

GETTER MARIE LEMBERG

The role of outdoor recess opportunities,  
schoolyard design, and parents in  
encouraging physical activity in school  
among 9–13-year-old students





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Institute of Sport Sciences and Physiotherapy, Faculty of Medicine, University of Tartu, Tartu, Estonia

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## LIST OF ORIGINAL PUBLICATIONS

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# 1. INTRODUCTION

Insufficient physical activity (PA) levels are a growing issue globally and are one of the main causes of various health problems for children, including overweight, obesity, and cardiorespiratory diseases (WHO, 2020). Globally, only about one-third of children meet the World Health Organization's (WHO) PA recommendation of an average of 60 minutes of moderate-to-vigorous PA (MVPA) per day (Aubert et al., 2022). In Estonia, only 43% of youth (7–17-year-olds) meet the global PA recommendation (Mäestu et al., 2023). Furthermore, the trend of declining PA and increased sedentary time can be seen across the lifespan (Pulido Sánchez & Iglesias Gallego, 2021). Consequently, the WHO emphasises the importance of promoting higher PA levels and reducing sedentary behaviour in children and adolescents (WHO, 2020). As a result, developing and investigating PA interventions for children and adolescents is essential.

Schools are important agents for positively influencing students' PA levels, as children and adolescents spend a significant amount of time at school and implementing PA interventions in schools holds the potential to engage all children regardless of gender, age, and socioeconomic status (WHO, 2022). This is especially important for students whose only possibility to engage in PA is during school time. Given the positive impact that PA can have on both health and learning, a whole-of-school approach has been recommended to help students achieve sufficient daily PA (Hazlehurst et al., 2023). This comprehensive strategy can greatly enhance students' PA levels by incorporating PA into the school day and extending it beyond. Recess, especially outdoor recess, has been related to greater PA participation of students (Erwin et al., 2012; Prince et al., 2019; Pulido Sánchez & Iglesias Gallego, 2021; Raney et al., 2019). In addition to increased PA, spending recess outdoors positively impacts mental health (Fyfe-Johnson et al., 2021), academic performance (Browning & Rigolon, 2019), as well as social and emotional development (Bates et al., 2018). An important aspect of the outdoor recess is the schoolyard, where students spend their time. Research indicates that students have varying preferences for their ideal schoolyards (Powell et al., 2016; Holmes, 2012); however, findings from the studies vary regarding the effectiveness of natural spaces versus constructed playgrounds in promoting MVPA among students, as existing research presents differing conclusions on this matter (Brink et al., 2010; Fuentes Diaz et al., 2024; Kjønniksen et al., 2022; Raney et al., 2019).

Outdoor recess is a popular part of the school day in various countries worldwide (Amicone et al., 2024; Delidou et al., 2016; Haapala et al., 2014b; Mikalsen et al., 2022; Pawlowski et al., 2020; Tran et al., 2013); however, in Estonia, it is still in its implementation phase. Over the last five years, multiple schoolyards in Estonia have undergone renovations to make them more appealing to students and to encourage increased PA during outdoor time. Thus, it is important to research how participation in outdoor recess affects students' PA levels in Estonia and how the design of schoolyards impacts PA levels during outdoor recess.

Unfortunately, to date, no research in Estonia has looked at what the possibilities are in Estonian schoolyards, how various recess types are related to students' PA levels and how providing PA opportunities in schools is associated with students' and parents' perceptions and beliefs about PA. Therefore, the present study mapped schoolyards in Estonia and measured students' PA levels during outdoor recess, to gain insight into which facilities and equipment in the schoolyard are more used during outdoor recess, which schoolyard design promotes more PA during outdoor recess, which recess type encourages more PA among students and how different PA opportunities in school are associated with students' attitudes toward PA.

## 2. LITERATURE REVIEW

### 2.1. Schoolyard characteristics and students' preferred activities during recess

The characteristics of the schoolyard play an essential role in increasing students' PA involvement and promoting active play during recess (Andersen et al., 2015, 2019; Anthamatten et al., 2014; Delidou et al., 2016). Studies have found that challenging, varied, and exciting schoolyards engage children more in PA during outdoor recess (Ishii et al., 2014; McCormick, 2017). However, the schoolyards have not always been diverse and engaging. Various studies about the schoolyard reconstruction state that before the restoration of the schoolyard, the school's outdoor space was mainly covered with asphalt, and the main focus was on ball-game areas (Andersen et al., 2019; Bohnert et al., 2022; Brink et al., 2010; Kelz et al., 2015). Furthermore, most of the traditional schoolyards in the Nordic countries and the Baltics have primarily flat topography and surfaces are covered with asphalt or concrete, and sports fields with artificial surfaces mostly dominate the open space (Rutkauskaitė et al., 2021). However, the Nordic countries have more variety in topography and greenery, including more natural elements (e.g. grass, vegetation, trees).

Gibson's theory of affordances explains how the physical environment influences human behaviour (Gibson, 1979). "Affordances" refer to the relational characteristics between the physical environment and an individual, which create an action-related context for the person in that environment (Heft, 1988). Depending on the affordances present in a specific environment, various PA behaviours can be encouraged. Affordances can be classified as potential or actualised (Gibson, 1979). Potential affordances refer to the various possibilities an environment provides. For example, an open space allows for running and jumping, while a tree offers climbing opportunities. Actualised affordances, on the other hand, describe the interaction between the physical environment and the child; they reflect how a child responds to that environment. This is expressed through specific actions that depend on the child's perceptions and their use of the different affordances available. In line with affordance theory, the natural environment enhances imagination and encourages exploration by providing more unstructured play opportunities for students (Amicone et al., 2024).

Studies show that green schoolyards that have a wide variety of natural elements offer a wide range of inclusive play opportunities (Root et al., 2017), fostering creativity, exploration (Zamani, 2016), and positive social interactions (Van Dijk-Wesselius et al., 2018). In addition, various studies suggest that schoolyards with green space allow students to obtain more MVPA minutes during recess compared to schoolyards which are limited to paved hardscape areas (Baquet et al., 2018; Brink et al., 2010; Kjønneksen et al., 2022; Lindemann-Matthies & Köhler, 2019; Raney et al., 2019). In contrast to these findings, Reimers and Knapp (2017) discovered that children were more active in public

playgrounds with more fixed play features and no green space, while Fuentes Diaz et al. (2024) found that accessing or not accessing outdoor play structures did not affect students' MVPA levels. Additionally, Van Kann et al. (2016) found that increasing the size of the playground or the area of green space did not enhance PA participation. Therefore, findings about schoolyard characteristics that enhance students' PA levels are inconsistent regarding what encourages more activity among students.

Observational studies of students' behaviour in different school environments, including schoolyards before and after the restoration process, have shifted towards more imaginative, constructive, and sensory play. Children in natural areas engage in more socially cooperative play behaviours compared to those using traditional asphalt playgrounds or fixed equipment (Cloward Drown & Christensen, 2014; Fjørtoft & Sageie, 2000; Herrington & Studtmann, 1998; Kuh et al., 2013; Stanley, 2011). In the natural environment, students engage more in exploratory behaviours, whereas in the built environment, students participate more in games with rules (Amicone et al., 2024). Natural schoolyards also appeal to a variety of students' interests and support a variety of play opportunities that promote all levels of PA (Bell & Dymont, 2006).

Boys and girls can have different preferences regarding the appearance of the schoolyard (Holmes, 2012; Powell et al., 2016), but most children enjoy natural spaces (Armstrong et al., 2019; Baquet et al., 2018; Chawla et al., 2014; Raney et al., 2019), markings on the ground (Baquet et al., 2018; Parrish et al., 2013), and different types of playgrounds (Anthamatten et al., 2014). Girls often participate in less physically demanding and non-sport-related activities, such as challenging themselves, climbing, and dancing, and they tend to enjoy more social activities (London, 2022; Pawlowski et al., 2016, 2019; Raney et al., 2023). In contrast, boys often prefer active games such as basketball, soccer, and other ball games (Andersen et al., 2015; London, 2022; Raney et al., 2019, 2023). Incorporating more greenery and natural elements into schoolyards can help to reduce PA equity gaps, offering more play opportunities for females (Bikomeye et al., 2021). In addition to providing more play opportunities for girls, Raney et al. (2019) found that girls spent significantly more time in MVPA during recess after the schoolyard greening process. Pawlowski et al. (2019) emphasized the importance of distinguishing between facilities for sports and play for girls, as recess serves distinct purposes for girls and boys. Girls enjoy the social aspect of the activities (London, 2022; Pawlowski et al., 2016), while boys enjoy the competitive aspect of various sports games (London, 2022; Raney et al., 2023). Therefore, it is important to distinguish between facilities for sports and play for girls (Pawlowski et al., 2019). Providing schoolyards with gender-specific equipment and activities during recess can encourage girls to participate more in PA (Haapala et al., 2017), and it might more effectively create opportunities for them to socialise during this time (Pawlowski et al., 2016). Therefore, it is essential for schools to have diverse schoolyards that offer PA opportunities for all students. In conclusion, creating inclusive schoolyard environments requires thoughtful consideration of both boys' and girls' distinct preferences and needs, ensuring

opportunities for PA and social engagement. By offering a diverse range of spaces, equipment, and activities that cater to these varied interests, schools can foster a more active and socially enriching recess experience for all students.

## **2.2. Schoolyards in Estonia**

Estonia has no national policies regulating schoolyard size, space, and equipment within the schoolyard, however, multiple countries near Estonia, such as Latvia, Lithuania, Finland, and Norway, have various policies regulating these factors of the schoolyard (Rutkauskaite et al., 2021). Estonia has a more general regulation determining that schools must have their own outdoor school area for safe learning. Schoolyards also must be secure for students to use; for example, there should be adequate lighting for darker periods, and teachers or supervisors must oversee the students, especially during recess for younger students (Health Protection Requirements for Schools, 2013). The primary features of an average schoolyard in Estonia are various sports fields (basketball, soccer, or track and field). Additionally, the schoolyards have mainly flat topography, some natural grass and vegetation, and some asphalt as well (Rutkauskaite et al., 2021). However, schoolyards in Estonia are changing, and numerous schoolyards in Estonia have been renovated in recent years through local governments' Participative Budgeting initiatives. Also, in collaboration with architects and the University of Tartu Move Lab, resources have been created to guide stakeholders in designing schoolyards that encourage PA among students (University of Tartu Move Lab, 2025).

## **2.3. Physical activity during outdoor recess**

School day structure plays a critical role in increasing students' school day PA; for example, students can acquire up to one-third of the total school time MVPA during outdoor recess (Erwin et al., 2012). Therefore, incorporating various PA options and opportunities for free play into the school schedule, especially outdoor recess, can tremendously enhance students' MVPA levels throughout the school day (Erwin et al., 2012; Pulido Sánchez & Iglesias Gallego, 2021). Rhea (2016) stated that recess should be an unstructured outdoor break that allows students to participate in activities such as role-play, PA, socialising, imaginative play, or simply reflecting. Besides taking brief breaks during academic lessons, students need unstructured outdoor playtime to refresh their minds and recharge their focus on learning (Rhea, 2016). The American Academy of Pediatrics emphasises recess and play for developing social skills like communication, cooperation, and coping, which are foundations for healthy development (Yogman et al., 2018). Furthermore, participating in outdoor recess positively impacts children's attention, reduces school fatigue, improves relationships between students and teachers (Brustio et al., 2018), enhances social well-being (Van Dijk-Wesselijs et al., 2018), and supports academic skills (Browning & Rigolon, 2019; Kuo et al., 2018).

Previous studies have compared PA levels during indoor and outdoor recess, revealing that students engage in more MVPA during outdoor recess (Hyndman et al., 2014; Tran et al., 2013). However, to the best of our knowledge, no study has examined the relationship between different types (outdoor recess vs indoor recess) and durations of recess and students' MVPA levels. A recent systematic review (Pulido Sánchez & Iglesias Gallego, 2021) concluded that students can achieve even higher MVPA levels during recess than during physical education (PE) lessons. Currently, there are no established guidelines for the optimal recess duration to maximise the time spent in MVPA. However, few authors offer specific recommendations for recess PA levels; it has been suggested that students should spend 40% to 50% of recess time in MVPA (Erwin et al., 2012; Ridgers et al., 2012). Additionally, Erwin et al. (2012) found that even a 15-minute recess can significantly contribute to the overall PA during school time. Beyond influencing students' PA levels, outdoor recess and well-equipped schoolyards are also key factors in promoting motor development and physical literacy (Jerebine et al., 2022). During outdoor recess, students develop skills like balancing, climbing, catching, throwing, etc., by using different play equipment (Fjørtoft, 2004). This highlights the importance of providing more opportunities for free play throughout the school day. Previous findings suggest that outdoor recess, even in short durations, significantly contributes to students' overall PA and motor skill development. However, the optimal duration and type of recess to maximise MVPA are still under investigation. Prioritising outdoor recess and well-equipped schoolyards is crucial for promoting physical health and physical literacy among students.

## **2.4. Outdoor recess in Estonia**

The integration of outdoor recess into the school day in Estonia is a relatively recent development within the educational framework, with many schools still in the early stages of implementation. In contrast, in Scandinavian countries such as Norway and Finland, outdoor recess has been an established part of the school day for many years (Haapala et al., 2014b; Mikalsen et al., 2022). In Estonia, recess has traditionally been held indoors, particularly during the autumn and winter months, due to the cool and wet weather conditions that persist throughout much of the academic year, requiring appropriate clothing. However, some schools do allow students to go outside during recess, whereas only some have incorporated longer outdoor recess periods into their schedules. Regular recess length per one 45-minute academic lesson is a minimum of 10 minutes (Basic School and Upper Secondary School Act, 2010). Although, the 10-minute recess is not enough time for students to go outside and engage in various activities. Furthermore, short recesses do not support the potential for developing positive PA habits and do not contribute to changes in school culture. However, national regulations allow schools to extend the length of recess, and as a result, some schools have incorporated 30–45-minute outdoor recesses into their daily schedules.

The Schools in Motion program is an innovative educational initiative in Estonia aimed at increasing students' PA levels by promoting various PA opportunities throughout the school day (Mooses et al., 2021). The program has successfully expanded from 10 pilot schools in 2016 to 216 schools in 2025 (Schools in Motion, 2025). Outdoor recess is one of many PA possibilities that the Schools in Motion program recommends to their member schools. The main goal is to include in the national strategy that all children are provided an opportunity to go outside during the school day and that schoolyards afford activities to all children with different skills, interests, ages, and genders. With input from the University of Tartu Move Lab, the implementation of outdoor recess is one of the action areas in a wider national PA strategy (The Competence Centre for Physical Activity, 2025). Additionally, the Estonian Coalition Agreement 2025–2027 states the commitment to carry out the national PA strategy that prioritises adapting school environments to promote PA (Republic of Estonia Government, 2025). This emphasises the importance of finding working solutions that help to improve students' school time PA levels on a national level.

## **2.5. Perceptions of physical activity and its influence on academic behaviour**

Existing literature suggests a positive association between various factors – including physical fitness, acute bouts of PA, long-term PA interventions, and time spent outdoors – and improvements in children's cognitive functions and academic conduct (De Greeff et al., 2018; Donnelly et al., 2016; Oswald et al., 2020; Sullivan et al., 2017). Nevertheless, the current body of evidence exhibits inconsistencies in its findings, and the specific mechanisms and magnitudes of influence of various parameters related to PA and outdoor time on cognition still require further exploration (Donnelly et al., 2016; Oswald et al., 2020). A meta-analysis by De Greeff et al. (2018) indicated that acute PA has the capacity to reinstate attentional resources, which positively impacts learning processes. However, longitudinal PA interventions have proven more effective at enhancing all aspects of executive functions in preadolescent children (Koutsandr ou et al., 2016; Van der Niet et al., 2016). These findings highlight the need to adjust school schedules, offering students more opportunities for PA during school hours. This change can lead to increased PA levels and enhanced cognitive functions.

PA during school hours, particularly outdoors, can restore students' attention and foster a more peaceful learning environment. (Brustio et al., 2018; Haapala et al., 2017; McCormick, 2017; Rhea, 2016; Van Dijk-Wesselius et al., 2018). After an outdoor break, students in Italy felt less fatigued and more attentive; however, only 37% of teachers noticed improved attention, and just 16% observed better academic performance (Brustio et al., 2018). In contrast, school staff in Finland reported that increased PA during the school day enhanced satisfaction with school and fostered a more peaceful learning environment (Haapala et al., 2017). Increased physical activity during recess is linked to improved peer

relationships and a greater sense of belonging and contributes positively to students' social development (Bates et al., 2018; Haapala et al., 2014a). Larouche et al. (2016) found that every hour per day spent outdoors decreased the likelihood of social problems among 7–14-year-olds by 31%. Another study revealed that parents and teachers noted increased behavioural issues during and after school on days when students were not allowed to go outside during recess (Cohen et al., 2021).

The socio-ecological model illustrates that an individual's behaviour influences and is influenced by their environment (McLeroy et al., 1988). According to this model, the school can play a crucial role in developing positive beliefs about PA and PA behaviours; however, a supportive home environment is equally important. Given their close relationship with children, parents influence the development of their behaviours and habits. Consequently, parental understanding of the beneficial outcomes of PA positively shapes students' engagement in active behaviours. Research by Pluta et al. (2020) suggests that including family is crucial for providing the necessary social support within school-based interventions promoting PA. Moreover, parental involvement has been associated with improved health outcomes in children (Kader et al., 2015; Grow et al., 2013), and early support from parents has been identified as a significant predictor of self-initiated PA (Edwardson et al., 2013). Given that PA habits established during childhood often continue to adulthood (Telama et al., 2014), a school environment that actively promotes movement and fosters positive attitudes towards PA is critical in influencing students' activity patterns beyond the school day (Dobbins et al., 2013; Huang et al., 2021).

Previous research has explored the influence of diverse school-related elements, such as a supportive PA culture and the availability of varied PA facilities, on students' PA habits and overall PA levels (Ishii et al., 2014; Pulido Sánchez & Iglesias Gallego, 2021; Suga et al., 2021). However, to our knowledge, existing research has not yet examined the association of different recess types and students' perceptions regarding PA and their engagement in leisure-time PA. Examining the effects of various recess types on a range of PA-related factors is crucial for providing stakeholders with pertinent insights into how modifications to the structure of the school day can influence students' PA habits, beliefs, and academic behaviour.

## **2.6. Summary of the literature review**

In recent years, numerous schoolyards in Estonia have been renovated, aiming to enhance their appeal and to foster greater PA among students during outdoor recess. Given this widespread effort to create activity-friendly school environments, it is crucial to understand the actual impact of outdoor recess on students' PA levels and to determine how specific schoolyard designs influence this activity. Notably, current research in Estonia has not yet investigated the existing potential of these renewed schoolyards, the differential effects of various types of recess

on students' PA, and the broader influence of school-based PA opportunities on the perceptions and beliefs of both students and their parents. Addressing this critical gap in knowledge is essential for optimising the design and implementation of schoolyard renovations to effectively promote students' health and well-being.

### 3. OBJECTIVES OF THE STUDY

The general aim of the present study was to map the schoolyards in Estonia to describe their features and affordances for PA and measure the PA levels and sedentary behaviour of 9–13-year-old students during different recess types in the school day. In addition, it was evaluated how different recess types are associated with students' and their parents' attitudes toward PA.

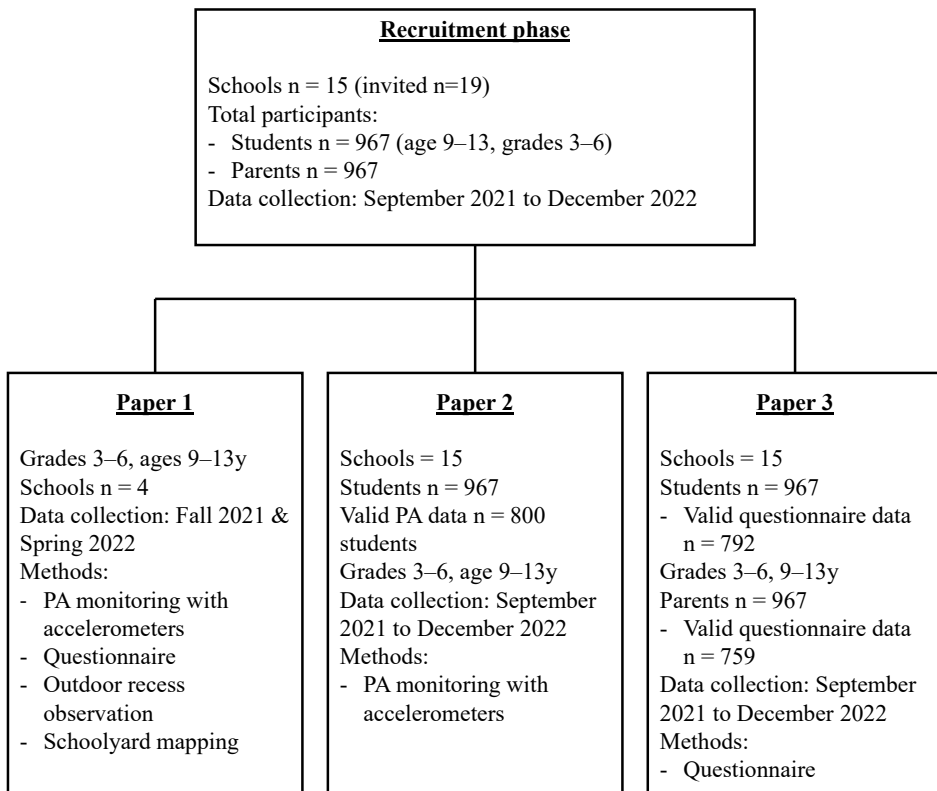
The specific aims of the present study were to:

1. describe the selected schoolyards and their affordances for PA, and students' activities during outdoor recess (Paper I).
2. compare recess PA levels and sedentary behaviour among students participating and not participating in outdoor recess (Paper I).
3. compare recess and school time PA and sedentary behaviour among schools with different recess types (Paper II).
4. examine how the length of different recess types is associated with students' PA and sedentary behaviour (Paper II).
5. evaluate students' and their parents' perceptions of outdoor recess, its benefits, and PA opportunities in schools with different recess types and whether the recess types are related to students' leisure-time PA (Paper III).

## 4. METHODS

### 4.1. Participants and study design

The sample of the present study was recruited from 15 primary schools in Estonia. Initially, 19 schools were invited to participate in the study; however, four schools did not consent to participate. All 15 schools were part of the Schools in Motion program, located in different parts of Estonia (urban vs rural schools), varied in size (116 vs 968 students), and recess types offered at school (outdoor recess vs active indoor recess). All students from grades three to six (9–13-year-olds) and one of their parents (or a legal guardian) were invited to participate in the study. Written informed consent was obtained from all schools, parents, and students participating in the study. The total number of students and parents who agreed to participate in the study was 967. Recruitment of participants and data collection were performed from September 1, 2021, to December 20, 2022 (Figure 1). All monitoring, collection of data, and analysis were treated anonymously and in line with ethical guidelines. The study was performed in accordance with the Declaration of Helsinki and was approved by the Medical Ethics Committee of the University of Tartu, Tartu, Estonia, approval no. 330/T-7.



**Figure 1.** Overview of school and participant recruitment, and data collection procedures.

The final study sample in the paper I included four schools and their students from grades 3–6. Schools varied in size (216 vs 909 students) and location (two urban and two rural schools). Data collection for paper I was performed in autumn 2021 and spring 2022.

In paper II, the final sample included 15 schools and 967 students who wore the accelerometer, and valid PA data were obtained from 800 students (357 boys, 443 girls; mean age  $10.4 \pm 1.3$  years). Recruitment of participants and data collection were performed from September 1, 2021, to December 20, 2022.

In paper III, the final sample included 15 schools, 967 students and their parents, whereas 792 students (353 boys, 439 girls; age  $10.5 \pm 1.2$  years) and 759 parents (667 women, 89 men, three did not indicate; age  $40.1 \pm 6.3$  years) completed the questionnaire. Recruitment of participants and data collection were performed from September 1, 2021, to December 20, 2022.

## **4.2. Geographical mapping and potential affordances of the schoolyards**

In paper I, schoolyards were analysed using a geographical mapping method that illustrated their design, characteristics, and facilities. A registration form was employed to map the schoolyard environments by identifying the layout, facilities, equipment, and landscaping features of each schoolyard (Rutkauskaitė et al., 2021; Kristiansand Municipality and University of Adger, 2006). The same registration form was used to determine the potential affordances of the four schoolyards based on Gibson's theory of affordances (Gibson, 1979). The schoolyard affordances registration form identified areas, equipment, facilities, and landscape design features that support various activities (e.g., ball games, climbing, running, riding, etc.). Based on these registrations, the schoolyards were evaluated to assess whether they provided the necessary facilities, equipment, and natural elements that promote PA. To map the schoolyards and register the affordances, the researcher walked through each schoolyard, noting the surfaces, facilities, and equipment on a registration form and the activities and basic motor skills supported by the schoolyard features. The Republic of Estonia Land and Spatial Development Board database was used as the map source. Orthophoto maps (Land and Spatial Development Board) were used to describe and identify the schoolyards and facilities for PA. Mapping results were processed with Adobe Illustrator (Adobe Inc., 2019). The researcher used different colours on orthophoto maps to illustrate schoolyard features representing surface materials and vegetation. Additionally, two-letter abbreviations for each feature were placed directly on the maps to precisely indicate their locations within the schoolyards. The size of the schoolyard area was calculated directly from the orthophoto map. School buildings and parking areas were extracted from the schoolyard area.

### **4.3. Outdoor recess observation**

In paper I, outdoor recesses were observed using the SOPLAY system, which is designed for monitoring play and leisure activities among youth (McKenzie, 2012). However, since the primary focus of outdoor recess observations was not assessing PA levels, the SOPLAY observation was modified to examine student behaviour, activities, and the utilisation of facilities. Researchers conducted observations during recess at each school over two consecutive days. Observations took place in autumn for Schools A and B, and in spring for Schools C and D. School A had two outdoor recesses, one for school level I and the other for school level II, and the recesses lasted 50 minutes and 30 minutes, respectively. School B also had two outdoor recesses lasting for 20 minutes each, but they were not specified for certain grades. Schools C and D had one outdoor recess lasting 40 minutes and 30 minutes, respectively. All students in all four schools went outside during the designated outdoor recess. Schoolyards were divided into equal-sized areas for the observations. Depending on the size and the design of the schoolyard, at least three researchers participated in the schoolyard observations. Researchers rotated the areas they observed in each school during the two days of observations. Observers took field notes throughout the outdoor recess, which were compared at the conclusion of each observation period. Subsequently, one of the researchers conducted a systematic analysis of these notes to determine which facilities and equipment were utilised most frequently in each schoolyard. The observation method was piloted at two schoolyards in spring 2021. During the pilot, the observed areas were rotated among four researchers. Two researchers observed the same area simultaneously, and field notes were compared after the recess to ensure inter-rater reliability.

### **4.4. Physical activity**

All students who consented to participate in the study wore the ActiGraph GT3X accelerometer (ActiGraph LLC, Pensacola, FL, USA), which was used to monitor PA and sedentary time during waking hours. Participants were asked to wear the accelerometer on the hip for seven consecutive days except during water-related sports and activities. Non-wearing time (at least 20 minutes of consecutive reading of zero counts and the night-time periods when the unit was removed) was eliminated from the analysis. PA data were analysed using ActiLife software version 6.13.4 (ActiGraph LLC, Pensacola, FL, USA). The sampling interval was set at 15s. Evenson cut-points for children (Evenson et al., 2008; Steene-Johannessen et al., 2020) were used to define sedentary behaviour ( $\leq 100$  CPM), light- (101 to 2295 CPM), moderate- (2296 to 4011 CPM), and vigorous-intensity ( $\geq 4012$  CPM) PA. In addition, students filled out an accelerometer diary, noting whether they had outdoor recess on a particular day and if they participated. If a student did not mark participation in outdoor recess or was absent from school, the analysis excluded recess data for that particular day. Accelerometer diaries

were utilised to obtain the recess participation data, while the school schedules provided the necessary information for extracting PA data during both recess and school time.

In paper I, only recess PA data were used in the statistical analysis. Every longest active recess of the school day (whether indoor or outdoor recess) that the student participated in was included separately in the analysis for every student. Participation cases (Table 4) indicate the total number of analysed recesses. An accelerometer diary indicated if the student participated in the outdoor recess during a particular day.

In paper II, only school time PA and recess PA data were used in the statistical analysis. Valid recording for PA and sedentary time required at least one full school day. On average, students whose data were included in the analysis wore the accelerometer for  $4.28 \pm 0.96$  school days. Moreover, 93% of students wore the accelerometer for at least three school days. Accelerometer diaries were used to obtain the recess participation data, and school schedules provided by the schools were utilised to extract the recess and school time PA data. Based on the information provided in the accelerometer diaries, only regular full school days were included in the analysis, and all irregular school days, e.g. days of class trips or sports days, were excluded.

## **4.5. Student and parent questionnaire**

All participating students and one of their parents (or a legal guardian) were asked to complete the questionnaire developed and previously validated by the Schools in Motion program (Mooses et al., 2021). The questionnaire included questions about demographics, PA opportunities in school, outdoor recess, and leisure-time activities; however, not all questions were used in this study. The section about outdoor recess has been previously used by Brustio et al. (Brustio et al., 2018) and was translated into Estonian and modified to fit the context of outdoor recess. Members of the research team handed out the questionnaires at school, and participants, both students and parents, completed the questionnaire at home and returned the completed questionnaire to the research team.

In paper I, the question used in the data analysis was the following: “What are three of your favourite activities to do during outdoor recess?” Each student provided up to three distinct responses to this question. The reported results reflect the frequency with which a particular activity was mentioned by students in their questionnaire answers. Responses were categorised according to similar activities, resulting in the formation of 17 subgroups. For example, different ball games like basketball, soccer, and table tennis were combined into the sports games subgroup. Swings, trampolines, bridges, and tunnels were all grouped as facilities. Climbing on monkey bars, adventure trails, or just climbing was combined into a climbing subgroup. Sitting, playing on the phone, drawing, playing board games, etc., were all grouped as sedentary activities.

In paper III, the questionnaire section used for data analysis of students included statements regarding outdoor recess. Students were asked to rate their agreement with statements about outdoor recess using a five-point Likert scale – (1) fully disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, (5) fully agree. Parents were asked about their attitudes towards the opportunities and promotion of PA in their child’s school. They rated these statements on a four-point Likert scale: (1) not important at all, (2) not important, (3) important, (4) very important. In addition, students were asked how often they engage in PA outdoors during leisure time, whether (1) rarely, (2) 1–2 times a week, (3) 3–4 times a week, (4) almost every day, (5) every day. For the statistical analysis, responses “every day” and “almost every day”, and “1–2 times a week” and “rarely” were combined into two broader categories.

## 4.6. Statistical analysis

SPSS software for Windows (version 29.0) was used for the statistical analysis. The normality of the data was tested using the Shapiro–Wilk test. Statistical significance was set at  $p < 0.05$ .

In paper I, students in all four schools were divided into two separate groups based on outdoor recess participation – 1) participated in outdoor recess; 2) participated in indoor recess. Information from accelerometer diaries was used to determine whether the student participated in outdoor recess or not. Participation data are presented, reflecting the number of recesses students participated in outdoor and indoor recess. The total participation in both outdoor and indoor recess was calculated by summing the daily occurrences of the two types of recess.

In paper II and paper III, schools were divided into three separate groups based on recess types in schools for the statistical analysis – 1) “daily outdoor recess” (group name used in paper III “outdoor recess”); 2) “irregular outdoor recess” (“outdoor recess on some days” in paper III); 3) “indoor recess”. From here on, the following group names will be used to present the results of the study – 1) “daily outdoor recess”; 2) “irregular outdoor recess”; 3) “indoor recess”. Schools in the “daily outdoor recess” group (paper II – 6 schools, students  $n=333$ , 44% boys; paper III – 6 schools, students  $n=320$ , 45% boys, parents  $n=309$ ) had a daily outdoor recess, where students actively participated throughout the whole school year. The duration of outdoor recesses in different schools in the “daily outdoor recess” group varied between 15–50 minutes, and it was obligatory for students to go outside during this time. Schools in the “irregular outdoor recess” group (paper II – 4 schools,  $n=243$  students, 45% boys; paper III – 4 schools, students  $n=229$ , 44% boys, parents  $n=222$ ) had one longer active recess daily. On some days of the school week, it was an outdoor recess. On other days, it was an active indoor recess where students could play in the gym or engage in other physically active activities. Recess length in this group varied between 25–30 minutes in different schools. Schools in the “indoor recess” group (paper II –

5 schools, n=224 students, 45% boys; paper III – 5 schools, students n=243, 45% boys, parents n=228) did not have outdoor recess as part of their school schedule. Schools in the “indoor recess” group had a longer active recess every day, where students could access the gym or engage in other physically active activities within the school building. The duration of the active indoor recesses varied between 15–50 minutes in different schools.

**Table 1.** Description of school groups in paper II and III.

	Paper II			Paper III		
	Daily outdoor recess	Irregular outdoor recess	Indoor recess	Daily outdoor recess	Irregular outdoor recess	Indoor recess
Schools (n)	6	4	5	6	4	5
Students (n)	333	243	224	320	229	243
Boys	44%	45%	45%	45%	44%	45%
Parents (n)				309	222	228
Recess length	15–50min	25–30min	15–50min			

For paper II, the average weekly PA data from outdoor recess were used in the analysis for the “daily outdoor recess” group, and weekly average PA data from the active indoor recess were used for the “indoor recess” group. The average PA data from outdoor recess and the equivalent indoor recess data were used for the “irregular outdoor recess” group. In total, 2923 recess data were analysed. 1160, 787, and 976 recesses were analysed in the “daily outdoor recess”, “irregular outdoor recess”, and “indoor recess” groups, respectively.

In paper I, a Univariate General Linear Model was conducted to examine differences in sedentary behaviour, PA, and preferred activities by gender and school levels (level I and II), whether one did or did not participate in outdoor recess. All the analyses were adjusted for the length of the recess.

In paper II, a Univariate General Linear Model was conducted to examine differences in sedentary behaviour and PA in recess: 1) between school groups, 2) within gender differences between school groups, and 3) between grades in different school groups. The analyses were adjusted for the length of the recess (except when % values were used), gender (except analysis 2, where gender was used as a fixed factor), and grade (except analysis 3, where the grade was used as a fixed factor).

In paper III, a Univariate General Linear Model was used to examine differences in children’s and their parents’ answers between school groups (mean ± SE). All models were adjusted for grade and gender. The distribution of being active (based on questionnaires) during leisure time between school groups was analysed using the Pearson Chi-Square Test.

## 5. RESULTS

### 5.1. Schoolyard mapping and affordances registration (Paper I)

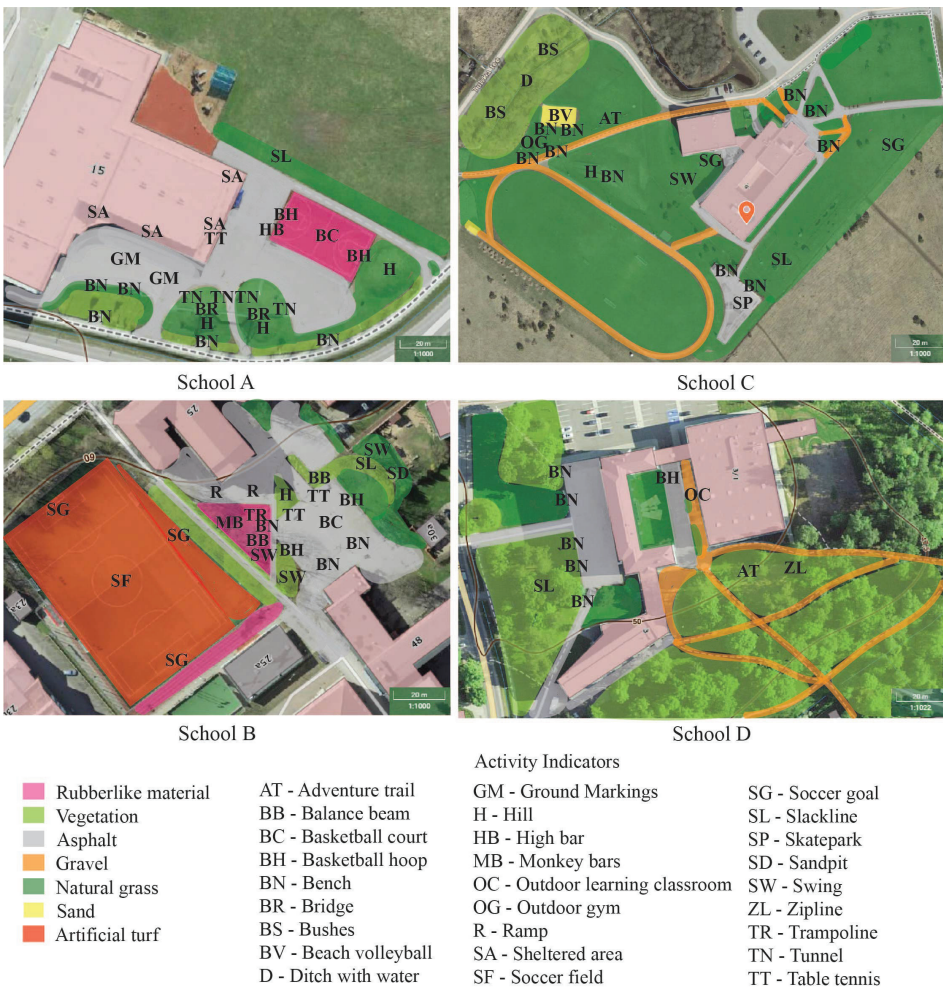
The total area of the schoolyards varied between 4581 and 39,905 m<sup>2</sup> (17–122 m<sup>2</sup> per child). School C had the largest schoolyard, providing the most space per child. While the schoolyards generally featured open and predominantly flat landscapes, schools A and C were distinguished by the artificial hill in the schoolyard. Vegetation was present across all schoolyards; however, natural grass dominated in rural settings and artificial ground coverings were more prevalent in urban schoolyards. Each observed schoolyard offered a slackline, possibilities for ballgames in the schoolyard, and climbing opportunities; however, dedicated full basketball courts were exclusive to urban schoolyards, and School C uniquely provided opportunities for play and climbing in a natural environment. The four schoolyards had many similarities and differences, described in more detail in Table 2 (Paper I – Table 1) and the text below.

**Table 2.** Schoolyard characteristics in four schools in Estonia.

School	Schoolyard Area, Pupils (n), and Area/Child	Landscape: Topography and Vegetation	Surface	Dominating Main Characteristics
School A	4581m <sup>2</sup> n=216 21m <sup>2</sup>	Mostly flat, two artificial hills, open. Vegetation: natural grass, trees.	Asphalt, natural grass, rubber-like material	Open asphalt area, possibility to bike. Basketball court, two hills connected with a bridge.
School B	15 406m <sup>2</sup> n=909 17m <sup>2</sup>	Flat, open. Vegetation: some natural grass and big trees.	Asphalt, natural grass, rubber-like material	Basketball court, multifunctional playground
School C	39 905m <sup>2</sup> n=327 122m <sup>2</sup>	Flat, open. Vegetation: some trees and bushes, and a ditch with water.	Natural grass, gravel, asphalt, sand	Open grass area, slacklines, skatepark, possibility to bike & rollerblade
School D	34 706m <sup>2</sup> n=764 45m <sup>2</sup>	Mostly flat, low, and long slope. Vegetation: a lot of big trees and bushes.	Natural grass, gravel, asphalt	Park, adventure trail with zipline, possibility to bike.

Figure 2 (Paper I – Figure 1) presents the schoolyard mapping cases from each school. School A, situated in an urban area in southern Estonia, featured a predominantly flat topography with three small artificially made hills covered

with natural grass and some vegetation. Trees in the schoolyard served the purpose of separating the schoolyard from the road. A significant portion of the schoolyard was covered with asphalt, marked to facilitate diverse games and activities and permit the use of scooters, bicycles, and skateboards. Furthermore, the schoolyard incorporated a basketball court, a slackline, several benches, a game of table tennis, two tunnels going through two hills, a bridge connecting these two hills, and a sheltered area in front of the school. The schoolyard provided opportunities for the development of fundamental motor skills, like running, jumping, walking, crawling, balancing, and climbing. Students also had access to different sports equipment, including balls and rackets, enabling throwing and catching activities. Potential safety considerations associated with this schoolyard included the absence of a fence around the school and the immediate proximity of a public road.



**Figure 2.** Schoolyards of different schools (descriptions of the schools A, B, C, and D are presented in Table 1), showing the characteristics of the design and facilities.

Situated in a southern Estonian city, School B featured a largely flat topography with trees and bushes around the sporting areas, along with natural grass and artificial ground coverings. Its multipurpose play area surfaced with a rubber-like material, incorporated six swings, monkey bars, four balance beams, and two in-ground trampolines. A significant portion of the schoolyard was covered with asphalt, encompassing the basketball court and some parking areas. The asphalt also accommodated two table tennis tables and two ramps, enabling students to use scooters, bicycles, and skateboards. The natural grassy area included a slackline, two swings, and a sandpit. While School B possessed an artificial turf soccer field, its use during recess was restricted to older students not participating in this study. Students lacked access to sports equipment such as balls and rackets. The available equipment and facilities supported activities like running, jumping, balancing, walking, climbing, hanging, throwing, and catching. A potential safety concern was a pedestrian street going through the schoolyard, which was also used by individuals on scooters and bicycles.

School C was located in a northern Estonian rural area, featuring a predominantly flat topography covered with natural grass and gravel, along with asphalt pathways near and around the school building. The area behind the school included a hill, bushes, and a water-filled ditch. The schoolyard also offered a beach volleyball court, a low-level adventure trail, outdoor fitness equipment, a skatepark with five ramps of varying sizes, multiple slacklines, six swings, and numerous soccer goals. Students had access to diverse sports equipment, such as various balls, rackets, and rollerblades. The asphalt road in front of the school allowed for rollerblading and the use of scooters, skateboards, and bicycles. Numerous benches provided spaces for student socialisation. Although a track and field stadium was part of the school grounds, it was under construction during the schoolyard mapping process and thus inaccessible to students. The schoolyard supported the development of motor skills, including running, walking, jumping, throwing, catching, hanging, climbing, and balancing. A potential safety concern was the road in front of the school, used by rollerblading students and parent vehicles.

Situated in a southern Estonian rural area, School D featured a predominantly flat topography with a gradual long slope with a lot of natural grass and vegetation, including trees and bushes. Gravel pathways were present within the grounds, along with some asphalt surfacing in front of the school and around the basketball hoop. The asphalt area at the school's entrance permitted students to ride bicycles, scooters, and skateboards. The schoolyard also included an outdoor learning space, a low-level adventure trail with a zipline, and a slackline. Numerous benches and tables were positioned around the school to facilitate social interaction and outdoor educational activities. The environment supported the development of motor skills such as running, balancing, walking, climbing, hanging, throwing, and catching. Potential safety concerns included a parking area adjacent to the basketball court and a lake situated behind the schoolyard.

## 5.2. Outdoor recess observations and students' preferred activities during outdoor recess (Paper I)

During outdoor recess for fourth and fifth graders (school level II) in School A, the basketball court and slackline area were the most frequently used by students throughout the entire recess (Figure 2, School A–BC, SL). The asphalt area near the school was utilised for riding scooters, running, walking, and playing some racket games (Figure 2, School A–grey area). In contrast, the hills, tunnels, and the bridge were infrequently used by students at the school level II throughout recess (Figure 2, School A–H, TN, BR). During an outdoor recess for grades one to three (school level I), the hills, tunnels, and bridge were highly popular, with continuous student engagement (Figure 2, School A–H, T, BR). The slackline also drew significant interest, evidenced by a queue next to it for everybody to be able to use it (Figure 2, School A–SL). The asphalt area was consistently active, with students running, walking, and playing games (Figure 2, School A–grey area). Students at the school level I also showed a preference for natural elements, with some boys climbing trees and a large group exploring the grass field next to the schoolyard. The basketball court was the least utilised area by the students at the school level I (Figure 2, School A–BC).

At School B, the multifunctional playground, featuring swings, trampolines, balance beams, and monkey bars, was the most frequently used area (Figure 2, School B–SW, TR, BB, MB). Trampolines and swings were particularly popular and consistently used by students from both school levels. Students at the school level I also utilised the slackline and engaged in play within the natural grass area (Figure 2, School B–SL). In contrast, the asphalt basketball court had limited use, with occasional bicycle riding and a small group of boys playing basketball (Figure 2, School B–BC).

At School C, the natural grass area, the asphalt road near the entrance, and the bushes behind the school were the most popular locations during recess (Figure 2, School C–BS). Many students were observed cycling and rollerblading near the school's entrance (Figure 2, School C–grey area). Students played different ball games, including multiple soccer games simultaneously (Figure 2, School C–green area). In the bushes, students engaged in activities such as tree climbing, carrying logs, building a shelter, and playing in the water-filled ditch (Figure 2, School C–BS, D). The slackline area was also consistently utilised throughout the recess period (Figure 2, School C–SL). Behind the school building, students played on the hill, used the swings, and played soccer (Figure 2, School C–H, SW, SG). The skatepark, low adventure trail, outdoor gym, and beach volleyball court saw less frequent use compared to the other areas of the schoolyard (Figure 2, School C–SP, AT, OG, BV).

The most frequently used spaces at School D were the low adventure trail with a zipline and the asphalt area located behind the school (Figure 2, School D–AT, ZL). Numerous boys were observed riding scooters and playing basketball on the asphalt area (Figure 2, School D–grey area). The low adventure trail was also highly popular, with four distinct groups of students utilising it. A group of girls

consistently used the zipline (Figure 2, School D–AT, ZL). Additionally, some students walked through the park towards a store, and a few boys explored the park’s general area (Figure 2, School D–light green area).

The three most frequently mentioned recess activities among boys in both school levels were active games, sports games, and socialising (Table 3; Paper I – Table 2). Girls reported enjoying active games, sedentary activities, and socialising. A comparison between genders revealed a significantly higher preference for sports games among boys, while girls indicated greater engagement in sedentary activities. For students at school level I, favourite recess activities included active games, sports games, and sedentary activities. School level II students favoured active games, sports games, and socialising, with socialising being mentioned considerably more often by this school level. A statistically significant difference was found for sports games between genders and socialising between school levels ( $p < 0.05$ ).

**Table 3.** Outdoor recess activity preferences (%) by gender and school level.

<b>Recess activities</b>	<b>Boys (%)</b>	<b>Girls (%)</b>	<b>School level I (%)</b>	<b>School level II (%)</b>
Active games (i.e., tag)	62.9	64.7	73.1	58.9
Sports games (i.e., basketball, soccer, etc.)	72.2*	28.3	46.3	51.9
Walking	21.7	30.3	17.9	30.2
Socialising	22.7	33.3	10.5#	37.2
Sedentary activity	12.4	35.4	25.4	23.3
Running	9.3	11.1	10.5	10.1
Climbing	9.3	15.2	16.4	10.1
Facilities (i.e., swing, trampoline, etc.)	16.5	13.1	20.9	11.6
Slackline	3.1	16.2	11.9	8.5
Using a natural space	13.4	2.0	17.9	37.2
Riding a bicycle, scooter/rollerblading	15.5	4.0	11.9	8.5
Singing/dancing	1.0	4.0	1.5	3.1
Studying	5.2	8.1	3.0	8.5
Imaginary game	1.0	3.0	6.0	0.0
Standing	2.1	0.0	1.5	0.8
Eating	0.0	4.0	0.0	3.1
Working out	0.0	1.0	0.0	0.8

Statistical significance was set at  $p < 0.05$ . \*Significantly different from girls. #Significantly different from school level II.

### 5.3. Comparison of physical activity levels of students participating and not participating in outdoor recess (Paper I)

In paper I, when comparing the activity levels of the students participating and not participating in outdoor recess, boys had significantly less sedentary time and significantly more time spent in other activity levels during outdoor recess than girls ( $p < 0.05$ ; Table 4; Paper I – Table 3). Time spent sedentary was significantly higher, and time spent in other activity levels was significantly lower when comparing students not participating in outdoor recess with those who did ( $p < 0.05$ ; Table 4; Paper I – Table 3).

**Table 4.** Differences in time spent in different activity levels (mean $\pm$ SE) during outdoor/indoor recess.

	Participated in outdoor recess			Participated in indoor recess		
	Boys	Girls	Total	Boys	Girls	Total
Participation cases <sup>&amp;</sup>	318	260	578	164	206	370
Sedentary behaviour (min/day)	11.5 $\pm$ 0.4	14.9 $\pm$ 0.5 <sup>#</sup>	13.0 $\pm$ 0.3	19.2 $\pm$ 0.6*	20.8 $\pm$ 0.6*	20.1 $\pm$ 0.4*
Light PA (min/day)	16.9 $\pm$ 0.3	15.5 $\pm$ 0.4 <sup>#</sup>	16.3 $\pm$ 0.2	13.8 $\pm$ 0.5*	12.8 $\pm$ 0.4*	13.2 $\pm$ 0.3*
Moderate PA (min/day)	5.4 $\pm$ 0.2	4.0 $\pm$ 0.2 <sup>#</sup>	4.7 $\pm$ 0.1	2.8 $\pm$ 0.3*	2.3 $\pm$ 0.2*	2.5 $\pm$ 0.2*
Vigorous PA (min/day)	3.2 $\pm$ 0.2	2.6 $\pm$ 0.2 <sup>#</sup>	2.9 $\pm$ 0.1	1.1 $\pm$ 0.2*	1.1 $\pm$ 0.2*	1.1 $\pm$ 0.2*
MVPA (min/day)	8.6 $\pm$ 0.3	6.6 $\pm$ 0.3 <sup>#</sup>	7.7 $\pm$ 0.2	3.9 $\pm$ 0.4*	3.4 $\pm$ 0.4*	3.6 $\pm$ 0.3*

PA – physical activity, MVPA – moderate-to-vigorous physical activity. Adjusted for the length of outdoor recess. <sup>&</sup>The number of children indicating participation in outdoor or indoor recess was counted for each day and was summed as total participation in outdoor or indoor recess. Statistical significance was set at  $p < 0.05$ . <sup>#</sup>Significantly different from boys. \*Significantly different from participation in outdoor recess.

During outdoor recess, students spent 35.5% of the recess time sedentary, compared to 54.7% of the time for the students not participating in outdoor recess. Students participating in outdoor recess engaged in MVPA for 20.4% of recess time, whereas students not participating in outdoor recess spent only 9.5% of the recess time in MVPA. During outdoor recess, girls acquired a higher portion of sedentary time (40.9% of recess time) compared to boys (31.2% of recess time).

Boys engaged in a greater amount of MVPA (22.9% of recess time) during outdoor recess than girls (17.3% of recess time).

Except for sedentary behaviour, all PA levels differed significantly ( $p < 0.05$ ) between outdoor recess participants in school level I and school level II (Table 5; Paper I – Table 4). All activity levels for students not participating in outdoor recess at school level II were significantly different ( $p < 0.05$ ) from students participating in outdoor recess. Students at the school level I engaged in sedentary behaviour for 35.2% and MVPA for 17.4% of outdoor recess. These values were 47.8% and 11.2% for their non-participating peers, respectively. Students at school level II spent 35.6% of the outdoor recess being sedentary and 22.2% in MVPA. In contrast, students who did not participate in outdoor recess spent 58.2% of recess time in sedentary behaviour and only 8.7% of the time in MVPA.

**Table 5.** Differences in time spent in different activity levels between school levels I and II (mean $\pm$ SE) during outdoor/indoor recess.

	Participated in outdoor recess		Participated in indoor recess	
	School level I	School level II	School level I	School level II
Participation cases <sup>&amp;</sup>	220	358	150	220
Sedentary behaviour (min/day)	12.9 $\pm$ 0.6	13.1 $\pm$ 0.4	17.4 $\pm$ 0.7*	21.5 $\pm$ 0.5 <sup>#</sup>
Light PA (min/day)	18.3 $\pm$ 0.4	15.2 $\pm$ 0.3 <sup>#</sup>	15.0 $\pm$ 0.5*	12.2 $\pm$ 0.4 <sup>#</sup>
Moderate PA (min/day)	3.8 $\pm$ 0.2	5.2 $\pm$ 0.2 <sup>#</sup>	3.1 $\pm$ 0.3	2.3 $\pm$ 0.2 <sup>#</sup>
Vigorous PA (min/day)	1.9 $\pm$ 0.2	3.5 $\pm$ 0.2 <sup>#</sup>	1.4 $\pm$ 0.3	1.1 $\pm$ 0.2*
MVPA (min/day)	5.7 $\pm$ 0.4	8.7 $\pm$ 0.3 <sup>#</sup>	4.5 $\pm$ 0.5	3.3 $\pm$ 0.3*

PA – physical activity, MVPA – moderate-to-vigorous physical activity. Adjusted for the length of recess. <sup>&</sup>The number of children indicating participation in outdoor or indoor recess was counted for each day and was summed as total participation in outdoor or indoor recess. Statistical significance was set at  $p < 0.05$ . <sup>#</sup>Significantly different from school level I. \*Significantly different from participation in outdoor recess.

Table 6 (Paper I – Table 5) compares the average time spent in different activity levels during recess in the four schoolyards. Students at School C recorded the highest MVPA engagement (24.4%), whereas time spent in MVPA for other schools ranged from 17–20%. The highest average sedentary time was in School B (37.5%) and School D (36.8%). The same indicator for the two other schools ranged from 34–35%. Students in school A spent the most time in light PA (47.8%); the same indicator for all other schools ranged from 41–43%.

**Table 6.** Differences in time spent in different activity levels between the four schools (mean±SE) during outdoor/indoor recess.

	Participation cases <sup>&amp;</sup>	Sedentary behaviour (min/day)	Light PA (min/day)	Moderate PA (min/day)	Vigorous (min/day)	MVPA (min/day)
<b>School A</b>						
Participated in outdoor recess	205	12.8±0.5	17.8±0.4	4.1±0.2	2.3±0.2	6.4±0.4
Participated in indoor recess	27	19.8±1.5*	14.4±1.1*	2.0±0.6*	0.9±0.5*	2.9±0.9*
<b>School B</b>						
Participated in outdoor recess	81	14.2±0.9	15.5±0.6 <sup>1</sup>	4.6±0.3	2.4±0.3	7.0±0.6
Participated in indoor recess	138	20.3±0.7*	13.6±0.5*	2.2±0.3*	0.9±0.2*	3.1±0.4*
<b>School C</b>						
Participated in outdoor recess	204	13.0±0.6	14.9±0.4 <sup>1</sup>	5.4±0.2 <sup>1,2</sup>	3.7±0.2 <sup>1,2</sup>	9.1±0.4 <sup>1,2</sup>
Participated in indoor recess	55	25.3±1.1 <sup>*1,2</sup>	8.6±0.7 <sup>*1,2</sup>	1.9±0.4*	1.1±0.4*	3.0±0.7*
<b>School D</b>						
Participated in outdoor recess	88	12.9±0.9	16.5±0.7 <sup>3</sup>	4.8±0.4	2.7±0.3 <sup>3</sup>	7.6±0.6 <sup>3</sup>
Participated in indoor recess	150	17.1±0.8 <sup>*2,3</sup>	15.1±0.6 <sup>3</sup>	3.3±0.3 <sup>*1,2,3</sup>	1.5±0.3*	4.8±0.5 <sup>*2,3</sup>

PA – physical activity, MVPA – moderate-to-vigorous physical activity. Adjusted for the length of recess. <sup>&</sup>The number of children indicating participation in outdoor or indoor recess was counted for each day and was summed as total participation in outdoor or indoor recess. Statistical significance was set at p<0.05. \*Significantly different from participation in outdoor recess. <sup>1</sup>Significantly different from School A. <sup>2</sup>Significantly different from School B. <sup>3</sup>Significantly different from School C.

## 5.4. Physical activity levels during different types of recesses (Paper II)

Compared to the “daily outdoor recess” and “irregular outdoor recess” groups, the “indoor recess” group spent significantly more recess time in sedentary behaviour and significantly less time in light PA and MVPA ( $p < 0.05$ ; Table 7; Paper II – Table 1). At the same time “irregular outdoor recess” group had significantly higher sedentary behaviour compared to the “daily outdoor recess” group ( $p < 0.05$ ). The proportion of students who spent at least 40% of their recess time in MVPA was 13.5% for the “daily outdoor recess” group, 8.2% for the “irregular outdoor recess” group, and 7.1% for the “indoor recess” group. Among the students in the “daily outdoor recess” group, 29.1% spent at least 30% of recess time in MVPA, and 25.5% of students in the “irregular outdoor recess” group reached this level. In contrast, only 14.3% of students in the “indoor recess” group spent at least 30% of recess time in MVPA.

**Table 7.** Differences in time spent in different activity levels (mean  $\pm$  SE) during recess in school groups.

	Daily outdoor recess (n=333)		Irregular outdoor recess (n=243)		Indoor recess (n=224)	
	Min/recess <sup>1</sup>	% <sup>2</sup>	Min/recess <sup>1</sup>	% <sup>2</sup>	Min/recess <sup>1</sup>	% <sup>2</sup>
Sedentary behaviour	8.7 $\pm$ 0.	30.8 $\pm$ 0.8	10.3 $\pm$ 0.3*	34.0 $\pm$ 1.0*	13.1 $\pm$ 0.3*#	43.6 $\pm$ 1.0*#
Light PA	13.3 $\pm$ 0.2	45.4 $\pm$ 0.6	12.9 $\pm$ 0.2	44.5 $\pm$ 0.7	11.7 $\pm$ 0.2*#	40.4 $\pm$ 0.7*#
MVPA	7.2 $\pm$ 0.2	23.8 $\pm$ 0.7	6.0 $\pm$ 0.2*	21.5 $\pm$ 0.8	4.3 $\pm$ 0.2*#	15.8 $\pm$ 0.8*#

PA – physical activity, MVPA – moderate-to-vigorous physical activity. <sup>1</sup>Adjusted for the length of outdoor recess, sex, and grade. <sup>2</sup>Adjusted for sex and grade. \*Significantly different from the “daily outdoor recess” group. #Significantly different from the “irregular outdoor recess” group.  $p < 0.05$ .

Both boys and girls in the “daily outdoor recess” group spent less time in sedentary behaviour and engaged more in MVPA compared to boys and girls in the “indoor recess” group ( $p < 0.05$ ; Table 8; Paper II – Table 2). Within girls, the “daily outdoor recess” group and “irregular outdoor recess” group had significantly higher PA compared to the “indoor recess” group ( $p < 0.05$ ).

**Table 8.** Differences in time spent in different activity levels (mean  $\pm$  SE) during recess within sexes in school groups.

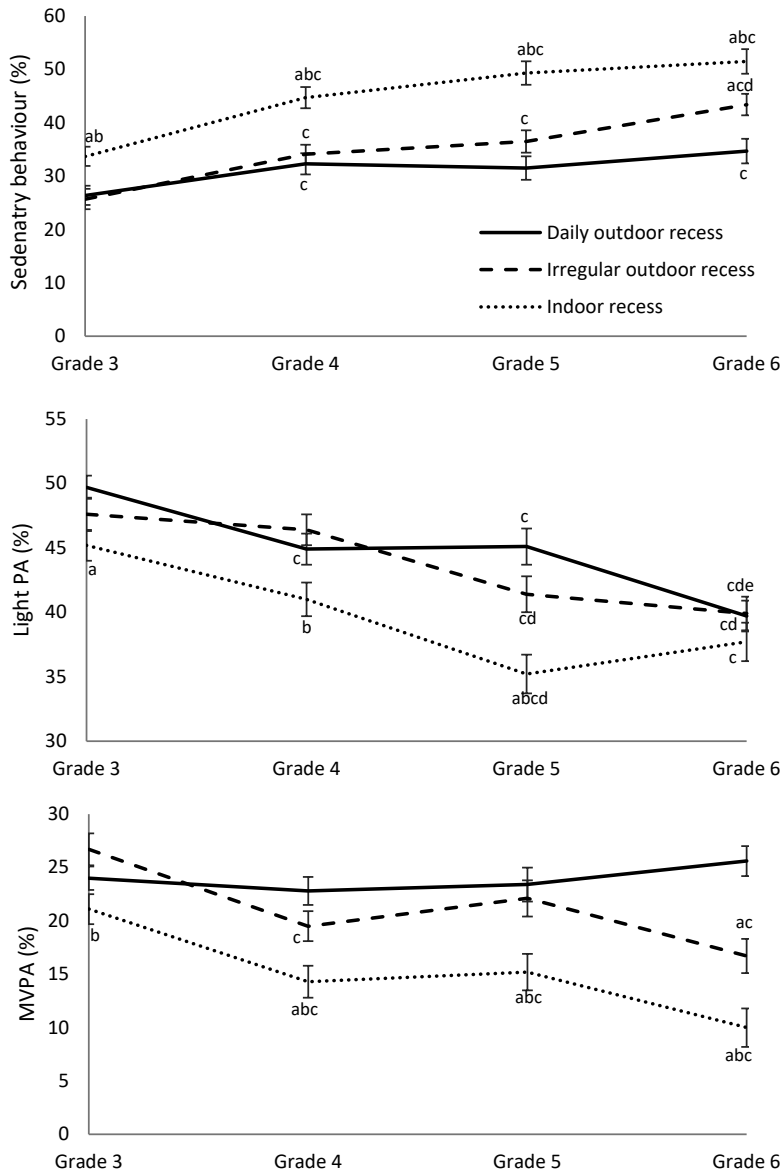
	Boys (n=357)			Girls (n=443)		
	Daily outdoor recess (n=147)	Irregular outdoor recess (n=109)	Indoor recess (n=101)	Daily outdoor recess (n=186)	Irregular outdoor recess (n=134)	Indoor recess (n=123)
Sedentary behaviour (%)	27.9 $\pm$ 1.3	27.9 $\pm$ 1.3	37.7 $\pm$ 1.5 <sup>1,2</sup>	33.2 $\pm$ 1.1*	36.6 $\pm$ 1.3*	48.3 $\pm$ 1.4* <sup>1,2</sup>
Light PA (%)	45.3 $\pm$ 0.9	45.0 $\pm$ 1.0	41.6 $\pm$ 1.0 <sup>1</sup>	45.5 $\pm$ 0.8	44.1 $\pm$ 0.9	39.5 $\pm$ 0.9 <sup>1,2</sup>
MVPA (%)	26.8 $\pm$ 1.0	24.3 $\pm$ 1.2	20.6 $\pm$ 1.2 <sup>1</sup>	21.3 $\pm$ 0.9*	19.3 $\pm$ 1.0*	11.9 $\pm$ 1.1* <sup>1,2</sup>

PA – physical activity, MVPA – moderate-to-vigorous physical activity. Adjusted for the grade. Statistical significance was set at  $p < 0.05$ . \*Significantly different from boys. <sup>1</sup>Significantly different from the “daily outdoor recess” group. <sup>2</sup>Significantly different from the “irregular outdoor recess” group.

Girls in all three groups spent less time in MVPA and more time sedentary than boys (Table 8; Paper II – Table 2). Within all three recess groups, significant differences were found between boys and girls for MVPA and sedentary behaviour ( $p < 0.05$ ).

Figure 3 (Paper II – Figure 1) illustrates the differences in sedentary time and PA levels during recess among students in grades three to six in different school groups. Compared to the “daily outdoor recess” group (excluding MVPA in grade 3) and the “irregular outdoor recess” group across all grades, the “indoor recess” group exhibited significantly more sedentary behaviour and less MVPA during recess ( $p < 0.05$ ). Results also revealed a pattern of increasing sedentary behaviour and decreasing MVPA as age increased. Across all school groups, grade 3 students exhibited significantly less sedentary time compared to students in other grades ( $p < 0.05$ ), with the exception of grade 3 students in the “daily outdoor recess” group. The most significant change in sedentary time was seen in the “indoor recess” group. Within this group, grade 3 spent significantly less recess time being sedentary compared to grade 6 ( $p < 0.05$ ). In the “indoor recess” and “irregular outdoor recess” groups, grade 3 students engaged significantly more in MVPA compared to students in other grades ( $p < 0.05$ ), with the exception of grade 5 students in the “irregular outdoor recess” group. In contrast, the “daily outdoor recess” group showed a consistent amount of time spent in MVPA across all grade levels (22.8–25.6%), and no significant difference was found.

The “daily outdoor recess” group spent significantly less time in sedentary and more time in MVPA compared to the “indoor recess only” group during all recess lengths ( $p < 0.05$ ), except for 30-minute recess (Table 9; Paper II – Table 3). Statistical significances were also found for the average amount of recess time spent in all PA intensities during 25-minute recess between the “indoor recess only” and “irregular outdoor recess” groups and for MVPA and sedentary behaviour during 40–50-minute recess between the “daily outdoor recess” group and “indoor recess” group ( $p < 0.05$ ).



**Figure 3.** Differences in time spent in different activity levels during recess in grades 3–6. Statistical significance was set at  $p < 0.05$ . a – significantly different from “Daily outdoor recess”; b – significantly different from “Irregular outdoor recess”; c – significantly different from grade 3; d – significantly different from grade 4; e – significantly different from grade 5. PA–physical activity, MVPA–moderate-to-vigorous physical activity.

**Table 9.** Differences in time spent (time in minutes and amount in percentage) in different activity levels (mean  $\pm$  SE) during recesses of varying length in school groups.

	Daily outdoor recess				Irregular outdoor recess				Indoor recess			
	Sedentary behaviour (min/recess)	Light PA (min/recess)	MVPA (min/recess)	Sedentary behaviour (min/recess)	Light PA (min/recess)	MVPA (min/recess)	Sedentary behaviour (min/recess)	Light PA (min/recess)	MVPA (min/recess)	Sedentary behaviour (min/recess)	Light PA (min/recess)	MVPA (min/recess)
15–20min recess	2.9 $\pm$ 1.4 (17%)	11.0 $\pm$ 1.0 (52.5%)	6.3 $\pm$ 1.1 (30.5%)	–	–	–	7.8 $\pm$ 0.5 (44%) <sup>1</sup>	7.2 $\pm$ 0.4 (40%) <sup>1</sup>	–	7.2 $\pm$ 0.4 (40%) <sup>1</sup>	2.6 $\pm$ 0.4 (16%) <sup>1</sup>	–
25min recess	6.1 $\pm$ 0.5 (24%)	11.6 $\pm$ 0.4 (48%)	7.1 $\pm$ 0.4 (28%)	7.7 $\pm$ 0.4 (31%) <sup>1</sup>	11.5 $\pm$ 0.3 (46%)	5.8 $\pm$ 0.3 (23%) <sup>1</sup>	10.9 $\pm$ 0.6 (44%) <sup>1,2</sup>	10.4 $\pm$ 0.4 (41% <sup>1</sup> *#)	–	10.4 $\pm$ 0.4 (41% <sup>1</sup> *#)	3.6 $\pm$ 0.5 (15%) <sup>1,2</sup>	–
30min recess	9.5 $\pm$ 0.4 (31%)	13.8 $\pm$ 0.3 (46%)	6.6 $\pm$ 0.3 (23%)	11.1 $\pm$ 0.4 (37%) <sup>1</sup>	13.0 $\pm$ 0.3 (43%)	5.9 $\pm$ 0.3 (20%)	10.2 $\pm$ 0.6 (34%)	12.4 $\pm$ 0.5 (42%) <sup>1</sup>	–	12.4 $\pm$ 0.5 (42%) <sup>1</sup>	7.2 $\pm$ 0.5 (24%)	–
40–50min recess	15.2 $\pm$ 0.5 (37%)	17.8 $\pm$ 0.3 (42%)	9.0 $\pm$ 0.4 (21%)	–	–	–	21.5 $\pm$ 0.7 (54%) <sup>1</sup>	15.3 $\pm$ 0.5 (38%) <sup>1</sup>	–	15.3 $\pm$ 0.5 (38%) <sup>1</sup>	3.2 $\pm$ 0.5 (8%) <sup>1</sup>	–

PA=physical activity, MVPA=moderate-to-vigorous physical activity. Adjusted for the grade and sex. Schools with outdoor recess on some days did not have recesses with a length of 15–20min and 40–50min. Statistical significance was set at  $p < 0.05$ . <sup>1</sup>Time in minutes and amount in percentage significantly different from the “daily outdoor recess” group. <sup>2</sup>Time in minutes and amount in percentage significantly different from the “irregular outdoor recess” group. \*The amount in percentage is significantly different from the “daily outdoor recess” group. #The amount in percentage is significantly different from the “irregular outdoor recess” group.

“Indoor recess” group accumulated significantly less total school time MVPA minutes (22.8±10.6min) compared to the “daily outdoor recess” (27.0±10.6min) and “irregular outdoor recess” group (24.7±9.5min) (p<0.05). Recess MVPA in the “daily outdoor recess” group contributed significantly more total school time MVPA compared to the “irregular outdoor recess” group and “indoor recess” group (p<0.05), and recess MVPA in the “irregular outdoor recess” group contributed significantly more total school time MVPA compared to the “indoor recess” group (p<0.05) (Table 10). Both boys and girls in the “indoor recess” group acquired less total school time MVPA during recess compared to the other school groups (p<0.05). In addition, girls in the “irregular outdoor recess” group acquired significantly less total school time MVPA during recess compared to the “daily outdoor recess” group (p<0.05).

**Table 10.** The proportion of total school time MVPA (%) acquired during recess in school groups.

	<b>Daily outdoor recess</b>	<b>Irregular outdoor recess</b>	<b>Indoor recess</b>
Overall	27.7±0.8	24.5±0.9 <sup>1</sup>	17.8±0.9 <sup>1,2</sup>
<b>Difference within and between sexes</b>			
Boys	26.9±1.1	24.6±1.3	19.8±1.4 <sup>1,2</sup>
Girls	28.3±1.0	24.4±1.2 <sup>1</sup>	16.2±1.2 <sup>1,2</sup>

PA – physical activity, MVPA – moderate-to-vigorous physical activity. Statistical significance was set at p<0.05. <sup>1</sup>Significantly different from the “daily outdoor recess” group. <sup>2</sup>Significantly different from the “irregular outdoor recess” group. Overall – adjusted for the grade and sex. Sex differences – adjusted for grade.

## **5.5. Students and parents’ perceptions about physical activity opportunities in school and outdoor recess (Paper III)**

The “daily outdoor recess” group had significantly more positive attitudes about outdoor recess compared to the “irregular outdoor recess” and “indoor recess” groups (p<0.05), except for the statement about concentration after outdoor recess for the “irregular outdoor recess” group (Table 11; Paper III – Table 1). The “indoor recess” group had significantly less positive attitudes about concentration after outdoor recess, and they agreed less with the statement that “Participating in the outdoor recess makes the rest of the school day lighter” when compared with the “irregular outdoor recess” group (p<0.05).

**Table 11.** Students’ perceptions about outdoor recess and leisure-time PA (mean ± SE).

	Daily outdoor recess	Irregular outdoor recess	Indoor recess
<b>In what degree do you agree with the following statements?</b>			
It is easier to concentrate in the lesson after the outdoor recess	3.62 ± 0.06	3.47 ± 0.07	3.18 ± 0.07 <sup>1,2</sup>
Participating in the outdoor recess makes the rest of the school day lighter	3.56 ± 0.07	3.17 ± 0.08 <sup>1</sup>	2.93 ± 0.08 <sup>1,2</sup>
Participating in the outdoor recess has helped to facilitate relationships with my peers	3.62 ± 0.07	3.18 ± 0.08 <sup>1</sup>	3.17 ± 0.08 <sup>1,2</sup>
Outdoor recess should be all year long	4.02 ± 0.08	3.78 ± 0.09 <sup>1</sup>	3.66 ± 0.09 <sup>1</sup>
I enjoy being active with my peers during outdoor recess	4.40 ± 0.06	4.05 ± 0.07 <sup>1</sup>	4.05 ± 0.07 <sup>1</sup>
<b>How often are you physically active outdoors during your leisure time? Do not include participation in organised sports*</b>			
	2.25 ± 0.05	2.07 ± 0.06 <sup>1</sup>	1.94 ± 0.06 <sup>1</sup>

Statements are rated on a five-point Likert scale. Adjusted for the grade and gender. \*Responses to this question were summarised into three groups: (1) rarely or 1–2 times a week; (2) 3–4 times a week; (3) almost every day or every day. Statistical significance was set at  $p < 0.05$ . <sup>1</sup>Significantly different from the “daily outdoor recess” group. <sup>2</sup>Significantly different from the “irregular outdoor recess” group.

The “daily outdoor recess” group stated being significantly more active outdoors during their leisure time compared to the “irregular outdoor recess” and “indoor recess” groups ( $p < 0.05$ ) (Table 11; Paper III – Table 1). 53.0% of the “daily outdoor recess” group indicated being active outdoors during leisure time every day or almost every day; the same answer was less common in the “irregular outdoor recess” (42.7%) and the “indoor recess” (37.3%) groups. The frequency of being active outdoors 3–4 times a week was similar across all three groups (19.2%–21.4%). Almost half of the students in the “indoor recess” group (43.0%) stated being active outdoors during leisure time for 2 times a week or less, while this answer was less common in the “daily outdoor recess” (27.9%) and “irregular outdoor recess” (35.9%) groups.

Parents of the “daily outdoor recess” and “irregular outdoor recess” groups considered it significantly more important that the school provides PA opportunities for students during the school day, especially outdoor recess and available equipment, compared to the “indoor recess” group ( $p < 0.05$ ; Table 12; Paper III – Table 2). Compared to the parents in the “irregular outdoor recess” and “indoor recess” groups, parents in the “daily outdoor recess” group agreed significantly more that it is beneficial for students to go outside during recess and that being active during recess decreases health risks of students ( $p < 0.05$ ). Furthermore, a significantly larger percentage of parents in the “daily outdoor recess” group

(75%) strongly agreed that “It is beneficial to go outside during recess,” compared to 60% of parents in the “irregular outdoor recess” group and 47% in the “indoor recess” group. Regarding the statement “being active during recess decreases health risks of students,” 52% of parents in the “daily outdoor recess” group strongly agreed, compared to 46% of parents in the “irregular outdoor recess” group and 41% in the “indoor recess” group.

Parents of the “daily outdoor recess” and “irregular outdoor recess” groups agreed significantly more with a statement that “Being active during recess promotes a more peaceful learning environment” compared to parents of the “indoor recess” group ( $p < 0.05$ ; Table 12; Paper III – Table 2). Specifically, 47% of parents in the “daily outdoor recess” and 49% of parents in the “irregular outdoor recess” groups completely agreed with this statement, compared to 38% of parents in the “indoor recess” group.

**Table 12.** Parents’ perceptions about PA opportunities during school time (mean  $\pm$  SE).

	<b>Daily outdoor recess</b>	<b>Irregular outdoor recess</b>	<b>Indoor recess</b>
<b>How important it is for you that...*</b>			
...your child’s school has provided opportunities for students to be active during the school day.	3.82 $\pm$ 0.02	3.80 $\pm$ 0.03	3.72 $\pm$ 0.03 <sup>1,2</sup>
...your child has outdoor recess every day.	3.71 $\pm$ 0.03	3.51 $\pm$ 0.04 <sup>1</sup>	3.25 $\pm$ 0.05 <sup>1,2</sup>
...your child has an opportunity to be active with their peers during recess.	3.81 $\pm$ 0.02	3.69 $\pm$ 0.03 <sup>1</sup>	3.55 $\pm$ 0.04 <sup>1,2</sup>
...the school has enough equipment (balls, balancing boards, hopscotch etc.) that students can use during recess.	3.69 $\pm$ 0.03	3.61 $\pm$ 0.04	3.50 $\pm$ 0.04 <sup>1,2</sup>
...school staff encourages students to be active during recess.	3.68 $\pm$ 0.03	3.62 $\pm$ 0.04	3.55 $\pm$ 0.04 <sup>1</sup>
<b>In what degree do you agree with the following statements?#</b>			
It is beneficial for students to go outside during recess.	4.71 $\pm$ 0.03	4.52 $\pm$ 0.04 <sup>1</sup>	4.31 $\pm$ 0.05 <sup>1,2</sup>
Providing opportunities for being active in recess promotes students’ relationships with each other.	4.35 $\pm$ 0.04	4.33 $\pm$ 0.05	4.31 $\pm$ 0.05
Being active during recess promotes a peaceful learning environment.	4.38 $\pm$ 0.04	4.35 $\pm$ 0.05	4.19 $\pm$ 0.05 <sup>1,2</sup>
Being active during recess decreases the health risks of students.	4.40 $\pm$ 0.04	4.26 $\pm$ 0.06 <sup>1</sup>	4.25 $\pm$ 0.05 <sup>1</sup>

\*Statements are rated on a four-point Likert scale. #Statements are rated on a five-point Likert scale. Statistical significance was set at  $p < 0.05$ . <sup>1</sup>Significantly different from the “daily outdoor recess” group. <sup>2</sup>Significantly different from the “irregular outdoor recess” group.

Table 13 (Paper III – Table 3) presents parents’ involvement in decision-making about PA opportunities in school. Parents of the “irregular outdoor recess” and “indoor recess” groups stated that the school has asked their opinion regarding PA opportunities during the school day significantly less compared to parents of the “daily outdoor recess” group ( $p < 0.05$ ; Table 13; Paper III – Table 3). Although parental cooperation and support for developing school PA opportunities were low, parents of the “daily outdoor recess” group reported significantly greater involvement than parents in the “irregular outdoor recess” and the “indoor recess” groups ( $p < 0.05$ ).

**Table 13.** Parents’ involvement in decision-making about PA opportunities in school.

	Daily outdoor recess	Irregular outdoor recess	Indoor recess
<b>School has asked my opinion about what could be different in schools, so students could be more active during the school day.</b>			
Yes	47.0%	31.7% <sup>1</sup>	17.1% <sup>1,2</sup>
No	53.0%	68.3% <sup>1</sup>	82.9% <sup>1,2</sup>
<b>I have cooperated with or supported the school when developing physical activity opportunities.</b>			
Yes	29.0%	9.5% <sup>1</sup>	11.8% <sup>1</sup>
No	71.0%	90.5% <sup>1</sup>	88.2% <sup>1</sup>

Statistical significance was set at  $p < 0.05$ . <sup>1</sup>Significantly different from the “daily outdoor recess” group. <sup>2</sup>Significantly different from the “irregular outdoor recess” group.

## 6. DISCUSSION

This study was conducted to measure students' PA levels during the school day, specifically during recess among students in grades 3–6 (9–13-year-old) in Estonian primary schools. Furthermore, the study examined how the schoolyard possibilities influence students' PA levels during outdoor recess and what activities students prefer. Lastly, it evaluated the association between different types of recesses and students' attitudes toward PA. Students in schools with “daily outdoor recess” obtained the most MVPA during recess compared to schools with “irregular outdoor recess” or schools with “indoor recess” only. In addition, MVPA levels during outdoor recess did not significantly change among students in the “daily outdoor recess” group with increasing age. The study also revealed that boys preferred more sport-related activities, whereas girls favoured more social and less physically demanding activities. Additionally, schoolyards that provided more space per child and featured a more natural environment generated more varied PA and higher MVPA. Moreover, students and parents in the “daily outdoor recess” group reported significantly more positive attitudes toward outdoor recess and PA opportunities in school.

### 6.1. Schoolyard design and most used areas in the schoolyards (Paper I)

The schoolyard mapping process revealed both similarities and differences across the four schoolyards. The four schoolyards predominantly featured flat topography, with either asphalt or natural grass as the main surface. The total area of the schoolyards varied considerably, from 4581 to 39,905 m<sup>2</sup> (17–122 m<sup>2</sup> per student), with the urban schools offering less space per student compared to the rural schools. In urban schools, open areas were mainly covered by asphalt and artificial surfaces, while the rural schools were characterised by natural grass and vegetation. Urban schoolyards in this study resembled traditional schoolyards in Estonia, which typically prioritise sports fields and artificial surfaces (Rutkauskaitė et al., 2021). However, these two schoolyards were relatively new, featuring additional fixed equipment (slacklines, multifunctional playgrounds, hills, etc.) that encourage PA among students (Anthamatten et al., 2014; Graham et al., 2021; Van Kann et al., 2016). One of the rural schools stood out as having the most diverse schoolyard of the four observed schoolyards, offering natural areas alongside a wide array of play structures, equipment (e.g. rollerblades, different balls) and facilities (e.g. swings, slacklines, a low adventure trail, soccer goals) for outdoor recess. Its natural areas, such as bushes and a ditch with water, fostered free and creative play opportunities for students. Previous research has highlighted the significant role of natural features in encouraging children's self-initiated PA, fostering creativity, and supporting their social and emotional development (Dowdell et al., 2011; Kiewra & Veselack, 2016; Engemann et al., 2019).

The environments, facilities, and equipment of the observed schoolyards all supported various motor skills, primarily encouraging locomotor and object control activities. Multifunctional schoolyards are recognised as important contributors to children's motor development by providing opportunities to practice basic movement patterns, stimulating motor skills, fostering social interactions, and increasing the desire to participate in PA (Tremblay et al., 2015; Tortella & Fumagalli, 2021). In addition to basic movement skills like walking, running, and jumping, the asphalt areas in the schoolyards enabled activities that supported the development of object control skills, such as riding scooters, bicycles, and rollerblading. Furthermore, all schoolyards included slacklines to support balance, adventure trails, and versatile playgrounds that allowed climbing, balancing, and hanging. The tunnels at one urban school also provided opportunities for crawling and creeping. Research has demonstrated that schoolyards featuring diverse zones and equipment promote various types of movement, allowing children to practice and develop a range of motor skills (Pawlowski et al., 2023). These skills are essential for children's overall physical development and play a significant role in their future participation in sports and PA (Lubans et al., 2010).

During outdoor recess, observations revealed that natural areas within the schoolyards were frequently used by students. Students at the school level I at one of the rural schools actively used a water-filled ditch and bushes during recess by carrying logs, building a shelter, and playing in the water. Such natural environments are known to foster physical literacy skills like climbing, balancing, coordination, etc., which are crucial for motor development (Fjørtoft, 2004). Similarly, students at school level I at one of the urban schools played in the large grass field next to the schoolyard during recess. Existing studies also indicate that children often prefer natural green spaces over artificial playgrounds due to the diverse possibilities they offer for varied play and their potential to reduce sedentary behaviour (Baquet et al., 2018; Raney et al., 2019; Lindemann-Matthies & Köhler, 2019). Lindemann-Matthies & Köhler (2019) found that enjoying natural grass areas decreased with age, a finding that may explain the current study's observation of students at the school level I more actively using and enjoying natural spaces during outdoor recess compared to the older students. Additionally, Pawlowski et al. (2019) suggested the particular importance of green environments for girls, noting their greater appeal to social play rather than competitive sports. This aligns with the present study's observations of numerous girls tending to walk and socialise within the greener areas of the schoolyard. The availability of green space is also recognised in the literature as a significant factor in children's well-being, overall health, and cognitive development (McCormick, 2017).

Observations of outdoor recess indicated that sports fields were among the least utilised areas. When these fields were used, it was typically not for full-court games but rather for modified versions, such as soccer played in front of one goal or basketball shooting at one hoop. Therefore, schools with limited schoolyard space may not need to include a full-size sports court; instead, incorporating one multi-sport court or a few basketball hoops or soccer goals is often sufficient

(Andersen et al., 2019; Fjørtoft et al., 2010; Rutkauskaite et al., 2021). Consequently, the design of schoolyards should prioritise flexibility and various uses rather than solely focusing on traditional sports fields. Observations also revealed that the most frequently used areas among students at the school level I were different facilities like swings, trampolines, monkey bars, adventure trails, and slacklines. Similarly, Powell (2016) found that adventure trails with balance beams, stepping-stones, and climbing frames like monkey bars and ropes were the most popular fixed equipment among 7–10-year-olds in the UK. Schools that provided students with diverse equipment, such as balls and rackets, saw greater utilisation of this equipment and related sports areas; for instance, during outdoor recess in schools with available equipment for ballgames students engaged in different ballgames such as soccer and basketball throughout the recess. In contrast in school where no equipment was provided, the basketball court and table tennis were rarely used during recess. Likewise, Ridgers et al. (2010) found that students with no equipment provision engaged in more sedentary activities during recess than those with equipment. Therefore, it can be argued that providing students with various equipment and options for active play encourages them to be more active during recess (Verstraete et al., 2006). In contrast, a recent comparative study found no difference in students' recess MVPA levels when accessing or not accessing outdoor play structures (Fuentes Diaz et al., 2024). Considering these varied findings, a comprehensive approach to schoolyard design, balancing fixed play structures, adaptable sports areas, and readily available equipment, appears essential to maximise student engagement in PA during recess.

The results of the current study confirm the previous findings that boys and girls often have different activity preferences (London, 2022; Holmes, 2012). According to student responses, boys showed a preference for sports, exploring natural environments, and riding scooters or bicycles during outdoor recess. In contrast, girls tended to favour socialising and less vigorous activities like sitting, drawing, playing board games, etc. Previous studies have also indicated that recess time serves an important social function for female students, who often show a preference for more sedentary activities (London, 2022; Pawlowski et al., 2016; Holmes, 2012), whereas boys prefer participating in more physical activities such as different ball games (London, 2022; Holmes, 2012). Pawlowski et al. (2019) highlighted the importance of differentiating between sports and play facilities for girls, noting their enjoyment of being active during recess but preferring non-sport activities like challenges, climbing, dancing, and active role-play. Similarly, girls in this study favoured active games such as tag, hide-and-seek, and jump rope over traditional ballgames. Providing schoolyards with equipment and activities tailored to girls' preferences may be a potential strategy to increase their PA levels during recess (Haapala et al., 2017) and simultaneously enhance their opportunities for social interaction during this time (Pawlowski et al., 2016).

Comparing the responses of school levels I and II, active games and sports games were the most frequently mentioned activities for both groups. However, students at school level I mentioned sedentary activities as their next most common choice, whereas older students highlighted socialising as their second most

frequent activity. The current study's findings align with Holmes' (2012) observation that from kindergarten to eighth grade, students enjoyed active and sport-related games. However, socialising with peers was less prevalent among younger students and increased in preference for children in grades three to eight. This indicates the distinct needs during recess between genders and that these differences become even more evident with age. Younger children generally prefer more playful and diverse activities, while sports and movement-based games become more popular as students age (Kjønniksen et al., 2008). Therefore, understanding these evolving gender-based differences is crucial for designing inclusive and engaging schoolyards that cater to the diverse needs of students across different age groups.

## **6.2. Differences in physical activity of students participating and not participating in outdoor recess in different schoolyards (Paper I)**

Consistent evidence suggests that the schoolyard is an important source for accumulating daily MVPA in children and youth (Dessing et al., 2013; Graham et al., 2021; Klinker et al., 2014). Similar results were found in the current study – students who participated in outdoor recess acquired higher levels of MVPA and significantly less sedentary behaviour compared to their peers who did not. This difference was particularly noticeable among older students (school level II), where students not attending outdoor recess accumulated over 50% less time in MVPA than their participating classmates. Consistent with the findings of this study, Tran et al. (2013) also observed higher levels of MVPA during outdoor recess compared to indoor recess. In this study, students spent about 21% of the outdoor recess in MVPA, with boys obtaining higher activity levels than girls, a finding consistent with previous research on gender differences in recess activity (Dessing et al., 2013; Pagels et al., 2014; Pawlowski et al., 2016; Tran et al., 2013; Van Kann et al., 2016). One potential reason for this could be boys' greater involvement in competitive sports, whereas girls often tend to choose activities that foster social interaction (Andersen et al., 2019; Graham et al., 2021; Pawlowski et al., 2016). Consistent with previous findings, the results of the current study also confirmed the findings of boys choosing more sport-related activities, whereas girls prefer less active activities. The duration of MVPA during outdoor recess in the observed schools was similar to or somewhat less than what has been reported in studies from the USA (Anthamatten et al., 2014; Ridgers et al., 2011), the Netherlands (Dessing et al., 2013), and Germany (Kobel et al., 2015), where recess MVPA ranged from 25.8% to 48.8% of the recess time. Access to outdoor play structures alone does not significantly increase MVPA among children (Fuentes Diaz et al., 2024). However, the availability of diverse sports equipment (Volmut & Šimunic, 2021), engaging play areas, natural outdoor environments, and larger playfields has been shown to promote higher levels of MVPA during recess (Pagels et al., 2014; Raney et al., 2023). This aligns

with the current study, where the two schools possessing the largest and most natural outdoor spaces exhibited the highest MVPA levels during recess, and an urban school with a smaller yard, showed the most sedentary behaviour. Contradicting these findings, research from the USA found the opposite, with paved schoolyard areas being associated with more MVPA than fields and grass areas (Hazlehurst et al., 2023).

While the overall time spent being sedentary during outdoor recess was similar for younger (school level I) and older (school level II) students, a notable difference emerged when examining those who did not participate in outdoor recess. Students at school level II who remained indoors during recess were significantly more sedentary than students at school level I. This suggests that younger students might find more opportunities for active play even when spending recess indoors (Wollersheim Shervey & DiPerna, 2017). Among students who did participate in outdoor recess, younger students spent significantly more time in light PA, whereas older students engaged in significantly more MVPA. This finding differs from earlier studies which found that younger children are generally more active than older ones during recess (Pagels et al., 2014; Pulido Sánchez & Iglesias Gallego, 2021). This difference in findings could be explained by the activity preferences reported in the current study, where younger students indicated enjoying activities like climbing and swinging, while older students favoured sports and active games that typically involve higher-intensity PA.

While outdoor play is a valuable means of increasing children's daily MVPA, the overall MVPA levels observed during the entire school day in this study remained considerably below the WHO's recommendations (WHO, 2020). The accelerometer data from outdoor recess indicated that Estonian children likely accumulate the majority of their recommended daily MVPA outside of school hours, despite spending a significant portion of their day at school. Across genders and school levels, students in this study achieved only about 12% of their daily MVPA during outdoor recess. In contrast, research from Norway suggests that children can achieve nearly the recommended 60 minutes of daily MVPA within school hours if schoolyards offer diverse and engaging multifunctional spaces (Kjønniksen et al., 2022). A systematic review found that school-based MVPA can contribute to more than 40% of the total daily MVPA (Pulido Sánchez & Iglesias Gallego, 2021), emphasising the significant role outdoor recess and physically active school schedule play in enhancing students' overall MVPA, particularly for those with limited opportunities for PA beyond school time, especially outdoors. Recognising this potential, Estonia is moving towards creating more opportunities for children to meet the 60-minute MVPA recommendation during the school day.

### 6.3. Physical activity levels in different types of recesses (Paper II)

Adjusting the school day to incorporate diverse PA opportunities, such as outdoor recess, boosts students' PA levels during school time, consequently increasing their daily MVPA (Erwin et al., 2012; Pulido Sánchez & Iglesias Gallego, 2021). Students in the “irregular outdoor recess” group in this study obtained significantly less MVPA during recess than those in the “daily outdoor recess” group, yet still accumulated significantly more MVPA than the “indoor recess” group. Moreover, the “daily outdoor recess” and “irregular outdoor recess” groups accumulated 27.7% and 24.5% of total school time MVPA during recess, respectively, compared to only 17.8% for the “indoor recess” group. This aligns with Erwin et al. (2012) findings that unstructured recess contributes to about one-third of total school-day PA. These results emphasise the value of even infrequent outdoor recess for increasing PA levels. Dessing et al. (2013) further emphasise the positive influence of schoolyards on MVPA, especially during recess. Consequently, providing unstructured outdoor recess is vital for promoting students' PA and supporting varied play, skill development, mental breaks, and social interaction (Farbo et al., 2020).

PA levels often decrease as students age, potentially due to reduced interest and time constraints of students' day-to-day activities (Nettlefold et al., 2011). Interestingly, in this study, while sedentary time increased with age in the “daily outdoor recess” group, the amount of time they spent in MVPA during recess remained relatively consistent across all grades (22.8–25.6%). Furthermore, across all grade levels, students in both the “daily outdoor recess” and “irregular outdoor recess” groups demonstrated significantly less sedentary behaviour and significantly more MVPA during recess compared to their peers in the “indoor recess” group. Grade 3 within the “daily outdoor recess” group was the only exception to this trend. These findings underscore the sustained benefit of outdoor recess on MVPA levels as students progress through school. Even though older students in the “daily outdoor recess” group spent more time being sedentary than younger students in the same group, their engagement in MVPA during recess did not significantly decline. This suggests that outdoor recess provides a consistent opportunity for PA across different age groups, potentially counteracting the general tendency for PA to decrease with age. Overall, the results emphasise that providing access to outdoor recess, regardless of frequency, is a valuable strategy for promoting and maintaining MVPA among students of all ages.

In the current study, boys in the “daily outdoor recess” group engaged in MVPA for 26.8% of the recess time, while the same indicator for girls in the same group was 21.3%. This aligns with other research indicating that boys tend to be more active during recess, with reported MVPA percentages ranging from 32.9–39.5% for boys and 23.4–25.3% for girls (Dessing et al., 2013; Ridgers et al., 2005; Tercedor et al., 2019). However, boys and girls in the current study generally exhibited lower MVPA levels during recess than these previous findings. Notably, Saint-Maurice et al. (2018) reported substantially higher MVPA during

recess (69.2% for boys and 52.3% for girls) than observed in the current study. These results highlight a consistent trend of boys engaging in more MVPA than girls during outdoor recess, a difference that may be attributed to previously noted activity preferences, with boys more often participating in competitive play, while girls tend to prioritise social interaction (Pawlowski et al., 2016).

Despite research on recess PA (Pulido Sánchez & Iglesias Gallego, 2021), there is no official consensus on the optimal recess duration for maximising its impact. However, Erwin et al. (2012) found that even a brief 15-minute recess can influence students' overall PA throughout the school day. Consistent with this, findings of the current study demonstrated that all school groups obtained the highest levels of MVPA and the least sedentary behaviour during a 15–20-minute outdoor recess. This supports Erwin et al. (2012) finding that the duration of recess does not have to be extremely long to significantly impact students' PA accumulation, suggesting that even a brief 15–20-minute outdoor recess can be a valuable addition to the school day for promoting PA. While this study observed a decrease in the percentage of recess time spent in MVPA and an increase in sedentary behaviour with longer recess periods, these extended durations (e.g., 30–50 minutes) did allow for a greater overall accumulation of MVPA minutes. Beyond just increasing MVPA minutes, longer recesses offer important additional benefits for students, including enhanced social interaction, cognitive restoration, and improved concentration upon returning to academic tasks (Rhea, 2016; Erickson et al., 2015). Furthermore, light physical activity remained a consistently high proportion of activity across all recess durations and in all three recess groups. This suggests that during shorter recesses (e.g., 15–20 minutes), students tend to engage in more moderate and vigorous activities, while longer recesses see a relative increase in sedentary behaviour. The extended time in longer recesses may allow for a wider variety of activities, including those of light intensity. While MVPA is recognised for its significant health benefits, light PA also plays a role in children's cognitive development, mental well-being, and the development of fundamental movement skills (Farbo et al., 2020).

Studies propose that students should engage in MVPA for at least 40–50% of their recess time (Erwin et al., 2012; Ridgers et al., 2012; Stratton & Mullan, 2005). However, the average MVPA time during recess across the three groups in this study (ranging from 23.8% to 15.8%) fell significantly below this suggested recommendation. Only a small fraction of students in the “daily outdoor recess” group (13.5%) achieved the 40% MVPA target during recess, with even lower percentages in the other groups. This aligns with findings from Ridgers et al. (2005), who reported that only 14.9% of the boys and 4.3% of the girls met this recommendation. In contrast, Tercedor et al. (2019) found a higher percentage of students (25.4%) reaching the 40% threshold. Given that outdoor recess is a relatively recent integration into the Estonian school schedule, aiming for 40–50% MVPA during this time might be disproportionate at this time. A more attainable goal within the Estonian context might be 30% of recess time spent in MVPA, as a significantly larger proportion of students in the “daily outdoor recess” (29.1%) and “irregular outdoor recess” (25.5%) groups achieved this level during their longest recess periods.

## **6.4. Students and parents' perceptions about physical activity opportunities in school and outdoor recess (Paper III)**

The current study found an association between the recess type and both students' and their parents' views on outdoor recess and PA opportunities at school. Specifically, the "daily outdoor recess" group had significantly more positive perceptions. Furthermore, students in the "daily outdoor recess" or "irregular outdoor recess" groups reported significantly better concentration in their lessons after outdoor recess, and they felt that it made the rest of the school day feel easier compared to the "indoor recess" group. Previous research indicates a positive link between outdoor recess and students' attention and concentration; however, these associations appear to be influenced by the type of schoolyard environment. For instance, Amicone et al. (2018) observed improved student attention after recess in a green schoolyard but a decline after recess in an artificial one. Similarly, Van Dijk-Wesselius et al. (2018) reported an increase in students' attention restoration scores after the greening of the schoolyard, compared to a control group with unchanged, non-green schoolyards.

While students in all three groups reported enjoying being active with their peers during outdoor recess, those in the "daily outdoor recess" group expressed a significantly higher enjoyment level than the other two groups. This finding aligns with previous research findings indicating a positive association between recess and peer relationships with outdoor recess specifically linked to fewer social problems among students (Cohen et al., 2021; Haapala et al., 2014a). Despite the enjoyment students derive from being active during outdoor recess, concerns about the weather and appropriate attire are often cited by school staff and parents as reasons for not including it in the school schedule. However, the findings of this study reveal that students in the "daily outdoor recess" group believe outdoor recess should be held year-round. This suggests that once a consistent culture of outdoor recess is established within a school, weather and clothing become less significant barriers, with students demonstrating a willingness to participate in outdoor recess throughout the whole school year, irrespective of weather conditions.

According to the socio-ecological model, an individual's behaviour is shaped by and also influences their surrounding environment (McLeroy et al., 1988). Given that students spend a significant portion of their day at school, the school environment has a substantial potential to shape their PA habits. Interestingly, students in the "daily outdoor recess" group reported significantly higher levels of outdoor PA during their leisure time compared to the other two groups. This suggests that schools which prioritize PA by offering various opportunities throughout the school day may foster positive PA habits that extend beyond the school setting into students' daily lives and leisure time. As a result, students in the "daily outdoor recess" group might perceive their leisure-time outdoor PA to be greater than those in the other groups. However, it's crucial to acknowledge

that these leisure time PA levels were self-reported and may not align with objective measurements, as both children and parents often overestimate their activity levels in self-reports (Slootmaker et al., 2009). Future research should, therefore, incorporate objective measures of leisure-time PA to gain a more accurate understanding of the connection between outdoor recess and PA outside of school.

The surrounding environment significantly influences individual behaviour, and family plays a vital role in forming children's PA habits and beliefs (McLeroy et al., 1988). Parents with positive attitudes towards PA are more likely to pass on these beliefs to their children. In this study, parents in the "daily outdoor recess" group held significantly more positive perceptions of outdoor recess and its benefits compared to the other two groups. Furthermore, parents in the "irregular outdoor recess" group also expressed significantly more positive views and beliefs than those in the "indoor recess" group. It's plausible that schools offering outdoor recess regularly have better communicated their benefits and the importance of overall PA to parents, leading to these more positive views. Notably, parents in the "daily outdoor recess" and "irregular outdoor recess" group reported that the school has asked their opinions on enhancing PA opportunities in school significantly more than parents in the "indoor recess" group. Actively involving and educating parents is essential for the successful and sustainable implementation of changes to school schedules and the development of a new school culture. This is further supported by prior research, indicating that parent engagement and support are linked to improved child health outcomes and predict self-initiated PA (Kader et al., 2015, Grow et al., 2013; Edwardson et al., 2013).

## **6.5. Strengths & limitations of the study**

The present study provides valuable findings on the relationship between schoolyard design, outdoor recess and students' PA levels. The overall strength of this study is that it was the first study that described and observed different schoolyards and their affordances, while at the same time measuring students' PA during different recess types in primary schools in Estonia. Another strength of the study is the large sample size of students, parents and schools that participated in the study. Schools participating in the study differed in size and location, which makes the results of the study more generalisable to schools in Estonia. PA during different recess types were objectively measured with accelerometers, and almost 3000 recesses were analysed during statistical analysis. Moreover, it was the first study to investigate the PA levels during recess in Estonia in a complex.

However, some limitations of the study should also be discussed. In paper I, researchers were unable to observe only the accelerometer-wearing students during recess, as all students had access to the outdoor space simultaneously. Furthermore, while accelerometer data was collected over seven days, direct observations were limited to the initial two days, potentially not capturing the full spectrum of activity patterns. The variability in seasonal conditions, particularly temperature, during data collection across different schools also presents a

limitation, as temperature is known to influence MVPA outdoors; future research should aim for data collection within a single season to enhance the objectivity of PA data.

Regarding schoolyard characteristics, the inclusion of schools with varying sizes and PA affordances in paper II likely influenced students' activity levels during outdoor recess. Consequently, future studies should consider the schoolyard design when assessing outdoor recess PA. Another limitation lies in the subjective nature of student questionnaire responses concerning leisure-time outdoor PA and the perceived impact of outdoor recess on concentration and academic behaviour (Paper III). Although objective accelerometer data was collected, it was not feasible to extract leisure-time outdoor PA for comparison with these subjective ratings. Similarly, some parents might not be informed about everything that happens at the school. Therefore, parental reports in the questionnaire may have been subject to incomplete information or recall bias. Finally, the inherent differences in schoolyard environments across participating schools could have influenced both student opinions about outdoor recess and the types of activities they engaged in.

## 7. CONCLUSIONS

1. Schoolyards typically featured open spaces with flat terrain and some vegetation; rural schools had natural grass while urban schools used artificial surfaces. Though all schoolyards encouraged PA, those with more space and a natural environment showed higher PA levels during outdoor recess. Observations indicated that natural areas, swings, and climbing facilities were the most utilised, while sports fields were the least used, especially without available equipment (Paper I).
2. Students participating in outdoor recess had significantly higher MVPA and less sedentary behaviour during recess compared to students not participating in outdoor recess at both school levels and within gender (Paper I).
3. Compared to “daily outdoor recess” and “irregular outdoor recess”, the “indoor recess” group spent significantly more recess time in sedentary and significantly less time in light PA and MVPA and accumulated significantly less total school time MVPA during recess (Paper II).
4. The highest proportion of MVPA during recess was obtained during 15–20-minute recess, and the proportion of sedentary behaviour during recess increased with longer recess durations; however, longer recess lengths did allow for a greater overall accumulation of MVPA minutes (Paper II).
5. Compared to “irregular outdoor recess” and “indoor recess” groups, students and their parents in the “daily outdoor recess” group had significantly more positive perceptions about outdoor recess, its benefits and PA opportunities in school, and students in the “daily outdoor recess” group stated being significantly more active outdoors during their leisure time (Paper III).

## 8. PRACTICAL IMPLICATIONS

The insights derived from this research have the potential for significant positive changes in the school environment and the PA levels of children and adolescents. The study's findings have already informed the development of national strategies; for instance, the PA data supports the inclusion of outdoor recess in school schedules as a key action within a broader national plan to increase PA levels. Furthermore, these results emphasise the importance of integrating outdoor recess into school schedules and demonstrate its potential to improve students' PA levels and mitigate the typical decline in PA with age. Additionally, the study's results offer insights into the optimal recess duration for maximising PA. Notably, the findings indicate that even short, irregular outdoor recess periods contribute to higher student PA levels compared to having no outdoor recess.

The findings regarding schoolyard design present practical implications for ongoing and future school infrastructure development. In light of the increasing trend of schoolyard renovations and new school constructions in Estonia over the past few years, there's a timely opportunity to incorporate the findings of this study into these projects. The authors' collaboration with architects, local governments, and school stakeholders has involved translating the study's findings, such as the positive impact of larger, more natural spaces and diverse play equipment on MVPA, into concrete design recommendations. By using research findings to guide design, the intention is to shift the focus of schoolyard development from purely aesthetic elements to creating environments that actively support and encourage increased PA among students throughout the school day. This proactive approach to infrastructure development can significantly contribute to building healthier and more active school communities in Estonia.

Additionally, the generalised findings of this study can be used in a wider context, not just in an Estonian context, as outdoor recess and schoolyard characteristics are universal factors in students' PA.

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## SUMMARY IN ESTONIAN

### **Õuevahetunni ja koolihoovi võimaluste ning lapsevanemate roll 9–13-aastaste õpilaste kehalise aktiivsuse toetamisel koolis**

Vähene kehaline aktiivsus on üha suurenev probleem kogu maailmas ning laste terviseprobleemide, sh. ülekaalu, rasvumise ja südameveresoonekonna haiguste, üheks peamiseks põhjustajaks (WHO, 2020). Ülemaailmselt umbes kolmandik lastest täidab Maailma Terviseorganisatsiooni kehalise aktiivsuse soovitus olla igapäevaselt keskmiselt vähemalt 60 minutit mõõduka kuni tugeva intensiivsusega kehaliselt aktiivne (MTKA) (Aubert et al., 2022) ning lisaks väheneb vanuse kasvades KA veelgi (Pulido Sánchez & Iglesias Gallego, 2021). Eesti 7–17-aastastest lastest ja noortest täidab ülemaailmselt kehalise aktiivsuse soovitus ainult 43% (Mäestu et al., 2023). Sellest tulenevalt on oluline välja töötada ning hinnata olemasolevaid sekkumisi, mis aitavad laste ja noorte kehalist aktiivsust suurendada ja istumisaega vähendada.

Kool on oluline koht õpilaste kehalise aktiivsuse mõjutamiseks, sest lapsed veedavad suure osa oma päevast just koolis ning kooli kaudu on võimalik jõuda kõikide lasteni, olenemata nende soost, vanusest või sotsiaalmajanduslikust seisundist (WHO, 2022). Kooli kontekstis on leitud, et just vahetunnil, eriti koolihoovis veedetud õuevahetunnil, on positiivne mõju õpilaste kehalisele aktiivsusele (Erwin et al., 2012; Prince et al., 2019; Pulido Sánchez & Iglesias Gallego, 2021; Raney et al., 2019). Lisaks suurenenud kehalisele aktiivsusele, on õues veedetud ajal positiivne mõju ka vaimsele tervisele (Fyfe-Johnson et al., 2021), akadeemilisele võimekusele (Browning & Rigolon, 2019) ning õpilaste sotsiaalsele arengule (Bates et al., 2018). Õuevahetunni juures on oluline roll koolihoovil, kus õpilased oma aega veedavad. Uuringud näitavad, et õpilastel on erinevad eelistused koolihoovis olevatele võimalustele (Powell et al., 2016; Holmes, 2012), kuid erinevad uuringud on leidnud mitmesuguseid tulemusi selle kohta, millised koolihoovid toetavad õpilaste kehalist aktiivsust enim (Brink et al., 2010; Fuentes Diaz et al., 2024; Kjønneksen et al., 2022; Raney et al., 2019). Õuevahetund on tavapärase koolipäeva osa paljudes riikides üle maailma (Amicone et al., 2024; Haapala et al., 2014b; Mikalsen et al., 2022; Pawlowski et al., 2020), kuid Eestis on paljud koolid alles alustamas selle lisamisega enda päevakavva. Viimaste aastate jooksul on Eestis mitmeid koolihoove uuendatud, et muuta need õpilaste jaoks huvitavamaks ning liikuma kutsuvamaks.

Sellest tulenevalt oli käesoleva doktoritöö eesmärk kaardistada koolihoove ja nende võimalusi, mõõta õpilaste kehalist aktiivsust erinevates vahetundides ning hinnata, kuidas mõjutab õuevahetunni olemasolu õpilaste ja nende vanemate hoiakuid kehalise aktiivsuse suhtes. Vastavalt doktoritöö eesmärgile seati järgmised konkreetsemad ülesanded:

1. Kaardistada ja kirjeldada koolihoovide võimalusi kehaliseks aktiivsuseks ning õpilaste eelistatud tegevusi õuevahetunnis (Artikkel I).
2. Hinnata ja võrrelda vahetunni kehalist aktiivsust ja istuvat aega õuevahetunnis osalevate ja mitte osalevate õpilaste seas (Artikkel I).
3. Hinnata ja võrrelda vahetunni ja kogu koolipäeva kehalist aktiivsust ning istuvat aega erinevate vahetunni võimalustega koolides (Artikkel II).
4. Hinnata, kuidas vahetunni pikkus, erinevate vahetunni võimalustega koolides, on seotud õpilaste kehalise aktiivsuse ja istuva ajaga (Artikkel II).
5. Hinnata õpilaste ja nende vanemate hoiakuid õuevahetunni, selle kasude ja liikumisvõimaluste kohta koolis, erinevate vahetunni võimalustega koolides ning hinnata, kas erinevad vahetunni võimalused on seotud õpilaste vabaaja kehalise aktiivsusega (Artikkel III).

Uuringus osales 15 Liikuma Kutsuva Kooli võrgustiku kooli. Koolid asusid erinevates Eesti piirkondades ning erinesid nii suuruse kui ka vahetunni võimaluste poolest. Uuringus osalesid 3.–6. klassi õpilased ning üks nende vanematest. Kokku andsid nõusoleku uuringus osalemiseks 967 õpilast ja lapsevanemat. Uuringu raames kaardistati nelja kooli koolihoovide võimalusi ning vaadeldi nende koolide õuevahetunde, et näha, mida õpilase õuevahetunnis teevad ning milliseid koolihoovi alasid rohkem kasutatakse. Kõigis uuringusse kaasatud koolides mõõdeti objektiivselt õpilaste kehalist aktiivsust aktseleomeetriga, et hinnata erinevate vahetunni võimaluste seost õpilaste kehalise aktiivsuse tasemega. Samuti täitsid õpilased ja nende lapsevanemad küsimustiku, kus hindasid väiteid õuevahetunni ja liikumisvõimaluste kohta koolis. Vahetunni võimaluste alusel jagati õpilased kolme gruppi: 1) igapäevane õuevahetund; 2) ebaregulaarne õuevahetund; 3) sisevahetund. „Igapäevase õuevahetunni“ gruppi (6 kooli) kuulusid koolid, kus õuevahetund oli ametlikult kooli päevakavas, see toimus iga päev ning õpilased osalesid selles kogu õppeaasta jooksul. „Ebaregulaarse õuevahetunni“ gruppi (4 kooli) kuulusid koolid, kus oli iga päev üks pikem aktiivne vahetund, kuid mõnel päeval oli selleks õuevahetund ning mõnel päeval aktiivne sisevahetund, kus õpilastel oli võimalik leida aktiivseid tegevusi näiteks võimlas või mujal kooli siseruumides. „Sisevahetunni“ gruppi (5 kooli) kuulusid koolid, kus ei olnud õuevahetundi kooli päevakavas, kuid igapäevaselt oli üks aktiivne pikem sisevahetund, mille ajal said õpilased kasutada võimlat või leida muid aktiivseid tegevusi kooli siseruumides.

Käesoleva doktoritöö tulemuste põhjal tehti järgmised järeldused:

1. Kõik vaadeldud koolihoovid olid avatud ruumiga, peamiselt tasase pinnasega ning osaliselt kaetud mingit sorti taimestikuga; maakoolides oli rohkem looduslikku rohelist, samas kui linnakoolides domineerisid tehiskultuurid pinnased. Kuigi kõik koolihoovid toetasid õpilaste kehalist aktiivsust õuevahetunnis, siis enam toetasid õpilaste õuevahetunni kehalist aktiivsust suuremad ja looduslikumad koolihoovid. Õuevahetunni vaatlustest selgus, et looduslikud alad,

kiiged ning erinevad ronimisvõimalusi pakkuvad vahendid, olid enim kasutatavad alad, kuid spordiväljakud, eriti kui õpilastel ei olnud võimalik kasutada erinevaid väikevahendeid, olid kõige vähem kasutatud alad õuevahetunnis (Artikkel I).

2. Õuevahetunnis osalenud õpilastel, oli vahetunnis oluliselt enam MTKA-d ja vähem istuvat aega võrreldes õpilastega, kes ei osalenud õuevahetunnis olenemata kooliastmest või soost (Artikkel I).
3. Õpilastel „sisevahetunni“ grupis oli vahetunni ajal rohkem istuvat aega ja vähem MTKA-d võrreldes „igapäevase õuevahetunni“ ja „ebaregulaarse õuevahetunni“ grupi õpilastega. Samuti kogusid õpilased „sisevahetunni“ grupis vahetunni ajal vähem kogu koolipäeva MTKA võrreldes kahe teise grupiga (Artikkel II).
4. Kõige vähem istuvat aega ja kõige rohkem MTKA-d oli kõikides gruppides 15–20 minutilise vahetunni ajal ning istuva aja osakaal suurenes vahetunni pikkuse suurenedes, samas pikema vahetunni jooksul oli võimalik õpilastel koguda rohkem MTKA minuteid (Artikkel II).
5. Õpilastel ja lapsevanematel „igapäevase õuevahetunni“ grupis olid oluliselt positiivsemad hoiakud õuevahetunni, selle kasude ning liikumisvõimaluste kohta koolis võrreldes õpilaste ja lapsevanematega „ebaregulaarse õuevahetunni“ ja „sisevahetunni“ grupis ning õpilased „igapäevase õuevahetunni“ grupis veedavad enesehinnanguliselt vabal ajal aktiivselt õues rohkem aega kui õpilased „ebaregulaarse õuevahetunni“ ja „sisevahetunni“ grupis (Artikkel III).

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## **PUBLICATIONS**

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Laste ja noorte kehaline aktiivsus, õuevahetund, koolihoov

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