



HENNA HAAPALA

Finnish Schools on the Move: Students' physical activity and school-related social factors

**FINNISH SCHOOLS ON THE MOVE:
STUDENTS' PHYSICAL ACTIVITY AND
SCHOOL-RELATED SOCIAL FACTORS**

HENNA HAAPALA

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Non scholae sed vitae discimus –
We do not learn for school, but for life.

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ABSTRACT

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Finnish Schools on the Move: Students' physical activity and school-related social factors

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The school-based promotion of physical activity (PA) is a great opportunity to reach the majority of school-aged children. Aside from many physical health benefits, participation in physical activities can foster social well-being and interaction. The purpose of this study was to investigate changes in PA and school-related social factors, as well as their associations in school-aged children in schools which participated in the Finnish Schools on the Move programme and its pilot phase in 2010–2012. Furthermore, school-based actions for PA promotion and staff experiences in the pilot schools were investigated.

The data were collected as part of the follow-up of the national Finnish Schools on the Move programme, which aims to create more physically active and pleasant school days through PA. Survey data were collected in 2010–2012 at four measurement points over two academic years from a total of 1463 students in grades 4–9. In addition, a fifth follow-up measurement was conducted with 385 eighth-graders in 2013. Questionnaires included measures of habitual PA, recess PA and school-related social factors. Furthermore, PA was measured objectively with ActiGraph accelerometers in a subsample of 319 students in grades 1–9. PA promotion processes at schools were investigated by means of diaries, interviews and online surveys with the local contact persons, principals and school staff.

Objectively measured school day moderate-to-vigorous-intensity PA increased and sedentary time decreased more in the programme primary schools compared to the reference school, although changes in total PA did not occur. In lower secondary schools, student participation in self-reported physical activities during recess increased in physically active play and ball games, mostly among male students. Self-reported PA during recess was positively associated with peer relationships at school, relatedness to school in primary school and school climate in primary-school females. However, school-related social factors in eighth-graders did not differ between the years 2011 and 2013. Organised recess activities, gender-specific physical activities and facilities, student recess activators, and equipment provision and sports facilities development were considered to have affected students' PA positively in lower secondary schools. The project was highly visible in schools, but there was great variation in school staff participation in its promotion.

The results of this study showed positive changes in school day PA and participation in physical activities during recess. The promotion of PA and social well-being perspectives at school require further attention to the effective implementation of promotion actions, school staff involvement as well as female and lower secondary school students.

Keywords: physical activity, social relationships, school, children, adolescents.

TIIVISTELMÄ

Haapala, Henna

Liikkuva koulu: Oppilaiden fyysinen aktiivisuus ja sosiaaliset tekijät koulussa

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Koulu on tärkeä lasten ja nuorten fyysisen aktiivisuuden edistämisen ympäristö, koska peruskoulun kautta tavoitetaan lähes kaikki kouluikäiset. Liikunnan monien terveyshyötyjen lisäksi liikuntaan osallistuminen voi edistää sosiaalista hyvinvointia ja vuorovaikutusta. Tämän tutkimuksen tavoitteena oli selvittää muutoksia, joita tapahtui oppilaiden fyysisessä aktiivisuudessa ja kouluun liittyvissä sosiaalisissa tekijöissä, sekä näiden tekijöiden välisiä yhteyksiä. Lisäksi arvioitiin Liikkuva koulu -ohjelman pilottivaiheeseen osallistuneiden koulujen fyysisen aktiivisuuden edistämistoimia sekä henkilökunnan kokemuksia.

Liikkuva koulu -ohjelman tavoitteena on luoda aktiivisempi ja viihtyisämpi koulu-päivä, ja tutkimuksen aineisto kerättiin osana ohjelman pilottivaiheen seuranta-aikana vuosina 2010–2013. Neljään seurantakyselyyn vastasi lukuvuosien 2010–2012 aikana yhteensä 1 463 luokkien 4–9 oppilasta. Lisäksi 385 8.-luokkalaista vastasi kyselyyn vuosi pilottivaiheen jälkeen vuonna 2013. Kyselylomakkeilla selvitettiin fyysistä kokonaisaktiivisuutta, välituntien fyysistä aktiivisuutta sekä sosiaalisia tekijöitä koulussa, kuten vertaissuhteita koulussa, yhteenkuuluvuutta koulussa ja kouluilmapiiriä. Objektiiiset fyysisen aktiivisuuden ja liikkumattoman ajan mittaukset tehtiin 319 luokkien 1–9 oppilaalle ActiGraph-kiihtyvyysanturimittareilla. Koulujen fyysisen aktiivisuuden edistämistoimia ja prosessia kartoitettiin koulujen hankevastaavilta, rehtoreilta ja henkilökunnalta päiväkirjoilla, haastattelulla ja kyselyillä.

Koulupäivien aikainen objektiiisesti mitattu reipas liikunta lisääntyi ja liikkumaton aika väheni ohjelmaan osallistuneissa alakouluissa verrokkikouluun nähden. Koko päivän aikana mitatussa fyysisessä aktiivisuudessa ei havaittu muutoksia. Yläkouluissa poikien osallistuminen välituntien liikuntapeleihin ja -leikkeihin sekä pallopeleihin lisääntyi. Aktiivinen osallistuminen välituntiliikuntaan oli positiivisesti yhteydessä oppilaiden vertaissuhteisiin koulussa, yhteenkuuluvuuteen alakoulussa sekä kouluilmapiiriin alakoulun tytöillä. Kahdeksaluokkalaisten kokemissa sosiaalisissa tekijöissä ei kuitenkaan havaittu eroja vuosien 2011 ja 2013 välillä. Yläkouluissa oppilaiden fyysiseen aktiivisuuteen koettiin vaikuttaneen positiivisesti organisoidut välituntitoiminnot, tytöille erilliset liikuntatoiminnot ja -tilat, välituntien vertaisohjaajat sekä välineiden tarjoaminen ja liikuntatilojen kehittäminen. Toiminta koettiin hyvin näkyväksi kouluissa, mutta henkilökunnan osallistumisaktiivisuus vaihteli.

Tutkimuksessa havaittiin myönteisiä muutoksia koulupäivän aikaisessa fyysisessä aktiivisuudessa ja välituntiliikuntaan osallistumisessa. Fyysisen aktiivisuuden ja sosiaalisen hyvinvoinnin edistämiseksi kouluympäristössä tulisi jatkossa kiinnittää huomiota edistämistoimien tehokkaaseen toteuttamiseen, henkilökunnan osallistumiseen sekä tyttöjen ja yläkoulun oppilaiden tarpeisiin.

Avainsanat: liikunta, sosiaaliset suhteet, koulu, lapset, nuoret.

LIST OF ORIGINAL PUBLICATIONS

The thesis is based on the following original publications, which are referred to in the text by their Roman numerals.

- I Haapala, H. L., Hirvensalo, M. H., Kulmala, J., Hakonen, H., Kankaanpää, A., Laine, K., Laakso, L. & Tammelin, T. H. 2017. Changes in physical activity and sedentary time in the Finnish Schools on the Move programme: a quasi-experimental study. *Scandinavian Journal of Medicine & Science in Sports* 27 (11): 1442–1453.
- II Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Lintunen, T. & Tammelin, T. H. 2014. Adolescents' physical activity at recess and actions to promote a physically active school day in four Finnish schools. *Health Education Research* 29 (5): 840–852.
- III Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Kankaanpää, A., Lintunen, T. & Tammelin, T. H. 2014. Recess physical activity and school-related social factors in Finnish primary and lower secondary schools: cross-sectional associations. *BMC Public Health* 14:1114.
- IV Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Lintunen, T. & Tammelin, T. H. 2017. Differences in physical activity at recess and school-related social factors in four Finnish lower secondary schools. *Health Education Research*. Epub 2017 October 31. doi: 10.1093/her/cyx069.

The original publications are not included in the electronic version of the dissertation.

ABBREVIATIONS

ANOVA	analysis of variance
<i>b</i>	unstandardised regression coefficient
BMI	body mass index
cpm	counts per minute
CSPAP	Comprehensive School Physical Activity Program
GPS	global positioning system
HBSC	Health Behaviour in School-aged Children study
HPS	Health Promoting Schools
MET	metabolic equivalent of task
MLR	maximum likelihood estimation with robust standard errors
MVPA	moderate-to-vigorous-intensity physical activity
OECD	Organisation for Economic Co-operation and Development
<i>p, p-value</i>	significance probability
PA	physical activity
PE	physical education
SB	sedentary behaviour
SE	standard error
ST	sedentary time
SD	standard deviation
WHO	World Health Organisation

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ABSTRACT

TIIVISTELMÄ

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ABBREVIATIONS

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1 INTRODUCTION

Physical activity (PA) and sedentary behaviour (SB) – like many other habits – are formed in childhood and adolescence (Telama et al. 2005). Various PA guidelines for children and adolescents recommend that children and adolescents should undertake at least 60 minutes of moderate-to-vigorous PA (MVPA) daily (Tremblay et al. 2011b; World Health Organization 2010). However, recent reports in European, American and Asian countries suggest that only half of children and adolescents, at best, meet these PA guidelines (Kokko & Mehtälä 2016; Roman-Viñas et al. 2016; Tremblay et al. 2016). PA habits in childhood tend to track over time to adulthood (Telama et al. 2014); therefore, it is important to investigate possibilities of affecting these behaviours positively already during childhood and adolescence.

PA has many benefits for the physical health of school-aged children, such as reduced adiposity, improved cardiometabolic risk factors, and enhanced bone health (Mitchell et al. 2017; Dias et al. 2015; Poitras et al. 2016). In recent years, PA has also been linked to cognitive functioning and academic achievement in young people (Donnelly et al. 2016). Through PA, young people are also introduced to social situations and the practise of social skills, such as negotiation, problem-solving and management of different feelings. PA situations can serve as a platform to create positive social development in young people. (Bailey et al. 2009.)

School is a context which applies to nearly all young people regardless of their background, and therefore it is considered as a fruitful setting to intervene health-related behaviours (Hills, Dengel & Lubans 2015). In recent years, school-based practices to promote students' health and well-being, including PA levels, have emerged. For example, recess times between lessons provide a unique opportunity for students to be physically active during the school day and accumulate up to 40% of the daily PA recommendations (Ridgers, Stratton & Fairclough 2006; Ridgers et al. 2012a). In general, the results imply that the effects of most school-based interventions on students' PA levels have been minor (Dobbins et al. 2013). Positive changes in students PA and sedentary time (ST) may occur during the school day, especially in younger children, but they have the tendency to be compensated for with increased sedentariness during leisure time (Ridgers et al. 2014; Ridgers et al. 2015). Therefore, more knowledge about the most effective strategies and follow-ups for longer time periods, especially in the adolescent population, are needed.

School-based PA promotion projects mainly concentrate on measuring and reporting their effects on PA and ST, and less focus is put on their possible association with other areas of student well-being. Especially little is known of the connections between students' PA and social well-being in the school community. In addition, the promotion processes of schools and staff perceptions are not commonly described in school-based promotion projects. Process evaluation and identification of the boosters and pitfalls in projects are critical in order to modify school-based promotion actions to be more effective.

The purpose of this thesis was to investigate the changes in students' PA levels and school-related social factors and their associations in a national-level,

school-based PA promotion programme. In addition, PA promotion actions and their effectiveness in the study schools were described and evaluated.

1.1 Physical activity in children and adolescents

PA has multiple benefits for the health and well-being of school-aged children and adolescents (Janssen & Leblanc 2010; Poitras et al. 2016). Sufficient levels of PA and the avoidance of excessive SB can diminish the emergence of non-communicable diseases (e.g. type-2 diabetes, cardiovascular diseases and cancer) (Lee et al. 2012). The early prevention of these diseases is of importance as the onset of these diseases often develops already in childhood (Fernhall et al. 2011; Väistö et al. 2014). Studies have also linked PA to learning, cognitive functions (Donnelly et al. 2016), academic performance (Centers for Disease Control and Prevention 2010; Singh et al. 2012) and mental health (Biddle & Asare 2011).

1.1.1 Definitions and assessment of physical activity

PA is defined as any bodily movements which increase energy expenditure above resting levels, whereas exercise involves planned, structured and repetitive bodily movements to maintain or improve the components of physical fitness (Caspersen, Powell & Christenson, 1985). On the other hand, physical fitness refers to a set of people's existing or achieved attributes which relate to the ability to perform PA (Caspersen, Powell & Christenson 1985). SB has been defined as activity in a sitting or reclined position that increases energy expenditure from the resting state only minimally (Yates et al. 2011). Recently, studies with electromyography have suggested that the definition of SB should also include very low to low muscle activity (Pesola et al. 2014; Pesola et al. 2016). On the other hand, physical inactivity refers to not meeting the recommended levels of PA and it is not a synonym of SB (Sedentary Behaviour Research Network 2012; Tremblay et al. 2011a). Therefore, it is possible that children meet the PA guidelines of 60 minutes of MVPA while remaining sedentary for the rest of the day.

An assessment of PA with accurate and precise methods is important in order to evaluate the levels of PA, examine the psychosocial and environmental factors linked to PA, and evaluate the effectiveness of interventions to increase PA. Assessment of PA can be done through a variety of methods, including direct observation and objective and self-report measurements (Ekelund, Tomkinson & Armstrong 2011). Direct observation is an appropriate criterion measurement for PA, and observational methods can capture short-term patterns and sudden changes in PA typical for children (Corder et al. 2008; Sirard & Pate 2001). However, direct observation is expensive and time-consuming and therefore it is not a feasible method for studying large populations (Corder et al. 2008). Until recently, subjective measurements of PA, such as questionnaires and recall, were the most common methods to assess PA (Dollman et al. 2009). Questionnaires and recall by children and parents are still the most feasible and cost-effective methods to assess different types and

settings of PA in large samples of children and adolescents (Dollman et al. 2009). However, it is difficult, especially for children, to recall past PA, and therefore questionnaires tend to over- or under-estimate PA levels (Welk, Corbin & Darren 2000). Social desirability bias may also have an effect on the validity of questionnaire-based estimates of PA (Dollman et al. 2009; Sallis & Saelens 2000).

Objective measures of PA include pedometers, heart rate monitors, electromyography, global positioning systems (GPS), and accelerometers or combinations of these methods (Butte, Ekelund, & Westerterp 2012). While all methods have their strengths and weaknesses, accelerometers have become the most commonly used method to assess PA objectively (Ekelund et al. 2011). The most commonly used accelerometers these days are triaxial (i.e. they measure movement in three planes). Accelerometers can be used to assess SB and the intensity of PA in different populations, and detailed data on PA throughout the day and week can be obtained with accelerometry (Butte et al. 2012). Like other objective measurements of PA, accelerometers also eliminate recall bias which enhances reliability and precise measurement of PA. However, most accelerometers cannot distinguish sitting from standing and accelerometers cannot assess PA that does not cause acceleration, such as cycling and swimming. (Butte et al. 2012; Corder et al. 2008; Ekelund et al. 2011.)

PA is a complex behaviour, and therefore school-aged children's PA behaviour should be considered in relation to the multiple dimensions and domains of PA, such as frequency, duration, intensity, and type. PA behaviour in childhood is characterised by spontaneous and intermittent bouts of activity and the need for frequent rest periods (Bailey et al. 1995; Welk et al. 2000). Therefore, it has been recommended that combining different methods, such as accelerometry and questionnaires, would provide a more comprehensive view on childhood PA than one method alone (Corder et al. 2008; Ekelund et al. 2011). The context of PA is an important factor to acknowledge, especially in the examination of social factors linked to PA. Although some new accelerometers (ActiGraph) can sense other accelerometers and provide some data on social aspects of PA, questionnaires are still the best methods to quantify the type and setting of PA, as well as the motivation and social context of being physically active (Ekelund et al. 2011).

PA is usually categorised as light, moderate, and vigorous based on PA induced energy expenditure. It is common to use the metabolic equivalent of task (MET) values to define the energy expenditure and usually the adult-based value of oxygen uptake (3.5 mL/kg/min) has been used. (Ainsworth et al. 2011.) However, it has been observed that resting energy expenditure in children and adolescents is higher than that of adults, suggesting that adult-based estimates may underestimate energy expenditure in children (Harrell et al. 2005). In adults, light PA, moderate PA, and vigorous PA have been defined as 1.5–2.9, 3–5.9, and ≥ 6 METs, respectively. Although definitive cutoff points for PA intensity in children exist (Butte et al. 2012), light PA has been defined as 1.5–4 METs, moderate >4 –7 METs, and vigorous >7 METs in children (Collings et al. 2017). Furthermore, the measurement of PA and ST using accelerometers has led to the development of different cutoff points based on acceleration for light, moderate, and vigorous PA. Although accelerometers are currently the reference method to estimate habitual PA in population samples,

a number of different cutoff points for ST and MVPA have been developed for different populations of children and adolescents. Such differing cutoff points may provide biased estimates of PA levels in youth (Brazendale et al. 2016; Ravagnani et al. 2017).

1.1.2 Recommendations and levels of physical activity in school-aged children

The World Health Organization (WHO) recommends that all school-aged children and youth should engage daily in at least 60 minutes of MVPA (World Health Organization, 2010). Updated Canadian recommendations also suggest that school-aged youth should undertake a minimum of 60 min of MVPA daily, but these guidelines also recommend achieving as much PA of any intensity during the day (Tremblay et al. 2011b). With increased interest in and research on SB, recommendations for SB have emerged as well. Guidelines for PA in school-aged children in Finland initially recommended avoidance of prolonged periods of sitting and an excessive amount of screen time (Tammelin & Karvinen 2008). More recently, national recommendations for SB, including children and youth, have been published for example in Canada, Finland and Australia. According to the Canadian guidelines, children and youth should limit their recreational screen time to two hours per day and minimise the ST spent in transportation, extended sitting and indoors (Tremblay et al. 2011a). The Finnish recommendations for reducing ST emphasise playing and spending time outdoors, taking breaks from screen-time sitting, and engagement in at least 60 minutes of MVPA per day. They also recognise the importance of parents and teachers as role models and modifiers of an active, non-sedentary environment (Ministry of Social Affairs and Health 2015).

Many children do not meet the daily recommendation of at least 60 minutes of MVPA, instead spending a lot of time in sedentary activities (Verloigne et al. 2012). Studies have shown a decline in MVPA and an increase in ST during childhood and adolescence (Colley et al. 2011; Ortega et al. 2013). Gender is correlated with PA levels as males are more physically active than females, both in childhood and adolescence (Bauman et al. 2012). Accordingly, 34% and 47% of 11-year-olds and 13% and 22% of 15-year-old Finnish females and males, respectively, meet the recommended levels of daily MVPA with self-reported measurements (Bucksch, Hamrik, & Nalecz 2016). Nevertheless, an interesting observation was made in the recent Finnish LIITU report, which used accelerometers; while only one-third of the participants met the daily recommendation of 60 minutes of MVPA, almost 80% of children and youth achieved at least three hours of some kind of PA daily, including light PA (Kokko & Mehtälä 2016).

A Finnish study has suggested moderate to strong tracking of PA from the age of three until young adulthood (Telama et al. 2014). Some other previous studies also indicate that physically active children are also active later in life. SB has been found to increase substantially with increasing age (Janssen et al. 2016; Pearson et al. 2017). SB was found to be relatively stable during school transition (i.e. moderate tracking) (Biddle et al. 2010; Pearson et al. 2017). The emphasis on PA opportunities

early in life seems to be borne out as healthy habits in later life, and all settings, including school, should be embraced for the promotion of PA opportunities among youth.

1.2 School-based promotion of physical activity in children and youth

School is an important environment to promote PA due to its potential to reach all age group of children and also inactive and unfit students (Hills et al. 2015). The amount of time spent in the school environment is significant, and therefore school offers a promising setting for public health promotion. A Cochrane review of school-based PA interventions reported on improvements in the proportion of children engaging in MVPA during school hours and also increases in the amount of MVPA and decreases in time spent watching television in children and adolescents (Dobbins et al. 2013). However, the effect sizes of school-based interventions for PA have been moderate at best, and knowledge regarding the most effective strategies remains limited (Dobbins et al 2013). A meta-analysis with objective PA measurements has suggested that PA interventions (including school-based and other approaches) in children aged up to 16 years produced only four additional minutes, on average, of daily MVPA (Metcalf, Henley, & Wilkin 2012). Moreover, in a Danish study a comparison of regular schools and schools offering increased levels of mandatory PE showed that children with increased PE were more active during school hours, but less active during leisure time; thus, no increase was observed for objectively measured overall PA during the day (Moller et al. 2014). In a review by Kriemler and colleagues (2011), positive effects of school-based interventions on school-related PA but not leisure time PA were observed. Careful analysis of facilitating and hindering factors is imperative to improve the effectiveness of school-based PA promotion.

The social-ecological model suggests that factors at multiple levels influence health-related behaviours, such as PA (Sallis et al. 2006). An individual is surrounded by family and peers, natural and built environments, and agencies and organisations. Therefore, these individual, social, environmental, and policy domains should be considered in the development and implementation of school-based interventions to create meaningful change in PA behaviour.

As a part of the Global School Health Initiative, WHO has created a framework called Health Promoting Schools (HPS) (Langford et al. 2016). Strategies such as input in the school curriculum, social and environmental changes at school, and partnership and engagement with families and surrounding communities are the core elements of the HPS framework to foster health and learning (Langford et al. 2014). Within the HPS framework, PA can be targeted alongside a variety of other health-related behaviours, such as nutrition, tobacco use and bullying. Another suggestion for the successful implementation of PA promotion in the school environment has been the whole-school approach (Institute of Medicine 2013). Here all segments of the school day are considered for PA opportunities: before school, during recess,

during lessons and after school. Both physical and human resources are incorporated into the promotion practices to encourage everyone to be more physically active (Institute of Medicine 2013).

Comprehensive School Physical Activity Program (CSPAP) is a school-based PA promotion model from the United States, and it consists of high-quality PE and PA added before, during and after school with staff, family and community engagement playing a vital role in PA promotion (Centers for Disease Control and Prevention 2013). This multi-component programme aims at enabling students to meet the recommendation of 60 minutes of MVPA per day and ensuring lifelong PA engagement in the long term. Each of the aforementioned five components of the CSPAP have recommendations. Duration and intensity of PE lessons, opportunities for recess and lunch-time and equipment provision, integration of PA in the classroom, and promotion of active school transportation and before- and after-school intramural activities are listed as leading opportunities for PA engagement. To maximise the potential of school-based PA, the CSPAP recommends professional learning in PA and wellness programmes for staff, involvement of family members in school sport during both evenings and weekends, and joint-use agreements in the community for the use of school facilities. (Centers for Disease Control and Prevention 2013.)

The CSPAP model has been developed further with a conceptual framework based on the social-ecological model (Carson et al. 2014). The CSPAP conceptual framework adds four levels of influence (i.e., components, facilitators, leaders, and culture) to the general goal of CSPAP at the individual level, namely PA behaviour. From a social-ecological perspective, the terms of micro-, meso-, exo-, and macrosystems are used to describe these levels of influence. The five components described above represent the microsystem level of influence, and facilitators at the mesosystem level consist of knowledge, skills and dispositions among the school personnel as well as resources and safety. Leaders at the exosystem level are individuals and groups, such primary coordinators at schools (“CSPAP champions”), supportive administration and CSPAP committee, which influence the implementation of PA promotion in schools. Policies and normative behaviours and beliefs construct the macrosystem level of influence, namely a school culture supportive of PA opportunities. All the four levels of influence are interactive towards the implementation of CSPAP and the central goal of daily PA. (Carson et al. 2014.)

The effectiveness of school-based interventions seems to be dependent on multiple factors. Van Sluijs and colleagues (2007) observed in their review that school interventions which combine multiple elements from educational, environmental, and policy-based approaches appear to be effective in PA promotion in adolescents, and this multicomponent approach has since been supported in settings with both children and adolescents (de Bourdeaudhuij et al. 2011; Kriemler et al. 2011; Sutherland et al. 2016). Some controversy exists regarding the effectiveness of family and community involvement in school-based interventions; younger schoolchildren seem to benefit more than adolescents, who become more autonomous from parents and their influence (Kriemler et al. 2011; van Sluijs et al. 2007).

Effective environmental and physical strategies in school-based interventions include providing an active schoolyard, overall facilities and equipment provision, for example (Kriemler et al. 2011; Naylor et al. 2015; van Sluijs et al. 2007), especially during recess times (Haug et al. 2010; Ridgers et al. 2012b). Playground markings and physical structures can contribute to the PA levels of schoolchildren during recess times in the short to medium term (Escalante et al. 2013). Policy changes, including increases in the number and length of PE lessons, giving students PA homework (Kriemler et al. 2011; van Sluijs et al. 2007), and changing break-time length (Morton et al. 2015; Parrish et al. 2016) have also been reported to be effective in terms of PA levels.

School staff members' perceptions of their role in promoting students' PA (Huberty et al. 2012) or their readiness for change (Ehlers, Huberty & Beseler, 2013) can vary between schools. Teachers' characteristics, engagement, motivation and self-efficacy have an impact on the implementation of school-based interventions (Naylor et al. 2015). Developed interventions could be more flexible and adjustable for implementation in schools, and this could help the school staff to adopt and sustain promotion practices. Yet, there is limited information about school discretion and the provision of individual solutions, as well as how this could contribute to the success of promotion.

1.3 Physical activity and school-related social factors

The benefits of PA in school-aged children, especially on physical health and well-being, are widely acknowledged. There is also some evidence that various PA settings can improve social development through opportunities for social interactions, meeting friends, co-operating with others, and problem-solving in children and adolescents (Bailey 2006; Blatchford 1998; Weiss & Stuntz 2004). The emphasis on the promotion of school-aged children's PA in school settings (Dobbins et al. 2013; Nettlefold et al. 2011) also raises the question of whether the promotion of and participation in school-time PA could serve as a tool for achieving other positive goals in the school environment, thereby benefitting students' school experiences and their school-related social factors.

1.3.1 School-related social factors: definitions and correlates

The school is an essential setting in children's and adolescents' lives, as they spend a notable amount of their time in school over the course of a decade. There are multiple definitions of students' relationship and connection to school. However, these definitions are thematically linked to each other with similar questions of belonging, liking school, support from teachers and peers, engagement in academic studies, fair discipline, and participation in extracurricular activities (Libbey 2004). In this thesis, measures of school-related social factors included peer relationships at school, relatedness to school, and school climate. *Peer relationships at school* consist, for example, of getting help from classmates, getting along with schoolmates, and having

friends in school (Konu & Koivisto 2011; Konu & Rimpelä 2002). *Relatedness to school* refers to the feeling of being supported by and safe among others (Osterman 2000; Richer & Vallerand 1998). *School climate* is usually a combination of multiple dimensions, such as teacher and peer support, student autonomy, and clarity and consistency in school rules (Way, Reddy & Rhodes 2007).

Social well-being in the school community contributes to students' overall well-being, and school-related social factors have been associated with different trajectories in student development. Peer relationships and peer support, especially in adolescence, are associated with health and health-related behaviours with short- and long-term consequences, and they contribute to students' subjective well-being (Konu, Lintonen & Rimpelä 2002), life satisfaction (Siddall, Huebner & Jiang 2013), self-esteem, liking school (Boulton, Don & Boulton 2011), learning, motivation and academic outcomes (Crosnoe & McNeely 2008; Gustafsson et al. 2012; Liem & Martin 2011; Viner et al. 2012). The satisfaction of basic psychological needs – competence, relatedness and autonomy – is important for students' well-being, social development and positive motivation towards learning (Ryan & Deci 2000; Ryan & Powelson 1991). Perceived autonomy and relatedness in school are linked to learning, academic motivation and performance as well as social adjustment outcomes and thus they contribute to school experiences (Buhs & Ladd 2001; Eccles et al. 1993; Furrer & Skinner 2003; Goodenow 1993).

Relationships with teachers and peers have been found to be resources for positive adjustment during middle-school transition (Eccles et al. 1993). Previous studies have shown that gender and age also determine the quality of social life at school; females seem to report higher school-related social support than males, and with time these perceptions tend to decline in both genders (Eccles et al. 1993; Furrer & Skinner 2003; Goodenow 1993; Way, Reddy & Rhodes, 2007). In addition, liking school a lot was also more common among females and younger students (age 11 vs. age 15) (Ramelow et al. 2012).

1.3.2 Physical activity and social interaction with special reference to school and recess times

PA situations seem to provide fruitful settings for social interactions and create encounters between participants (Bailey et al. 2009; Weiss & Stuntz 2004). Sport and physical activities may build co-operative experiences and strengthen their sense of cohesion by bringing people together due to a shared interest. These shared experiences can lead to improved social capital and promote social inclusion (Bailey 2005; Glover & Hemingway 2005). For example, Iannotti and associates (2009) observed that higher overall PA was related to better peer relationships in adolescents at the ages of 11, 13 and 15. However, the associations and effects of PA on social factors in children and adolescents seems to have received relatively small attention in research, and there is a lack of evidence especially in the school context. Some reports have suggested that physical education (PE) and sports in schools are linked to students' improved social development, social skills and prosocial behaviour (Bailey

2006; Bailey et al. 2009). Brown and Evans (2002) observed in their study that participation in school sports as an extracurricular activity was positively linked with greater school connection in adolescents, regardless of ethnicity. In the Canadian intervention 'Action Schools! BC' targeting increased PA opportunities in school for 4–6-graders, teachers reported enhanced interactions with students, and administrators found the school climate to be better after the 11-month intervention (Naylor et al. 2006).

School recess is acknowledged as one of the key opportunities for PA during school hours (Ridgers et al. 2006), and recess times can contribute up to 40% of the daily MVPA and recommended levels of PA in school-aged children (Erwin et al. 2012; Ridgers et al. 2012b). Recess is an important arena for learning social skills and experiencing social life; recess provides children and adolescents with the opportunity to engage in free play, and this may improve their social development (Ramstetter, Murray, & Garner 2010). For younger students playground games have a largely social function, and games are a key element in break-time activities until age 11 (Blatchford 1998). During recess, students have opportunities for informal social interaction without the control of adults or classroom structure, and while playing they learn and develop skills needed in everyday life, including negotiation, problem-solving, and co-operation (National Association of Early Childhood Specialists in State Departments of Education 2001). These interactions and the skills acquired during recess can contribute to students' school experiences (Council on School Health 2013). Schools that provide opportunities for physical activities at recess could offer practical means to socialise with new peers outside the structure of the classroom. This could be important especially to adolescents changing from primary school to lower secondary school and enhance their learning, motivation, academic outcomes (Crosnoe & McNeely 2008; Gustafsson et al. 2012; Liem & Martin 2011; Viner et al. 2012) and liking of school (Boulton et al. 2011).

1.4 Finnish perspectives: school system and school-based physical activity promotion

Concern about physical inactivity in youth is globally shared, and many countries have developed their own PA initiatives with whole-school approaches to tackle this issue. For example, McMullen and colleagues (2015) presented international approaches to school-based PA promotion from Finland, Ireland, Poland and USA. Each of these countries have their own school system and cultural differences in schooling and moving, and these differing preconditions have created unique possibilities and challenges for school-based PA promotion. Some of these countries have emphasised high quality PE while others have targeted PA across the school day. Some initiatives have emphasised PA leadership through committees and teams, and others have provided separate funding for school level promotion actions. (McMullen et al. 2015.) Therefore, strict comparisons between international initiatives cannot be made, but gathered knowledge, research results, successful strategies and best

practices can be shared and discussed across countries for further development and advances in evidence-based practices.

In Finland, students have succeeded in international tests of literacy in reading, mathematics and science (OECD 2010), and the reason for these learning outcomes has been linked to the Finnish school system. Education in Finland is highly valued, and the compulsory nine years of basic education in Finland starts at the age of seven (Väljärvi et al. 2007). Classroom teachers usually teach children for the first six years, and specialised subject teachers (including PE teachers) are responsible for teaching during the last three years of basic education. The characteristics of the Finnish comprehensive school system are equality (regardless of region and family background), an environment that highly values education, support for individual students, highly educated teachers, pedagogical freedom, and responsibility and cultural homogeneity enabling decisions made in consensus. (Väljärvi et al. 2007.) Municipalities and schools get to create their own local curriculums based on the national core curriculum, and thus they have the ability to create their own timetables for school days.

Learning concepts have changed along with the changes in the school system in Finland. Social constructivism is nowadays one of the key concepts of learning in Finland, and it emphasises the importance of collaboration, the social nature of learning, constructing new information on the basis of previous knowledge, and individual motivation and abilities (Finnish National Board of Education 2004, Finnish National Board of Education 2014). The Finnish national core curriculums for basic education in 2004 and 2014 have emphasised a learning environment that is supportive of interaction among students, guiding them towards team-work and a positive atmosphere (Finnish National Board of Education 2004, Finnish National Board of Education 2014). Although the curricular emphasis in the last decades has been to get students to interact, engage and take part in decision-making, a considerable number of students in Finland do not like school and have negative feelings towards school (Currie et al. 2012; Haapasalo, Välimaa, & Kannas 2010). A recent Health Behaviour in School-aged Children (HBSC) study reported that only 13% of 15-year-old females and 9% of males in Finland like school a lot, and 65% of Finnish females and 54% of males feel pressured by schoolwork some or a lot (Inchley et al. 2016). In the recent basic education curriculum reform in 2016, promoting student autonomy, a joy of learning and a collaborative atmosphere and developing schools as learning communities are central themes to meet future challenges (Finnish National Board of Education 2014). The new core curriculum also underlines the importance of student participation and the active role of the student in learning. The key question in the new core curriculum is how to (instead of why and what can) make the school a supportive and encouraging learning environment which enhances the meaningfulness of studying, the ability to work with others, and the capacity to learn and develop, and which supports the development of a sustainable lifestyle. (Finnish National Board of Education, 2014.)

From a historical perspective, the promotion of students' well-being through PE and school-based physical activities is not a totally new phenomenon in Finland. PE was included in the school curriculum in 1843 in order to improve students' poor

health. Already in 1925, the curriculum of the rural primary school stated that ‘...let’s open up the windows and take a run around the school building...’ (Kansakoulun opetussuunnitelmakomitea 1925). The committee report of the national primary school curriculum from 1952 addresses ‘the prevention of school injuries caused by sitting...’ (Kansakoulun opetussuunnitelmakomitea 1952). The possibilities of high-quality, school-based PA are also recognised in the new Finnish curriculum for basic education: that PE received two additional lesson hours and the integration of school-based PA can be considered as useful ways for the new curriculum to achieve its goals. School-based PA – including PA integrated into school subjects, recess, commuting to and from school, and extracurricular activities – can be promoted by the school’s individual arrangements (Heikinaro-Johansson, Lyyra & McEvoy 2012). The provision of several, regular recesses within the Finnish school day seems to be unique from an international perspective, as the restriction of time allocated to school recesses due to academic concerns is increasing around the world (Murray & Ramstetter 2013). Recess has also been a central context in school-based PA promotion in Finland. In the Finnish school system, the length of recesses and lunch breaks are not regulated by national law and teaching time should be divided into appropriate teaching periods. Thus, in practice, students in Finland are provided with several recess periods daily, and schools arrange lessons and break times relatively independently. There are usually from two to four recess periods of 10–15 minutes after each 45–90-minute lesson and one longer recess period of 30 minutes for school lunch and other activities.

To make a positive contribution to the physical and social-emotional situation of Finnish school-aged children, a national, ongoing action programme called Finnish Schools on the Move was launched by the Finnish government. The programme has the aim to create more active and pleasant school days through PA in Finnish comprehensive schools (Tammelin, Laine & Turpeinen, 2012). PA is not only the goal but also a tool used to improve other school-related outcomes, such as school atmosphere, support for learning, and student empowerment – as outlined in the new national curriculum for basic education. An important feature of this programme is a bottom-up approach; the participating schools and municipalities apply for funding to implement their own individual plans to increase PA and decrease ST during the school day. Specific actions are not required from the schools; however, the programme supports the schools by disseminating best practices and ideas in national seminars and programme webpages and providing opportunities for support from experienced local mentors. (McMullen et al. 2015; Tammelin et al. 2012.) The approach of the programme is also in line with the overall Finnish education policy relying on customisation, creativity, encouragement of risk-taking, and shared responsibility and trust (Sahlberg 2011). Most of the programme schools in the pilot phase (2010–2012) emphasised and targeted the promotion of recess PA and PA in general.

The Finnish Schools on the Move programme is the largest school-based PA promotion programme conducted in Finland so far, and its evaluation and the research conducted on the programme’s effects, facilitators and hindering factors are central to its development and effectiveness. To date, this thesis represents the first

national, large-scale study on students' school-based PA promotion in Finland. The approach of the thesis is explorative, and a mixed method approach with multiple designs is used to examine and describe the complex and multi-faceted behaviour of schoolchildren's PA and its promotion in the nationwide programme. The relationship between students' recess PA and school-related social factors is also examined in this thesis to complement the limited knowledge on the possibilities of school-based PA promotion to support students' social well-being in the school environment.

2 AIMS OF THE STUDY

The purpose of the present thesis was to examine the changes and associations of students' PA levels and school-related social factors during the pilot phase of a national-level, school-based PA promotion programme, Finnish Schools on the Move (2010–2012). In addition, PA promotion actions and their effectiveness in the study schools were described and evaluated. The specific aims were:

- Aim 1. To investigate the changes in objectively measured MVPA and ST for students in grades 1–9 over two academic years in programme schools compared with the reference schools. (Study I)
- Aim 2. To examine the changes in adolescents' recess PA and overall PA and to describe PA promotion actions in four programme schools over two academic years as well as to investigate perceptions of the actions' effects on students' PA. (Study II)
- Aim 3. To investigate the associations of recess PA with school-related social factors in primary and lower secondary school students. (Study III)
- Aim 4. To investigate the differences in PA at recess and school-related social factors among eighth-grade students during and after the pilot phase of the programme in 2011 and 2013, and to increase understanding about the staff experiences of the promotion. (Study IV)

3 MATERIALS AND METHODS

3.1 Study design and population

Data collection was related to the evaluation of the national, ongoing Finnish Schools on the Move programme. This action programme aims to establish a physically active culture in Finnish comprehensive schools (Tammelin et al. 2012), and it is currently part of the Finnish Government Programme (Prime Minister's Office 2015). The programme is funded by the Ministry of Education and Culture and organised by the Board of Education, regional state administrative agencies, and other organisations. In spring 2010, the Ministry of Education and Culture launched an application round for school-based PA projects to be included and funded in the programme. A total of 58 applications from municipalities were received, and the office holders of the ministry granted funding to 21 projects from autumn 2010 onward. During the pilot phase in 2010–2012, these 21 regional local projects included 45 schools with approximately 10,600 students in grades 1–9 throughout Finland (Tammelin et al. 2012). The data used in this thesis were gathered during the pilot phase of the programme and one year later in 2013. Figure 1 presents the different types and timeline of the gathered datasets, such as student-level data and school process data. The inclusion of different datasets by each study are also visualised in Figure 1.

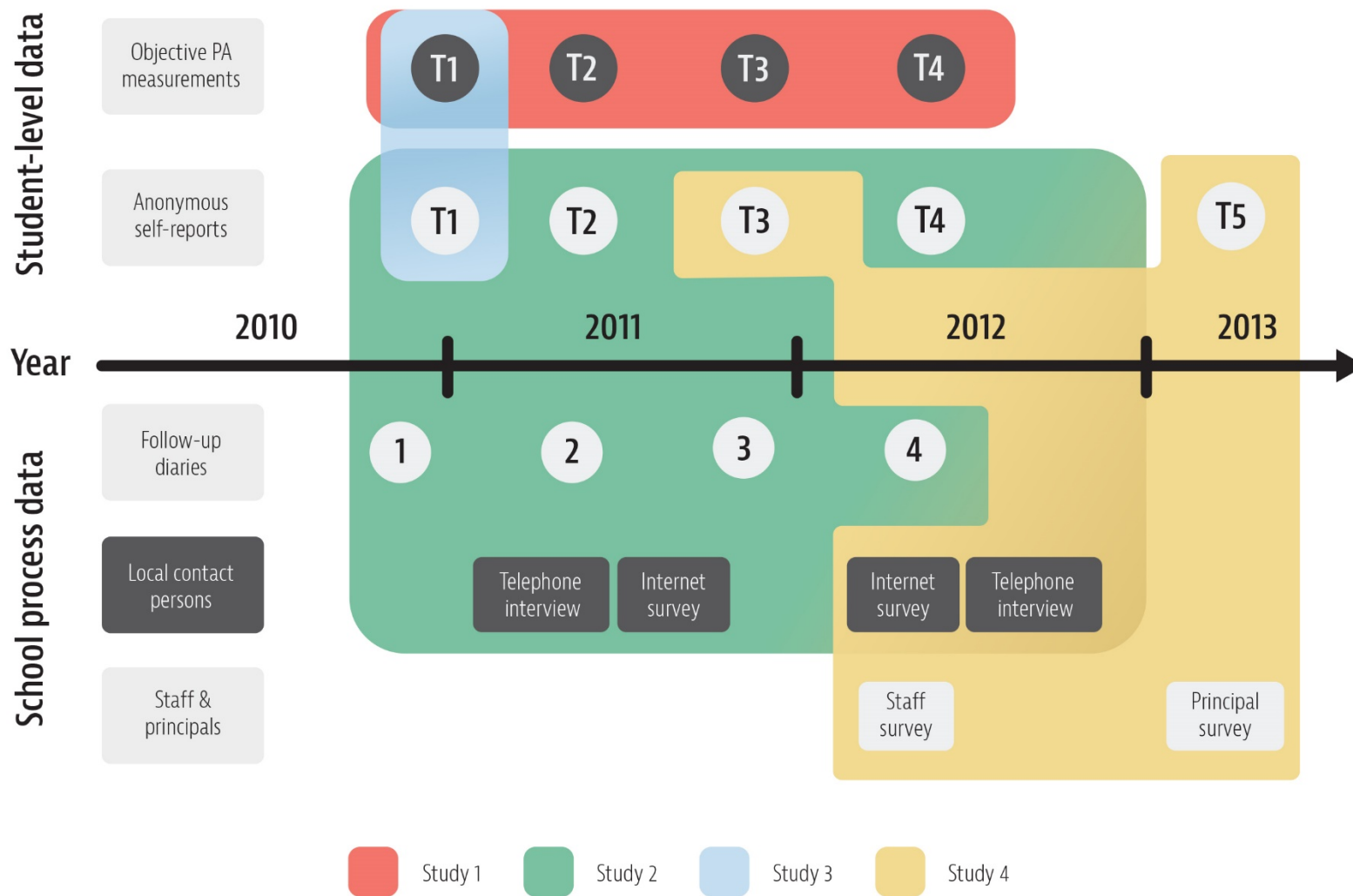


FIGURE 1

Timeline of the data collection.

The programme schools that were included in each study were selected on the basis of the official funding applications, which included action plans to promote PA during the school day. Selections were made in a research group meeting, and the selection criteria emphasised variety in geographical location and school levels (both primary and lower secondary schools in studies which included both school levels) and viability, versatility, and comprehensiveness of the project action plans to promote school-based PA. A key element in the project applications was the schools' plans to increase PA during recess times and to obtain equipment. Therefore, recess times were chosen as a central theme in this thesis and in the examination of students' school-based PA. The characteristics of Studies I, II, III and IV are presented in Table 1.

TABLE 1 Characteristics of Studies I, II, III and IV.

Study	Setting	Population	Outcome variables
I	Quasi-experimental follow-up study in four programme schools compared to two reference schools over two academic years (2010–2012)	<ul style="list-style-type: none"> ▪ Grade 1–9 students, 152 males and 167 females ▪ Individual follow-up for 1.5 years 	School day MVPA, school day ST, leisure time MVPA, leisure time ST, whole-day MVPA, whole-day ST
II	Follow-up study in four lower secondary schools over two academic years (2010–2012)	<ul style="list-style-type: none"> ▪ Grades 7–9 students, 363 males and 426 females ▪ Anonymous questionnaires for grade 7–8 students in 2010–2011 and grade 8–9 students in 2011–2012 ▪ 7 local contact persons 	<ul style="list-style-type: none"> ▪ Spending recess outdoors, physically active play at recess, ball games at recess, at least 5 days a week with > 60 min MVPA per day ▪ Promotion actions in schools ▪ Perceptions of effective actions on students' PA
III	Cross-sectional study in 19 schools in 2010	<ul style="list-style-type: none"> ▪ Grade 4–5 and 7–8 students, 744 males and 719 females 	PA at recess (controlled with overall PA) in association with peer relationships at school, relatedness to school, and school climate
IV	Case study in four lower secondary schools in spring 2011 and spring 2013	<ul style="list-style-type: none"> ▪ Grade 8 students, 387 males and 371 females ▪ 7 local contact persons ▪ 74 staff members ▪ 3 principals 	<ul style="list-style-type: none"> ▪ PA at recess, peer relationships at school, relatedness to school, school climate ▪ School PA promotion processes ▪ Staff experiences of the school's promotion process

Note: MVPA = moderate-to-vigorous-intensity physical activity. ST = sedentary time. PA = physical activity.

Students' participation in the study was voluntary, and students completed a self-report questionnaire with measures of study variables and demographic items during their regular school day. Researchers administered the questionnaire completion, monitored understanding and answered possible questions. In Study I, identification information was gathered from the students. In Studies II–IV, students completed an anonymous self-report questionnaire.

Study I. Using a quasi-experimental design, data were collected between 2010 and 2012 from four programme schools and two reference schools. The programme schools included two primary schools (A and B) and two lower secondary schools (D and E). One primary school (C) and one lower secondary school (F) from similar areas and school levels as the programme schools were invited to act as reference schools (i.e. schools not involved in the programme). The study population consisted of 319 females and males aged 7–15. An invitation to participate was sent to 303 primary school (grades 1–6) students and 334 lower secondary school (grades 7–9) students. From the invited sample, 188 (61%) primary school students and 131 (39%) lower secondary school students agreed to participate and were included in the final study sample. The participation rates of the schools varied between 26% and 79% in the first measurement in autumn 2010.

Study II. Four lower secondary schools were selected for this mixed method study based on high response rates, variety of school size and geographical location and promising action plans. The data were collected from students in grades 7–8 in 2010–2011 and one year later from the same classes, which were in grades 8–9 in 2011–2012. The mean age of the students was 14.1 ± 0.6 years at baseline. At the baseline measurement, the number of participants varied between 704 and 791 (males 45–47%). Surveys were conducted without individual identification, and the study population may have partly changed during the course of the measurements. However, according to school information, the yearly student turnover was less than 3%. The average response rates varied between 82% and 87% in schools A, B, C and D. In addition, two researchers from the research centre conducted recorded, theme-based, telephone interviews twice (1/2011, 5/2012) and Internet surveys twice (5/2011, 1/2012) with seven local contact persons in the projects as part of the general evaluation of the school project, its progress, success and challenges.

Study III. Cross-sectional data were collected from 26 programme schools (grades 1–9) in autumn 2010. The youngest students in grades 1–3 were excluded from the current study due to having a different questionnaire than the older students. Altogether 19 schools with students from grades 4–5 and grades 7–8 were included in this study. Seven schools were located in an urban area, one school in a suburban area and 11 schools in a rural area. The study population consisted of 579 children in grades 4–5 (primary school; mean age 11.0 ± 0.6 ; 53% males) and 884 adolescents in grades 7–8 (lower secondary school; mean age 14.1 ± 0.6 ; 49% males). The response rates were 91% in grades 4–5 and 83% in grades 7–8.

Study IV. This mixed method study used both quantitative and qualitative data from the same four study schools as in Study II. The student-level data were collected from eighth-graders both in spring 2011 and one year after the programme's

pilot phase had ended in spring 2013. Survey data was gathered from 385 participants (52% males) in spring 2011 and from 373 respondents (mean age of 14.9 ± 0.4 years; 50% males) in spring 2013. The response rates varied between 74% and 94% in schools A, B, C and D. Furthermore, local contact persons from the schools completed an online survey (1/2012) (n=6) and took part in recorded, theme-based, telephone interviews (5/2012) (n=7) for a general evaluation of the school project, its progress, success and challenges. In a school staff survey (n=74) in 1–2/2012 teachers were asked to evaluate the school actions, staff and student opinions and possible changes in the aforementioned. From comprehensive schools with both primary and lower secondary school students, only answers from lower secondary school teachers were included in the study. In addition, school principals filled in an email survey (5/2013) with open-ended questions concerning the school process, its continuity and staff engagement. Responses were obtained from schools B, C and D.

3.1.1 Description of study schools

The bottom-up approach of the programme enabled the participating schools to plan and implement their own individual plans to make the school day more physically active. Therefore, the characteristics and process descriptions of the schools which were involved in the follow-up studies of this thesis are described briefly below and in Table 2 (Study I) and Table 3 (Study II and Study IV). The urbanity of the schools was described by means of a statistical grouping of municipalities according to their degree of urbanisation and rurality (Statistics Finland, 2017).

Study I. Four programme schools apart from School A had not started their promotion actions at the time of the first measurement (Table 2). *Primary School A* from an urban area had already sought a more physically active school day for several years before the start of the programme. They continued to offer promotion actions between 2010 and 2012: for example, two longer recess periods (25 and 40 min) during the school day for both organised and unorganised physical activities, as well as provision of adequate equipment for PA and the development of school sports facilities, especially outdoors. Physical activities at recess were developed and organised by a hired project worker with the help of students acting as recess activators (peer instructors). *Primary School B* from an urban area had a longer recess period (30 min) for PA in the first academic year of the programme and changed this to two longer recess periods (25 and 40 min) during the second academic year of the programme. They also built an outdoor equipment area for recess and after-school use, trained older students to be recess activators for younger students, and educated their staff about children's PA. *Lower secondary School D* from an urban area focused on developing cycling culture by buying bicycles and helmets for school lessons taught outside the school building, motivating the students to commute to school in a physically active way, encouraging students and staff to engage in muscle training by developing the school gym, and educating both students and staff. *Lower secondary School E* from a rural area included regular physically active morning assemblies and walks during the school day, whole-school events involving sports and

PA, physical activity led by students during the lunch break, and training of students to be recess activators. *Reference School C* from an urban area and *reference School F* from a semi-urban area were not involved in the programme. Therefore, only PA measurements were conducted at these schools.

TABLE 2 Schools and students participating in the follow-up Study I and measurement points for each school.

School	Primary schools (grades 1–6)			Lower secondary schools (grades 7–9)		
	A	B	C ¹	D	E	F ¹
Urbanity	Urban	Urban	Urban	Urban	Rural	Semi-urban
School size (n of students) ²	184	95	260	351	134	325
Grades in the school	1–6	1–4	1–6	7–9	7–9	7–9
Grades included in the follow-up	1–2, 4–5	1–3	2, 4–5	7–8	7–8	7–8
Participants, n (%) ³	90 (79)	35 (59)	63 (49)	58 (45)	40 (49)	33 (26)
Measurement points (students)						
T1	10/2010	11/2010	11/2010	10/2010	11/2010	2/2011
T2	3/2011	5/2011	4/2011	3/2011	5/2011	5/2011
T3	10/2011	11/2011	12/2011	10/2011	11/2011	2/2012
T4	3/2012	5/2012	4/2012	3/2012	5/2012	5/2012

Note: ¹ Reference school (not included in the programme), ² Autumn 2010

Studies II and IV. The same four lower secondary schools were included in Studies II and IV (Table 3). In *School A*, there were organised recess activities and gender-specific physical activities and facilities available. This school also implemented physically active morning openings and physically active homework. A project worker was also hired to work on physical activity promotion along with the staff. In *School B*, the local contact person was mostly responsible for the planning and implementation of new promotion actions. Longer recess periods with organised physical activities were introduced, and students were also instructed by their peers (recess activators). In *School C*, longer recess periods and gender-specific physical activity opportunities during recess were implemented. Two daily outdoor recesses were introduced in the first programme year, and this changed to one outdoor recess in the second year. The school also had a number of staff members involved in a working group for physical activity promotion, and they developed networks with parents and municipality office-holders. In *School D*, organised physical activities at recess were introduced in the usual recess periods and physical break activities were implemented during lessons. Students also created a school physical activity working group in addition to training on physical activity and acting as recess activators.

TABLE 3 Schools and students participating in the follow-up Studies II and IV and measurement points for each school.

School	Lower secondary schools (grades 7–9)			
	A	B	C	D
Urbanity	Semi-urban	Rural	Semi-urban	Urban
School size (n of students) ¹	619	301	596	484
Grades in the school	1–9	1–9	7–9	7–9
Grades included in the follow-up	7–8	7–8	7–8	7–8
Participants, n (%) ²	85 (75)	84 (90)	332 (88)	288 (84)
Measurement points (students)				
T1	11/2010	11/2010	1/2011	2/2011
T2	5/2011	4/2011	5/2011	5/2011
T3	11/2011	11/2011	12/2011	12/2011
T4	5/2012	4/2012	5/2012	5/2012
T5	4/2013	5/2013	5/2013	5/2013

Note: ¹ Spring 2012, ² From the first measurement

The structure of school days and recess periods. The recess characteristics of the schools in Studies II and IV are presented in Table 4. The schools had five to six recesses per school day, with a mean length of 14–16 minutes per recess. Lunch breaks were included in the total number of recesses, and their length varied from 30–40 minutes. The total recess minutes per school day were 95 minutes in schools A and D, and 85 minutes in schools B and C. In school A, all recesses changed to compulsory outdoor recesses in the second academic year (2011–2012) in the programme. The school building in school B was under renovation between 2010 and 2013, and students were not allowed to stay indoors during recess. However, students were allowed to walk 200 metres to a nearby sports hall and outdoor field for recess activities. In 2011–12, school B introduced a daily outdoor activity recess. School C had two compulsory outdoor recesses per school day in the first programme year, and one outdoor recess in the second programme year. In school D, there was no obligation to go outside the school building during recesses.

TABLE 4 Recess periods and total recess minutes during the school day before the programme and in the first and second programme year (Studies II and IV).

Recess n:o	School A			School B			School C			School D		
	Be- fore	1 st y	2 nd y	Be- fore	1 st y	2 nd y	Be- fore	1 st y	2 nd y	Be- fore	1 st y	2 nd y
1	5	5	<u>5</u>			5	12	12	12	10	10	10
2	15	15	<u>15</u>	15	15	5	8	<u>8</u>	<u>8</u>	10	10	10
3	30	30	<u>30</u>	30	30	35	30	30	30	40	40	40
4	15	15	<u>15</u>	15	15	10	15	15	15	15	15	15
5	15	15	<u>15</u>	15	15	<u>25</u>	15	<u>15</u>	<u>15</u>	10	10	10
6	15	15	<u>15</u>	10	10	5	5	5	5	10	10	10
Total min / school day	95	95	95	85	85	85	85	85	85	95	95	95

Note: 1st y = first programme year 2010–2011. 2nd y = second programme year 2011–2012. School lunch breaks are presented in bold. Compulsory outdoor recesses are underlined.

3.2 Measurements

3.2.1 Self-reported physical activity

Overall physical activity. The level of overall physical activity was evaluated with a question taken from WHO's Health Behaviour in School-aged Children (HBSC) survey (Roberts, Tynjälä & Komkov 2004). The measure has been reported to be reliable (intraclass correlation coefficients ranging between 0.77 and 0.82) (Liu et al. 2010; Prochaska, Sallis & Long 2001) and valid (significant correlation with accelerometer data: $r = 0.40$, $p < 0.001$) (Prochaska et al. 2001) among school-aged children. Students used an 8-point scale (0–7 days) to report the number of physically active days they had had during the previous week with at least 60 minutes of MVPA per day.

Physical activity at recess. Physical activity at school recess was measured with a scale of physical activities at recess. The question, 'What do you usually do at school recess?' was followed by five statements: 'I sit', 'I stand around', 'I walk', 'I take part in physically active play', and 'I play ball games, for example football'. Students responded on a 4-point scale (0 = never; 1 = sometimes; 2 = at most recesses; and 3 = at all recesses).

In Study II, the following two statements were used: 'I take part in physically active play' and 'I play ball games, for example football'. The response alternatives 'sometimes', 'at most recesses' and 'at all recesses' were combined. In Study III and Study IV, the items of sitting and standing were reverse coded to create a new variable, 'physical activity at recess', and the items in this measure were averaged. The internal reliability (Cronbach's α) for this new measure was acceptable ($\alpha = 0.62$).

In order to evaluate the validity of measures of recess activities, a separate smaller subsample in a different dataset from the Finnish Schools on the Move pro-

gramme was used to compare these self-reported measures with objectively measured school-day physical activity. Thus, 229 students from grades 4–5 and 7–8 (42% males) completed identical questionnaires to this study and wore ActiGraph GT1M or GT3X -accelerometers for seven consecutive days in autumn 2010. Recess activity measures were then compared with objectively measured school day ST, light PA and MVPA (minutes/hour). Objectively measured school day MVPA had strong positive associations with physically active play, ball games, and physical activity at recess, and there were strong inverse associations with sitting and standing around. Walking correlated inversely with the objectively measured school day ST in males (Table 5).

TABLE 5 Pearson’s correlation coefficients for self-reported physical activities at recess and objectively measured PA (minutes/hour) during the school day in grade 4–5 and 7–8 students.

	Males (n=95)			Females (n=134)		
	ST	Light PA	MVPA	ST	Light PA	MVPA
Sitting	0.41**	-0.32**	-0.44**	0.31**	-0.42**	-0.42**
Standing around	0.47**	-0.34**	-0.53**	0.44**	-0.53**	-0.47**
Walking	-0.22*	0.20	0.20	-0.15	0.08	-0.09
Physically active play	-0.63**	0.53**	0.61**	-0.55**	0.63**	0.42**
Ball games	-0.62**	0.50**	0.62**	-0.43**	0.44**	0.47**
PA at recess ¹	-0.63**	0.51**	0.64**	-0.56**	0.61**	0.51**

Note: ST = sedentary time. PA = physical activity. MVPA = moderate-to-vigorous-intensity physical activity. * Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level. ¹ Measure is the mean of the measures ‘sitting’, ‘standing around’, ‘walking’, ‘physically active play at recess’, and ‘ball games at recess’.

Spending recess outdoors or indoors. Spending most recesses outdoors or indoors was measured with the question ‘Where do you usually spend your school recess?’ The response alternatives were ‘outdoors’ or ‘indoors’.

3.2.2 Accelerometer-assessed physical activity and sedentary time

MVPA and ST were measured in Study I by using ActiGraph GT1M or GT3X accelerometers. The vertical axis output of GT1M and GT3X monitors has been confirmed to be similar (Sasaki, John & Freedson 2011). ActiGraph sensors have been widely studied and shown to have adequate reproducibility, validity, and feasibility for both children and adolescents (de Vries et al. 2006). During the regular school day, trained researchers and staff distributed the accelerometers to the children face-to-face at the schools. The children were instructed to wear the accelerometer on their right hip with an elastic band during waking hours for seven days, except during water activities. Students were shown how to keep a diary to monitor their school hours, sleeping hours, and the types of activities the accelerometer did not measure (such as cycling, strength training, and swimming). In free-living physical activities, children tend to move in short bursts (Bailey et al. 1995), and thus, a 10-s epoch was

chosen for the monitoring. Measurements were conducted four times at each school between 2010 and 2012, and each school had their measurement day the same month in the autumn and spring (Table 2).

Data reduction. Actilife software (Version 5.0 or later) was used to initialise the accelerometers and download the data. A customised Visual Basic macro for Microsoft Excel software was used for data reduction. Non-wearing time was calculated as periods of more than 30 minutes of consecutive zero counts. The accelerometer data for school hours (school day) and outside school hours (leisure time) were filtered from the whole-day data based on the school hours reported in the student diaries. Wearing time during school hours was required to be 80% of the full school day. In addition, 500 minutes of total wearing time was required for a valid day. All school day, leisure time, and whole-day PA measures were calculated as daily averages for students meeting both conditions for at least two weekdays. PA during the school day, leisure time, and the whole day was expressed as average counts per minute (cpm). MVPA and ST during the school day were expressed as minutes per hour (min/h) in order to compare the results of school days of varying lengths. MVPA and ST during leisure time and the whole day were expressed as minutes per day (min/day) and minutes per hour (min/h, adjusted for wearing time), respectively. Cutoff points based on Evenson et al. (2008) were used to calculate ST (<100 cpm) and MVPA (>2,295 cpm). A 20,000 cpm upper limit was set to avoid any spurious data (Heil, Brage & Rothney 2012).

3.2.3 School-related social factors

Peer relationships at school were measured with a subscale of the social relationships domain from the School Well-being Profile developed according to the School Well-being Model (Konu & Koivisto 2011; Konu & Rimpelä 2002; Lintonen & Konu 2006). The scale included eight statements: 'Pupils in my class enjoy being together', 'Working in teams goes well in my class', 'Classmates interrupt if some pupil is being bullied', 'Classmates help each other in school tasks', 'Classmates help each other in problem situations', 'It's easy to get along with schoolmates', 'I have friends at this school', and 'Schoolmates accept me as I am.' Students responded on a 5-point Likert scale (0 = totally agree; 1 = agree; 2 = neither agree nor disagree; 3 = disagree; and 4 = totally disagree). The items in this measure were averaged, and the internal reliability (Cronbach's α) for the scale in this study was high ($\alpha = 0.85$). Additionally, the structure of the questionnaire has been verified to fit the School Well-being Model, and the internal reliability (Cronbach's α) of the social relationships subscale was good ($\alpha = 0.79$ in primary schools, $\alpha = 0.89$ in lower secondary schools) (Konu & Koivisto 2011).

Relatedness to school was measured with a 5-item subscale from the Need for Relatedness Scale (Richer & Vallerand 1998). This scale was originally developed for the workplace, but its construct validity and reliability have also been supported in PE settings (Standage, Duda & Ntoumanis 2003; Standage, Duda & Ntoumanis 2006). The stem was modified for the school context to read, 'In this school, I feel...', followed by items of feeling 'supported', 'listened to', 'understood', 'valued' and 'safe'.

Students responded on a 5-point Likert scale (0 = totally agree; 1 = agree; 2 = neither agree nor disagree; 3 = disagree; and 4 = totally disagree). The items in this measure were averaged, and the internal reliability (Cronbach's α) for this scale was high ($\alpha = 0.92$).

School climate was measured with a question modified from the home climate question in HBSC surveys (Currie et al. 2004) by replacing the word 'home' with 'school'. Students answered the following question: 'How do you experience the climate in your school?' Students responded to the question on a 5-point scale (0 = very good; 1 = fairly good; 2 = not good or poor; 3 = fairly poor; and 4 = very poor).

All the measures of school-related social factors were reverse coded before the analyses, so that higher scores indicated positive measures.

3.2.4 Other assessments

The gender of the student participants was taken into consideration in the quantitative analyses (included in the statistical models or separate analyses by gender) and qualitative analyses. Overall physical activity was used to adjust for the possible effects of overall activity on being physically active at recess in the statistical models in Study I.

In Study I, body weight and body height were measured in light clothing during the distribution of accelerometers by the research team. Body weight was measured twice to an accuracy of 0.1 kg using SECA 877 scales. A third measurement was conducted if the first two results differed more than 0.2 kg. The mean of the two values closest to each other was calculated and written in the records. Body height was measured twice by standing without shoes using a portable Charder HM 200P - height rod. A third measurement was conducted if the first two results differed more than 0.4 cm. The mean of the two values closest to each other was calculated and written in the records. Body mass index (BMI) was calculated by dividing the weight in kilograms by the square of height in metres and then used as a measure for body adiposity.

3.2.5 School process data

Data on the school process to promote a physically active school day were gathered with each project's official applications, follow-up diaries, telephone interviews and online surveys. The data on school actions provided background information about different school processes to interpret the changes observed in students' PA participation and school-related social factors. The questions and themes for the aforementioned tools were compiled by three researchers from the research centre.

The local contact persons in the projects kept follow-up diaries of the operations at schools, including the following themes: basic information of the project, recess physical activities, trips, procurements and construction, theme days, active commuting to school, training, and meetings and other actions implemented. The diary form included the aforementioned themes, and each action under these

themes was recorded with a date, duration, description of the action, participants and number of participants, realisers of the actions and registrar in the diary. Diaries were gathered four times during the pilot phase in years 2010–2012.

Two researchers from the research centre conducted recorded, theme-based, telephone interviews twice (1/2011, 5/2012) and Internet surveys twice (5/2011, 1/2012) with seven local contact persons in the projects as part of the general evaluation of the school project, its progress, success and challenges. The questions of the interviews and surveys are presented in Table 6.

TABLE 6 The questions of the telephone interviews and Internet surveys conducted with the local contact persons.

	Telephone interview	Internet survey	Internet survey	Telephone interview
	1/2011	5/2011	1/2012	5/2012
▪ Estimate how many percent of the students have participated in the project actions (in the primary school level and in the lower secondary school level).	X	X	X	
▪ How have the students participated in the project actions? In which ways?	X			
▪ What have been the biggest successes so far?	X	X		
▪ What have been the biggest problems so far?	X	X		
▪ What were the factors that pushed the project forward?		X	X	
▪ What were the factors that hindered the project to move forward?		X	X	
▪ What are your opinions on the effects of the project so far?	X	X		X
From the students' / teachers' and staff's / school community's and culture's / network's point of view?				X
▪ What is your opinion on the co-operation you have had in your project with the school principal / teachers and other staff members / parents / municipality / voluntary sector (sports clubs, other organisations)?	X			
▪ Which networks have been involved in the project, and how have they been committed to the project? (a list of possible networks provided)		X		
▪ Estimate the role of the aforementioned networks to the project in practice so far (not involved / support in the background / active partner).		X		
▪ How have you distributed the work of the project in your municipality?	X			
▪ Have you co-operated with the mentor assigned for your project? If you have, in which ways?	X	X		
▪ Have the teachers in your school attended the updating training provided by the University of Jyväskylä?				X
▪ What kind of support would you like to have from the Finnish Schools on the Move programme organisation?	X	X		
▪ Other comments?	X	X	X	X

The school staff survey was a single online survey to the teachers after a year and a half in the programme (1-2/2012) (n=74). Teachers were asked to evaluate the school actions, staff and student opinions and possible changes in the aforementioned. The response alternatives varied from 'totally disagree/disagree/not agree or disagree/agree/totally agree' to 'yes/no/I don't know' depending on the question. The statements and response alternatives used in this thesis are described in detail

in Table 7. From comprehensive schools with both primary and lower secondary school students, only answers from lower secondary school teachers were included in the study.

TABLE 7 Statements and response alternatives from the school staff online survey in 1–2/2012.

<ul style="list-style-type: none"> ▪ I believe there will be lasting changes in our school from the project.¹ ▪ Increasing physical activity during the school day increases satisfaction with school.¹ ▪ Students' physically active recess contributes to a peaceful learning environment.¹ ▪ I have participated in the implementation of the project.² ▪ The project is discussed among the teachers.³ ▪ The project is clearly visible in the operations of our school.³

Note: ¹Totally disagree/disagree/not agree or disagree/agree/totally agree. ²Yes/no/I don't know. ³Totally agree/agree/not agree or disagree/disagree/totally disagree.

School principals filled in an email survey (5/2013) with open questions concerning the school process, its continuity and staff engagement (Table 8). Two researchers from the research centre contacted the principals for the surveys, and responses were obtained from schools B, C and D.

TABLE 8 The questions of the principal survey via email in 5/2013.

<ul style="list-style-type: none"> ▪ How did the Schools on the Move realise in the everyday work in your school in autumn 2012? ▪ Estimate whether the activities have remained the same, decreased or increased compared to spring 2012? ▪ What barriers have you encountered in carrying on with the Schools on the Move activities in your school? ▪ What factors have supported the Schools on the Move activities to become even better in your school? ▪ How has the school staff participated in the Schools on the Move activities in autumn 2012? ▪ What means have you used to make the school staff participate? ▪ Have the Schools on the Move activities spread to other schools in your municipality? ▪ Other comments?
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Supplementary information on changes in the structure of the school day (for recess periods, see Table 4) during the programme was acquired by telephone from the local contact persons in 11/2013.

3.3 Ethics statement

The study setting for the measurements was approved by the Ethics Committee of the University of Jyväskylä. All measurements were carried out in accordance with the Declaration of Helsinki and Finnish legislation. During the data collection, analysis and reporting, the principles of good scientific behaviour and unconditional

confidentiality were adhered to. Participation in the study was voluntary and could be discontinued at any point during the course of the study. The collected data was kept in the researchers' and research centre's statisticians' personal computers and accessible only with the user's personal password. Data were completely confidential and used solely for the purposes of the research conducted in this thesis and in the national programme.

Study I. Written informed consent was obtained from all participants and their parents, and only those students who provided a completed consent form (signed by both the student and the guardian) on their first measurement day were included as participants in the study. Participants' personal information was replaced with ID codes. None of the individuals were identifiable when the results were published.

Studies II–IV. At the start of the study, the participants were informed of the study protocol and the purpose of the study in two ways: verbally and in writing on the participant information sheet on the cover page of the questionnaire. No individual identification information was collected. The participants gave their assent/consent to participate in the study by returning the questionnaire to the researchers. Parental consent was not obtained. According to the ethical principles of the Finnish National Advisory Board on Research Ethics, it is not necessary to request a guardian's permission in Finland if the head teacher of a school has determined that the study would produce useful information for the school and the study can be carried out as part of the normal activities of the school. Broad questionnaires that do not directly collect identifying information for research purposes can be carried out without the consent of parents. (National Advisory Board on Research Ethics 2009.)

3.4 Analytical strategies

This thesis uses both quantitative and qualitative analysis methods. Quantitative statistical analysis was used in Studies I and III and partly in Studies II and IV. Qualitative analysis was used in conjunction with quantitative analysis in Studies II and IV (mixed method studies). The following sub-sections describe the use of different analytical strategies generally, and more detailed information on the analysis methods is presented in the original articles.

3.4.1 Quantitative analysis

The quantitative analysis of the collected data was conducted using IBM SPSS Statistics (Version 20.0, IBM Corp. Armonk, USA), and linear growth curve modelling was conducted using Mplus 7.0 software (Studies I and III) (Muthén & Muthén 2012). SPSS was mainly used for preliminary and descriptive analysis, whereas Mplus was used for linear growth curve modelling and multiple linear regression analyses.

Means and standard deviations for the student-level data were calculated for continuous variables and as percentages for categorical variables for programme schools and reference schools, genders and school levels. Student's *t*-test and chi-

square test were used to investigate the differences in study variables between the programme and reference schools, student groups by gender and school level, and also to compare students with complete data on MVPA and ST from all four measurement points with those students with incomplete data in Study I. Pearson's correlation coefficients were calculated for the study variables in Studies II and III.

In Study I, linear growth curve modelling was used to examine the effect of the programme on the development of MVPA and ST and the level of MVPA and ST during the follow-up period (including four measurement points). The path diagram for the hypothesised model is presented in Figure 2. A multi-level modelling approach was chosen to fit the growth model. The data were converted to long format and the 'student' (ID) was considered as a cluster variable (repeated measures nested within the students). The regression coefficient between time and MVPA time (and ST) was specified as a random slope, meaning the coefficient was allowed to vary among students. The level of MVPA and ST was also treated as a random intercept. At the between-subject level, the effect of the programme on the development (slope) and on the level of MVPA and ST was estimated and tested for significance. The model at the between-subject level was controlled for potential confounding variables (background variables that differed between the programme and the reference schools at the first measurement). In addition, the model was controlled for background variables that related to missingness. The parameters of the models were estimated using the full information maximum likelihood (FIML) estimation method. Missing data were assumed to be missing at random (MAR). MAR means that missingness can be a function of observed covariates and observed outcomes. Unlike the listwise deletion method, FIML uses all available information in a dataset and produces unbiased parameter estimates under MAR assumption. As there were minor violations of normality assumption, maximum likelihood with robust standard errors (MLR) was used. The significance level of the study was set at 0.05. The effect size (Cohen's d) was calculated as the difference in the mean changes (from the first measurement to the last measurement) between the programme schools and the reference schools divided by a pooled standard deviation at the first measurement. The effect size of $d = 0.2$ was considered small; $d = 0.5$, medium; and $d = 0.8$, large (Cohen 1992).

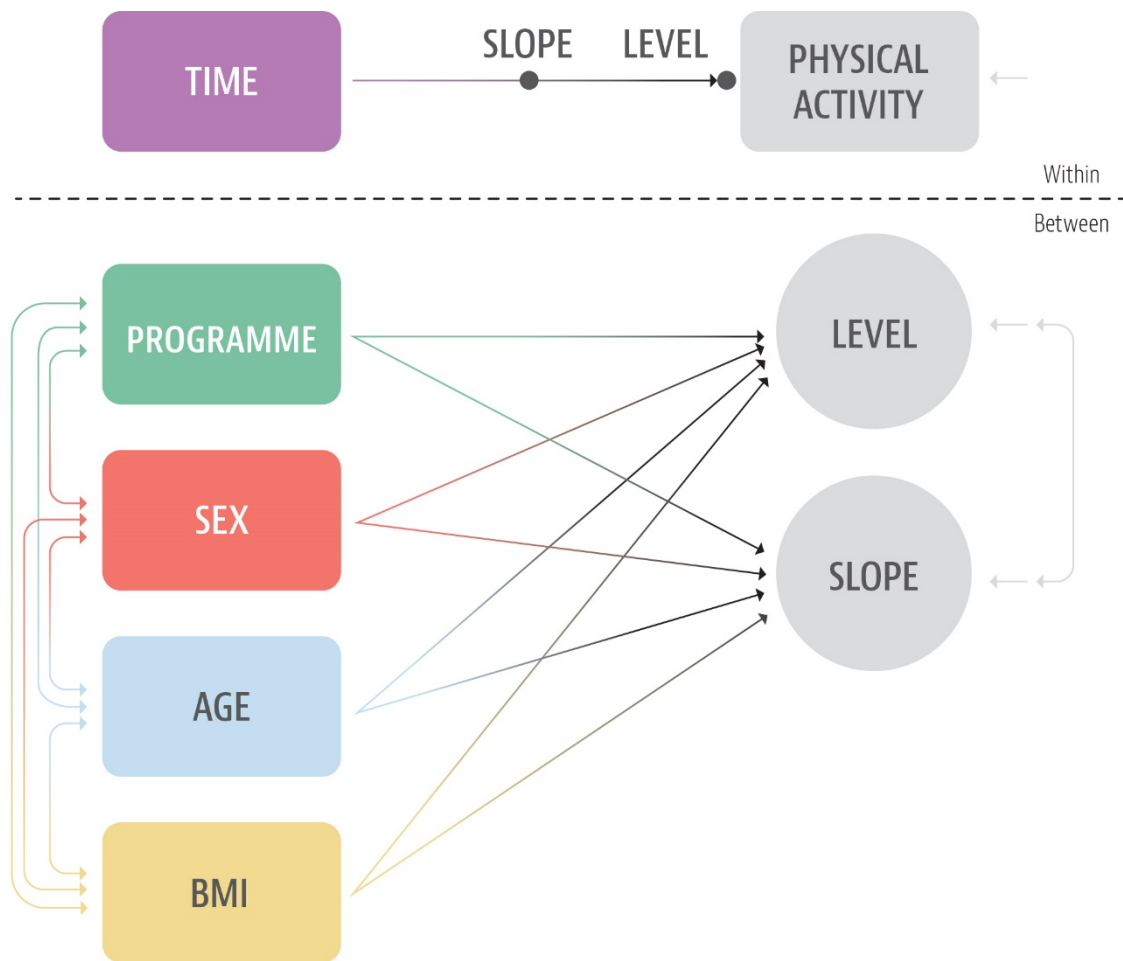


FIGURE 2 The path diagram of a linear growth model carried out as a multi-level model.

In Study II, the data on students' PA measures obtained from the student surveys were distributed into males and females by schools and all schools together. The differences between genders were analysed separately with cross-tabulation and a chi-square test for each PA measure (spending recess outdoors, physically active play at recess at least sometimes, playing ball at recess at least sometimes and overall PA with at least five active days per week with more than 60 minutes of MVPA per day).

In Study III, multiple linear regression analyses were conducted to discern whether physical activity at recess and overall physical activity were associated with peer relationships at school, relatedness to school and school climate in primary school (grades 4–5) and in lower secondary school (grades 7–8). To handle non-independence of the data due to clustered sampling, with school as the primary sampling unit, the special analytical feature of Mplus for complex sample data (command TYPE = Complex) was used. This approach produces corrected standard errors for regression coefficients by using a sandwich estimator in the computations. The intra-class correlation coefficients (ICC) were calculated for the outcome variables in primary and lower secondary schools in order to evaluate the proportion of

the total variance explained by the cluster level. The distributions of all school-related social measures were negatively skewed and leptokurtic. In addition, the distribution of physical activity at recess was positively skewed and overall physical activity was negatively skewed. Maximum likelihood estimation with robust standard errors (MLR) was used when the assumption of normality was not met. Multiple linear regression models were fitted for males and females by using a multiple-group analysis method. Analyses were conducted separately for primary and lower secondary schools. Standardised estimates, standard errors and p-values were reported, as well as the coefficient of determination (R²) for the saturated models. Full information maximum likelihood (FIML) estimation was used under the assumption of data missing at random (MAR) in analysing incomplete data.

In Study IV, two-way analysis of variance (ANOVA) was used to analyse the differences of eighth-graders at T1 and T3 in PA at recess and school-related social factors by gender, year (T1–T3) and gender*year interaction. Two-way ANOVA was calculated separately for each school.

3.4.2 Qualitative analysis

In Study II, the goal of the analysis of school actions data was to describe the practices implemented to enhance students' PA in the school setting. First, recorded telephone-interview data were transcribed by two researchers. The written data (96 pages of follow-up diaries, 34 pages of interviews and 6 pages of surveys) were then analysed using quantitative content analysis by one researcher. The data were classified into 26 different actions, and they were regrouped under six categories. The local contact persons' perceptions of the actions' effects on students' PA were also identified and marked in the subcategories. The drafts and the final version of the results were discussed and agreed on by the research team.

In Study IV, the study schools had differences in the levels of PA at recess at the first measurement and in the selected PA promotion actions. Therefore, a researcher panel from the study group decided to analyse and present case descriptions of each school project. First, the qualitative data from the local contact persons, school staff and principals and the quantitative student-level data were organised under separate school cases using Microsoft Word. All qualitative data were transcribed into written data with Microsoft Word (altogether 12 pages). Secondly, two researchers separately and independently analysing and producing case descriptions of each school. Many types of qualitative data enabled perspectives of different people to be compared and interviews could be checked against other documents (Patton 2002). Therefore, the analysis combined characteristics of classification, a narrative approach and content analysis (Schreier 2014). The researcher panel with a third researcher then compared the findings and case descriptions, discussed the possible differences and agreed on the final version of the results.

Trustworthiness was of highest importance while qualitative data was collected and analysed in Studies II and IV. All the qualitative data from the study schools were collected by the same researchers during the course of this study,

which enabled rapport to develop with the informants in the schools. The data collected from the schools were handled confidentially. Strategies to ensure trustworthiness during the data analysis included methods triangulation (both quantitative and qualitative data), triangulation of sources, analyst triangulation with multiple researchers analysing and/or verifying the findings or pointing out evidence of disconfirming findings, and taking notes carefully and reporting different phases of analysis with highest precision. Negative cases and contradictory findings were reported with equal importance to the possible positive and confirming results.

4 OVERVIEW OF THE RESULTS

Age-related differences were observed in both objectively measured and self-reported physical activities. According to the accelerometer measurements, primary school students were more physically active and less sedentary during the school day, leisure time and the whole day ($p < 0.001$) (Study I). Younger students reported more days with least 60 minutes of MVPA compared to older students, and PA at recess was more common in grades 4–5 than in grades 7–8 (Study III).

Differences in physical activities between genders were also observed in the studies. Males reported more days with at least 60 minutes of MVPA compared to females (Study III). The levels of PA at recess were higher among males than among females in primary and lower secondary schools (Study III). Males spent their recesses more commonly outdoors than females in measurement points 2–4 ($p < 0.003$), and males participated more in recess activities than females (physically active play $p < 0.001$; ball games $p < 0.001$) (Study II).

4.1 Changes in students' objectively measured physical activity and sedentary time (Study I)

The regression coefficient (b) between the programme (1 = programme, 0 = reference school) and level refers to the difference in the overall level of the outcome variable between the programme and the reference school; the regression coefficient between the programme and slope refers to the difference in the change that occurred during the follow-up period for the programme schools and the reference schools.

4.1.1 Changes in physical activity and sedentary time by school levels

Missing data. Of the total number of participants ($n=319$), 185 students (58%) provided school day PA data at all four measurement points, 75 students (23.5%) at three measurement points, 37 (11.6%) at two measurement points, and 19 (6%) at one time point. Furthermore, three students (0.9%) did not have valid accelerometer-assessed school day PA data at all. The students with all four measurements of school day PA ($n=185$) were compared with the students with incomplete data ($n=134$). Females had complete data more often than males ($\chi^2(1) = 9.92, p = 0.003$). The students with complete data were older and had a slightly higher BMI than those students with one or more missing values [$t(317) = -2.00, p = 0.046$ and $t(314) = -1.91, p = 0.057$, respectively]. No differences in PA measures in the first measurements were observed, except for school day and whole-day ST [$t(284.27) = -2.21, p = 0.028$ and $t(301) = -2.89, p = 0.004$, respectively]. Students with complete data had more school day ST compared with students with incomplete data.

Because there were differences between the programme schools and reference schools in terms of age at the first measurement point, and missing data were

dependent on sex and BMI, all the models were controlled for these variables. The path diagram for the hypothesized model is presented in Figure 2.

In the primary schools, the level of school day MVPA was 1.1 min/h higher ($p < 0.001$), while leisure time MVPA was 5.8 min/day lower ($p < 0.038$) in programme schools compared with reference schools (Table 9, level estimates). The level of school day ST was 2.1 min/h lower ($p < 0.001$) and whole-day ST was 2.5 min/h lower ($p < 0.001$) in programme schools compared with reference schools at the primary school level. In the lower secondary schools, there was no difference in the levels of MVPA or ST between the programme schools and reference schools, with the exception of school day ST being 1.5 min/h higher ($p = 0.006$) in the programme schools compared with reference schools (Table 9).

In the programme primary schools, school day MVPA increased ($p = 0.010$) and school day ST decreased ($p = 0.008$) more than in the reference schools during the follow-up period (Table 9, slope estimates). The effect sizes for these differences were small ($d = 0.18$ and $d = -0.27$, respectively). In the lower secondary schools, there were no significant differences between programme and reference schools in the change in different PA and ST measures during the follow-up (Table 9).

TABLE 9 The regression coefficients for the effect of the programme on the level and slope of school day, leisure time and whole-day moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST).

	Level			Slope		
	<i>b</i>	SE	<i>p</i>	<i>B</i>	SE	<i>p</i>
Primary schools						
School day MVPA (min/h)	1.14	0.28	<0.001	0.27	0.10	0.010
School day ST (min/h)	-2.07	0.54	<0.001	-0.52	0.20	0.008
Leisure time MVPA (min/day)	-5.77	2.78	0.038	0.13	0.99	0.894
Leisure time ST (min/h)	0.10	0.57	0.869	0.04	0.26	0.879
Whole-day MVPA (min/day)	1.40	3.57	0.695	1.33	1.16	0.250
Whole-day ST (min/h)	-2.50	0.69	<0.001	-0.19	0.35	0.584
Lower secondary schools						
School day MVPA (min/h)	0.13	0.19	0.481	0.06	0.11	0.561
School day ST (min/h)	1.52	0.55	0.006	-0.48	0.26	0.063
Leisure time MVPA (min/day)	-3.89	2.62	0.137	-1.31	1.48	0.376
Leisure time ST (min/h)	0.39	0.60	0.518	0.10	0.27	0.709
Whole-day MVPA (min/day)	-2.78	3.18	0.382	-0.65	1.68	0.698
Whole-day ST (min/h)	0.53	0.49	0.285	0.33	0.24	0.162

Note: 1 = programme school, 0 = reference school. *b* = unstandardised regression coefficient. SE = standard error. The models controlled for sex, age and body mass index. Statistically significant values presented in bold ($p < 0.05$).

4.1.2 Changes in physical activity and sedentary time by each programme school

When the results were analysed separately for all four programme schools, the level of school day MVPA was higher ($p < 0.001$) and school day ST was lower ($p < 0.001$) only in primary School A compared with reference School C (Table 10). However, no significant differences were observed in the change (slope) of school day MVPA ($p = 0.054$) or ST ($p = 0.526$) during the follow-up period for School A and reference School C. School day MVPA increased ($p = 0.016$) and school day ST ($p < 0.001$) and leisure time MVPA ($p < 0.001$) decreased more in primary School B than in reference School C during the follow-up period. School day ST decreased ($p = 0.039$) more in the lower secondary School D compared with the reference School F during the follow-up period. Leisure time MVPA and whole-day MVPA decreased more ($p = 0.001$ and $p < 0.001$) in the lower secondary School E compared with the reference School F.

TABLE 10

The regression coefficients for the effect of the programme on the level and slope of school day, leisure time and whole-day moderate-to-vigorous-intensity physical activity (MVPA) and sedentary time (ST).

Schools	Level			Slope		
	<i>b</i>	SE	<i>p</i>	<i>b</i>	SE	<i>p</i>
Primary schools						
School A						
School day MVPA (min/h)	1.70	0.29	<0.001	0.17	0.11	0.135
School day ST (min/h)	-2.84	0.58	<0.001	-0.15	0.21	0.486
Leisure time MVPA (min/day)	-4.54	2.87	0.113	0.62	1.05	0.553
Leisure time ST (min/h)	0.10	0.27	0.717	0.11	0.60	0.717
Whole-day MVPA (min/day)	5.53	3.66	0.131	1.45	1.21	0.231
Whole-day ST (min/h)	-2.50	0.74	0.001	-0.22	0.52	0.674
School B						
School day MVPA (min/h)	-0.38	0.40	0.350	0.38	0.16	0.016
School day ST (min/h)	-0.45	0.72	0.529	-1.38	0.27	<0.001
Leisure time MVPA (min/day)	-6.80	1.46	<0.001	-1.92	0.02	<0.001
Leisure time ST (min/h)	-0.59	0.85	0.488	0.58	0.32	0.073
Whole-day MVPA (min/day)	-8.11	4.86	0.095	-0.16	1.60	0.921
Whole-day ST (min/h)	-2.45	1.29	0.058	-0.14	1.35	0.916
Lower secondary schools						
School D						
School day MVPA (min/h)	0.57	0.23	0.012	0.13	0.13	0.327
School day ST (min/h)	1.28	0.61	0.035	-0.56	0.27	0.036
Leisure time MVPA (min/day)	-2.42	2.67	0.364	-1.26	1.58	0.426
Leisure time ST (min/h)	0.31	0.64	0.628	0.19	0.27	0.499
Whole-day MVPA (min/day)	0.39	3.27	0.904	0.05	1.81	0.978
Whole-day ST (min/h)	0.31	0.50	0.530	0.19	0.18	0.294
School E						
School day MVPA (min/h)	-0.56	0.15	<0.001	-0.05	0.11	0.672
School day ST (min/h)	1.81	0.57	0.001	-0.30	0.25	0.227
Leisure time MVPA (min/day)	-5.55	1.25	<0.001	-1.54	0.47	0.001
Leisure time ST (min/h)	0.40	0.77	0.600	0.30	0.27	0.262
Whole-day MVPA (min/day)	-7.21	6.80	0.289	-1.82	0.19	<0.001
Whole-day ST (min/h)	0.95	0.61	0.118	0.19	0.18	0.313

Note: 1 = programme school, 0 = reference school. Results analysed separately for four programme schools compared to reference school (primary schools A and B vs. reference school C, and secondary schools E and F vs. reference school G). *b* = unstandardised regression coefficient. SE = standard error. The models controlled for sex, age and body mass index. Statistically significant values presented in bold ($p < 0.05$)

4.2 Physical activity at recess and promotion of a physically active school day in lower secondary schools (Study II)

4.2.1 Changes in adolescents' physical activity at recess

During the two-year follow-up, the proportion of students who spent recess outdoors increased in all students from 17% to 33%. The proportion of students who participated in physical activities at recess at least sometimes increased from 30% to 49% in physically active play and from 33% to 42% in ball games. These increases in both forms of PA at recess were mostly due to the improvements in males' participation rates (Figures 3 and 4). Moreover, overall PA declined slightly in all students during the follow-up period. The proportion of males who had at least five active days per week with over 60 minutes of MVPA per day decreased from 51% to 44%. The trend was similar in females with a decline from 45% to 40%.

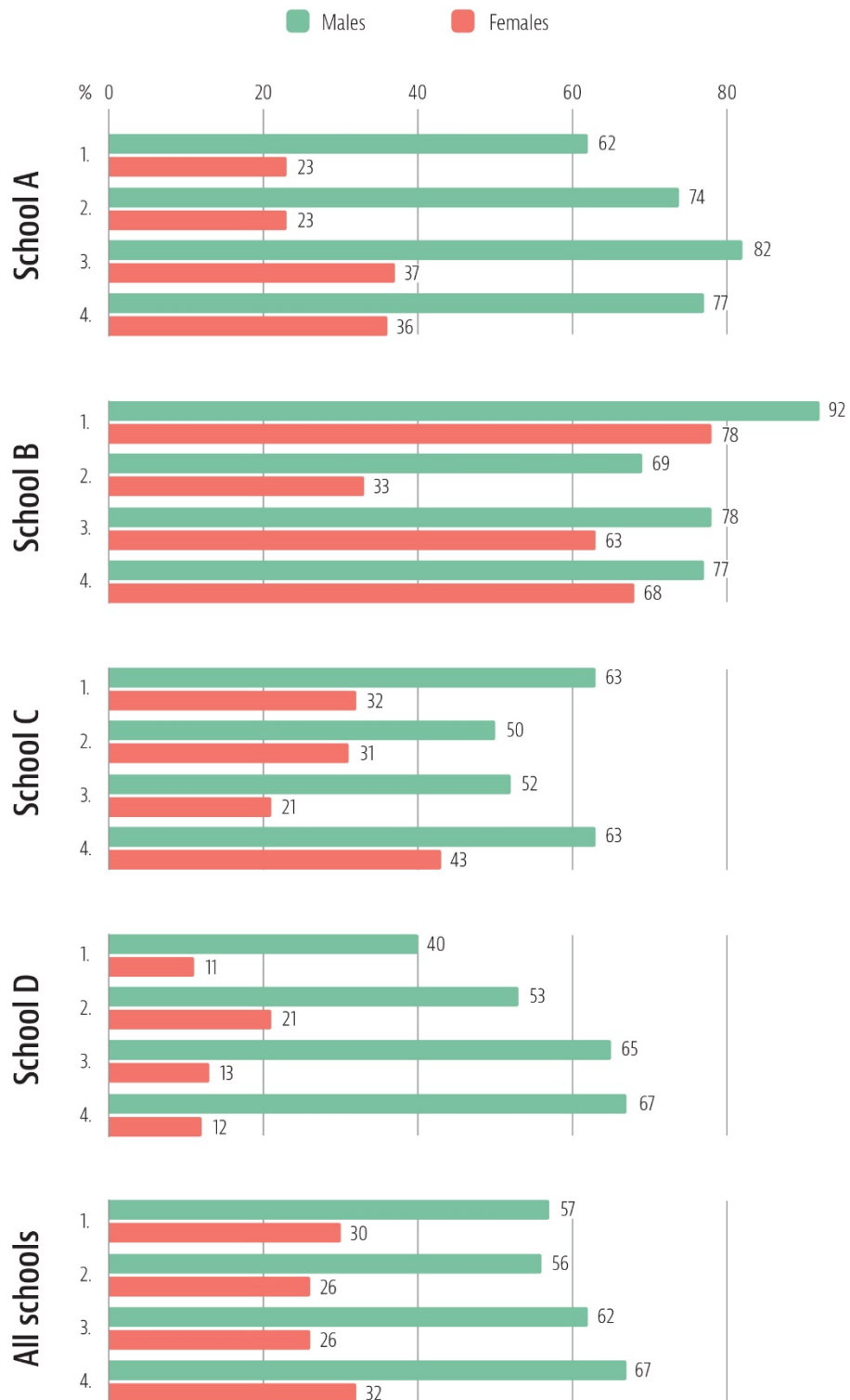


FIGURE 3

The proportion of students (%) who participated in physically active play at recess at least sometimes at the baseline and at the measurement points 2, 3 and 4 in schools A, B, C and D.

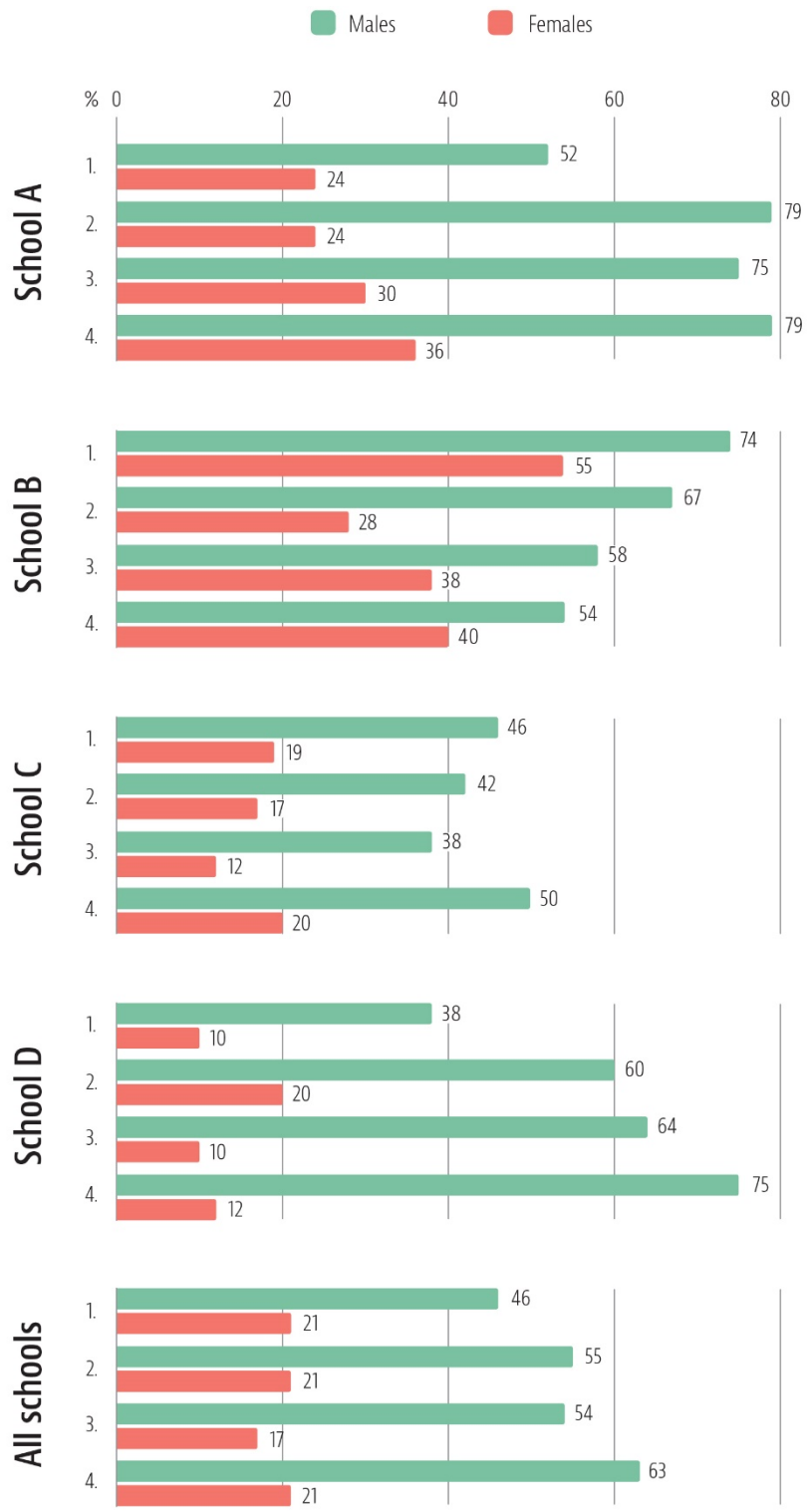


FIGURE 4 The proportion of students (%) who participated in ball games at recess at least sometimes at the baseline and at the measurement points 2, 3 and 4 in schools A, B, C and D.

4.2.2 Actions to promote a physically active school day and their effectiveness in students' physical activity

The programme schools were able to independently plan the PA promotion considered to work in practice within the school community. The quantitative content analysis of the school actions condensed these actions into six main categories (Table 11). 'Activities within the school setting' includes actions that transformed the structures of the school day and provided concrete opportunities for PA, such as longer recess periods and active morning openings. 'Equipment and facilities' describes physical changes in the school environment, such as the provision of new game equipment, playground markings or playing fields both indoors and outdoors. 'Student involvement' refers to students' opportunities to partake in the planning and decision-making of the physical activities implemented in the schools. 'Leadership and staff engagement' defines the school personnel's involvement in the process of making the school day more physically active. 'Informing and co-operation' describes the schools' efforts to share knowledge and interest with different networks having possibilities to affect schoolchildren's physically active lifestyle, such as parents and local sports clubs. All the aforementioned categories included both practices implemented in the schools to directly promote students' PA and factors behind the successful promotion process.

Most schools developed their equipment and facilities for PA. The majority of the physical activities carried out in the schools were non-curricular and outside lessons, such as recess and after-school activities. Student involvement was applied especially when designing recess activities, and students were recruited in all the schools to activate other students at recess (recess activators/peer instructors). Organised recess activities both inside and outside the school building were also present in all schools. In addition, providing students with adequate and inspiring equipment for physical activities was one of the key strategies for PA promotion in the school. The local contact persons considered organised recess activities, student recess activators, equipment provision and sports facilities development to have especially affected students' PA positively (Table 11).

Principals in all four schools supported the implementation of promotion actions, and all schools trained their staff about PA (Table 11). Those schools that had a staff working group for PA promotion reported more than just a few teachers involved in the actions. Furthermore, information and communication within the school community were emphasised in all schools. Most of the schools also participated in mentoring, which meant contacting and developing ideas with an expert in the field of schoolchildren's PA. The national programme had individually assigned a mentor for each local project, and the decision of its usage was left up to the projects themselves.

TABLE 11 Actions conducted in schools A, B, C and D to create a more physically active school day.

Actions	School			
	A	B	C	D
Physical activities organised in the school setting				
Daily compulsory outdoor recess			X	
Longer recess period for PA		X	X*	
Gender-specific physical activities or facilities	X		X*	
Organised physical activities during recess	X*	X*	X	X
Afterschool activities / clubs	X	X	X	
Physically active morning openings	X			
Physical break activities in lessons			X	X
Physically active homework	X			
Whole-school events related to sports and PA	X	X*		X
Equipment and facilities for PA				
Outdoor equipment available	X*	X	X*	X
Indoor equipment available	X	X	X*	X
Sports facilities developed	X	X	X*	X*
Student involvement				
Students participate in the school PA working group	X			X
Students as recess activators / peer instructors at recess	X*	X*	X	X
Schooling the students on PA and instructing	X	X	X	X
Leadership and school staff engagement related to the project				
Principal's support	X	X	X	X
Hired project worker	X			
Schooling the staff on PA	X	X*	X	X
More than only a few teachers involved in the project	X		X	
Staff working group for physical activity promotion	X		X	
Informing and co-operation related to the project				
Informing within the school	X	X	X	X
Co-operation with parents	X		X	
Co-operation with municipality & office-holders	X	X	X	
Co-operation with local sport clubs	X			
Experienced mentor supporting the project	X	X	X	
Other actions				
Physical activity monitoring for students	X	X		

Note: PA = physical activity. *Actions that the local contact persons in each school perceived to have had a positive effect on students' PA.

4.3 Recess physical activity in relation to school-related social factors (Study III)

No differences between genders were observed in school-related social factors. All school-related social factors – peer relationships at school, relatedness to school, and school climate – were reported more positive in grades 4–5 than in grades 7–8. The mean values for all school-related social factors in primary school students were 3.02–3.11 in primary schools and 2.76–2.84 in lower secondary schools, while the range in these measures was 0–4.

In primary school, PA at recess was directly associated with peer relationships at school (males: $b = 0.17$, $p = 0.007$ and females: $b = 0.21$, $p < 0.001$) (Table 12). In lower secondary school, PA at recess was positively associated with peer relationships at school (males: $b = 0.09$, $p = 0.006$ and females: $b = 0.12$, $p = 0.010$). Gender differences were observed for the models in both primary school ($\chi^2(2) = 6.05$, $p = 0.049$) and lower secondary school ($\chi^2(2) = 26.03$, $p < 0.001$). Further analysis revealed that the association between PA at recess and peer relationships at school was similar among females and males in primary school ($b = 0.17$ vs. $b = 0.21$, $p = 0.747$) and in lower secondary school ($b = 0.09$ vs. $b = 0.12$, $p = 0.215$), but the association between overall PA and peer relationships at school differed between gender groups in primary school ($b = 0.14$ vs. $b = -0.03$, $p = 0.009$) and lower secondary school ($b = 0.26$ vs. $b = 0.12$, $p = 0.006$).

In primary school, PA at recess was positively associated with relatedness to school (males: $b = 0.18$, $p = 0.002$ and females: $b = 0.24$, $p < 0.001$). In lower secondary school, PA at recess was not associated with relatedness to school (males: $b = 0.01$, $p = 0.667$ and females: $b = 0.03$, $p = 0.739$). No gender differences were observed for the models (primary school: $\chi^2(2) = 1.73$, $p = 0.422$ and lower secondary school: $\chi^2(2) = 2.34$, $p = 0.310$).

In primary school, PA at recess had a positive association with school climate among females, but the association was not significant among males (females: $b = 0.17$, $p = 0.001$; males: $b = 0.14$, $p = 0.095$). In lower secondary school, PA at recess was not associated with school climate (males: $b = -0.02$, $p = 0.493$ and females: $b = 0.04$, $p = 0.434$). No gender differences were detected for the models (primary school: $\chi^2(2) = 0.24$, $p = 0.888$ and lower secondary school: $\chi^2(2) = 1.40$, $p = 0.497$).

TABLE 12 Multiple liner regression analysis for physical activity (PA) at recess and its association with peer relationships at school, relatedness to school and school climate.

	Males			Females		
	Estimate	SE	p-value	Estimate	SE	p-value
Primary school						
Peer relationships at school						
PA at recess	0.17	0.06	0.007	0.21	0.05	<0.001
Overall PA	0.14	0.06	0.020	-0.03	0.08	0.720
R ²	0.05			0.04		
Relatedness to school						
PA at recess	0.18	0.06	0.002	0.24	0.05	<0.001
Overall PA	0.04	0.10	0.651	-0.04	0.06	0.525
R ²	0.04			0.06		
School climate						
PA at recess	0.14	0.08	0.095	0.17	0.05	0.001
Overall PA	-0.02	0.04	0.722	-0.05	0.07	0.546
R ²	0.02			0.03		
Lower secondary school						
Peer relationships at school						
PA at recess	0.09	0.03	0.006	0.12	0.05	0.010
Overall PA	0.26	0.06	<0.001	0.12	0.03	0.001
R ²	0.09			0.03		
Relatedness to school						
PA at recess	0.01	0.01	0.667	0.03	0.08	0.739
Overall PA	0.34	0.03	<0.001	0.18	0.08	0.017
R ²	0.12			0.04		
School climate						
PA at recess	-0.02	0.03	0.493	0.04	0.06	0.434
Overall PA	0.12	0.06	0.038	0.11	0.02	<0.001
R ²	0.01			0.01		

Note: PA = physical activity. SE = standard error. Standardised regression coefficients are presented. Statistically significant values (p < 0.05) are presented in bold.

4.4 Differences in physical activity at recess and school-related social factors: cases in lower secondary schools (Study IV)

4.4.1 Differences in physical activity at recess and school-related social factors for eighth-graders

Student-level data was analysed for PA at recess and school-related social factors, such as peer relationships at school, relatedness at school and school climate. Differences in PA at recess for eighth-graders between spring 2011 and 2013 were observed in two of the four study schools, and the results are presented in Table 13. In schools A and B, there were no differences in PA at recess in males or females. In both in Schools C and D, male students reported higher levels of PA at recess in spring 2013 compared to spring 2011 while no differences were observed in females (p for interaction = 0.004 and p for interaction = 0.003, respectively).

Differences in school-related social factors for eighth-graders between the two springs were minor or non-existent. In Schools A, B and C, no differences in PA at recess or school-related social measures were observed between the two time-points (Table 13). However, both female and male students in School D reported lower levels of peer relationships at school and school climate in spring 2013 compared to spring 2011 (Table 13).

TABLE 13 The results of two-way ANOVA for the differences between eighth-graders in spring 2011 and spring 2013.

	School A		School B		School C		School D	
	F	<i>p</i>	F	<i>p</i>	F	<i>p</i>	F	<i>p</i>
PA at recess	F(1,88)		F(1,65)		F(1,335)		F(1,252)	
Model	2.553	0.061	1.902	0.138	12.973	<0.001	1.960	<0.001
Gender	5.545	0.021	4.066	0.048	25.592	<0.001	2.291	<0.001
Year	0.763	0.385	1.902	0.173	7.078	0.008	1.997	0.001
Gender x Year	0.763	0.385	1.068	0.305	8.565	0.004	1.581	0.003
Peer relationships at school	F(1,87)		F(1,65)		F(1,336)		F(1,248)	
Model	0.966	0.413	0.723	0.542	0.176	0.913	2.031	0.110
Gender	0.047	0.829	0.000	0.998	0.314	0.576	0.512	0.475
Year	1.892	0.172	0.749	0.390	0.004	0.950	4.475	0.035
Gender x Year	0.867	0.354	1.115	0.295	0.197	0.658	1.470	0.226
Relatedness at school	F(1,85)		F(1,65)		F(1,329)		F(1,246)	
Model	1.226	0.305	0.207	0.891	0.128	0.943	3.015	0.031
Gender	3.112	0.081	0.373	0.543	0.214	0.644	2.801	0.095
Year	0.307	0.581	0.049	0.825	0.011	0.917	0.401	0.527
Gender x Year	0.222	0.639	0.086	0.771	0.162	0.688	5.841	0.016
School climate	F(1,84)		F(1,63)		F(1,331)		F(1,248)	
Model	0.264	0.851	0.830	0.482	2.341	0.073	4.306	0.006
Gender	0.161	0.689	1.453	0.233	6.548	0.011	0.293	0.589
Year	0.089	0.766	0.595	0.443	0.045	0.832	11.393	0.001
Gender x Year	0.529	0.469	0.815	0.370	0.260	0.610	1.894	0.170

Note: PA = physical activity. Gender was coded as 1 = male, 2 = female. Statistically significant values presented in bold ($p < 0.05$).

4.4.2 School process of physical activity promotion and staff experiences

The schools in this study were involved in the programme's pilot phase for two academic years from autumn 2010 to spring 2012. The local contact persons, staff and principals were contacted to gather information on the school process for PA promotion and their experiences of the process, their participation and the benefits of being involved in the programme. The analysis was mostly based on the issues the aforementioned persons brought up themselves in the open-ended questions (apart from the staff survey questions). Criticism and negative issues were seldom found in their answers, and therefore the synthesis of the school PA promotion process and staff experiences was mostly positive.

From visibility to staff participation

Based on the staff survey, the project was seen as highly visible at the school. However, discussion among the teachers about the project varied from nearly all teachers to three quarters (Figure 5). Even greater variation occurred with teachers' participation in the project; although the project was experienced as highly visible, the

number of teachers who actually participated in the implementation of the project varied from nearly all to only one-fourth of the respondents (Figure 5).

Finnish Schools on the Move has been visible as a thing all the time, even too much according to some teachers. Teachers are aware of what it's about, but they haven't become eager to join in the actual activities.

– Local contact person from School B

A whole-school matter

In some of the schools, the project was seen as an integral part of everyday life in the schools. In School A, the local contact person of the project reported that the project had offered teachers new tools for their work, and their commitment and attitudes were positive. The promotion of school day PA had been taken as a whole-school matter including the school strategy, and possible resistance among the teachers in the beginning had eased. According to the principal in School C, other subject teachers had been somewhat jealous for the increased attention towards PA promotion, and by organising club activities during recess in other areas than PA, this had changed into a more positive feeling. The principal also mentioned that teachers no longer perceived the supervision of recess times as laborious, and teachers participated in recess activities alongside the students. This improved teacher-student relationships, and thereby it promoted teachers' participation and engagement in the promotion actions.

Physical activity is not just the job of the physical education teacher, but all teachers have the possibility to create physically active operations along with their teaching – this kind of thinking has clearly increased.

– Local contact person from School A

Student empowerment as a key element

Student empowerment and students' participation were mentioned in many of the study schools as a key element in the school projects and their implementation. According to the local contact person from School B, students had assumed responsibility in implementing recess activities, and one of the project goals was to improve students' experience of their importance and to take student opinions into account in the project. In School C, the local contact person mentioned that the empowerment of students was one of the key factors in the project, and teachers' attitudes towards the project had become more positive during the project. Students participated in and took responsibility for the planning and implementation of the project. The principal concluded that school spirit had improved, and providing students with more meaningful things to do outside lessons had resulted in less bullying and

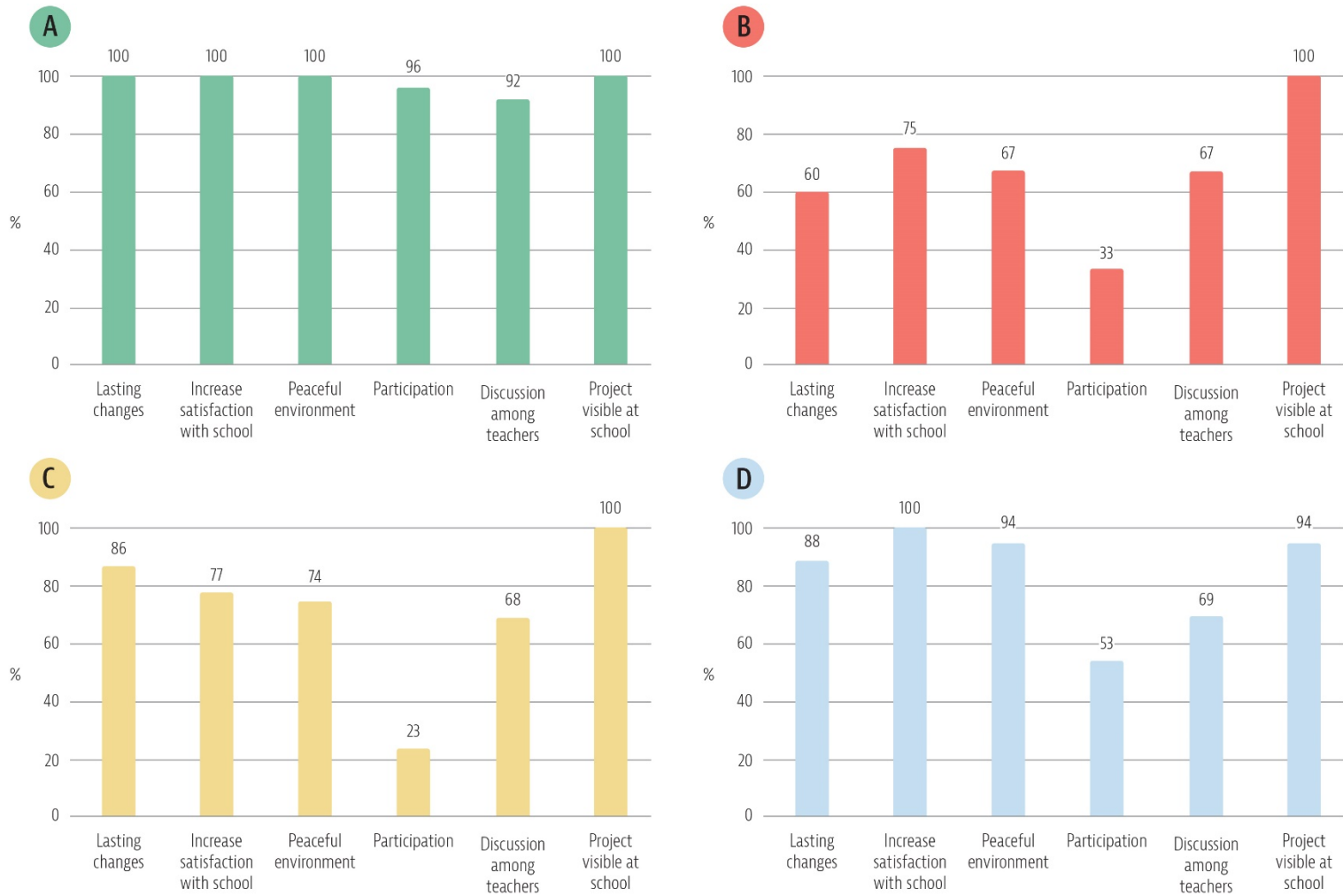


FIGURE 5 Proportions of those staff members who agree and totally agree in the school staff survey in schools A, B, C and D.

mischievous. The local contact person from School D confirmed that students were included in the planning and implementation of the activities.

There's a saying: If you don't provide youth with sensible things to do, they will come up with senseless things to do themselves.

– Principal from School C

Benefits of school-based PA

Indeed, the school staff in all of the schools mostly agreed that PA during the school day increased satisfaction with school and physically active recess contributed to a peaceful learning environment (Figure 5). The local contact person from School D concluded that positive changes had been seen in classroom discipline due to increased PA. The school culture had become more physically active, and according to the principal, the school staff's own PA and encouragement and reasoning about the importance of PA had increased their engagement. The local contact person also mentioned that PA was perceived more as a theme of school well-being than related to a specific school subject.

Attitudes towards the promotion of well-being have improved; before this was perceived as sports and physical education. Now, the promotion of students' well-being is a matter of the whole school and every adult in the school.

– Local contact person from School D

Improvements in opportunities and facilities for PA

The schools had made improvements in the possibilities for PA during the school day, especially in the physical environment. In School B, opportunities and conditions for PA had improved and these structures for PA had become more sustainable, according to the local contact person. In School C, the principal mentioned that parking in the schoolyard had been changed and all possible facilities had been used for PA purposes; there were still too few facilities for physical activities due to the renovation of the school building, according to the local contact person. The local contact person from School D mentioned that school facilities for PA were developed.

Challenges with resources and different student groups

Challenges were mentioned in terms of staff and time resources and certain student groups. In School A, the local contact persons mentioned that operations had been somewhat vulnerable due to the strong role of the project worker, the absence of a key teacher and the lack of time to plan and discuss the initiatives. In School B, the principal also mentioned school transportation schedules for students coming from a longer distance as one of the hindering factors in prolonging recess times. In both Schools C and D, the local contact persons mentioned challenges around the encouragement of female students and the least active students to be physically active, with the least active students not being reached with the activities.

From lasting changes to community engagement

Based on the staff survey, most of the staff apart from school B were positive about the achievement of lasting changes by the project (Figure 5). Based on the interviews with the local contact persons in School A, the municipality had also supported the school initiatives and the idea had spread to other schools in the municipality. Parents also provided general positive feedback about the programme. The local contact person from School B mentioned that the ideology of a more physically active school day had spread to other school levels in the municipality, such as upper secondary school. The local contact person from School C concluded that co-operation with the municipality and its officials had begun, and the well-being of children and youth had been brought up as a common theme and topic for discussion. The principal in School D was also highly involved in project planning and implementation but had encountered challenges due to the insufficient commitment of the municipality, which had led to the school being responsible for the project on its own.

5 DISCUSSION

The purpose of the present thesis was to examine the changes and associations of students' PA levels and school-related social factors in a national-level, school-based PA promotion programme. In addition, PA promotion actions, their effectiveness in the study schools, and staff experiences were described and evaluated. First, the results of this thesis are discussed in relation to previous literature. Secondly, the strengths and limitations of this thesis are discussed. Finally, general conclusions, practical implications and future directions for research are presented.

5.1 Changes in physical activity across the day

The findings of this thesis showed small but positive increases in objectively measured school day MVPA in the programme primary schools compared to the reference schools. In addition, school day ST decreased more in the programme primary schools than in the reference schools (Study I). However, these changes were not significant during the whole day in this study. In the self-reported measurements of this thesis, participation rates in PA at recess increased, but there were no increases in overall PA levels (Study II). These findings are in line with previous studies which have provided evidence that school-based PA interventions have relatively small effects on PA levels in children and adolescents (Dobbins et al. 2013). In study I, School A's higher levels of MVPA and lower levels of ST in the first measurement may have affected the possibilities to achieve statistically significant changes compared to the reference school. The present results also suggest that students compensated for increased school day MVPA and decreased ST by decreasing MVPA in leisure time. This finding is supported by studies conducted with school-aged children that indicate a tendency to compensate for increased PA levels by diminishing PA afterward. In Denmark, despite additional, compulsory PE lessons to increase PA during school hours, children decreased their PA levels after school hours and no increase in overall PA was observed (Moller et al. 2014). Likewise, the results of the study conducted by Ridgers et al. (2014; 2015) showed a compensation of increases in children's PA levels by decreased PA levels the same day or the following day.

The present results showed favourable changes in the MVPA and ST levels of school-aged children during the school day and increases in male participation rates in recess physical activities. Although changes in the amounts of whole-day PA and ST were not observed in this thesis, being more physically active and less sedentary during school hours could have benefits for the health and well-being of schoolchildren. This is of special importance as school days account for nearly half of the students' waking hours and appear to be very sedentary (van Stralen et al. 2016). Previous studies suggest that school-based PA has either positive or no association with students' academic performance (Rasberry et al. 2011), and by providing students with opportunities to be physically active during the school day (e.g. during recess and in the classroom), schools could enhance prerequisites to learn and concentrate during academic lessons. In the school-based PA intervention by Kriemler and colleagues (2010), the increases in school day PA were com-

pensated during hours outside of school; however, the attenuation of age-related decreases in PA levels with the provision of school-based PA opportunities could lead to favourable changes in cardiometabolic risk factors.

The present results on the age differences in PA and ST suggest that specific attention to the opportunities of PA should be given when students change from primary to lower secondary school. The change in both the school's physical and social environments seems to be a risk factor for both PA and SB (Marks et al. 2015; Morton et al. 2016; Pearson et al. 2017). Changing school resulted in greater reductions in objectively measured PA intensity during school lunch and recess times and greater increases in screen time during leisure time, compared to students who did not change school environment (Marks et al. 2015). However, carefully considered school PA promotion in secondary school can be effective for students changing school. For example, smaller reductions in school day MVPA were observed in a four-year follow-up when lower secondary schools offered longer recess periods than students' previous primary schools, and lunchtime opportunities for PA in lower secondary schools resulted in smaller increases in ST and smaller reductions in MVPA during lunchtime (Morton et al. 2016). Therefore, the attenuation of age-related decline in adolescents' PA could also be a reasonable objective for PA promotion in schools.

In this thesis, adolescents' participation in physical activities at recess increased in three lower secondary schools out of four during the follow-up in both physically active play and ball games. Spending recess outdoors also increased in these same schools. However, these increases were mostly due to increases in male participation. Ridgers et al. (2013) have suggested that those adolescents who were involved in sport or PA during school recess had higher levels of light PA and MVPA in the long term. Accordingly, the increases in participation in recess physical activities and outdoor recesses in Study II are a promising trend. Time spent outdoors also correlates positively with PA levels in children (Ferreira et al. 2007), and outdoor facilities and equipment seem to be associated with adolescents' break time activity at school (Haug et al. 2010). The importance of equipment and facilities for students' PA was also acknowledged by the local contact persons in Study II. Increases in recess PA participation and outdoor activities also observed in our study might attenuate the decrease of PA levels during adolescence, thereby improving health outcomes.

In line with previous findings of greater physical activeness in males at recess times (Ridgers et al. 2012b; Ridgers et al. 2013), in this thesis gender differences were obvious in PA participation during recess time. Both in physically active play and in ball games male students had significantly higher rates of participation compared to females, and they also spent most of their recesses outdoors more often than females. In this thesis, school recesses seemed to not reach females to the same extent as males, as seen in the increases in participation rates in the follow-up (Study II) and differences between the years (Study IV). Male students prefer rough-and-tumble play and aggression in their play behaviours, at least in the primary school's recess and play context (Blatchford, Baines & Pellegrini 2003; Pellegrini & Smith 1998). Male students' dominance of space in recess in a way that most females avoid leaves less opportunities for females to be active (Blatchford et al. 2003). Conflicts and teasing experienced by the opposite sex in play situations may also contribute to the lower participation rates in physical activities in ado-

lescent females (Slater & Tiggemann 2010; Slater & Tiggemann 2011). However, promising results in the promotion of PA in adolescent females have been shown with the provision of non-competitive and innovative activities in PE settings (Camacho-Miñano et al. 2011). In addition, the provision of gender-specific activities is supported by the importance of enjoyment and concerns of body attractiveness in adolescent females (Biddle et al. 2005). In Study II, two schools (A and C) were able to increase the participation of female students, and both schools applied separate, gender-specific physical activities at recess times. Individualisation and gender-sensitiveness could be key strategies in school-based PA promotion among female adolescents (Camacho-Miñano et al. 2011).

5.2 Physical activity as a tool to promote social well-being in schools

In the present study, PA at recess was positively associated with peer relationships at school in both primary and lower secondary school students, relatedness to school in primary school students, and school climate in primary school females. These associations were independent of students' overall PA. Previous research has identified PA as a multi-dimensional and contextual behaviour (Sallis, Prochaska, & Taylor 2000; van der Horst et al. 2007); for example, recess activities have been noted to provide opportunities for social development (Bailey 2006; Blatchford 1998). The provision of recess physical activities could be one factor behind the successful promotion of peer relationships at school and liking school. On the other hand, it should be noted that PA at recess could be just one of many ways to support the positive development of social factors in school. As studies on extracurricular activities have shown, participation in other activities at recess, such as music and other performing arts not included in this study, could have similar benefits for social factors (Eccles et al. 2003; Linver, Roth & Brooks-Gunn 2009). Furthermore, building social relationships and promoting social responsibility are important learning objectives in school PE. Finnish PE also aims towards positive psychological and social outcomes, such as community spirit, responsibility, fair play, and safety, along with a physically active lifestyle. (Finnish National Board of Education 2004; Finnish National Board of Education 2014.)

Sport and PA in general have been connected to promoting prosocial behaviour and counteracting disaffection in youth, although the mechanisms mediating the effects of sport and PA on these positive social outcomes remain unclear (Sandford, Duncombe & Armour 2008). The positive social impact of participation in physical activities, including at recess times, could be increased by providing students with further opportunities to co-operate with each other (Sandford, Armour & Warmington 2006; Sandford et al. 2008). However, situations related to PA can sometimes have negative effects. They may create conflicts between participants, lead to aggressive behaviour and negative peer interaction, and include pressure to make morally questionable choices (Eccles et al. 2003; Hansen, Larson & Jodi 2003; Weiss & Stuntz 2004). In making use of the findings of the present results, the importance of environmental, contextual, structural, and educational aspects of PA situations should be emphasised, such as involving participants in decision-making

and encouraging them to take leadership roles, in order to create positive social experiences (Long & Sanderson 2001; Mahoney, Eccles & Larson 2004; Patton & Viner 2007). Trained educators and appropriate adult supervision are important factors for the development of social skills and positive youth development in school-based PA programmes (Danish et al. 2005; McNamara et al. 2017). In addition, safety as one of the facilitators in the CSPAP conceptual framework could play a vital role in successful PA promotion from a social and emotional perspective (Carson et al. 2014).

Students in the present study both in the primary and lower secondary school levels reported positive school-related social factors on average. However, latest findings on school experiences in Finland create an unfortunate picture of students' well-being in schools. Remarkably many students in Finland have negative feelings towards school (Haapasalo et al. 2010), and only 13% of the 15-year-old females and 9% of males in Finland like school a lot, according to the recent HBSC study (Inchley et al. 2016). Although Finland has for many years achieved very good results in international PISA learning tests for academic subjects, Finnish students' motivation to achieve was the lowest of all OECD countries (OECD 2017). Promoting a physically active school culture could lead to a positive spiral where enhancing a physically active lifestyle in schools promotes students' social well-being, which may again support their engagement in PA. This approach is also supported by the Finnish national core curriculum for basic education, which emphasises a learning environment supportive of interaction among students, guided towards teamwork and a positive atmosphere (Finnish National Board of Education 2004; Finnish National Board of Education 2014).

According to the present results, younger students reported better school-related social factors than older students, which is in line with the results of previous studies (Eccles et al. 1993; Furrer & Skinner 2003; Goodenow 1993; Way et al. 2007). The maturation process and onset of puberty causes mental and physical changes (Patton & Viner 2007), and those changes could partly explain the differences observed between younger and older students. In addition, the impact of the change from primary school to lower secondary school could explain some of the differentiation processes in social factors between the age groups. In Finland, transitioning to lower secondary school at age 13 is a major change in students' lives. For most students, the transition to lower secondary school means new school buildings and teachers as well as many new peers. Different school cultures, new teaching groups, and social norms could affect the perceptions of school-related social factors in older students. A sense of belonging in the school community is one of the basic needs for every student, and it consists of relationships with teachers and peers (Osterman 2000). These relationships have been found to be resources for positive adjustment during school transition (Eccles et al. 1993). The present study showed positive associations between recess PA and different school-related social factors; therefore, recess could play an important role in providing students with a context to socialise for example through physical activities, especially in the change from one school level to another.

In addition to more physically active school days, one of the goals of the Finnish Schools on the Move programme is a more pleasant school day through PA (Tammelin, Laine & Turpeinen 2012). Although PA participation, especially during recess, has been positively connected to social factors in young people in the present study and in previous studies (Bailey 2006), differences in school-related social factors for eighth-graders were

minor between the two years during and after the programme's pilot phase. Therefore, positive changes in social factors did not seem to occur as a by-product of PA participation or its promotion in this study. The lower secondary schools in Studies II and IV did not take social factors into special consideration when planning the physical activities which has been considered important in the promotion of both positive social development and PA levels (Lintunen & Gould 2013; McNamara et al. 2017). High staff participation and engagement in promotion activities could be related to improved teacher-student relationships and perceived staff support for both PA and the school climate possibly leading to better school engagement (Haapasalo et al, 2010; Klem & Connell 2004) and higher school connectedness (Whitlock 2006) in adolescents. In the field of education, studies have reported promising results for the active teaching of social and emotional learning in the school environment (Durlak et al. 2011). These school-based programmes on social and emotional learning enhanced students' social and emotional skills and attitudes, increased prosocial behaviour and improved academic performance. Therefore, the aspects of social well-being should be taken into special consideration in the promotion of PA in order to create positive social changes.

5.3 School-based physical activity promotion: lessons learned from Finland

In general, there can be great variation in the pedagogical practices of schools in Finnish basic education. Schools are allowed to create their own school curricula with local emphases based on the national curriculum for basic education, and they can also plan their own projects to make the school day more physically active (Finnish National Board of Education 2004; Finnish National Board of Education 2014).

The Finnish Schools on the Move programme has an internationally unique approach to a more physically active school day. The programme could be described as a network of projects, and it offers the participating schools communication, peer support by other schools, mentoring by experts, and funding for promotion actions. The bottom-up approach in the programme gives schools and municipalities the liberty to plan and implement actions they consider to be useful and successful. Customisation, creativity, encouragement of risk-taking and shared responsibility and trust – the key elements of Finnish education policy – are present in the programme's approach (Sahlberg 2011). All the schools in the present thesis applied these possibilities by creating both educational and environmental/policy dimensions in promoting physical activities, as suggested by the social-ecological model (Sallis et al. 2006). The implementation of such multi-component approaches has shown promising results in improving adolescents' PA levels (van Sluijs et al. 2007). In addition, a choice-based model with individualised school plans has shown positive results in the elementary level in both students' PA levels and programme flexibility (Naylor et al. 2006). The opportunity to combine components freely within each school also allows the schools' unique features to be taken into consideration, whether due to the readiness or knowledge of the staff, current facilities and equipment or already

existing co-operation with different networks. This is also supported in the CSPAP conceptual framework, which encourages to target school-specific needs with highest chances of success (Carson et al. 2014).

The present results showed a compensation effect between leisure time behaviours and increases in PA during school hours, in line with previous studies (Ridgers et al. 2014; Ridgers et al. 2015). Stronger efforts towards a 'whole-school approach' could be key means of avoiding this (Institute of Medicine 2013). Opportunities before, during and after the school day should be included from environmental and social perspectives instead of just intervening in activities during school time. In this way, school could serve as a key share-point for the promotion of PA across the day. Examples of such approaches with effectiveness are the 'KISS' study with increased PE classes and PA homework (Kriemler et al. 2011) and the 'Active Living' study with PA and ST issues included in school, transportation to school within the neighbourhood, and out-of-school activity programmes during leisure time (van Kann et al. 2016).

The present results, especially in Study I, showed that the schools shared some mutual strategies to promote PA despite their independency in PA promotion, such as staff and student training on PA and student participation in planning and implementation. All the schools applied environmental-level strategies such as modification of school facilities and equipment (Kriemler et al. 2011; van Sluijs et al. 2007) and structural changes in the school day (Kriemler et al. 2011), which have shown effectiveness in previous studies. For example, in a large school playground with adequate equipment sixth-graders were more physically active during recess than with poorer facilities (Delidou, Matsouka & Nikolaidis 2016). However, favourable changes across the day were not seen in the study schools here. The lack of effectiveness of the applied strategies may be due, for example, to insufficient intensity or frequency in the delivery, decreases in staff motivation during the follow-up, or the possibility of students compensating for the school day changes in PA during leisure time (Ridgers et al. 2014). Environmental characteristics can also radically differ between school levels, as lower secondary schools can have very few facilities and equipment for PA compared to primary schools.

In the present results, the changes in objectively measured MVPA and ST in the lower secondary school students were small or non-existent between the programme and reference schools. In fact, adolescents in Finnish society are quite independent already in the lower secondary school phase, and the Finnish educational and school culture supports this development. Developmentally speaking, adolescents seek independence from adults, especially their parents, and peer relationships have an increased effect on both health behaviours and decision-making (Viner et al. 2012). At the same time, the PA levels in adolescents decline especially steeply in Finland (Currie et al. 2008; Iannotti et al. 2012). Continuous discussion and engagement of lower secondary students could be one solution of getting them to be proactive and to participate in the planning and implementation of school-based PA. Adults in the school have the potential to either hinder or encourage PA for students (Huberty et al. 2012); for example, reducing restrictions has been associated with increased school break-time PA and decreased SB in adolescents (Ridgers et al. 2013). According to the present results, student involvement and empowerment to promote PA within the school environment were implemented in all four lower secondary schools. Also, the local contact persons emphasized the role of student recess activators as affecting students' PA positively. Adolescents themselves have emphasised social and

physical environmental factors as key strategies to promote their PA participation, such as improving social support from peers, availability of activities and the provision of organised activities at school (Hohepa, Schofield & Kolt 2006). The provision of equipment and allowing students to bring their own equipment to school (Ridgers et al. 2013), as well as gender-specific activities for females (Camacho-Miñano, LaVoi & Barr-Anderson 2011), have shown promising effects on adolescents' PA levels. Additionally, supporting active commuting could be an effective strategy in the adolescent population, as active commuting to school has been related to greater MVPA (Mendoza et al. 2011).

The present study showed similarities between the four lower secondary schools that were involved in the programme, such as ownership of the process, a supportive school climate and leadership. A feeling of ownership of the process at the school level could be an important factor for the success of promotion. If a school project is developed within the school itself and not given from outside, staff is more likely to be involved and the project is more likely to become part of the school culture (Inchley, Muldoon & Currie 2007). Empowering students and staff to create opportunities for PA can build a sense of control over the process and make school culture accessible for all (Inchley et al. 2007). Staff and teacher involvement can also realise role models by them being physically active themselves with the students or by encouraging students to be physically active (Janssen et al. 2015). Staff commitment, involvement and positive experiences can be encouraged through opportunities for collaboration, resources and a choice-based design (Sulz et al. 2016). The principal also has a major role in the effectiveness of schools (Hallinger & Heck 1998). Leadership can affect teachers' motivation and perceptions of changes (Hallinger & Heck 1998), and by encouraging or prohibiting promotion activities principals can have a direct impact on the school's PA promotion. Effective and maintained PA promotion requires supportive administration (Carson et al. 2014), and it seems that school principal's attitude should be at least passively but preferably actively positive towards PA promotion for it to be successful. From a leadership perspective, school size could also be one factor behind effective PA promotion. The smallest school (School B) in Study I achieved favourable changes in PA and ST levels during school hours. A smaller number of staff members may facilitate decision-making and improve staff engagement, thus contributing positively to the school culture for PA promotion.

The Finnish Schools on the Move programme provides schools with great autonomy and flexibility in their PA promotion process compared to many other school-based programmes (McMullen et al. 2015). However, effectively increasing students' PA levels may require more individualised support and analysis based on schools' strengths and weaknesses. In addition, more information about 'best practices' and support to execute plans based on pre-analysis may be more effective. These approaches may enable schools to notice possibilities for PA promotion at multiple levels, as suggested by the social-ecological model (Sallis et al. 2006) and the CSPAP conceptual framework (Carson et al. 2014), such as school facilities and equipment, student and staff participation, emotionally and physically safe and inspiring settings, curricular approaches, teaching methods, active commuting, before- and after-school activities and co-operation of different networks. The importance of staff participation in the successful planning and execution of the promotion process should be acknowledged within schools, and finding solutions to increase staff participation is imperative. For example, educating and enhancing knowledge, skills

and dispositions among staff members on school-based PA promotion, including their own values and attitudes, could improve their commitment (Carson et al. 2014).

The development of the programme to achieve improved effectiveness should focus also on the potential of classroom lessons and the increasingly sedentary lifestyle of students. For example, classroom-based activities were limited in the study schools. The majority of the school day was spent on lessons in the classroom, and intervening in this setting both environmentally and educationally (e.g. modifying the classroom furniture and equipment, sharing knowledge and ideas with teachers about active teaching/learning methods) could be effective. In addition to PA, the enhancement of students' academic achievement by delivering physically active lessons could motivate teachers to use this approach, as it would facilitate the main aim of education, namely, learning (Mullender-Wijnsma et al. 2016). Furthermore, reduction of ST during the school day was not mentioned as a goal in the programme schools of this study. Most schools in the pilot phase of the programme (2010–2012) concentrated on increasing levels of MVPA, which is by no means a poor aim in itself. However, most school days are very sedentary, as seen in this study and previous research (van Stralen et al. 2014), and the possibilities for moving about as intensely as MVPA requires are not many during usual school hours. The possibilities to break up and reduce ST are numerous in the current school environment, and this goal should be visible and a point of education in the schools to improve the well-being of all their students.

5.4 Strengths and limitations

The studies (I–IV) in the present thesis include several strengths. The designs of the studies presented three different ways of examining changes in schoolchildren's PA with a variety of methods and populations: a quasi-experimental follow-up with identification information, a follow-up of school classes without identification information, and a school-level follow-up with eighth-graders from two different time points. Combining these different approaches created a unique landscape for the PA promotion implemented during the national programme and its pilot phase. In addition, multiple viewpoints provided a more comprehensive examination of complex behaviour, such as PA and its promotion in the school environment.

The use of both quantitative and qualitative data as a mixed method approach is one of the major strengths of this thesis (Studies II and IV). Different qualitative materials provided more in-depth knowledge on the school processes employed to create a more physically active school day, and together with the data from the students' PA, they created a more holistic vision of the school culture in transformation. In addition, the description and explanation of the PA in the school setting included factors in the different systemic levels of the school. Since most follow-up studies and interventions concentrate on reporting the procedures and effects of the direct actions for school PA promotion, the present results also widen the perspective to a whole-school approach. The content analysis revealed the involvement of school staff and students in the promotion actions, which is seldom reported. The bottom-up approach of this study has value, because it demonstrates how different approaches and solutions work for different schools.

The longitudinal setting in the school environment, the use of objective measurements of PA, and the extraction of the data from school day PA and ST within the school curriculum in Study I enabled an accurate examination of changes within the school day. Seasonal variation was also controlled by using comparisons with the reference schools, while differences in age and BMI were controlled for in the analyses. The examination of student-level data with two cohorts of eighth-grade students in Study IV enabled students' perceptions to be measured after several years of programme implementation.

An important aspect of this research is the examination of associations between participation in recess PA and school-related social factors (Study III). Many other studies conducted on the benefits of PA conclude that participation in physical activities enhances social relationships and social well-being, but they do not elaborate on this issue further. Knowledge on the associations between PA in the school environment and social factors related to school is scarce, and therefore the present results outline an important base for further examination of PA and social wellbeing in the school environment. In addition, Study III had a relatively large sample of Finnish schoolchildren and high response rates which indicate representative samples within the schools. The analyses also enabled the examination of differences in the associations between the genders and the adjustment for overall PA.

Finally, a valuable aspect of the present research is the possibility it offers to examine the data by taking participants' gender and age into consideration. Studies conducted in lower secondary schools are fewer than ones in primary schools, and this thesis contributes to this gap of knowledge on older students and their school-related PA and social factors. In addition, examination of PA behaviours by gender revealed differences in the levels of PA, effectiveness of school-based promotion actions and workable solutions, especially with female students.

Some limitations should be considered when interpreting the results of this doctoral thesis. First, the study population and design with student follow-up with no identification information gave high response rates with good representativeness, but hindered possibilities for individual follow-up (Studies II and IV). This affected the ability to interpret the significance of the changes in PA measures. In Study II, there were also fewer male participants in school B, which may have a bearing on the results of the PA measures for that particular school. The actions to promote PA in the schools were also all different, and this factor also affects the possibility of interpreting causal relationships between certain actions and the changes observed in PA and ST.

Secondly, the setting in Study I could have possibly lead to a selection bias, with the study population being drawn from schools that were more inclined to encourage activity and motivated to enrol in the programme. No randomisation was used. The programme guidelines given to the schools mainly concerned reporting to the funding agent and participation in the evaluation by the research centre. However, there were no detailed guidelines on how and what kind of promotion actions should be conducted at school, due to the bottom-up approach of the programme. Programme fidelity in the study schools was evaluated based on qualitative data gathered from the overall follow-up of the national programme (Tammelin, Laine & Turpeinen 2012). Local contact persons in each school project participated in interviews (1/2011 and 5/2012) and answered surveys (5/2011 and 1/2012) concerning implemented strategies, benefits, facilitators and barriers from the perspectives of students, staff, school community/culture and networks

(Tammelin, Laine & Turpeinen 2012). In conjunction with the notes on discussions and observations from school visits, the programme schools in this study implemented the majority of their planned actions. Overall, programme fidelity in the study schools appeared to be high.

Thirdly, the sample size in Study I was relatively small, and the participation rates left room for improvement, particularly in the reference schools. There is a possibility that those students who participated in the study may have been more physically active students, especially in the reference schools, a factor which may have led to selection bias. The objective measurement method is also sensitive to the effects of weather, and even though the geographical differences in the school locations were considered when agreeing on measurement dates, weather conditions could have differed between the schools. Furthermore, the accelerometer assessments may not have been able to capture all types of PA performed during the school day and outside school hours, such as cycling, strength training, climbing, skateboarding, and balancing. This may have been an issue particularly in School D, in which school-based PA promotion focused on developing cycling culture and gym training.

Fourthly, the design of Study III was cross-sectional. Thus, it can only indicate associations between measures; it does not suggest causal relationships. In addition, the possibility cannot be excluded that other factors in the students' backgrounds existed that may have influenced PA and social factors.

Fifthly, self-report measures, especially of PA, can result in measurement errors and social desirability bias (Sallis & Saelens 2000; Shephard 2003). However, the correlations between the self-reported physical activities at recess and objectively measured school day PA data were moderate (Table 5). The numbers of students in Schools A and B in Study IV were relatively low, which may have affected the interpretation of the student-level results and been insufficient to produce statistically significant interactions in the ANOVA analysis. For example, the graphs of differences in PA at recess in both Schools A and B had similar directions as in Schools C and D, but gender*year interaction was not statistically significant.

Finally, the nature of the analysis of school actions in Studies II and IV does not allow the extent and power of the actions presumed within each school. Given the half-structured nature and open questions of the interviews and surveys for the local contact persons, the data on school actions may not be comprehensive and the classifications made may not be all-encompassing in school PA promotion. In addition, the assessment of the school promotion actions and their effects on the school culture concentrated on the perceptions of the adults in the schools (staff, principals and local coordinators), as students were not interviewed. More than one researcher conducting the quantitative content analysis in Study II would have strengthened the analysis and provided more points of views. The response rate in the staff survey was also less than 50% in all schools and may have represented staff members who are more interested in the matter (Study IV). One school's principal (School A) in Study IV was not reached after several attempts, and this may have affected the case description of this school.

6 CONCLUSIONS

6.1 Summary and main conclusions

This doctoral thesis examined the changes and associations of students' PA levels and school-related social factors in a national-level, school-based PA promotion programme. In addition, PA promotion actions and their effectiveness in the study schools were described and evaluated. Based on the results of this thesis, favourable changes in school-aged children's MVPA and ST during the school day can be achieved at the primary school level. However, changes in MVPA and ST throughout the day and older, lower secondary school students seem harder to achieve. In lower secondary schools, male students' participation in physical activities at recess times, such as physically active play and ball games, increased during the follow-up period. Participation in recess PA was also positively associated with peer relationships at school, relatedness to school in primary school and school climate in primary school females. However, changes in school-related social factors during the follow-up period were few.

Effective strategies in the school environment to increase students' PA were considered the provision of organised recess activities, equipment and facilities for PA, peer instructors and gender-specific physical activities or facilities. All schools had their individual routes towards a more physically active school day. The project was highly visible in all schools and it was discussed among the teachers. The staff in the study schools mostly agreed on the positive effects of increased school-based PA, yet there was great variation in participation in the actual implementation of the project.

In summary, the results of this thesis suggest that school-based PA promotion has the potential to increase students' PA levels and participation rates, at least during the school day and at recess times. However, the PA promotion actions seemed to be most effective among students at the primary school level and male students. In addition, PA at recess time was positively associated with school-related social factors. Nevertheless, it seems that school-based PA promotion per se is not sufficient to create positive changes in students' social well-being in the school environment. Support of students' social experience in school would require specific attention to the organisation and implementation of school-based physical activities. Each of the programme schools had the autonomy to promote their own kind of more physically active school day, and this individuality and variation was seen both in the actions implemented by schools and in staff participation.

6.2 Practical implications and future directions

The present thesis provides important information about the changes in PA and school-related social factors in school-aged children and their associations. In addition, it provides increased knowledge on effective PA promotion actions in schools and staff experiences, in order for school staff and professionals in education, as well as stakeholders in

municipalities and at the state-level to make informed decisions regarding the development of a healthier and more pleasant educational system. The topic is very germane at the moment both internationally and nationally in Finland.

Physical inactivity is increasing among school-aged children around the globe, and actions to counteract this trend are highly relevant. The enhancement of PA in school settings has increased internationally, and Finland has created its own approach to school-based PA promotion from a national perspective. The Finnish Schools on the Move programme is one of the key projects in the field of knowledge and education in the Finnish government programme (Prime Minister's Office 2015). The programme started with a pilot phase in 2010–2012 with 45 schools, and in May 2017, more than 90% of municipalities and 80% of comprehensive schools (2,000 schools) in Finland were involved in it. Research that shows potential and positive changes in PA and ST during the school day and recess times can foster further emphasis on the importance of the development of PA promotion in the school context at both municipal and state levels.

Although this study showed positive connections between participation in physical activities at recess and school-related social factors, physical activities need to be carefully selected and implemented with the social dimension in mind to promote positive changes in social well-being at school – it does not happen by itself. This is an important observation for school staff to acknowledge; for example, there are many possibilities to organise recess activities – through free play, student empowerment with peer instructors or staff-led activities. School staff has a leading role in the provision of these activities to be socially supportive, and reviewing a school's PA promotion actions from a social perspective can contribute significantly to the quality and effectiveness of those actions.

The national curriculum for basic education has recently been renewed in Finland, and there is an even stronger emphasis on a supportive learning environment, student autonomy and collaborative learning (Finnish National Board of Education 2014). Endorsing possibilities for movement, student empowerment and decision-making and joint discussion on PA promotion in schools can create meaningful learning environments, joy of learning and collaboration both between peers and between students and staff. Those schools which have been involved in the Finnish Schools on the Move programme for a few years already have actually been implementing the elements of the new national curriculum in their every-day school life. Promoting a physically active lifestyle in schools may support the change in school curricular practices and teacher work.

As resources are limited, schools should place value on targeting the least active students and those populations most in need of support in their physically active lifestyle. Engaging youngsters with low levels of PA in the physical activities of their preference and motivating them towards an active lifestyle could enhance not only their physical health but also their capabilities to focus on schoolwork, concentrate and learn. The results of the present study call for specific attention to females and lower secondary school students. Although some effective strategies were identified by the local contact persons in this study to promote PA in females, there is a lack of information on the motivational and environmental aspects of their PA promotion in the school environment.

The results of the present study show that lower secondary school students have lower levels of PA and PA promotion in lower secondary schools is not as easy as in primary schools. Therefore, more research is needed on effective strategies for lower secondary school students' PA promotion and possibilities of enhancing their experiences of

empowerment and participation. In addition, future studies should examine the change from primary to lower secondary schools and which elements of the school environment might foster or protect the PA during changes between school levels (Corder et al. 2015).

It is imperative to acknowledge the perspectives and experience of staff in the successful promotion of PA in the school context. It would be valuable to examine teacher commitment to PA promotion in schools and which factors might influence it. Further research on choice-based approaches to PA promotion should be conducted as there are some good results regarding its connection to teacher commitment (Sulz et al., 2016). Future studies should also investigate how to engage teachers of other subjects than PE in lower secondary schools in the promotion of school-based PA.

Recess would be worth further investigation in the efforts to promote students' PA and social factors in school; recess time offers opportunities for daily PA (Erwin et al. 2012; Ridgers et al. 2012a), social interactions (Blatchford et al. 2003; Pellegrini et al. 2002) and adjustment to school (Pellegrini & Bohn 2005). In the future, the development of recess PA measures to include various types of physical activities should be examined. Adding more choices to the self-reported measures of PA at recess, such as dancing, hopping, and skipping, might detect more recess behaviours in which females, in particular, participate. In addition, comparing different ways to organise recess activities, such as free play, students as peer instructors and staff-led activities, would provide valuable information on their effectiveness, motivational potential and feasibility in school-based PA promotion.

Furthermore, this study provides important knowledge on the associations of PA at recess and school-related social factors. These results suggest that future studies should focus on longitudinal and intervention studies to evaluate the effects of increased PA during the school day and at recess times on school-related social factors. Further information is needed on how PA at school recess should be structured to improve students' social interaction and school experiences. In addition, evaluations of the long-term effects of these types of interventions are needed.

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LIST OF ORIGINAL PUBLICATIONS

The thesis is based on the following original publications, which are referred to in the text by their Roman numerals.

I Haapala, H. L., Hirvensalo, M. H., Kulmala, J., Hakonen, H., Kankaanpää, A., Laine, K., Laakso, L. & Tammelin, T. H. 2017. Changes in physical activity and sedentary time in the Finnish Schools on the Move programme: a quasi-experimental study. *Scandinavian Journal of Medicine & Science in Sports* 27 (11): 1442–1453.

II Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Lintunen, T. & Tammelin, T. H. 2014. Adolescents' physical activity at recess and actions to promote a physically active school day in four Finnish schools. *Health Education Research* 29 (5): 840–852.

III Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Kankaanpää, A., Lintunen, T. & Tammelin, T. H. 2014. Recess physical activity and school-related social factors in Finnish primary and lower secondary schools: cross-sectional associations. *BMC Public Health* 14:1114.

IV Haapala, H. L., Hirvensalo, M. H., Laine, K., Laakso, L., Hakonen, H., Lintunen, T. & Tammelin, T. H. 2017. Differences in physical activity at recess and school-related social factors in four Finnish lower secondary schools. *Health Education Research*. Epub 2017 October 31. doi: 10.1093/her/cyx069.

The original publications are not included in the electronic version of the dissertation.

