in the school's outdoor area. They dealt schools into two groups according to the size of the outdoor area, $>$ 50 m^2 per pupil and $<$ 50 m^2, and then compared the PA behavior of the pupils in the two respective groups. They found no difference in PA during the school day on this basis. However, a study suggests that both the size of the school's outdoor area and facilities within the outdoor area have the potential to impact on the PA behavior in pupils (Thorén et al., 2019). Support for the latter can be found in several studies (Haug et al., 2008; Eather et al., 2013; Hood et al., 2014).

Research question

Previous research supports the theoretical understanding that the physical environment is a determinant of the physical behavior of children and adolescents. Thorén (2019) claimed, however, that there is a need for more information about the role played by the school's outdoor area in children's health and wellbeing. Therefore, this study will examine the relationship between the size of the school's outdoor area (m^2) and the pupils' MVPA during schooltime, through two research questions:

1. Is there an association between the total area of the school's outdoor area in m^2 and pupils' total MVPA during schooltime?
2. Is there an association between the school's outdoor area per pupil in m^2 and pupils' total MVPA during schooltime?

Materials and methods

Previous research involving PA behavior can be questioned due to the inconsistent methods used in measuring pupils' PA, i.e., accelerometer (Harten et al., 2007; Dowda et al., 2009; Escalante et al., 2012; Kolle et al., 2012), questionnaire (Ozdemir and Yilmaz, 2008; Gomes et al., 2014; Hood et al., 2014; Delidou et al., 2016), and observation (Zask et al., 2001). Accelerometers are, however, seen by many researchers as the most precise measure of children's PA (Plasqui and Westerterp, 2007; Van Cauwenberghe et al., 2011; Brage et al., 2015) correlating strongly with oxygen consumption in children in free play activities (Eston et al., 1998). In comparison, self-reported measures of PA, as in a questionnaire, have been found to overestimate activity (Helmerhorst et al., 2012). The data material in this cross-sectional study comprises, therefore, accelerometer measurements of 12–13-year-olds' level of PA. Kolle et al. (2012) described an accelerometer as a robust, small, and light electronic monitor that registers every movement it is subject to, filtering out all activity outside the range of normal activity. It can be carried over a long period without disturbing the person's normal pattern of movement. Accelerometers are, therefore, seen as being well suited to measuring young people's patterns of activity in everyday situations (Plasqui and Westerterp, 2007; Van Cauwenberghe et al., 2011; Brage et al., 2015; Pedišić and Bauman, 2014). Objective measurements of PA have thus been assessed to strengthen the reliability and validity of studies, even compared with the observation of pupils in PA, because of the complexities of the patterns and intensity of movement (McKenzie et al., 2000; Zask et al., 2001; Butte et al., 2014). According to our research question, only accelerometer measurements from the start and finish times of the school day of the participants were included, as well as calculations of the total outdoor area/playground (m^2) of the participating schools. The accelerometers used in the study had previously been evaluated against global health recommendations and found to be satisfactory (Hansen et al., 2014).

Participants

The sample in this study consists of 300 12–13-year olds (73% of their cohort), 155 girls (51.67%), and 145 boys (48.33%), from 18 primary schools in two medium-sized (∼15–22,000 inhabitants) municipalities in mid-Norway. One small school with few pupils didn't wish to participate. The remaining 13% of the cohort also consisted of pupils who refrained from participating. The pupils were in their final 7th year of primary school. Sixty-two percent came from schools in urban areas, while 38% came from rural schools. The municipalities can be seen as representative of other medium-sized Norwegian municipalities, according to social, political, and structural conditions. However, because of our stratified sample (not randomized), we cannot make any conclusions about the representativity of our results. The study was approved by the Norwegian Centre for Research Data (NSD) in 2016. Both parents and children gave their written consent to participate in the study before data collection began.

Data collection

Pupils' activity was measured as MVPA, in accordance with the national recommendations regarding a healthy level of PA and in keeping with earlier mapping studies of PA among

children and adolescents (Directorate of Health; Kolle et al., 2012; Steene-Johannesen et al., 2019). Data collection was by means of the accelerometer Actigraph GT1M (ActiGraph, Fort Walton Beach, FL, United States), between 15 April and 15 May 2017. The pupils were instructed to place the accelerometer on their right hip and to keep it there for 7 days apart from when sleeping and during water activities, in keeping with established procedure (Trost et al., 2005; Penpraze et al., 2006; Addy et al., 2014). The pupils' PA was registered as counts per minute. Counts per minute (cpm) express the number of vertical accelerations produced by human movements. The limit for valid data was set to a minimum of 8 h registering daily for a minimum of 2 days (Kolle et al., 2012; Steene-Johannesen et al., 2019). The cutoff value for MVPA, in keeping with the national mapping studies (Kolle et al., 2012; Steene-Johannesen et al., 2019), was set to 2,000 cpm. Measurement time interval (Epoch) was set to 10.

Mapping the duration of the school day at all 18 schools in the study was by means of verbal communication with the schools' principals. To carry out the analysis using the number of pupils and to calculate the area per pupil of the outdoor area, the number of pupils and the number of pupils in year 7 at each of the 18 participating schools were taken from the Directorate of Education's (2018) official web resource "The School Portal." Pupil numbers were taken from the schools participating in the research project during the school year 2016/2017, when the measurements of the pupils' PA were carried out. To study the schools' outdoor area, information about the schools' gross area (the school's entire plot), net area (the available usable area for the pupils in the school buildings), and outdoor area was taken from municipal floor plans, communicated by municipal employees responsible for buildings and construction. This information from municipal plans was then checked against official data from Geoinnsyn's (2019). These two sources proved to agree with each other. Each school's outdoor area per pupil was calculated by dividing the number of pupils by the school's total outdoor area. However, the largest school in the study (school 11 with 744 pupils—340 pupils in primary school) divided its outdoor area between the primary and secondary school. Pupils from both primary and secondary school at school 11 are represented in the table, giving the school a significantly higher total of pupils than the other schools.

Data analysis

The data collected by the accelerometers were downloaded to the program ActiLife v6 (ActiGraph, LLC, Pensacola, FL, United State). Invalid data were filtered out ($\geq$ 8 h, $\geq$ 2 days). To investigate pupils' weekly MVPA during school hours, their PA during school hours was filtered out, using the start and end times of the respective schools' day, with the help of Actilife v6.13.3. Then, the number of minutes MVPA during schooltime was added together and divided by the number of school days with valid activity registrations. Daily MVPA, therefore, formed the basis for calculating weekly MVPA in school hours.

Descriptive analyses of MVPA and the schools' outdoor areas, as total area and area per pupil, were carried out to find the mean (m) and standard deviations (SD). Linear regression was also used to investigate the relationship between the pupils' MVPA during schooltime and the school's outdoor area, and area per pupil. The conditions for using a linear regression analysis were considered and found to be satisfied (normal distribution, independent sample, interval level, and no multicollinearity between the independent variables; Ringdal, 2013). The dependent variable, weekly measured MVPA during schooltime, was analyzed against the independent variables: total outdoor area and outdoor area per pupil. The significance value was set at $p < 0.05$. All analyses were conducted using SPSS version 26 (IBM, Armonk, NY, United States).

Results

Table 1 gives an overview of each of the 18 schools in random order. The table shows that there were large variations in the schools' number of pupils and the size of the outdoor area. The total number of pupils varied from 33 to 744 (average 200 pupils per school). Total outdoor area varied from 7,500 m^2 to 36,731 m^2 (average 18,568 m^2 per school). Outdoor area per pupil varied from 27 m^2/pupil to 758 m^2/pupil (average 162 m^2/pupil). The average weekly MVPA of the whole sample was 170 min, which is, on average, 34 min of daily MVPA during schooltime. There were large variations between schools in pupils' average weekly MVPA (mean = 106–250 min MVPA weekly) and a wide spread in pupils' weekly MVPA within schools (SD = 34–73 min MVPA weekly).

Relationship between pupils' moderate-to-vigorous PA and school area

The regression analyses in **Table 2** show no significant relationship ($p > 0.05$) between pupils' minutes of MVPA during schooltime, and both the schools' total outdoor area and outdoor area per pupil, with very low unstandardized regression coefficients.

The lack of relationship ($p < 0.05$) between the schools' total outdoor area and the pupils' weekly measured minutes of MVPA during schooltime in **Table 2** is shown in a scatter plot in **Figure 1**. From the regression line in the figure, we see no significant relation nor tendency toward either positive or negative relation between the schools' total square meters of outdoor area and the pupils' measured weekly MVPA during

TABLE 1 Descriptive characteristics of the participating schools in relation to the number of pupils, outdoor area, and pupils' MVPA.

School	Number of Pupils per school	Number of pupils 7th grade	Number of pupils 7th grade with valid data	Total outdoor area (square meters)	Outdoor area per pupil (square meters)	Pupils MVPA (SD)
1	140	15	15	18289	131	114 (51)
2	91	14	13	20799	229	244 (73)
3	354	45	34	12591	36	199 (58)
4	189	33	26	10340	55	120 (34)
5	96	12	11	19300	201	106 (39)
6	343	47	27	32641	95	173 (67)
7	65	10	8	12691	195	146 (37)
8	165	20	9	12737	77	173 (55)
9	93	8	7	36731	395	112 (51)
10	249	28	24	19607	79	201 (48)
11	744	49	34	20000	27	157 (46)
12	189	21	16	16000	85	192 (54)
13	33	5	4	25000	758	181 (66)
14	245	12	8	13000	53	250 (66)
15	58	7	3	7500	129	129 (58)
16	61	7	7	10000	164	161 (35)
17	289	35	24	25000	87	244 (64)
18	193	42	30	22000	114	152 (61)

schooltime. As we see from the figure, there is generally a wide spread in the measurements of pupils' PA at school.

The lack of relationship ($p < 0.05$) between the schools' outdoor area per pupil and the pupils' weekly measured minutes of MVPA during schooltime in **Table 2** is shown in a scatter plot in **Figure 2**. As in **Figure 1**, the regression line in **Figure 2** shows no significant relationship between the outdoor area per pupil and the pupils' weekly measured minutes of MVPA during schooltime. As we can see in the figure, there are large differences between the schools' outdoor area per pupil. Two schools differ from the other schools by having significantly more square meters per pupil than the rest of the schools.

Discussion

The study found large variation in the different school's total outdoor area and total outdoor area per pupil, as well as pupils' minutes of MVPA during weekly schooltime. However, the regression analysis found no significant relationship between the pupils' weekly minutes of MVPA during schooltime and the total outdoor area in square meters per school. The finding indicates that the schools' total outdoor area has no significance for the pupils' PA level in primary school. This finding may nonetheless represent an important nuance in the knowledge about the outdoor area's importance for pupils' PA during schooltime.

Furthermore, the regression analysis found no significant relationship between the number of square meters of outdoor area per pupil and the pupils' weekly minutes of MVPA during schooltime. This finding is partly in contradiction with other studies, showing a positive correlation between children and adolescents' PA level and the number of square meters of outdoor area at school per child/adolescent (Harten et al., 2007; Ozdemir and Yilmaz, 2008; Dowda et al., 2009; Escalante et al., 2012; Delidou et al., 2016). However, it is important to point to the age of the sample, the nature of the outdoor area, and the method of measurements of PA behavior, which may possibly explain why our results differ from those of other studies. For example, Dowda et al. (2009) studied 3- to 5-year-old preschool children ($n = 299$), in the context of preschool. Most preschool children live the greatest part of their waking day at preschool (The Norwegian Directorate of Health, 2019), where they spend a significant amount of time in play and PA (Fossdal et al., 2018; Kippe and Lagestad, 2018). Primary school pupils, on the contrary, must follow the schedule-related

TABLE 2 Relationship (linear regression) between weekly MVPA during schooltime and total outdoor area of the school and outdoor area per pupil.

	Model 1, b (std. rror)	Model 2, b (std. error)
Total outdoor area	0.00 (0.00)	0.00 (0.00)
Square meters of outdoor area per pupil		−0.07 (0.04)
Constant	161.992	162.853
R^2	0.00	0.01

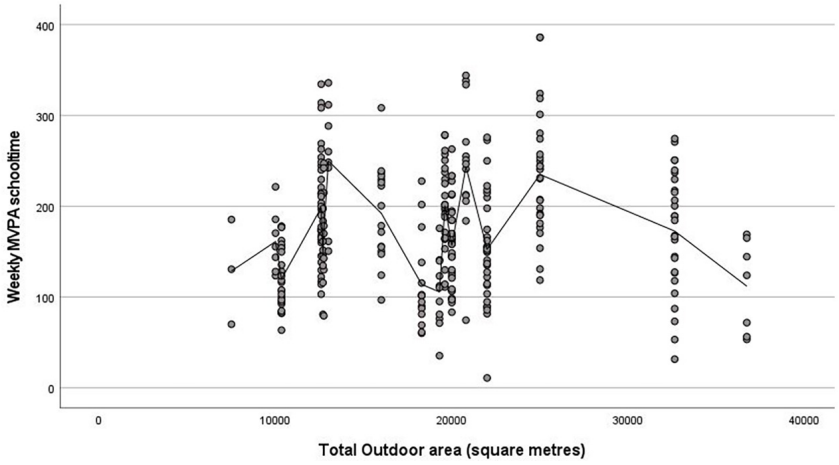

FIGURE 1
Scatter diagram showing the schools' total outdoor area (in square meters) along the *X*-axis and the pupils' weekly MVPA along the *Y*-axis ($p \leq 0.05$).

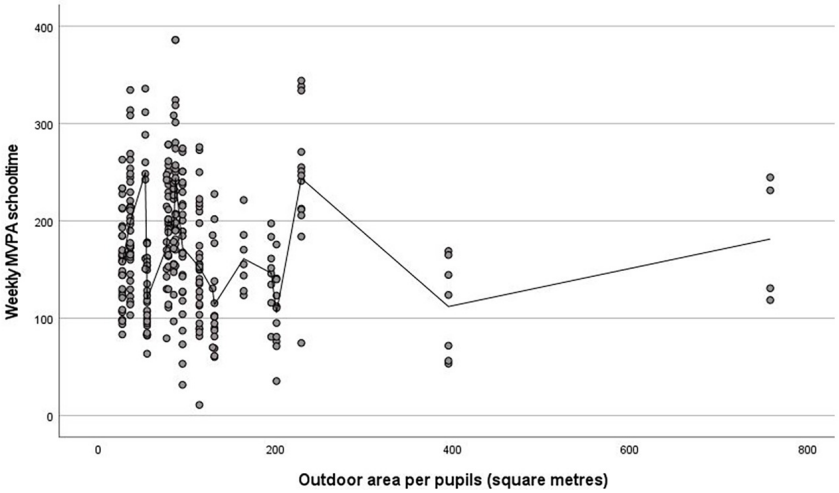

FIGURE 2
Scatter diagram showing the schools' outdoor area per pupil (in square meters) along the *X*-axis and the pupils' weekly MVPA during schooltime (in minutes) along the *Y*-axis ($p \leq 0.05$).

regulations regarding PA, and much more of the time is spent sitting still in lessons. Other studies were revealing positive relationships between the outdoor area of primary schools and pupils' PA during schooltime: Turkish 3rd and 4th grade pupils (Ozdemir and Yilmaz, 2008), Greek 6th grade pupils (Delidou et al., 2016), Spanish 7- to 11-year olds (Escalante et al., 2012), and Australian 8- to 11-year olds (Harten et al., 2007). One possible explanation for the different findings can be related to the fact that the total outdoor area (m^2) in the schools in these studies, having a spread that is at a much lower number of square meters per pupil than in our study and that variations between a very small area and a slightly larger area, according to the Norwegian context, is of greater significance for pupils' PA behavior in everyday school life. Delidou et al. (2016), for example, defined a "large" outdoor area as $>$ 7.8 m^2/pupil (for schools with six classes), $>$ 6.5 m^2/pupil (for schools with nine classes), and $>$ 5.9 m^2/pupil (for schools with 12 classes). Escalante et al. (2012) defined a "large" outdoor area as $>$ 15 m^2/pupil. In comparison, **Table 1** shows that schools in this study have a significantly larger outdoor area at their pupils' disposal. In other words, the school with the least area per pupil in our study (27 m^2/pupil) would be categorized as a "large" outdoor area in relation to Greek and Spanish schools (Escalante et al., 2012; Delidou et al., 2016). Australian

schools from Harten et al.'s (2007) study defined, however, a large outdoor area as > 80 m^2/pupil and a "small" outdoor area as < 80 m^2/pupil. That is, area sizes are perhaps more comparable with the outdoor areas in this study's schools. However, the Australian study showed that the size of the school's outdoor area per pupil was related to pupils' MVPA during schooltime.

Differing findings can be seen in relation to the cultural, structural, and economic conditions of pupils' PA behavior during schooltime. Such relational understanding of PA behavior as a dynamic phenomenon increasing or decreasing in scope, depending interactively on a number of factors on several levels of organization, is consistent with both an ecological perspective on human thinking and behavior and previous research on this topic (Haug et al., 2008; Ommundsen and Samdal, 2008; Martins et al., 2017; Lerner et al., 2018).

The findings of this study, that there is no correlation between either schools' total outdoor area and pupils' MVPA during the school day, or between the school's total outdoor area per pupil and pupils' MVPA during schooltime, can help to promote a more nuanced academic and political debate about schools' structural design (Thorén et al., 2019). Furthermore, these findings may support the need to discuss how best the school's outdoor area can be optimized as a health-promoting and educational resource, on the basis of both its extent and content. For example, several studies point to the beneficial, health-promoting effects of an increased number of facilities in the school's outdoor area, increasing pupils' PA (Haug et al., 2008; Taylor et al., 2011; Nielsen et al., 2012; Gomes et al., 2014; Hood et al., 2014; Delidou et al., 2016; Thorén et al., 2019). According to Gibson (1979) and the theory of affordances, an increased number of facilities and specific activity spaces in the outdoor area can help to increase physical-motor, psychological, and social activities by inviting exploration, play, and games. A more complex outdoor area will probably require a larger size than the school's outdoor area. However, studies conducted by the Norwegian Directorate of Health in 2011 indicate that the nature of the outdoor area in itself does not automatically lead to pupils being more physically active during schooltime. On the basis of the correlation analysis of the relationship between the number of facilities within the school's outdoor area and pupils' level of PA, a moderate correlation was found between the number of facilities and PA during schooltime in combined primary and secondary schools. The same relationship was not found in either primary school or secondary school, although it was a tendency in primary schools. These results, also, bring the school's culture around PA into consideration, that is, the extent to which the school's pedagogical practices include and emphasize pupils' PA in everyday school life as being valuable, from both a pedagogical and a health perspective. Establishing and developing the school's outdoor area as an important health-promoting resource for children and adolescents, therefore, seem to concern both the outdoor area's physical extent and content and, not least, the school's basic value-based understanding of pupils' daily PA in a health perspective.

Strengths and weaknesses of the study

A strength of this study is the objective measurements taken of 300 youngsters (n = 300), which represented 73% of their total cohort. Moreover, the dropout of participants (27%) was seen as being random. Further, the sample had a gender balance of 48% boys and 52% girls, which is in keeping with the gender balance within Norwegian primary schools. The respondents came from 18 large and small schools from both densely populated (62%) and rural (32%) areas and therefore seem to be representative of other similarly aged pupils in Norway from similar medium-sized municipalities (ca. 5–25,000 inhabitants), also containing a medium-sized town within the municipality (Langørgen and Aaberge, 2011).

Another strength is that all measurements of PA were made objectively through the use of accelerometers. Additionally, all measurements and data collection were performed by the same test leader, using the same equipment and the same test procedures, in the same time period (spring, 2017), which increased the reliability of the study. This strategy decreased the likelihood that the weather or season affected the pupils' PA behavior to any significant degree. The calculations of the area regarding the schools were also double checked, using both maps and register data. Finally, a literature search suggests that this is the first study to investigate the importance total outdoor area and outdoor area per pupil, having primary school pupils' MVPA during schooltime.

However, the study has some limitations. The accelerometers fail to register activities such as cycling and strength training, particularly of the upper body (Bassett et al., 2000; Hendelman et al., 2000). The reason for this is that these activities include a lower level of vertical acceleration. The underlay on which the activity takes place (soft/hard) and the type of shoe may also affect the registration of acceleration by the accelerometer. In addition, the accelerometer cannot record activities in water. Limited registration of cycling, strength training, and water activities is, however, not problematic at schooltime among the 7th grade pupils. Only a few of the schools had cycles available for use during recess, strength training of the upper body rarely takes place among the 7th graders, and no school provided the possibility of water activities during schooltime in the period of the measurements. In addition, it is important to be aware that the calculation of weekly MVPA is based on random valid weekdays. Other days might have yielded another level of activity among the sample. Based on general knowledge of the schools' teaching practices, which vary throughout the week but unsystematically, and that the data material is based on random days among a relatively

large sample, we consider our basis for calculating weekly MVPA to be satisfactory.

Conclusion

Our study found no statistically significant relationship between pupils' weekly minutes of MVPA during schooltime and schools' total outdoor area or outdoor area per pupil—indicating that the pupils' PA during schooltime is not depending on the school's available total outdoor area or outdoor area per pupil. This makes other factors such as the content or nature of the outdoor area, the form of facilities or specific areas of activity, or school policy and socio-cultural conditions interesting to highlight in debates about the school's role as a health-promoting resource for children and adolescents. The findings can contribute to a more nuanced debate about measures concerning the school's outdoor area and the school's value-based understanding of pupils' daily PA from a health perspective.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

GN contributed to the design and the first draft of the manuscript. PL advised the design and the analysis of the data. HM contributed to the data collection and the final design and draft of the manuscript. PL and HM read and approved the final manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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