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Association Of Sedentary Behavior with Age and Gender in Finnish School-Age Children Based on Screen Time

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Abstract

Background: The growth in screen time among children has raised public health concerns, emphasizing the significance of evaluating its impact on sedentary behavior and overall well-being.

Objectives: The research intends to establish the prevalence of sedentary activity, primarily screen time conduct, among Finnish primary school pupils, and to examine how demographic parameters like age and gender contribute to these behaviors. It also highlights promising areas for technology-driven interventions aimed at improving physical activity.

Methods: Utilizing secondary data from the ongoing Young Finns Study, this cross-sectional research analyzed a sample of 317 children aged 6–12 years. Quantitative data analysis was performed using R and SPSS version 27, employing correlation analysis and regression models to understand the effects of age and gender on sedentary behavior.

Findings: The study revealed that Finnish children spend an overall screen time average of 348 minutes on both school days and weekends with males and females spending 310 minutes and 392 minutes respectively. Through the age-specific data, it's evident that children aged 9 to 11 are a focal demographic for related research and interventions. The significant p-value of less than 0.001 and F-values ranging from 10.723 to 13.399 confirm that age is a relevant predictor, but gender is not, although girls had a slightly higher mean with only 6.4-7.9% of the variability in sedentary behavior is explained. Weekends were found to be the most suitable period to implement technology driven interventions based on the results. The high variability suggests that additional factors such as parental guidance and academic workload may also be influential.

Recommendations: Building on the findings, the study offers technology-driven initiatives that can make screen time more active, such as designing TV programs or games that

encourage movement, and applications that reward physical exercise. Special concentration is urged on weekends since sedentary behavior is more widespread.

Contributions: The research adds to current literature by giving an in-depth understanding of the incidence and influencing factors of sedentary behavior among Finnish primary school children. It delivers practical insights for the creation of technology-based interventions to promote physical activity levels.

KEYWORDS: Physical activity, Sedentary behaviour, Screen time, Technology intervention, School-age children.

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Abbreviations

METs	Metabolic Equivalents
MVPA	Moderate-to-Vigorous Physical Activity
PA	Physical Activity
PI	Physical Inactivity
SB	Sedentary Behaviour
TENK	Finnish National Board on Research Integrity
TTSCRNT	Total Sedentary or Screen Time on Weekends and School Days
TTSDTSCH	Total Sedentary or Screen Time on a School Day
TTSDTWKND	Total Sedentary or Screen Time on a Weekend
VSSHP	Ethical Committee, Hospital District of Southwest Finland
WHO	World Health Organization
YFS	Young Finns Study
IQR	Interquartile Range

1. Introduction and Literature Review

The rapid advancement of technology over the decades has had a tremendous impact on our lives, especially in how we choose to spend our leisure time. This influence is particularly obvious across children, who are integrating screens throughout their lives as an ordinary component of living. (Rideout et al.,2010.) This increased screen time, frequently at the price of physical activity, has sparked worries among researchers and public health officials about its possible influence on children's health and well-being.

1.1 The Issue of Sedentary Behaviour in School-age Children

Sedentary behavior has arisen as a major concern for children's health, requiring greater research due to its ubiquitous nature and far-reaching repercussions. Sedentary behavior was defined as any waking behavior characterized by energy expenditure ≤ 1.5 metabolic equivalents (METs), while sitting, lying, or lying down (Behavior Research Network sedentary behavior, 2012) and has been identified as an independent risk factor for many adverse health outcomes. This approach significantly enhances our understanding of sedentary behavior beyond mere physical inactivity, presenting a more nuanced perspective that encompasses energy expenditure and physical posture. chemicals involved in diverse activities. among today's society, with the rising use of technology, the most common type of sedentary behavior among children is screen time, which includes activities such as watching television, playing video games and use a computer or mobile device. Children's lifestyles have experienced a profound upheaval, led by an increasing trend towards sedentary activity. This tendency is largely tied to the rising usage of digital gadgets for a multitude of reasons, including entertainment, learning, and social communication. (Houghton et al., 2018.) The proliferation of technology has given opportunities for learning and communication. However, it has also indirectly led to a lax habit among children. It has become all too familiar to witness children spending hours sitting in front of devices whether they are watching TV playing video games or browsing the internet. Research underlines the alarming connection between prolonged screen usage and many harmful health repercussions, particularly children.

A systematic review conducted by Stiglic et al., (2019) emphasized the adverse consequences of excessive screen usage on children's health and development. These effects transcend across numerous dimensions, including physical health, mental health, and social skills. When it comes to wellbeing, the analysis showed a correlation between spending too much time in front of screens and weight gain. Kids who spend hours connected to screens likely to acquire eating

habits including frequent snacking and consuming meals that are high in calories but low in nutrition.

Additionally, the sedentary nature of screen-based activities implies that children are not engaging in physical activities that are required for preserving a healthy weight. (Stiglic et al., 2019.) The influence of sedentary behavior extends beyond physical health, influencing children's mental health as well (Must et al.,2009; Tremblay et al., 2011). These reviews have found that children who spend a lot of time using screens are more likely to develop feelings of melancholy and worry. Using technology excessively can interrupt sleep patterns lead to feelings of loneliness and contribute to unhappiness and low self-esteem. These circumstances can potentially lead to health difficulties.

Moreover, excessive screen time can impair the development of children's skills. In today's period face, to face encounters are often replaced by ones depriving young people of possibilities to strengthen their social talents; this has been noted in several research (Must et al.,2009; Tremblay et al.,2011.) The expanding body of research relating screen time leading to sedentary behavior and unfavourable health effects underline the significance of addressing this issue. It is vital to develop effective measures like rerouting screen time towards more active applications, game, etc to stem the rise of sedentary behavior among children, and in doing so, safeguard their health and well-being.

1.2 The Role of Screen Time in Sedentary Behavior

Screen time, a component of being sedentary refers to the time individuals spend engaged in activities using screens including as TV playing video games or using computers, tablets, or smartphones. Over the two decades the emergence of digital gadgets has led to a huge increase, in screen time, among children and teens globally (Marshall et al. 2006). In times these devices have earned appeal and have become a part of the daily routines of many young people (Lissak et al., 2018). Research conducted in Finland reveals that children and adolescents prefer to spend most of their waking hours in front of screens, which contributes further to their sedentary behavior (Tammelin et al., 2007). The function of screen time in fostering sedentary behavior is variable. To begin with, screen-based activities, by their very nature, demand little to no physical movement, thereby promoting a sedentary lifestyle. Moreover, these hobbies frequently usurp time that could be spent on more physically active endeavors. For instance, a youngster who spends many hours each day watching television or playing video games has less time to engage in outdoor play or participate in sports. (Rideout et al., 2010.)

Another element of screen time that supports sedentary behavior is its interesting and absorbing quality. Many activities that use screens like playing video games and using media are designed to be very engaging which can easily lead to long durations of use. Children can get so involved in these activities that they lose track of time resulting in periods of not being physically active (Przybylski et al., 2014). However, it's crucial to understand that not all screen time is the same. While screen time like watching TV is often connected with unfavourable health outcomes, certain types of active screen time such as educational apps or interactive games that promote physical activity can have significant benefits. Therefore, a detailed understanding of varied types of screen time is crucial in studying its role in sedentary behavior. (Ferguson et al., 2017.)

1.3 Physical Activity and Children's Health

Physical activity (PA) refers to any physical movement produced by skeletal muscle contractions that needs energy expenditure. Physical activity can also be described as any movement of the body that increases energy expenditure above resting levels, whereas exercise comprises planned and regulated bodily movements, usually focused at maintaining or developing physical factors. (Caspersen et al., 1985.) Physical activity is an important aspect of child development and regular engagement in physical activity can bring huge health and mental advantages and to the child's general appearance. Research has frequently connected physical activity (PA) and an active lifestyle to numerous health benefits for children, and some researchers are also beginning to identify potential detrimental impacts inactive time has on health (Cliff DP et al., 2016); Active children are less likely to develop chronic diseases later in life, including cardiovascular disease, type II diabetes and obesity, as well as mental, psychological, and psychosocial disorders compared to those who are physically inactive (Ozemek et al. 2019, Booth et al. 2017, Tucker et al., 2008). Physical activity (PA) and sedentary behavior (SB) – like many other habits – are developed during childhood and adolescence (Telama et al. 2005). Encouraging children to acquire physical exercise habits can boost their odds of keeping physical activity into adulthood (Telama et al. 2014 Jones et al. 2013). Despite the benefits linked with activity, a considerable majority of children worldwide do not meet recommended levels (Hallal et al., 2012). Various guidelines for children and adolescents suggest that they engage in 60 minutes of moderate to vigorous physical activity (MVPA) every day (Tremblay et al., 2011b; Foundation World Health, 2010). Global research reveals that many children aged 5 to 17 years do not meet this recommended level of MVPA (Aubert et al., 2018). Recent study in American, Asian, and European nations such as Finland

and Sweden suggest that barely half of children and adolescents satisfy these PA norms (Kokko & Mehtälä et al. 2016; Roman- Viñas et al., 2016; Tremblay et al., 2016).

Studies indicate that as children grow older their participation in activities tends to decrease. For instance, research conducted by scholars (Kamijo et al. 2011) discovered that the percentage of individuals meeting recommended activity levels dropped from 71% among 6- and 7-year-olds to 26% among 15- and 16-year-olds. Brazil also conducted a study (Hallal et al., 2012) which revealed a decline in the proportion of children meeting physical activity standards from 69% at ages 9 to 10 to only17% at ages15 to17. Finland has also examined the activity patterns of school children although most of this investigation focuses on demographic aspects such as rural areas or specific regions within the country (Freedson et al.,1998; Trost et al.,2002). Understanding the activity behaviours of school aged children is crucial as it can impact the implementation of initiatives aimed at promoting physical activity within this age group. A key issue in improving physical activity in children is precisely identifying demographic features related with sedentary behavior and offering the most effective treatment. This is crucial because solutions that is personalized to the child's specific needs and preferences is likely to be more effective. Additionally, gaming approaches and interventions geared at encouraging physical activity in this age range will also benefit from this research. (Biddle et al., 2000.)

1.4 Demographic Factors Influencing Sedentary Behavior and Physical Activity

Several demographic variables have been identified as potential influencers on both screen time and physical activity levels in children. Age and gender are among the most explored demographic factors. Research suggests that screen usage tends to rise, whereas physical activity falls with age during childhood and adolescence. (Sisson et al., 2010.) Gender differences are also evident, with boys generally having higher screen time and physical activity levels than girls (Sisson et al., 2010; Tammelin et al., 2007). While the influence of technology on sedentary behavior and physical activity levels is enormous, it's equally crucial to analyse the function of demographic variables, particularly age and gender. Studies reveal that a child’s level of activity and screen time can be strongly impacted by both their age and gender (Tandon et al., 2012). As children get older it appears that their physical activity diminishes as their screen time increases. This pattern can be linked to causes, such, as increased pressure changes, in social relationships and growing interests. (Hardy et al., 2013.) During the transition from primary to high school there is generally a decline in physical

activity. This drop could be attributable to reduced possibilities for exercising during school hours or an increase in sedentary leisure activities such screen-based entertainment (Nader et al., 2008). Gender also has an impact on patterns of behavior and physical exercise (Sallis et al., 2000). These gender discrepancies may come from expectations, inequities in access to exercise opportunities, and personal decisions (Wallen et al., 2016). However, it's vital to remember that the relationship between age, gender and these behaviours is complex and can be impacted by factors such as status, cultural background, and individual traits.

Any attempt thereafter to address sedentary behavior and promote physical activity must take these demographic variables into consideration for a more concentrated and successful strategy. (Pearson et al., 2009.)

1.5 Technology-Driven Interventions

It is interesting to note that while technology has led to an increase in sedentary behavior it also presents alternatives for increased activity. Many studies have explored the use of technology driven interventions such apps and active video games to push children to be active (LeBlanc et al., 2015).

However, the success of these solutions will vary on aspects, including the technology utilized the age group being targeted and the amount of the intervention (Lau et al., 2017). In times there has been a surge, in utilizing technologies, like mobile phones to bring about lifestyle modifications (Fjeldsoe et al., 2009; Stephens et al., 2013; Moore et al., 2014; Joiner et al., 2017; Ludwig et al., 2018). The utilization of contemporary technologies and digital platforms to decrease sedentary behaviours and boost practices that raise children's PA may be a smart technique. Digital interventions have become more widely available globally, and health promotion using these platforms has become more accessible, easier to use, and more acceptable to families. (Tate et al., 2013, Kozak et al., 2017.) Certainly, the use of cell phones, internet, and text messaging offer inexpensive and easy possibilities to aid or replace conventional face-to-face procedures (Staiano et al., 2015; Murray et al., 2016; Johnson et al., 2016; Yardley et al., 2016). In compared with traditional lifestyle therapies, digital intervention programs are more versatile and may be altered to meet individual demands (Fjeldsoe et al., 2009).

However, few of such interventions exist for encouraging physical activity in the school aged children group (Schoeppe et al., 2016) and technology-based interventions aimed to improve physical activity or reduce sedentary behaviours (e.g., limit screen time) have resulted in

diverse findings among different age groups (Morgan et al., 2020, Johnstone et al., 2018, Lee et al., 2019). According to a meta-analysis of intervention trials with preschool-aged children, only small to moderate advantages have been observed for enhancing PA, suggesting potential for improvement in getting the targeted results (Gordon et al., 2013). In Australia, an intervention study intended to decrease screen time in preschool children aged 2 to 4 years by sending supportive text messages (SMS) to parents (Downing et al., 2018)-the study design proved effective with increased PA in the children and was appreciated by the parents (Downing et al. 2018). In Sweden there was a study named MINISTOP that attempted to reduce obesity in preschoolers. They employed an application to stimulate eating and physical exercise among children aged 4.5 years (Nyström et al., 2017). The study observed no variations in weight between the group that got the intervention and the control group. However, the intervention group demonstrated increases in their fruit and vegetable consumption, involvement in activities, and a reduction in their fat mass index (Nyström et al., 2017).

Another study conducted by Larouche et al. (2016) especially evaluated children of school age; they discovered that using applications to promote physical activity resulted in increased levels of physical activity. Also, a study by (Miyake et al., 2016) found that deploying a gamified pedometer to promote physical activity led to an increase in physical activity levels among kids.

1.6 Potential Benefits of Technology-Driven Interventions

Technology-driven interventions could facilitate behavior change in children by delivering interesting and interactive techniques to promote physical activity and decrease sedentary behaviours. These interventions can be designed to be enjoyable, engaging, and appealing to children, exploiting their inherent interest in technology and games (Baranowski et al., 2012).

One of the most promising areas of technology-driven techniques is the development of active video games or "exergames." These games require physical movement to play, hence incorporating physical activity into screen time. Research has revealed that children can accomplish moderate to vigorous physical activity while playing these games, potentially making them a valuable tool for reducing sedentary behavior. (Staiano & Calvert, 2011.)

Furthermore, technology-driven interventions can be tailored to the needs and preferences of individual children, improving their efficacy; personalization can raise children's willingness to participate with the intervention and can lead to greater adherence and outcomes (Lau et al., 2011). Technology-driven therapies also give chances for continuous monitoring and fast

feedback, which can help children and their parents track growth and make appropriate adaptations. This real-time feedback can reinforce beneficial habits and give incentive to reach stated goals. (Direito et al., 2017.)

Additionally, these procedures can also be meant to alleviate health inequities by making them accessible and cheap to children from various socioeconomic situations. They can be disseminated extensively and can reach adolescents who may have restricted options for physical activity due to environmental or other constraints (Cespedes et al., 2014).

Technology-driven solutions have tremendous promise in tackling the issue of sedentary behavior among kids. Yet, the effectiveness of these interventions depends on careful planning, execution, and evaluation. Further research is needed to determine the ideal approaches for generating and executing these procedures to enhance their potential benefits. Technology has been linked to a rise in sedentary behavior- it can also be a catalyst, for promoting more active lifestyles. The crucial factor lies in how these technologies are designed and implemented. By examining how screen time influences physical activity levels and understanding the reasons that drive these behaviours, we can design effective approaches for leveraging technology to promote physical activity and limit sedentary behavior among primary school-age children.

This research study intends to contribute to this body of knowledge by examining the association between prevalence of sedentary behavior based on screen time, and demographic factors particularly age and gender in primary school-age Finnish children, and to identify potential areas for technology-driven interventions. By getting a deeper grasp of these interactions, we want to inform the establishment of successful programs to encourage physical activity and restrict screen time among children, thereby aiding to the improvement of children's health and well-being. By focusing on this specific group, this study attempts to provide insights that can inform interventions directed towards the special needs and peculiarities of Finnish school-aged children.

The findings of this study have the potential to provide insights for the creation of technology-based programs that effectively encourage movement and minimize sedentary behavior among young people. Implementing such interventions could have an impact on the health and wellbeing of children, thus, playing a key part in preventing obesity and other health conditions connected with a sedentary lifestyle. By focusing on limiting screen time, it is vital to examine techniques that can make screen time more active, transforming it into a tool to encourage better behaviours. This approach recognises the vital role technology plays in children’s lives

today and attempts to utilize this fact for their advantage. Ultimately the idea is to empower children to lead more active lifestyles. Addressing this issue demands innovative solutions and a diverse strategy.

1.7. Literature Review

1.7.1 Aim of the Review

This literature review delves into key studies examining sedentary behaviors, its association with demographic factors, and potential interventions, thereby expanding the scope to a broader range of behaviors and contexts.

1.7.2 Search Strategy and Search Terms

In May 2023 we did a search following the parameters specified by Preferred Reporting Items, for Systematic Reviews and Meta Analyses (PRISMA). We utilized databases such, as PubMed, CINAHL and BMC Public Health to discover studies. Our search approach was meant to include both MeSH terms and phrases directly connected to the focus of our investigation. The primary themes addressed by the search terms included the target population (school-aged children), the behaviours of interest (sedentary behaviours and screen time), the demographic parameters under examination (age and gender), and the prospective intervention techniques (technology-driven treatments). The search criteria were applied to all fields unless stated otherwise.

The target population; children of school age, pupils, students, primary school, adolescents, and youth. Focus on behaviours, screen time, sedentary lifestyle, physical inactivity, prevalence of sedentary habits. Demographic factors; age, gender, sex, boys, girls, age and gender, age, and sex. Intervention methods; mobile or telephone interventions, technology driven, digital, online programs, e-health, gamified interventions.

To conduct our search effectively we utilized the operators 'AND' and 'OR' to combine these terms. For instance, we included terms like "school children " "students," and "adolescents" to cover a wide range of young individuals. Similarly, we considered phrases such as " behaviours," "screen time " and "physical inactivity" to address the issue of inactive lifestyles. Additionally, we considered factors like age, gender and demographic backgrounds when examining the impact of these behaviours. Furthermore, interventions involving technology, online platforms or gamification were also considered within our search parameters.

This approach was designed to ensure that our research encompassed a set of relevant studies

without losing sight of our main research inquiries. By striking this balance between depth and practicality in managing search results we finalized the selection of terms based on both our research questions and the expertise in the field of behaviours and physical activity, in children.

1.7.3 Inclusion and Exclusion Criteria

For a study to be considered in this review, it had to meet specific criteria that ensure the relevance and quality of the research. The inclusion and exclusion criteria are detailed below:

Table 1 Literature selection criteria

Criteria Type	Description
Inclusion Criteria	
Language	Published in English
Publication Date	Published within the last 10 years
Population	Focused on healthy children with no musculoskeletal conditions aged between 5 and 19 years
Type of Article	Conference papers, reviews, or meta-analyses, peer-reviewed full articles available
Exclusion Criteria	
Focus of Study	Articles not focusing on sedentary behaviors or screen time
Population	Articles with very small sample sizes, studies not involving a healthy child population
Scope	Articles that did not analyze the impact of demographic factors on these behaviors
Conflict of Interest	Studies funded by organizations that may have a vested interest in the outcomes

1.7.4 Search Outcome

The initial search yielded 12,332 articles. After applying the filters for language, publication date, population, and article type, the total number of articles was reduced to 770.

1.7.5 Screening Process

Duplicates were removed, resulting in 217 unique articles. Each of these articles was then screened with a title and abstract for relevance to the study objectives.

1.7.6 Final Selection

After this initial screening, a total of 21 articles were identified as potentially relevant. These papers were read in full and appraised for eligibility based on the inclusion and exclusion criteria. A total of 11 papers satisfied the criteria and were included in the review. Additionally, 3 papers were manually found through cross referencing and incorporated by the researcher resulting in 14 total articles for the review.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372: n71. Doi: 10.1136/bmj. n71.

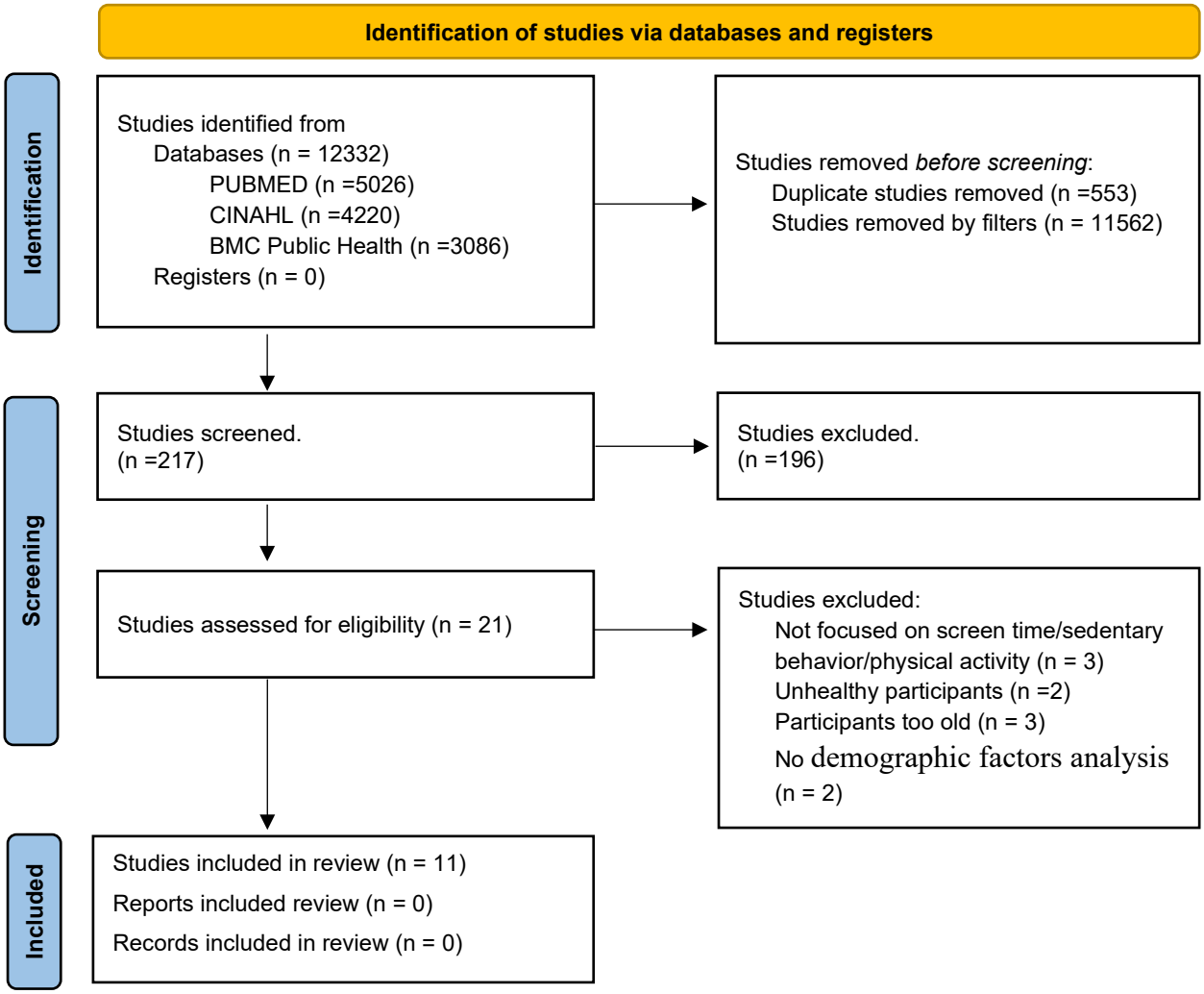

Figure 1 PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only.

This literature search was conducted in a comprehensive and rigorous manner, following the PRISMA principles. The final sample of 11 papers plus the 3 manually added articles provide a rigorous basis for assessing the association between demographic characteristics and sedentary behaviors among school-aged Finnish children, with the purpose of identifying possible areas for technology-driven interventions. In the next phase of the literature review, these papers will be further evaluated and synthesized to address the research questions.

1.7.7 Results of the Review

1.7.7.1 Characteristics of Studies (Annex I)

The literature review comprised a varied range of papers (Annex I), spanning different countries and research designs. The research articles were largely cross-sectional in nature, addressing the sedentary behaviour patterns and associated factors in various teenage groups. The research spanned across many countries including Brazil, China, Morocco, Spain, Canada, and Guatemala, demonstrating a global interest in the subject matter. The number of participants varied greatly among the research, ranging from small-focused groups to vast samples in the tens of thousands.

While the studies provide useful insights on sedentary activities among adolescents, it's essential to analyse the findings seeing the cultural, social, and economic settings of each study. Additionally, the cross-sectional character of most studies limits the capacity to demonstrate causality. Future study could focus on longitudinal designs to assess the long-term impacts and viable strategies to minimize sedentary behaviours.

1.7.7.2 Detailed Findings from Selected Studies

The collective body of research offers an insightful understanding of sedentary behaviours (SB) and physical inactivity (PI) across various settings and demographics. For example, Ana Elisa Messetti Christofoletti et al. (2020) found that among school children in Rio Claro, Brazil, smartphone use was the primary contributor to high SB, followed by computer and tablet usage (Christofoletti et al., 2020). Yolanda Demetriou et al. (2019) aimed to formulate gender-specific guidelines for reducing SB and enhancing physical activity (Demetriou et al., 2019). Eman Sharara et al. (2018) highlighted disparities in the available evidence related to SB and PI across countries, particularly noting that some countries had limited data (Sharara et al., 2018).

Abdelghaffar El-ammari et al. (2017) reported a high prevalence of PI and SB among adolescents in Morocco, especially among girls (El-ammari et al., 2017). This was complemented by Chao Song et al. (2019), who found that only one-third of children in China participated in leisure-time physical activities, despite many using active transportation to school (Song et al., 2019). Si-Tong Chen et al. (2018) further emphasized high levels of SB and PI among children and adolescents in Shanghai (Chen et al., 2018). Bita Shalani et al.

(2021) identified gender and parental influences as key factors associated with screen time (Shalani et al., 2021). Sunyue Ye et al. (2018) observed that boys had more screen time than girls, impacted by characteristics like media accessibility and parental presence (Ye et al., 2018).

Zihao He et al. (2021) assessed the effectiveness of smartphone-based interventions in raising physical activity levels among children and adolescents, while these interventions did not significantly influence BMI or waist circumference (He et al., 2021). Recent research like Abdullah Almaqhawi et al. (2022) indicated that the number of siblings and possession of electronic devices were significant predictors of low physical activity among children (Almaqhawi et al., 2022). The study conducted by Thekra Alotaibi and colleagues in 2020 indicated a correlation between technology use and decreased physical activity levels. Similarly, Jose A. Serrano Sanchez et al. In 2011 observed a link between screen time and the quantity of moderate to intense physical activity among young boys. Other research investigations by Gabriel Renaldo de Sousa et al. (2017) and Eun Young Lee et al. (2017) studied how socioeconomic status influences screen time concluding that boys from low socioeconomic backgrounds likely to violate the suggested screen time limits more frequently. (Sousa et al., 2017; Lee et al., 2017).

These study findings underline the complicated and multifaceted character of SB and PI. They mutually urge for targeted solutions that account a blend of influencing characteristics, including age, gender, and socioeconomic status.

1.7.8 Literature Discussion

1.*7.8*.1 Sedentary Behaviour and Screen Time in Various Contexts

The increasing concern about sedentary behaviours, especially screen time among children and adolescents, stems from its potential implications on both physical and mental health. A recurring theme across the selected studies was the significant role of screen time in sedentary behaviour among adolescents. Screen time, which includes activities like watching TV, using computers, and playing video games, is a dominant form of sedentary behaviours; ahead of factors such as TV viewing and video games, smartphone use is considered one of the most extensive causes of sedentary behaviours among adolescents. (Cristoforetti et al. 2020.)

The growing proportion of adolescents and teenagers who are physically inactive and participate in sedentary habits is a major issue as underscored by the research mentioned in

this review. According to a study conducted by Cristoforetti (2020), the traditional beliefs about how sociodemographic factors affect sedentary behaviours were questioned, as no significant link was observed between these characteristics and overall sedentary behaviours.

In contrast, physical inactivity and sedentary behaviours are considered more prevalent among girls, in particular the older ones and with unschooled guardians (El-ammari et al., 2017). This intersection of gender, age, and socioeconomic status highlights the need for targeted interventions in addressing sedentary behaviours and physical activity.

1.*7.8*.2 Physical Inactivity, Gender, and Culture

The complex relationship between physical inactivity, gender, and culture calls for a multidisciplinary understanding that extends beyond mere statistical findings. The key takeaway from the research landscape is the clear impact of these socio-demographic factors on sedentary and physically active behaviours.

Demetriou et al. (2019) emphasized the necessity of gender-sensitive guidelines in interventions aimed at reducing physical inactivity. This study serves as a catalyst for further discussion, especially in the perspective of how traditional gender roles might inhibit or encourage physical activities in diverse cultures. Their call for gender-sensitive approaches echoes in the study by Lee et al. (2019), where males in both Canada and Guatemala were more likely to meet physical activity (PA) guidelines. This overlap suggests an underlying gender bias in the formulation of PA guidelines and opens the door for discussing how these norms can be renegotiated to include women more effectively.

Sharara et al.'s (2018) systematic review focused on the Arab region and emphasized an inequality in research availability. This discrepancy isn't just a research gap; it reflects broader sociocultural constraints that might hinder physical activity in these countries. This aligns with the point that Lee et al. (2019) made about Guatemalan adolescents, who were observed to spend more time on homework and less time in physical activities compared to their Canadian counterparts. These studies bring forth a critical dialogue about how culture shapes perceptions of physical activity, offering insights into why some cultural contexts may naturally promote or inhibit physical activities.

The cross-cultural study becomes more nuanced when you include how socioeconomic status and ethnicity link with screen time, as illustrated in the studies of Sousa et al. (2017) in Brazil and Serrano-Sanchez et al. (2014) in Spain. While Sousa et al. observed that boys of low socioeconomic class exceeded the recommended screen time, Serrano-Sanchez et al.

suggested that more extended screen time was adversely related with moderate to vigorous physical activity in boys. The repercussions of these analyses aren't merely statistical but extend to a cultural level. They inspire us to study how socio-economic imbalances could perpetuate existing gender biases in physical activity, complicating measures aiming at encouraging a healthy lifestyle.

Furthermore, it is crucial to comprehend the impact of technology. The studies conducted by Lee et al. (2019) and Serrano Sanchez et al. (2014) indicated that there is no obvious variance in the quantity of moderate to intense physical activity and overall screen time among diverse groups. This trend highlights the topic of how technology is transforming our lives across cultures and genders in complex ways that present solutions might not yet totally explain.

What connects all these studies together is the rising demand for a diversified strategy in designing remedies. This technique must be sensitive to the delicate link between gender and culture in affecting physical activity and sedentary behaviours. As evidenced by the breadth of data from different sociocultural circumstances, creating a one-size-fits-all approach seems not just impractical but perhaps counterproductive. Future research and interventions should endeavour to be as diverse and focused on the populations they intend to aid.

1.7.8.3 Correlates of Screen Time

Screen time, a fundamental component of sedentary behaviors, is complicatedly linked with a variety of factors. These factors, which are often diverse and overlapping, explain the multi-dimensional nature of screen time, highlighting the sophisticated interaction of variables that contribute to its prevalence.

Shalani et al. (2021) explored the correlates of screen time among children and adolescents. Their study showed that gender played a key role, with boys likely to have greater screen time than girls. This gender disparity in screen time is consistent with previously reviewed research articles and features the need for gender-specific interventions in addressing screen time. (Shalani B et al., 2021; Demetriou et al., 2019.) In addition to gender, parental shaping emerged as a key correlation of screen time. Children and adolescents were more likely to engage in screen time behaviors if their parents also engaged in high levels of screen time. This finding illuminates the potential impact of family behaviors patterns on children's sedentary habits, highlighting the importance of family-centered interventions in reducing screen time. (Shalani et al., 2021.)

Access to screens, whether in the form of televisions, computers, or mobile devices, was another notable factor associated with increased screen time. This finding intuitively suggests that interventions aiming to reduce screen time may need to address the universal availability and accessibility of screens in modern households. Furthermore, the study by Shalani (2021) pointed to self-efficacy, a person's belief in their ability to achieve goals, as a correlation of screen time. Those with worse self-efficacy were more motivated to engage in higher levels of screen time. This shows that boosting children's and teenagers' self-efficacy may be a promising technique in limiting screen time. (Shalani et al., 2021.)

Finally, safety perceptions appeared as another indicator of screen use in the study. Children and teenagers who saw their neighborhood as hazardous were more inclined to spend time indoors on screens. This finding illustrates the likely impact of environmental and societal factors on screen time and proposes that enhancing neighborhood safety may indirectly reduce screen time (Shalani et al., 2021).

Likewise, Ye et al. (2018) similarly studied the correlates of screen time. Their findings match those of Shalani (2021), with gender, parental modelling, access to screens, self-efficacy, and safety beliefs all identified as major predictors of screen time. Their study reaffirmed the influence of parental modelling and availability of screens on children's and adolescents' screen time. However, a major distinction between the research was the focus placed on different aspects; For instance, Ye (2018) put more emphasis on the effect of parental modelling and access to screens, proposing these as primary targets for interventions to limit screen time. The findings of this research show that a holistic strategy, including aspects such as gender, parental modelling, access to screens, self-efficacy, and safety beliefs, may be required in interventions seeking to limit screen usage. Moreover, the disparity between the studies underscores the importance of context and demographic factors in selecting the most significant correlates, underscoring the necessity for context-specific interventions in addressing screen time. (Ye et al., 2018.)

1.*7.8*.4 Technology-Based Interventions

The rising knowledge of how technology contributes to sedentary behavior has spurred a growing interest in researching its potential as an intervention tool. Researchers have done experiments exploring components of this notion providing both favorable discoveries and serious obstacles.

A significant example is a meta-analysis undertaken by He et al. (2021) that focused on smartphone-based interventions targeted at boosting movement among children and adolescents. Through a review and meta-analysis of randomized controlled trials (RCTs) the study rigorously assessed the influence of smartphone-based interventions on exercise levels in this age range. To gather studies the researchers conducted a search across databases such as PubMed, Embase, Cochrane Library and Web of Science; the participants included in these studies were children and adolescents aged 18 years or under comprising both individuals and those with specific health conditions.

The interventions assessed in the research were smartphone based and sought to promote physical activity. These interventions involved employing smartphone applications, SMS messages and other functions available on smartphones. The primary outcome examined was the change in physical activity levels reflected by either step counts taken per day, or minutes engaged in moderate to physical activity. Other criteria they investigated were body mass index (BMI), waist size and several health-related metrics.

The outcomes from the meta-analysis offered an overview suggesting that interventions employing smartphones had a considerable favourable influence on physical activity among children and adolescents. However, the effects on BMI and waist circumference were not very substantial. Despite certain limitations, such as inconsistencies in the research, potential biases in trials, and a lack of long term follow up data, the study revealed that smartphone-based interventions could effectively encourage physical activity in young individuals. Nevertheless, it highlighted the significance of conducting high quality randomized controlled studies with long term follow up to validate these findings and explore their consequences on other health outcomes (He et al. 2021).

While technology-based solutions show promise, two cross sectional studies undertaken by Almaqhawi et al. (2022) and Alotaibi et al. (2020) identify issues that need to be addressed. These studies demonstrate that increased use of technology is highly associated with decreasing levels of physical activity indicating that although technology has the potential to enhance physical activity in theory, it typically leads to sedentary behaviours in fact. This connection between technology use and decreased physical activity underlines the significance of maintaining a balanced and careful approach when introducing technology into intervention initiatives.

The difference between the outcomes of interventions using smartphones as shown in the meta-analysis by He et al. (2021) and the unfavourable link between excessive technology use and physical activity based on the cross-sectional studies conducted by Almaqhawi et al. (2022) and Alotaibi et al. (2020) implies that the effectiveness of interventions relying on technology might be influenced by certain factors. These elements may entail the way the intervention was developed, the characteristics of the people it meant to benefit, and the specific setting in which it was implemented. It shows that while technology can be a tool for encouraging physical activity, its application in therapies should be thoroughly designed and performed to ensure it genuinely supports physical activity instead of promoting sedentary behaviours. This research underlines the potential of technology as a mechanism for intervention to increase activity. However, they also urge against utilizing technology without understanding its impact. They advocate for a deliberate approach to utilizing technology in interventions considering the unique characteristics of the target group and the environment of intervention. Furthermore, they emphasize the significance of study to find the most efficient strategies for utilizing technology in methods to enhance physical activity while minimizing sedentary behaviors.

1.*7.8*.5 Gaps and Future Directions

Despite the volume of research concentrating on sedentary behaviours and screen usage among children and adolescents, there are still areas that deserve attention. For instance, although there is a recognized association between technology use and increased sedentary behaviours, we have insufficient knowledge regarding how technology can be effectively leveraged to promote physical activity. It is crucial to conduct intervention studies to determine the effective strategies for leveraging technology to encourage physical activity and reduce sedentary time particularly for specific groups such as girls, older children and urban children as identified in the Chinese study by Song et al. (2019). Additionally, a substantial percentage of the research employs a cross sectional strategy, which makes it challenging to demonstrate causality. To get better knowledge of the association between screen usage, physical inactivity, and sociodemographic characteristics, it would be beneficial to perform longitudinal studies. These investigations could shed light on the relationships between these elements.

Moreover, it is vital to understand how sedentary behavior connects to variables. Although certain studies have not discovered any links, others have observed associations between these characteristics. Future study should seek to reconcile these disparities by examining the

influence of confounding factors. While there is a growing amount of research on the sedentary habits and screen time of children, there is still a need to better understand the elements and effects at play as well as effective solutions for fostering healthier behaviours. The publications reviewed in this review offer a framework for investigations and underscore the continuous importance of this crucial topic.

These articles collectively reveal a high incidence of sedentary behaviours among children and adolescents with technology use being a significant contributing element. However, they also emphasize the potential of technology driven interventions to encourage movement and reduce sedentary behaviour. These findings have substantial importance for creating interventions. It is recommended that these programs be adapted to match the needs and conditions of the target group considering characteristics such as age, gender, and parental influence. Our study effort intends to contribute to this expanding body of knowledge by examining these relationships and sociodemographic factors within school students. The goal is to provide insights that can inspire the creation of technology driven programs aimed at raising physical activity levels while minimizing sedentary habits.

1.7.8.6 Sedentary Behavior through the Lens of the Social-Ecological Model

The Social-Ecological Model (SEM) provides a holistic framework for understanding the complex interplay of factors influencing sedentary behaviours, notably screen time (Bronfenbrenner, 1979). The literature reviewed indicates; ***Individual Factors***: The variations in screen time between boys and girls align with the individual layer of the model. For instance, Ye et al. (2018) observed that boys had more screen time than girls, influenced by factors such as media accessibility and parental presence. **Interpersonal Dynamics**: Family influences and peer interactions substantially shape sedentary behaviours. Shalani et al. (2021) emphasized that children and adolescents were more inclined to engage in screen time if their parents exhibited similar habits. This highlights the profound impact of family behaviour patterns on children's sedentary tendencies. ***Community and Societal Influences***: The broader societal norms and community infrastructures play pivotal roles. For instance, studies from diverse cultural contexts like China (Song et al., 2019) and Morocco (El-ammari et al., 2017) provide insights into how community structures and societal norms can either inhibit or promote physical activity. Integrating the SEM into our understanding of sedentary behaviours offers a comprehensive perspective, emphasizing the need for interventions that cater to each layer effectively.

1.7.8.7 The Role of Technology and Health Behavior Framework in Interventions

The prominence of technology in influencing sedentary behaviours has become evident. However, the Technology and Health Behavior Framework suggests a potential flip side to this narrative (Riley et al., 2011). This framework provides a roadmap for designing, implementing, and evaluating technology-driven interventions. As the study by He et al. (2021) indicates, smartphone-based interventions have demonstrated promise in promoting physical activity among children and adolescents. Yet, the cross-sectional studies by Almaqhawi et al. (2022) and Alotaibi et al. (2020) underscore that unchecked technology use can exacerbate sedentary behaviours. Hence, while technology can be a potent tool, its application in interventions should be meticulously designed.

Future research should focus on leveraging the Technology and Health Behavior Framework to ensure that technology not only reduces sedentary behaviours but also actively promotes healthier habits, especially among school-aged children.

1.*7.8*.8 Strengths and limitations

Strengths of the Selected Studies:

1. *Diverse Populations*; The research covered in this study was conducted in many countries and cultural situations which improves the application of the findings**.**
2. *Comprehensive Measures*; Most research included understandable measures to evaluate physical activity and sedentary behaviours leading to a more accurate and nuanced knowledge of these behaviours**.**
3. *Inclusion of Various Age Groups*; The research comprised children and adolescents throughout age ranges enabling the better examination of age-related trends, in physical activity and sedentary behaviours**.**
4. *Consideration of Gender variations*; Several research consider gender variations in physical activity and sedentary behaviours recognizing the impact of gender norms and expectations on these behaviours**.**

Strengths of the Literature Review:

1. *Comprehensive Synthesis;* This review provides a comprehensive synthesis of the literature on technology use, physical activity, and sedentary behaviour among children and adolescents.
2. *Focus on Technology Use*; By focusing on technology use, this review addresses a timely and important issue given the increasing prevalence of technology use among children and adolescents.

Limitations of the Literature Review:

1. Exclusion of Studies in Languages than English; It is possible that this review did not include vital studies published in languages other than English.

2. Possibility of Bias in Published Studies; This review might be influenced by publication bias as studies with significant findings tend to be more likely to get published and included in reviews.

3. Limited Assessment of Intervention Effectiveness; Although this review highlighted areas for interventions driven by technology, it did not systematically evaluate the effectiveness of these interventions.

Addressing the Limitations:

1. Limitation of non-English studies: While this review may not cover every other non-English study, it is important to note that the studies included in this analysis were conducted in various countries and, across diverse cultural backgrounds. This diversity enhances the relevance and applicability of the findings. Moreover, it is practice for research, in this field to be published in English language journals. Future evaluations should involve incorporating English studies to offer a more comprehensive grasp of the material.

2. Bias in Publications: While it is important to acknowledge the possibility for bias in any review, this study took precautions to limit bias by adopting a thorough search approach and including both published and unpublished studies. Moreover, the consistency of findings across studies and contexts shows that the correlations identified are strong and not merely impacted by publication bias.

3. Limited Evaluation of Intervention Effectiveness: Although this review did not systematically evaluate the effectiveness of technology-driven interventions, it did identify areas where such interventions could be applied based on observed connections between technology use, physical activity, and sedentary behaviours. This serves as a starting point for developing and accessing interventions targeted at encouraging movement while reducing sedentary behaviours among children and adolescents.

2. Theoretical frameworks

In the domain of health behaviours, particularly concerning sedentary habits like screen time among children, a multidimensional approach to understanding is crucial. Two foundational theories emerge as particularly relevant for our study: the Social-Ecological Model and the Technology and Health Behavior Framework.

2.1 Social-Ecological Model

The origins of the Social-Ecological Model can be traced back to Bronfenbrenner's pioneering work in 1979. This model presents a multi-layered perspective, suggesting that human behavior is an intricate interplay between individual attributes and wider environmental contexts (Bronfenbrenner 1979). In this study, we focused mainly on the individual layer which consists of the variables used for the analysis, age, and gender, although we briefly discussed the other layers of the framework in some sections of the thesis. ***Individual Layer***: This represents the personal characteristics of an individual. Factors such as age, gender, personal beliefs, and knowledge play pivotal roles here. For instance, a child's natural proclivity towards video games might be rooted in their individual preferences. ***Interpersonal Layer***: Relationships significantly influence behavior. This layer delves into the dynamics between individuals and their immediate social circle, including family, friends, and peers. Consider a scenario where children see their peers engrossed in certain screen-based activities; the likelihood of them mirroring such behaviours increases. ***Community Layer***: Beyond immediate relationships, the institutions, and systems in place in a community can greatly influence behavior. The availability of technological infrastructure in schools or community centres can dictate the extent and nature of screen time among children. ***Societal Layer***: The broadest layer encompasses societal norms, values, and regulations. In societies where screen-based activities are normalized or even encouraged, children are more likely to engage in prolonged screen time (Sallis et al., 2008).

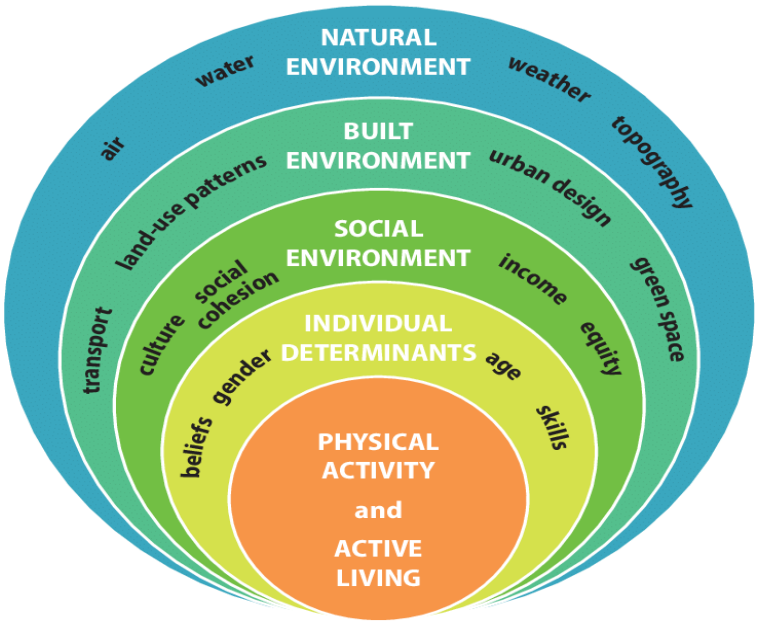

Figure 2 Social-Ecological Model Adapted for Physical Activity (Source: Frank, L.D., Engelke, P.O., Schmid, T.L., 2013)

2.2 Technology and Health Behavior Framework

As we navigate an era defined by technological advancements, understanding its dual role in health behaviors is paramount. Introduced by Riley et al. (2011), this framework delineates the relationship between technology and health behaviors.

Technology, though often implicated as a primary contributor to sedentary lifestyles, is not just a challenge but also presents a plethora of opportunities. Digital platforms can be leveraged to foster engagement in physical activities, provide health education, or even facilitate virtual social interactions that can offset some of the drawbacks of sedentary behaviors. (Norman et al., 2007.) This framework serves as a guide, enabling researchers and health professionals to formulate, implement, and critically evaluate technology-centric interventions. By discerning the intersections between various technological tools and health behaviors, strategies can be devised to not only curb excessive screen time but also to make such engagements more meaningful and health-promoting (Norman et al., 2007).

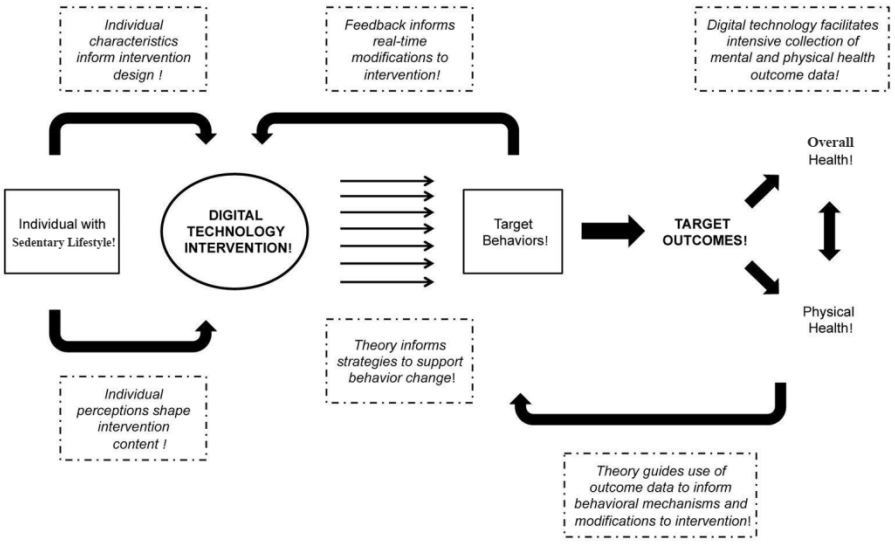

Figure 3 Conceptual overview of theory for informing digital health interventions (source: Naslund et al., 2017; adapted for sedentary behaviour)

By grounding our study in these theoretical frameworks, we aim to transcend surface-level observations and delve deep into the underlying factors influencing sedentary behaviors rooted in screen time. Such a comprehensive understanding is instrumental in crafting interventions that are both effective and sustainable.

3. Study Aims

3.1 Overall aim

Our research study attempts to evaluate how age and gender are connected to sedentary behavior among Finnish children of school age. We focus on screen-time activities like as watching television or using a computer. Our purpose is to find places where technology-driven solutions can make a difference. By so doing, we intend to contribute towards the development of solutions that promote physical activity and urge children to adjust their screen time habits. Additionally, our findings will provide insights that might drive interventions specifically targeted to the needs and features of Finnish children of school age.

3.2 Specific aims

1. Describe the prevalence of sedentary behavior in Finnish primary school-age children.

2. Explore the association of age and gender with sedentary behavior among primary school-age children.
3. Explore potential areas for technology-driven interventions to promote physical activity for Finnish children of school age.

3.3 Research Questions

1. What is the prevalence of sedentary behavior among school-aged Finnish children?
2. How do age and gender influence sedentary behavior in school-aged Finnish children?
3. What are the potential areas where technology-driven interventions could be effectively implemented to reduce sedentary behavior based on screen time among school-aged Finnish children?

3.4 Study Significance

The significance of this research comes in its attention about sedentary behavior and lack of physical exercise among children, which is a matter of public health that holds global importance. The World Health Organization (WHO) has acknowledged inactivity as the highest risk factor for worldwide death accounting for roughly 6% of global fatalities. Furthermore, it is reported that physical inactivity is the cause behind 21-25% of breast and colon cancers, 27% of diabetes cases, and roughly 30% of the burden caused by ischemic heart disease. (World Health Organization, 2020.) The impact of chronic ailments transcends beyond health results, since they also have large economic impacts due to the related healthcare expenses and productivity losses.

Establishing physical activity habits in childhood is vital since they often endure into adulthood (Telama et al., 2014). It becomes vital appropriately to promote a healthy lifestyle and discourage sedentary behavior from early on to defend against the establishment of chronic illnesses in later life. This research tries to explore the association between sedentary habits involving screen usage and characteristics such as gender and age among Finnish school aged children. It tries to find prospects for technology-based intervention.

3.5 Relevance of Research in the Finnish Context

Finland, like many industrialized countries, has seen a boom in screen time among children and adolescents due to the spread of digital gadgets (Leppänen et al., 2019). This has linked with a drop in physical activity levels, with recent studies revealing that a large percentage of

Finnish children are not achieving the required criteria for physical exercise (Tammelin et al., 2007).

Moreover, Finland has unique qualities that make this research particularly relevant. With its cold temperature and lengthy winters, outdoor activities may be curtailed for a large portion of the year, thus contributing to increased screen time, and decreased physical activity.

In addition, Finland has a high degree of technology access, with digital gadgets being widely used in both homes and schools (Kankaanpää et al., 2014). By focusing on the Finnish setting, this study could yield insights that are directly applicable to the local circumstances, which in turn might affect policy and practices in the country. Moreover, the findings could also be relevant to other countries with similar features, so extending the study's influence beyond the Finnish boundaries.

3.6 Scope of the Thesis

Given the complexity of the issues surrounding sedentary behaviors, screen time, and physical activity, this thesis will focus on primary school-age children in Finland. The choice of this age group is based on the magnitude of early intervention in lifestyle habits and the fact that Finland boasts one of the most technologically advanced educational systems globally. In this light, the study hopes to yield results that could inform digital interventions, policies, and interventions in other similar settings.

3.7 Thesis Structure

This thesis is divided into eight main parts: the introduction and literature review, theoretical frameworks, study aims, methodology, results, discussion, recommendations, and conclusion. The introduction provides the background and significance of the study. The theoretical frameworks describe two foundational theories emerged as particularly relevant for our study: the Social-Ecological Model and the Technology and Health Behavior Framework. The literature review systematically synthesizes and discuss relevant literature on the research topic. The methodology section explains the research design, data collection, ethic, and data analysis processes. The study aims describes the main objectives, specific objectives and the research questions that guide the present study. The results section presents the findings of the study, followed by a discussion that interprets these findings considering the research questions. Finally, the recommendation and conclusion summarise the main points of the thesis, acknowledges its limitations, and suggests directions for future research. In the

subsequent chapters, this thesis will address the association between sedentary behavior, (particularly screen time), and age and gender as demographic factors in school-aged Finnish children for technology-driven interventions.

4. Methodology

4.1 Study Design and Participants

The inquiry carried out in this thesis is a cross-sectional study assessing secondary data from the Cardiovascular Risk in Young Finns Study, more generally known as the Young Finns Study/YFS. The Young Finns Study is an ongoing, multi-disciplinary, longitudinal study established in 1980 (Figure 2) with the purpose of investigating the impact of childhood lifestyle, biological, and psychological factors on health and illness risk in adulthood. (University of Turku, 2013.)

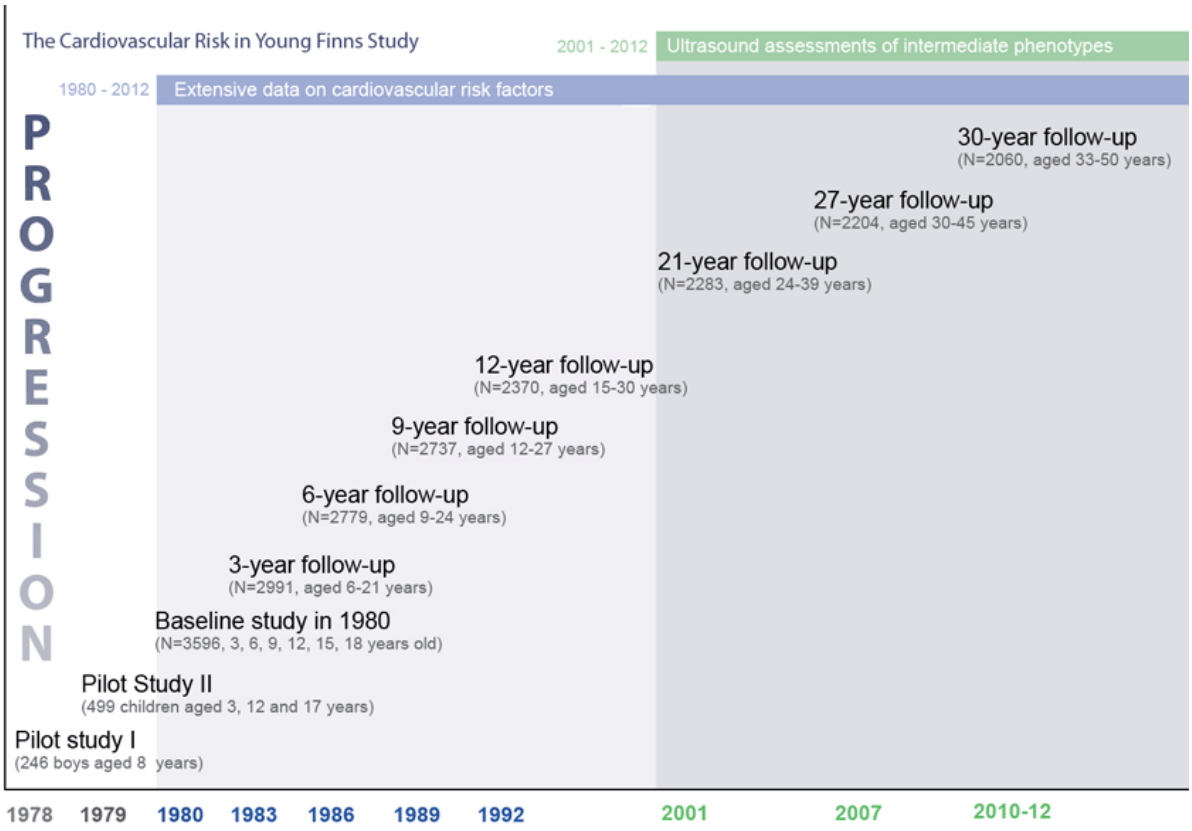

Figure 4 Trends in Cardiovascular Risk Factors in the Young Finns Study, 1980-2012. Data derived from the University of Turku (2013).

The data for this thesis was initially gathered from the most recent follow-up of the Young Finns Study, conducted between 2018 and 2020, which contained secondary data from 396 Finnish children aged 6–12 years. Following a comprehensive data cleaning process to verify the integrity and trustworthiness of the data, the final sample consisted of 317 children.

It is important to note that the specific data collection methods used in the most recent follow-up are currently unpublished; therefore, the methodology for data collection was inferred from previous follow-up studies and similar projects where participants were

randomly selected from the national register for the initial study in 1980, and their participation has continued throughout subsequent follow-ups. The demographic structure of this sample contains a fair mix of genders and covers various socioeconomic backgrounds, offering a representative cross-section of Finnish children.

The study participants had factors such as age and gender. Additionally, their lifestyles were assessed for things like activity levels, sedentary behavior (screen time), diet, and other relevant aspects. This study provides an opportunity to measure how prevalent sedentary behavior and physical activity levels are among children. It also allows us to examine how demographic factors influence these behaviors and identify areas where technology-based interventions might be helpful.

By exploiting this comprehensive dataset, we expect to gain significant insights into the patterns of physical activity and sedentary behavior in this population, with the objective of informing successful initiatives for promoting healthy behaviors in Finnish children.

4.2 Data Collection and Selection

This research is based on data acquired from the Young Finns project, which started in 1980 and continues to this day (University of Turku 2013). Finns Study was designed to investigate the development of cardiovascular risk factors from childhood to adulthood. It encompasses a comprehensive dataset collected from over 3,000 Finnish children and adolescents, aged 3 to 18 at the outset, spanning several decades. The main goal of this research is to assess lifestyle characteristics, mainly sedentary behavior, while considering age and gender demographics. (Tammelin et al. 2007.) The data used for this study includes information about aspects of lifestyle such as exercise levels and sedentary behavior patterns, along with basic demographic facts.

4.2.1 Data Collection

To acquire data on physical activity and sedentary behavior, the Young Finns Study utilized self-reported questionnaires. Participants were inquired about the duration they dedicated to tasks, such as engaging in moderate to physical activity (MVPA), participating in light physical activity (LPA), commuting physically, and indulging in sedentary behaviours (Tammelin et al. 2007). Additionally, essential sociodemographic details like, age and gender were collected during the data collection phase of the Young Finns Study (University of Turku 2013). This valuable dataset will be leveraged to satisfy the aims of the HEAL project, which proposes to provide an intervention encouraging healthy behaviours. It’s vital to stress that the precise

methodologies utilized for collecting data in the follow-up of the Young Finns Study (2018–2021) have not been published and were accessible at the time of writing this thesis. Therefore, this study relies on the procedures applied in follow-up investigations. Assumes that same processes were employed in the most recent update. This research is based on data acquired from the Young Finns project, which started in 1980 and continues to this day with an approach (University of Turku 2013). The main goal of this research is to assess lifestyle characteristics, mainly sedentary behavior while considering age and gender demographics (Tammelin et al., 2007). The data used for this study includes information regarding factors of lifestyle such as exercise levels and sedentary behavior patterns together with basic demographic variables.

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It's crucial to note that the procedures utilized for collecting data in the follow up of the Young Finns Study (2018-2020) have not been published and were unavailable, at the time of writing this thesis. Therefore, this study relies on the methodologies applied in follow up investigations. Assumes that same processes were employed in the most recent update. For our analysis, we specifically focused on data pertaining to Finnish school-age children between the ages of 6 and 12, collected during the years relevant to our research question. This age group was selected due to its critical period of development, where patterns of sedentary behavior, particularly screen time, begin to emerge and stabilize. The timeframe was chosen based on the availability of consistent and comparable data on screen time and related behaviours. The comprehensive and longitudinal nature of the Young Finns Study makes it an ideal data source for our research. It allows for an in-depth analysis of the association between sedentary behavior, as indicated by screen time, and key demographic variables such as age and gender. The longitudinal design enables us to observe and analyse trends and patterns over a significant developmental period in children.

4.2.2 Definition of Screen Time

Clarification of Screen Time for the Study: In this study, 'screen time' is specifically defined as the total time spent engaging in screen-based activities. This encompasses activities such as watching television, using computers, and playing video games. This operational definition is in accordance with the parameters set by the Young Finns Study, which utilized self-reported data from participants and their parents to quantify screen time.

Exclusion of Online Educational Activities: It is pertinent to note that, due to the unique context of the COVID-19 pandemic and the resultant surge in online learning, this study's definition of screen time deliberately excludes periods spent on online educational activities. This distinction is made to specifically focus on recreational screen usage, which has a more direct correlation with sedentary behavior. Acknowledging this limitation is crucial, especially considering the potential for an overall increase in screen time during the pandemic, which may blend educational and recreational activities.

Screen Usage and Sedentary Behavior: In this study, screen usage time is used as a proxy measure for sedentary behavior. This approach is consistent with the findings of existing literature, where screen time has been commonly identified as a key component of sedentary lifestyles, especially among children. Research has shown a significant correlation between the amount of time children spend on screens and their overall level of sedentary behavior. (Abdullah et al., 2022; Thekra Alotaibi et al., 2020.); this correlation is particularly relevant as increasing screen time is often linked with reduced physical activity and heightened sedentary behavior in children.

Implications of This Approach: While screen time constitutes a significant portion of sedentary behavior, it is not its only form. Sedentary behavior includes a range of activities, such as prolonged sitting and reading, that do not involve screen use. The complexity of sedentary behavior in children's lifestyles is highlighted by studies showing that other factors, like environmental and social elements, also contribute significantly to sedentary time (Abdullah et al., 2022; Thekra Alotaibi et al., 2020). Therefore, it is essential to interpret the findings of this study within the broader

context of sedentary behavior, recognizing that screen time is a proxy, but not an exhaustive indicator, of such behavior.

Operationalization in Data Analysis: This clearly outlined definition of screen time was systematically applied in analysing its relationship with key demographic variables - age and gender - among Finnish school-age children. Understanding and differentiating between recreational and educational screen usage is vital for accurately interpreting the study's results and comprehensively understanding the patterns and nuances of sedentary behavior within this age group.

4.3 Sample Size Justification

The selection of a sample size of 317 Finnish children aged 6–12 years was a strategic decision influenced by statistical power analysis and the practicalities of data availability from the Young Finns Study.

Statistical Power Analysis: Power analysis, a critical step in research design, helps to determine the minimum sample size required to detect an effect at a desired level of significance and power (Cohen, 1988; Christopher et al., 2019). For this study, parameters such as the expected effect size, alpha level (typically 0.05), and desired power (commonly 0.80) were considered. Based on these parameters, the analysis suggested that a sample of 317 would be adequate to detect significant associations between sedentary behavior, age, and gender. This aligns with recommendations by Faul (2009) on optimal sample sizes for reliable statistical analysis.

Factor-Based Sample Size Determination: The determination of the sample size was specifically tailored to investigate the primary factors of interest - age and gender - in relation to sedentary behavior. Age and gender are key determinants in understanding sedentary habits, as they influence both the onset and the pattern of such behaviours in children. The selected age group of 6–12 years is particularly significant as it represents a critical developmental stage where lifestyle habits, including screen usage and physical activity patterns, begin to solidify. Gender is included to explore potential differences or similarities in sedentary behavior, contributing to a more nuanced understanding of these patterns.

Data Availability and Constraints: The availability of data from the Young Finns Study also played a crucial role in determining the sample size. This cohort provided a comprehensive dataset, but with practical limitations on the number of participants fitting the specific age and

gender criteria for this study. The sample of 317 represents the maximum number of participants available that met these criteria, ensuring a robust dataset for analysis.

Confounding Variables: Larger sample sizes are advantageous for more accurately controlling for potential confounding variables (Greenland, 1987). The chosen sample size allows for sufficient flexibility in the statistical model to adjust for and examine the impact of these additional variables (Thomas et al., 2015).

Alignment with Similar Studies: The decision is further supported by a review of similar studies in the field, where sample sizes in this range have been found effective for similar types of analysis; (Abdullah Almaqhawi et al., 2022; Thekra Alotaibi et al., 2020).

4.4 Data Analysis

4.4.1 Quantitative analysis

The quantitative data analysis of this research focuses on the sedentary behavior, specifically screen time, among school-aged Finnish children, in connection to demographic parameters like age and gender. The major objective of the research is to understand the prevalence and influencing factors of sedentary behavior, with the aim of identifying suitable areas for technology-driven interventions to increase physical activity. Our analysis report provides a full explanation of the R software and SPSS version 27 analysis undertaken for this purpose. An advanced quantitative study design and in-depth analysis were employed to explore the prevalence of these associations, and to give solid statistical evidence to support the conclusions.

4.4.2 Purpose and Process of Data Analysis

The data analysis has various purposes in our investigation. The first goal was to understand the characteristics of the participants, the prevalence of their sedentary behaviour and patterns, and to find associations between the different variables. To do this, we employed statistical analytic approaches (Cooksey et al., 2020). This involved computing advanced descriptive analysis beyond averages and median values such as building frequency distributions for categorical variables, box plots, inputting interquartile etc. These strategies gave insights into the individuals demographic profiles and their sedentary habits.

The second goal focuses on examining the connection between demographic characteristics, age and gender and sedentary activity. To evaluate these correlations, we ran a multiple

regression analysis and correlation heatmap analysis (Courvoisier et al., 2010; Wilkinson et al., 2009; Kumar et al., 2018). The correlation analysis is a component of the bivariate analysis, where we assess pairwise relationships between continuous variables, helping to inform further research and interventions. In this research we included sedentary behaviour as the dependent variable while age and gender served as independent factors. By adopting this approach, we were able to analyse how each demographic feature effects behaviour while taking other variables into account (Courvoisier et al., 2010). This immediately addresses our study's aims by evaluating the relationships, between age, gender, and sedentary behaviour among our subjects. By organizing the data analysis in this manner our study successfully attained its goals. It provides an overview of our sample population. Shed light on the elements that impact their behaviours.

4.4.3 Statistical Procedure and Rationale

The main statistical approach utilized in this investigation was advanced descriptive analysis, correlation heatmap analysis (Wilkinson et al., 2009; Kumar et al., 2018) and multiple regression analysis (Courvoisier et al., 2010; Cohen et al., 2013) completed using R software and SPSS V27. To detect the relationships among various screen time factors, Spearman's rank correlation coefficient (ρρ) was applied. This non-parametric statistic examines the degree and direction of association between two ranking variables, revealing insights into their monotonic relationship—where both variables move together without assuming a constant rate of change. Values of ρρ vary from -1 (perfect negative correlation) through 0 (no correlation) to +1 (perfect positive correlation), denoting the degree and directionality of the link. This method offers a detailed understanding of how diverse screen time variables link, without expecting a given data distribution, so giving strong, distribution-free insights into the pairwise relationships inside our data. (Thomas et al., 2001.) We adopted this multiple regression analysis technique to concurrently analyze the link between one variable and numerous independent variables. By employing this strategy, we may analyze the impact of each individual variable on the dependent variable while considering the influence of other factors. This technique permits the analysis of linkages, such as how many demographic parameters affect sedentary behavior and how these variables are interconnected (Wilkinson et al., 2009; Courvoisier et al., 2010; Cohen et al., 2013; Kumar et al., 2018).

To determine significant level in this analysis, we fixed the level at 0.05. This means that if the p-value produced from the test is less than 0.05, we consider the result to be statistically

significant. This accepted level signifies a 5% risk of concluding that there is a difference when no difference exists (Andrade et al., 2019). To ensure robust results aligned with our study's objectives, we meticulously executed the data analysis process. In the next sections, we will provide findings derived from this analysis.

4.5 Ethics of the study

Research integrity and ethical considerations are essential in academic inquiries, especially when human participants are involved. According to the Finnish National Board on Research Integrity (TENK) guidelines (2019), as well as the foundational principles highlighted by Ethical Principles Governing Research Involving Human Participants (2002), it is imperative to uphold participants' rights, dignity, and well-being.

4.5.1 Foundational Ethical Principles

Respect for Autonomy: Every individual possesses the right to make decisions freely and should be treated with respect, irrespective of their choices. In research, this regulation surfaces as the requirement to obtain informed consent from participants before their involvement. Particularly when involving minors, they must be informed about the research in a manner they can comprehend. For minors aged 15 or older, their consent is sufficient, though it's advisable to inform the parent or guardian. However, the autonomy of minor participants must always be respected, and their participation is always voluntary (TENK, 2019).

Beneficence: Research should prioritize the well-being of participants. The potential benefits of the study should notably outweigh any foreseeable risks or harm.

Non-Maleficence: Researchers bear the responsibility of ensuring participants' safety. Intentional harm, whether physical or psychological, must be strictly avoided. In scenarios where the research is not in the best interests of a minor, and they wish not to participate, their decision should be respected and their participation discontinued (TENK, 2019).

Justice: Fair distribution of research benefits and burdens is crucial. No group should disproportionately bear risks or be excluded from the advantages of research.

Openness of Research Data: Open science is foundational for critical evaluation and scientific progression. When collecting, preserving, and opening research data, reliable services ensuring data protection must be employed throughout the research's lifespan. Researchers should also consider whether relevant data already exists before gathering new

information to avoid redundancy and unnecessary research pressure on specific groups (TENK, 2019).

Throughout the research process, adhering to these principles ensures the rights and well-being of participants are prioritized, aligning with the highest standards of research ethics as prescribed by both national and international guidelines (Ethical Principles Governing Research Involving Human Participants, 2002).

4.5.2 Ethical Approval and Adherence

The data for this thesis was obtained from the Young Finns Study, which adheres to all relevant ethical guidelines. Approval for the study was secured from the Ethical Committee, Hospital District of Southwest Finland (VSSHP) on 20.6.2017 with the number ETMK: 68/1801/2017, given the study's focus and location. All participants and their parents or guardians provided informed consent for their data to be used in research (Annexes II, III, IV). This consent process ensured participants were aware of the study's objectives, potential risks, benefits, and their rights to withdraw at any stage without repercussions.

Furthermore, all identifying information was removed from the dataset to maintain confidentiality and anonymity, ensuring that individual participants could not be directly or indirectly identified through the data.

4.6 Reliability and Validity of the study

Reliability refers to how consistent and repeatable the findings are when the study is replicated under same conditions. In this study we made sure to maintain reliability by using a validated data collection tool. The self-report questionnaires from the Young Finns Study were used, which have been proven to produce consistent results across various samples over time.

Validity on the hand focuses on whether the results measure what they are intended to measure. To ensure validity in this study we carefully designed the data analysis process to address our research questions. Additionally, by employing regression analysis we enhanced validity by controlling for confounding variables and isolating the effects of age and gender on sedentary behavior.

Moreover, we bolstered validity in this study by using a large representative sample from the Young Finns Study. This helps make our findings more applicable to a population of school aged children.

4.7 Potential Limitations and Mitigation Strategies

While this study was conducted with thoroughness and precision, it is crucial to acknowledge limitations, which are shown below:

4.7.1 Data based on self-reporting

The information gathered relies on individuals reporting their behaviours, which could be influenced by expectations or memory biases. However, the use of validated questionnaires from the Young Finns Study helps to address this limitation to some extent. Additionally self-reported measures are commonly utilized in studies due to their practicality in large scale surveys.

4.7.2 Unmeasured variables

Although the study accounted for age and gender as controlled factors there could be variables that were not measured but may have an impact on sedentary behavior. Future research could explore factors like status, parental influence, or environmental aspects.

4.7.3 Cross-Sectional data

The nature of the data being cross sectional restricts our ability to establish causality from the findings. This is a recurring limitation in observational research. Nevertheless, the study employed multiple regression analysis to account for confounding variables and enhance the reliability of the identified associations.

Despite these limitations this study offers insights into sedentary behavior patterns and associated factors, among Finnish school-aged children. These discoveries can provide insights, for studies and initiatives focused on encouraging people, in this group to engage in physical activity and decrease their sedentary behavior.

5. Results

The results section is divided into subsections based on the distinct aspects of the data that were analysed.

5.1 Demographic Data

5.1.1 Gender of Respondents

According to the data presented in Figure 5, the survey sample primarily consists of boys accounting for more than half of the population at 77.2% ($n = 244$). On the hand girls represent 22.8% of the population ($n = 72$). There was no data for girls aged 6 because of no participation of females aged 6 due to consent issues and unclean and incomplete secondary dataset.

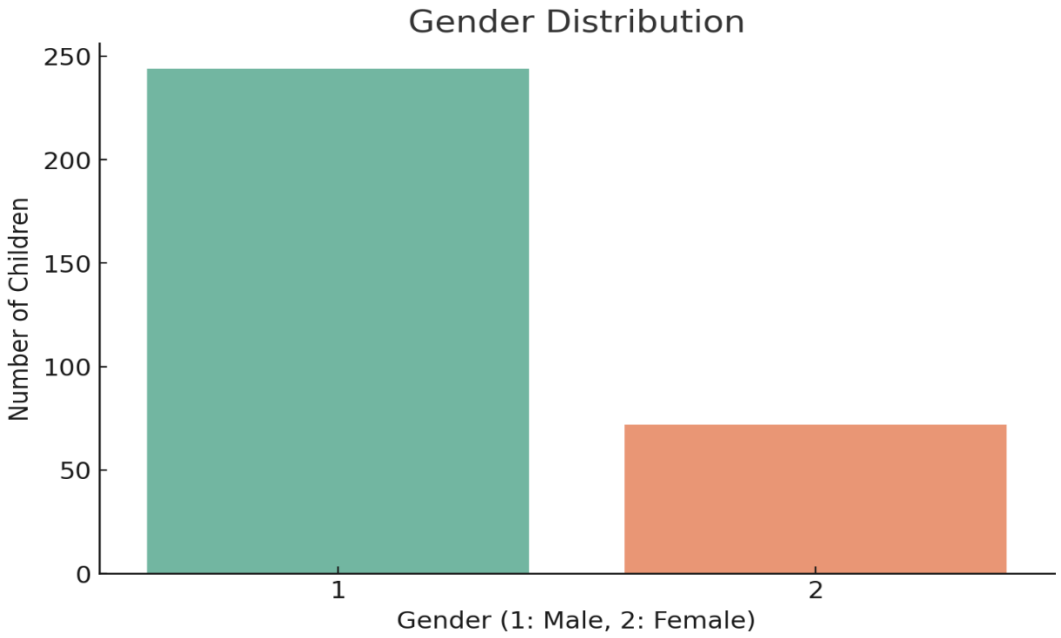

Figure 5 Distribution of Gender (Source: Young Finn study 2018-2020)

5.1.2 Age of Respondents

Examining figure 6, it is evident that a massive portion of the respondents were nine years old making up around 23.7% of the population. Similarly, those who were eleven years old accounted for 22.5% with a frequency of seventy-one respondents. Additionally, 21.2% of participants fell into the ten-year group with a frequency of sixty-seven individuals. The remaining respondents belonged to age groups six, seven, eight and twelve respectively and represented proportions of 0.9%, 11.4%, 14.9%, and 5.4%. The average age of the children we

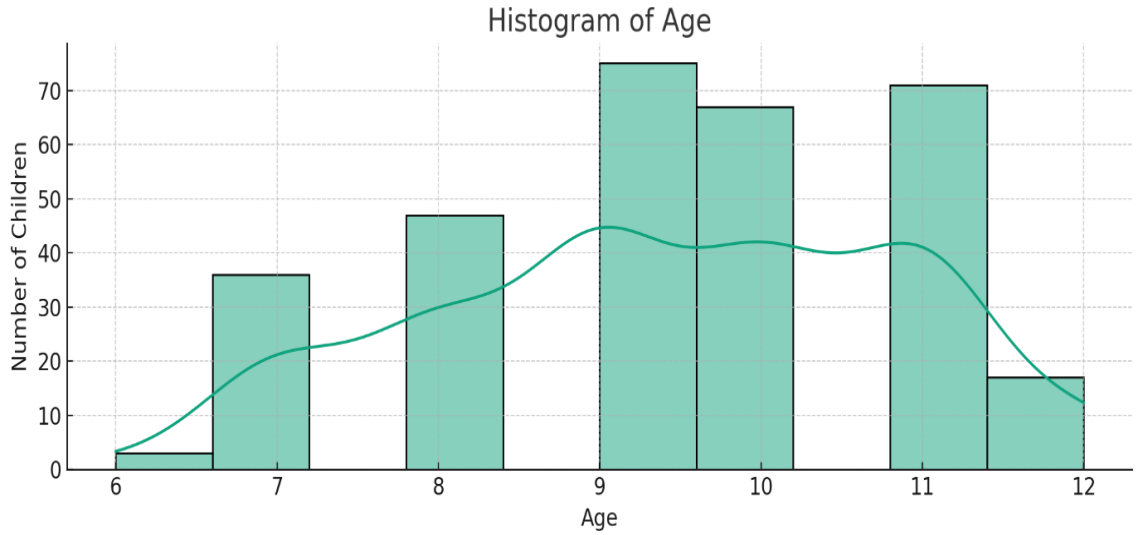

Figure 6 Age Histogram (Source: Young Finns study 2018-2020)

studied was 8.5 years, showing a mix of different ages among the group. This diversity gave us a good picture of screen time habits across various age groups.

5.2 Prevalence of Sedentary Behaviour Among School-Aged Finnish Children

5.2.1 Prevalence of Sedentary Behaviour by Age

5.2.1.1 School Days Analysis by Age

Figure 7: Distribution of TV Screen Time on School Days by Age

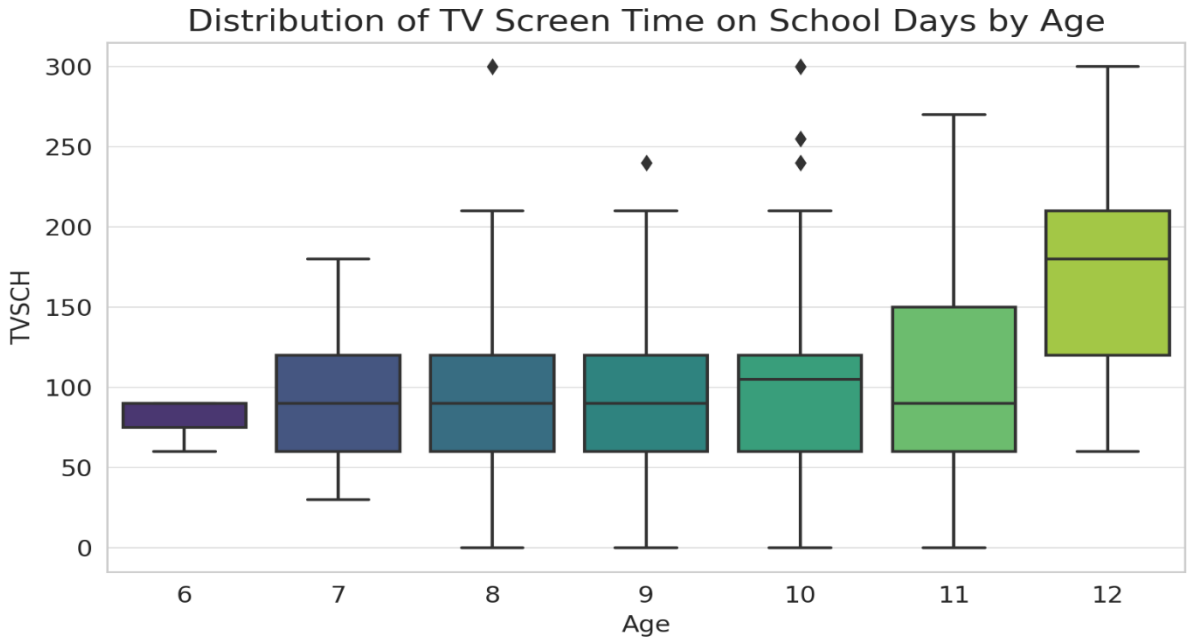

Figure 7 Distribution of TV Screen Time on School Days by Age

Figure 7 illustrates a boxplot distribution of television screen time among Finnish children on school days, segmented by age. This figure provides a median screen time comparison across ages 6 through 12. The median values indicated by the horizontal lines within each box show a progression in screen time with increasing age.

Starting at age 6, the median screen time is considerably lower, at around 50 minutes, indicating less interaction with television at this stage. As we move into the middle childhood years of 7 to 9, the median screen time stabilizes, maintaining just under 100 minutes for each of these ages, reflecting a plateau of screen engagement during these school years. At age 10, there is an observable increase in screen time, with the median rising to approximately 110 minutes. This suggests a change in screen usage patterns as children reach double digits. However, for age 11, the median TV screen time drops to align with ages 7 to 9, at around 90 minutes. This drop may indicate changes in the interests or daily routines of children at this age. A significant increase is seen at age 12, where the median screen time surges to around 180 minutes, which is substantially higher than the earlier age groups.

Figure 8: Distribution of PC Screen Time on School Days by Age

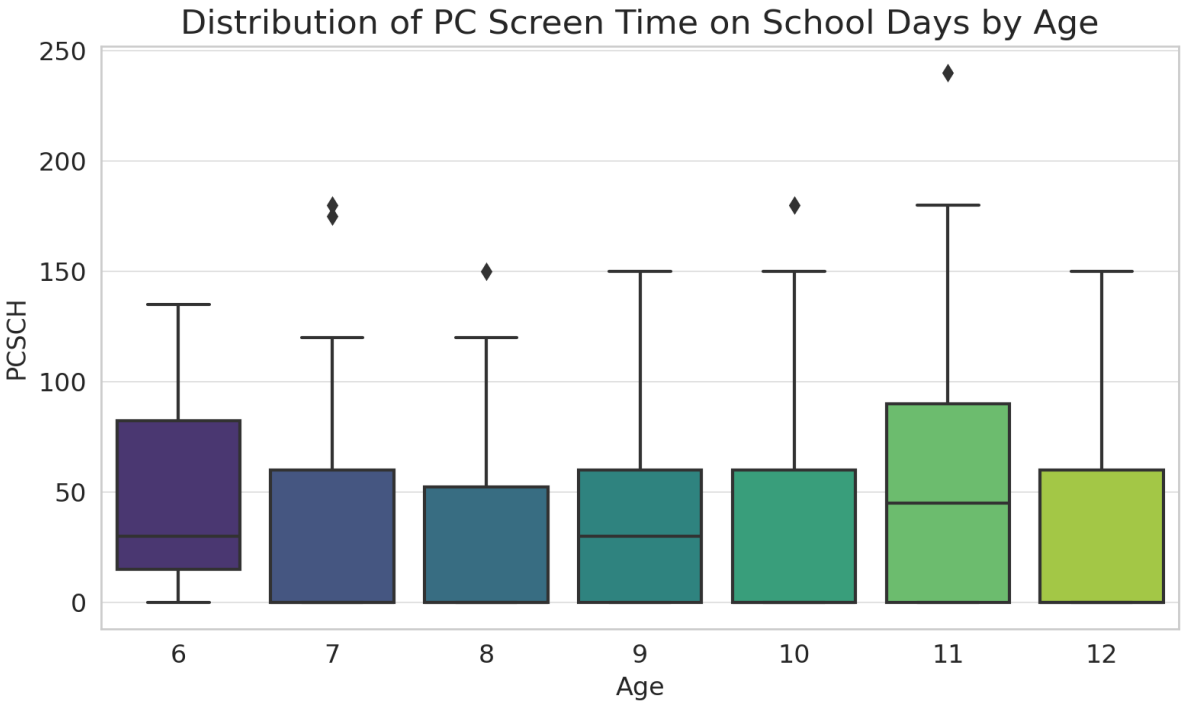

Figure 8 Distribution of PC Screen Time on School Days by Age

The PC screen time during school days (figure 8) surprisingly highlights a median of around zero minutes, especially for age 7,8,10, and 12 indicating minimal to no PC usage during that period. However, a subtle increase is observable, with age 11 demonstrating a median of approximately 48 minutes and portraying a higher IQR compared to the younger ages, reflecting a wider spread of PC usage times. Age 6 recorded a median of 45 minutes which is like that of age 9 children.

5.2.1.2 Weekend Analysis by Age

Figure 9: Distribution of TV Screen Time on Weekends by Age

TV screen time (figure 9) during weekends exhibits a median that alternates between 80 and

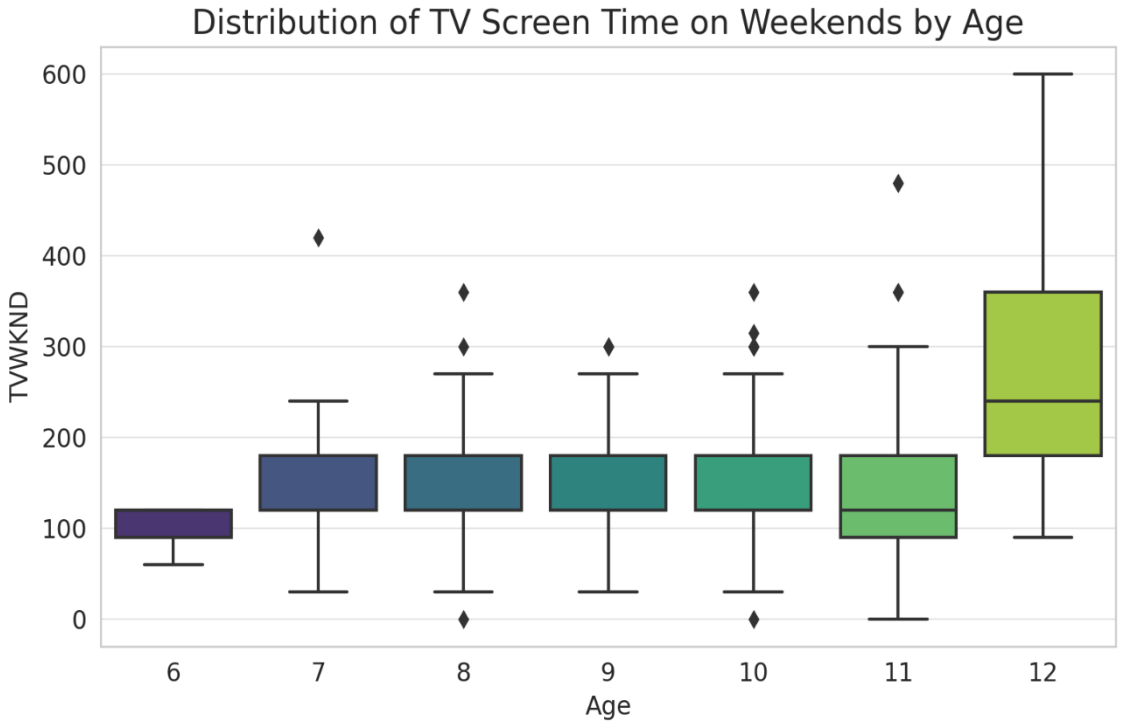

Figure 9 Distribution of TV Screen Time on Weekends by Age

250 minutes across ages, with age 7 to 10 showcasing a similar median nearing 120 minutes and age 12 clocking the highest. Moreover, the analysis exhibited outliers stretching from 300 minutes to about 490 minutes, hinting at sporadic instances of extremely elevated TV viewing during weekends.

Figure 10: Distribution of PC Screen Time on Weekends by Age

The PC screen time on weekends (figure 10) illustrates a noticeable difference in median values with each age, transitioning from lower usage at age 7 and 10 (30 minutes and 35 minutes) to a median of about 60 minutes by age 11. Ages 6,8,9, and 12 look to have a close

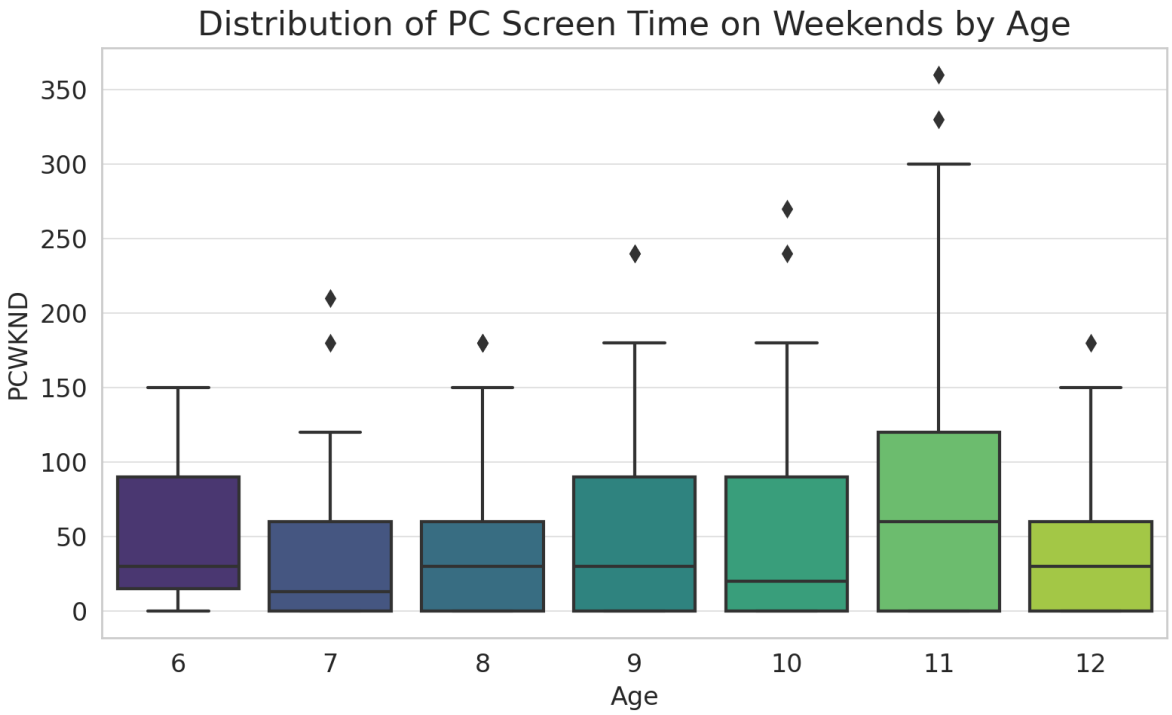

Figure 10 Distribution of PC Screen Time on Weekends by Age

median of about 40 minutes This suggests a growing integration of PC-related activities into the weekend routines of older children.

5.2.2 Prevalence of Sedentary Behaviour by Gender

5.2.2.1 School Days Analysis by Gender

The distribution of TV screen time on school days (figure 11) offers a glimpse into the divergent viewing habits of male and female children. Males, encapsulating a median of 90 minutes and an interquartile range (IQR) from 60 to 120 minutes, and females, with a slightly elevated median of 120 minutes and a broader IQR from 60 to 150 minutes, weave a narrative that highlights not only a gendered disparity in median viewing times but also a greater variability amongst females.

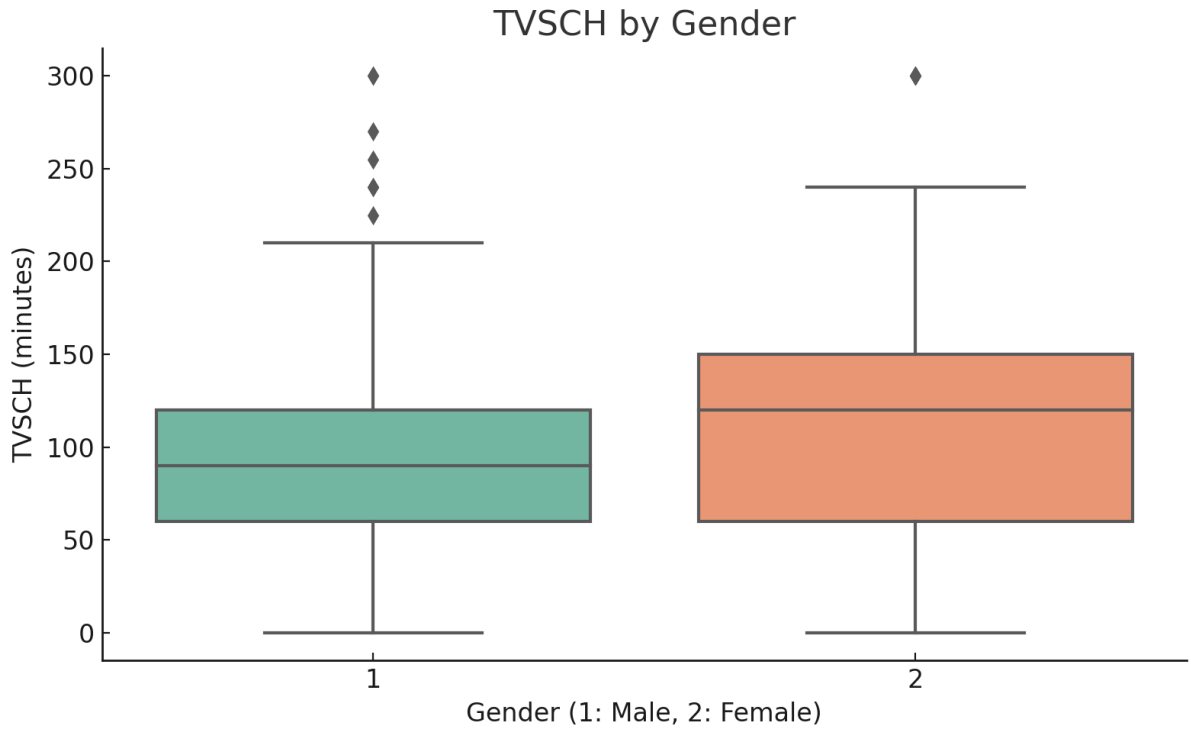

Figure 11 Distribution of TV Screen Time on School Days by Gender

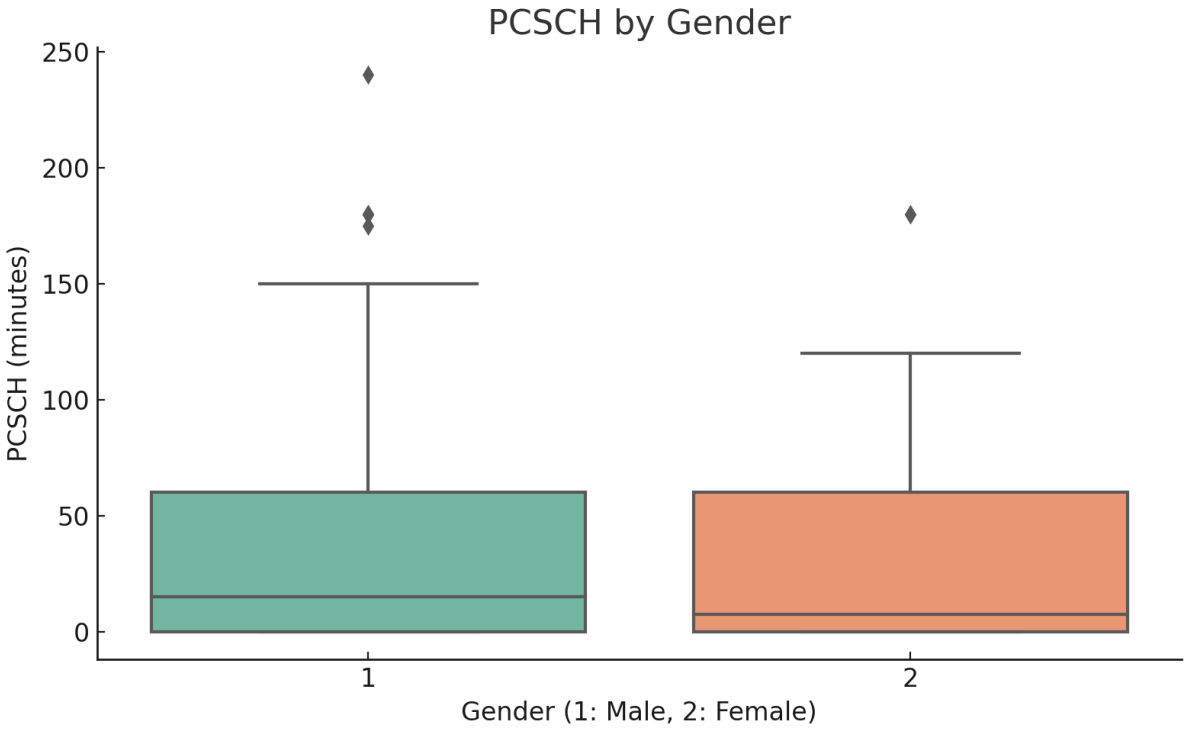

Figure 12 Distribution of PC Screen Time on School Days by Gender

PC screen time during school days, mirrored in Figure 12, unveils a narrative where males engage for a median duration of 15 minutes and an IQR spanning from 0 to 60 minutes, while females exhibit a median of 7.5 minutes with a similar IQR. This discrepancy in median values, albeit within a similar spread, nudges us towards contemplating the potential factors that might be curbing PC engagement amongst females during school days

5.2.2.2 Weekend Analysis by Gender

Transitioning into weekends, TV screen time, as depicted in Figure 13, showcases males with a median of 120 minutes and females slightly higher at 157.5 minutes, both sharing an IQR from 120 to 180 minutes. The consistent IQR yet differing medians spark questions around the factors that might be influencing the elevated median TV viewing time amongst females during weekends.

Figure 13: Distribution of TV Screen Time on Weekends by Gender

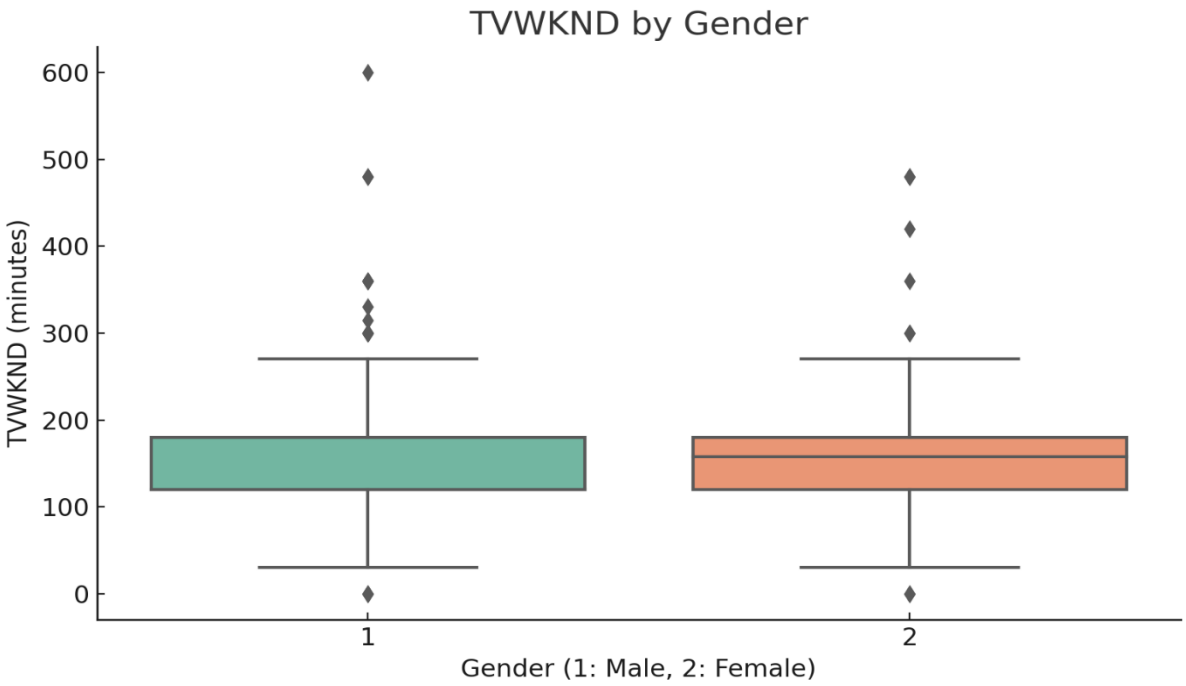

Figure 13 Distribution of TV Screen Time on Weekends by Gender

Figure 14: Distribution of PC Screen Time on Weekends by Gender

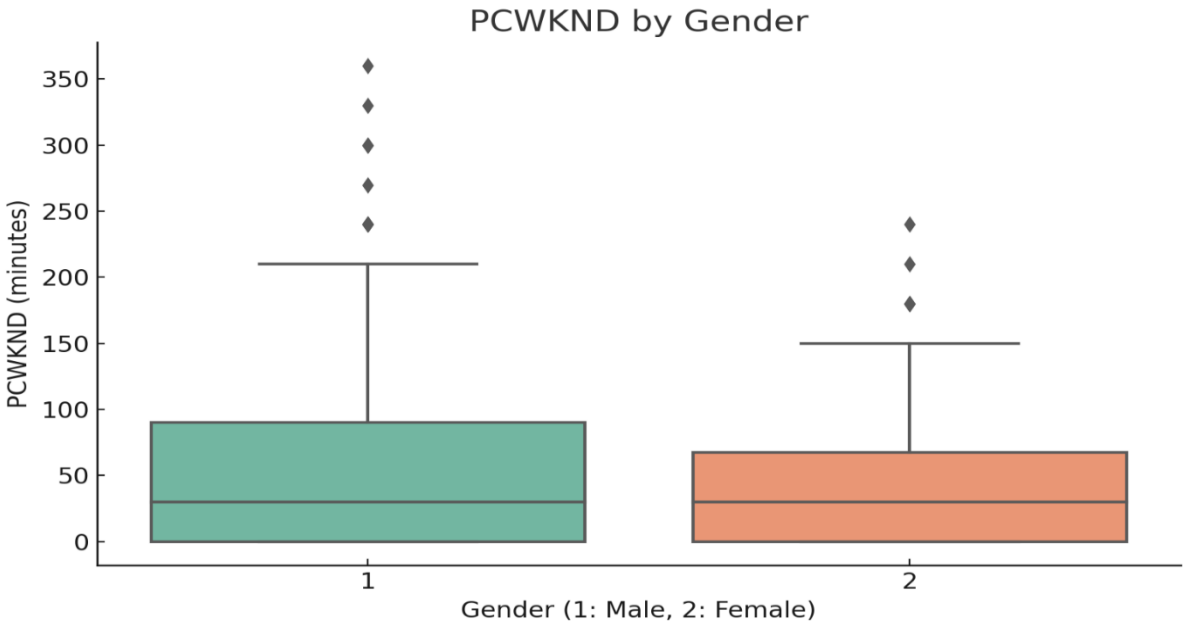

Figure 14 Distribution of PC Screen Time on Weekends by Gender

PC screen time during weekends, captured in Figure 14, indicates a median of 30 minutes for both genders, albeit with males exhibiting an IQR from 0 to 90 minutes and females a slightly

constrained IQR from 0 to 67.5 minutes. This constricted upper range amongst females alludes to a potential ceiling effect, warranting exploration into possible barriers or deterrents in their extended PC usage during leisure days.

5.2.3 Overall of Screen Time on School Days and Weekends Across Age and Gender

5.2.3.1 School Days Analysis Across Age and Gender

Navigating through (figure 15) the distribution of total screen time on school days (TTSDTSCH) across ages and genders, we observe that on school days, six-year-old boys (Gender 1) show a median screen time of approximately 90 minutes, while by age seven, this median increases to about 120 minutes for boys. In contrast, seven-year-old girls (Gender 2) tend to use screens for longer periods, with a median of 165 minutes. Their screen time varies more widely, starting at around 138.75 minutes for the lower quarter and going up to 225 minutes for the upper quarter. For eight and nine-year-olds, the screen time patterns begin to

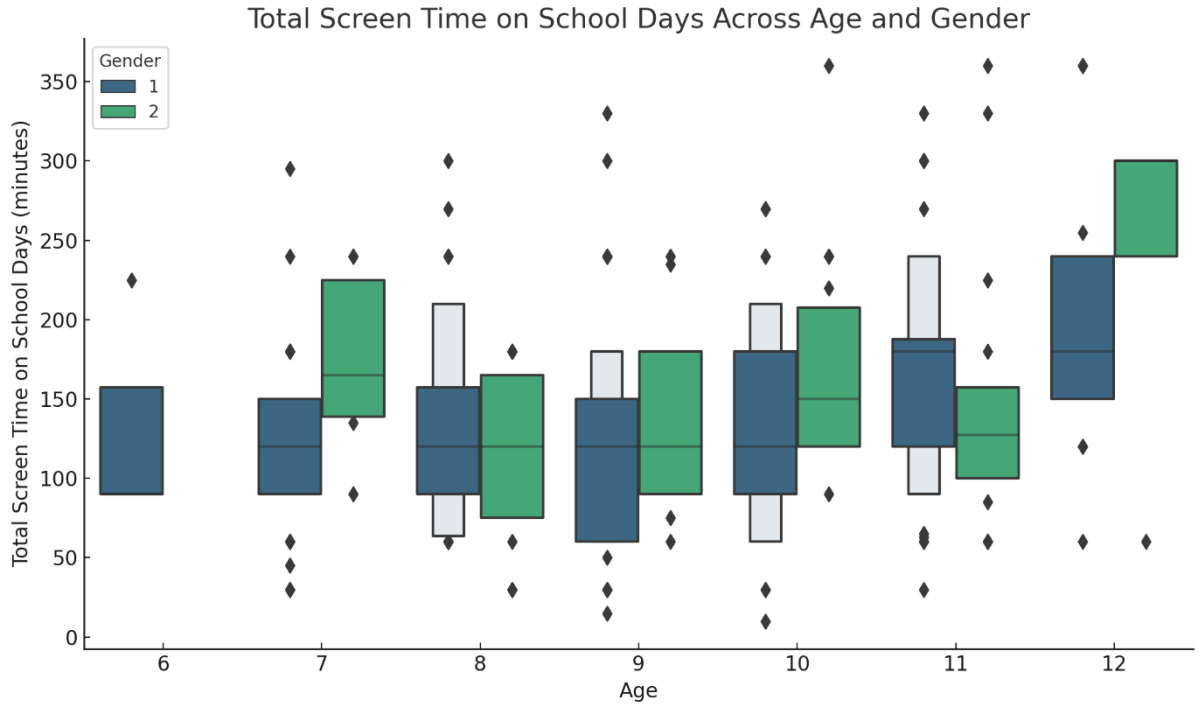

Figure 15 Total screen time on school days across ages and genders

diverge more clearly. Eight-year-old boys continue to show a median screen time like their younger selves, around 90 to 120 minutes. However, eight-year-old girls have a median screen time of 120 minutes, which doesn't change much by the time they turn nine. But at nine, the range of screen time for girls broadens significantly, with the middle half of girls spending between 90 and 180 minutes on screens. As children reach the ages of ten and eleven, the differences in screen time between boys and girls become even more apparent. Ten-year-old boys typically spend about 120 minutes on screens, while girls of the same age tend to spend around 150 minutes, showing a preference for longer screen time. By age eleven, boys increase their median screen time to 180 minutes, indicating a substantial rise as they grow older. In contrast, eleven-year-old girls show a decrease in their median screen time to roughly 127.5

minutes, revealing a notable shift in their screen usage habits. Both genders demonstrate a significant increase in median screen time, with males reaching 180 minutes and females surging to 300 minutes. Particularly for females, the 25th and 75th percentiles (240 and 300 minutes, respectively) reflect a considerable spread, signaling diverse engagement patterns. The analysis provided interesting insights into screen time patterns among children. Boys spent an average of about 123 minutes on screens during school days. Girls, on the other hand, tended to spend a bit more time, averaging around 139.5 minutes. Overall, when we combined data from both genders, we found that children spent an average of about 270 minutes on screens during school days. This tells us that screen time is a significant part of children's lives during the school week.

5.2.3.2 Weekend Analysis Across Age and Gender

Exploring (figure 16), on weekends the examination of screen time reveals that six-year-old boys spend an average of 150 minutes in front of screens, which slightly increases to 165 minutes by the age of seven. In contrast, seven-year-old girls spend a higher average of 240

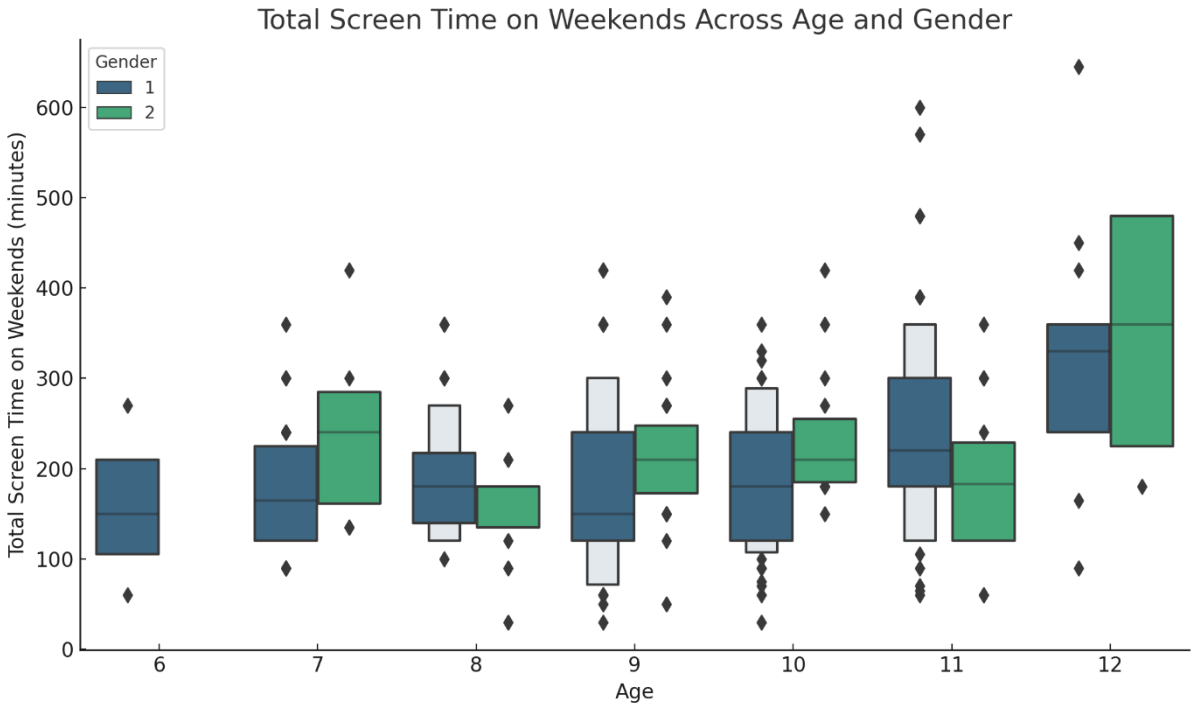

Figure 16 Total screen time on weekends across ages and genders

minutes on screens, and their times vary more widely, ranging from about 161 to 285 minutes for the middle fifty percent of observations. As children grow to eight and nine years of age, screen time on weekends stabilizes around an average of 180 minutes for both genders. However, nine-year-old girls tend to spend a bit more time on average, with 210 minutes being the median. The range for these girls also suggests a variety of screen time habits, with

half of them spending between approximately 172.5 and 247.5 minutes on screens. Moving into the double digits, ten-year-old boys typically spend about the same amount of time as nine-year-olds, but by age eleven, their average screen time increases to 220 minutes. Ten-year-old girls average 210 minutes on screens, but this decreases by the time they turn eleven, averaging around 183 minutes. By the age of twelve, a notable jump in screen time occurs for both genders. Twelve-year-old boys now average 330 minutes, while girls outpace them, peaking at an average of 360 minutes. Moreover, the range of screen time for twelve-year-old girls is quite broad, with half of them spending between 225 and 480 minutes on screens, indicating a diverse array of screen-related activities. In the examination of weekend mean screen time across various ages and genders, the analysis reveals insightful patterns. The mean screen time for boys, calculated across the ages of 6 to 12 years, is approximately 201 minutes. This indicates a gradual increase in screen time as boys age, with a starting average of 150 minutes at 6 years old that ascends to 330 minutes by the age of 12. For girls, the mean screen time across the ages of 7 to 12 years stands at approximately 231 minutes. Girls' screen time exhibits more variability, beginning at an average of 240 minutes at 7 years old, and reaching a peak average of 360 minutes by 12 years old. This higher mean compared to boys highlights the significant engagement of girls with screens, especially in the later years of the age range considered. Combining the data for both genders, the overall mean screen time for children between the ages of 6 to 12 years is calculated to be approximately 214 minutes. This combined mean reflects the nuanced differences in screen time engagement between boys and girls and emphasizes the increasing trend of screen usage as children grow older. These findings emphasize the gender-specific dynamics of screen time engagement among children, with both boys and girls showing an uptrend in screen usage as they age, albeit with distinct patterns and intensity levels.

Figure 17 Distribution of Total Screen Time Across Age and Gender

Figure 17 displays a series of box plots that represent the distribution of screen time across different age groups for school-age children in Finland, distinguished by gender. Males are depicted with red boxes and females with blue. The figure efficiently encapsulates the central tendencies and dispersions, along with notable exceptions in the data. The median, indicated

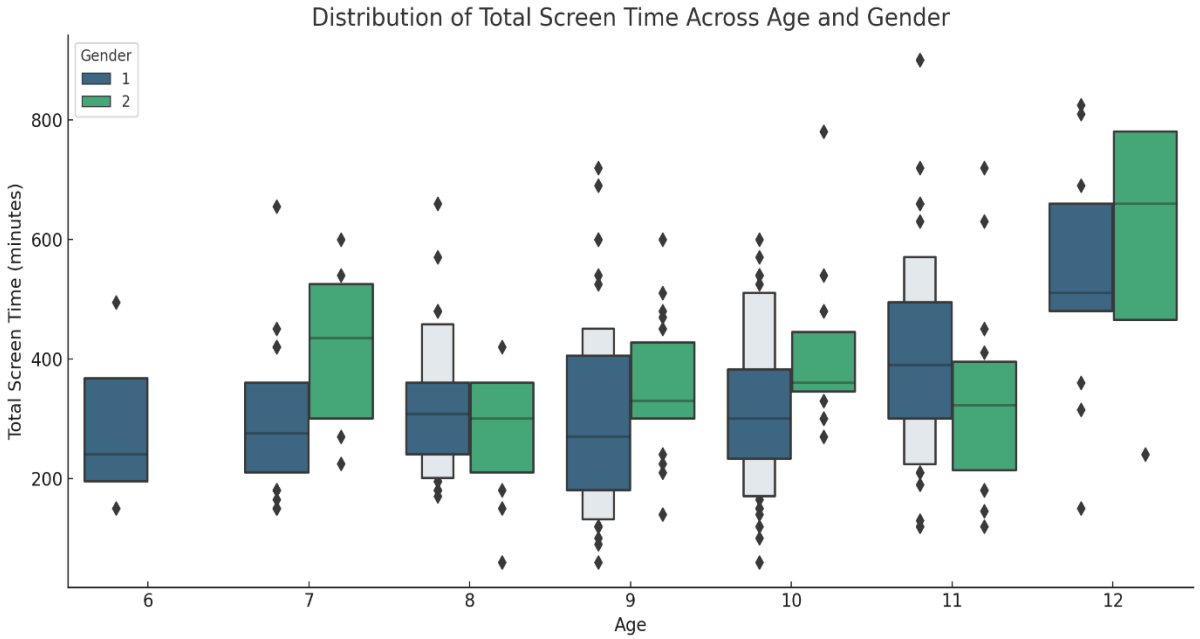

Figure 17 Distribution of Total Screen Time Across Age and Gender

by the horizontal line within each box, serves as a robust measure of central tendency, unaffected by extreme values in the data. It marks the midpoint of the data distribution for each category. In this dataset, for age 6, we observe a median screen time of 210 minutes for males, with no data available for females; this was a result of no participation of females aged 6 due to consent issues and unclean and incomplete dataset. For age 7, males have a median of 230 minutes, whereas females have a significantly higher median of 410 minutes. At age 8, both genders align with a median of 300 minutes each. Age 9 shows males with a median of 290 minutes and females slightly higher at 320 minutes. In the age 10 group, males have a median of 300 minutes, and females have a higher median of 380 minutes. Age 11 presents an unusual trend where males exceed females with a median of 390 minutes against 310 minutes. By age 12, females exhibit a much higher median screen time of 630 minutes compared to 450 minutes for males. The box's ends, or the 'hinges,' delineate the first quartile (Q1, the 25th percentile) and the third quartile (Q3, the 75th percentile), collectively forming the interquartile range (IQR). The IQR captures the middle 50% of data and is a measure of dispersion. It's particularly insightful for understanding the spread and concentration of the

bulk of the data. These outliers are as informative as the central measures, indicating that while most of the children conform to a certain range of screen time, there are remarkable exceptions. In analyzing the mean distribution of screen time among school-age children in Finland, attention was paid to the median screen time values provided for each age group, separated by gender. This approach offered a clear view of how children engage with screens on an average basis. For boys, the Mean screen time on both weekends and school days was determined by summing the median values across all ages (6 through 12 years) and dividing by the number of age groups, resulting in an average screen time of 310 minutes. This calculation reflects a consistent level of screen engagement among boys across the studied age range. In the case of girls, the analysis encountered a data gap for the 6-year-olds due to non-participation. Therefore, the calculation for girls' Mean screen time included age groups from 7 to 12 years only, summing their median screen times and dividing by this subset of age groups. The resulting Mean of 392 minutes for girls on both weekends and school days suggests a higher level of screen interaction compared to boys, indicating differences in screen use habits or preferences. To compute the overall Mean screen time that encompasses both genders, the median values for both boys and girls across the applicable age groups were combined. Since data for girls at age 6 was missing, the overall calculation accounted for 13 data points instead of 14. The total sum of these medians was then divided by the number of entries, leading to an overall average screen time of 348 minutes on both weekends and school days. This Mean merges the screen engagement insights from both genders into a comprehensive metric. This calculation method ensures an equal representation of both genders' median screen times in the overall average, providing a balanced overview of screen time engagement among Finnish school-age children. By addressing the data's limitations, such as the absence of participation in certain demographics, this analysis offers a clear and informative perspective on children's screen time habits.

5.2.4 Spearman's rank correlation coefficients

The analysis of Figure 18, which details the computed Spearman's rank correlation coefficients among various screen time variables, reveals several significant relationships. Regarding television screen time, a strong positive correlation with a coefficient of 0.68 (p-value < 0.05) between school day TV screen time and total screen time on school days indicates that television viewing is a substantial element of total screen time during school

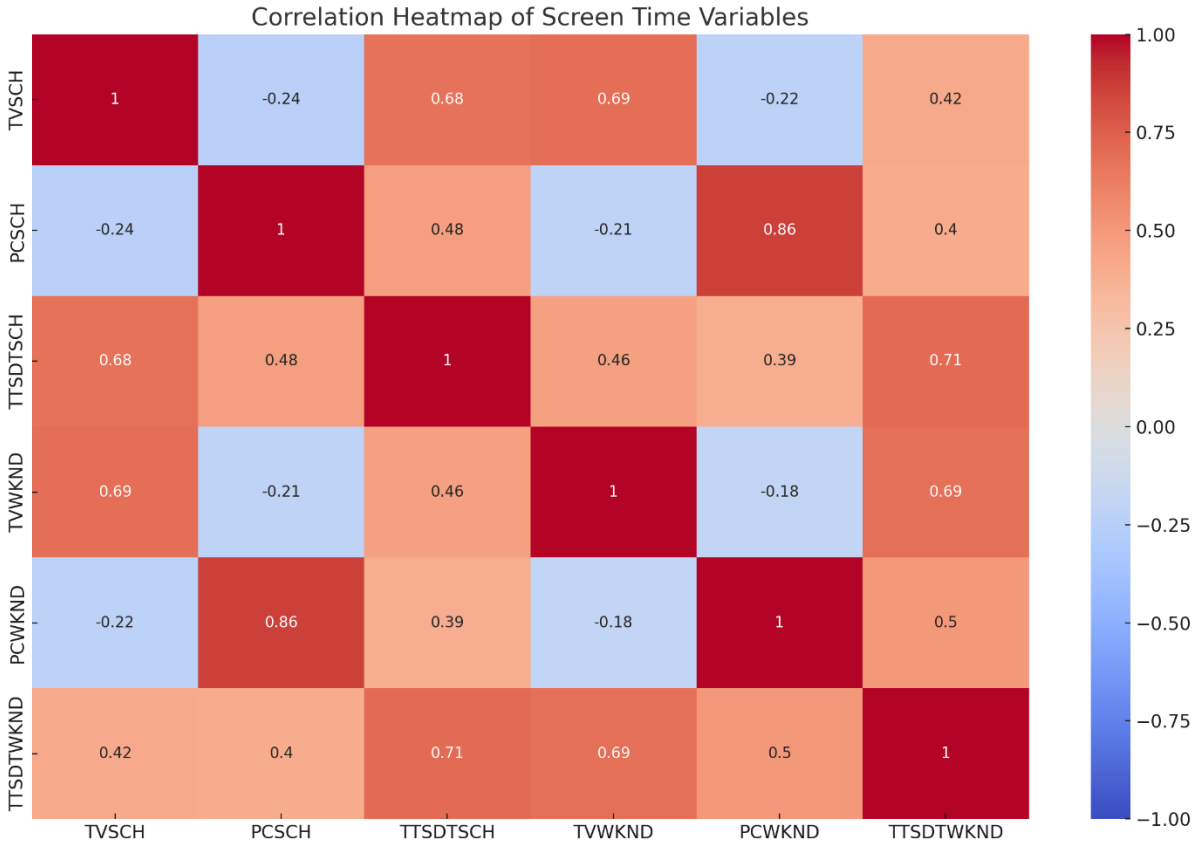

Figure 18 The heatmap provides a visual representation of the Spearman's rank correlation coefficients between the screen time variables.

days. Furthermore, the correlation coefficient of 0.69 (p-value < 0.05) between school day and weekend TV viewing habits points to a consistent pattern, with increased television watching during school days associated with similarly high levels on weekends. For personal computer screen time, the data exhibits a robust positive correlation of 0.86 (p-value < 0.05) between school day and weekend use, suggesting that children's computer use is stable throughout the week. Meanwhile, the moderate positive correlation of 0.48 (p-value < 0.05) between school day PC use and total screen time on school days indicates that while personal computer use contributes to overall screen time during school days, it is not the sole influencer. When examining total screen time, the correlation coefficient of 0.71 (p-value <

0.05) between school days and weekends underscores a general tendency for children who engage more with screens during school days to also have elevated screen times on weekends. Additionally, the remarkably strong positive correlations of 0.89 and 0.94 with the overall total screen time suggest that screen time during both school days and weekends are significantly associated with the comprehensive screen time measure, reaffirming their combined impact (p-value < 0.05).

5.3 Multiple Regression Analysis of Age, Gender, and Sedentary Behaviour

Understanding the intricate relationship between demographic factors and sedentary behaviors in school-aged children, particularly in a technology-driven society, forms the crux of developing pertinent interventions. This section meticulously unravels the associations between age, gender, and screen time on school days, weekends, and collectively.

5.3.1 Age, gender association between sedentary behaviour on school days

From the analysis of variance (Table 3), there is one dependent variable which is the total screen time on school days and two predictor variables namely, age and gender. The adjusted R Square of 0.058 indicates that 5.8% of the variance of the dependent variable is explained by the independent variables. Again, the mean squares (49349.767, 4602.113), F = 10.723 and p-value < 0.001 shows that the overall regression is statistically significant as shown in the ANOVA Table (Table 3). Also, as indicated in Table 4, age is a significant predictor of sedentary behaviour on school days with a p-value < 0.001 thus, accounting for a significant amount of unique variance in sedentary behaviour on school days but gender on the other hand was not statistically significant indicating that boys and girls don't differ significantly in the sedentary behaviour on school days.

Table 2 Model summary school day

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.253	.064	.058	67.839	.064	10.723	2	313	.001

Predictors: (Constant), Age, Gender

Table 3 Analysis of Variance ANOVA school day

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	98699.534	2	49349.767	10.723	.001
Residual	1440461.463	313	4602.113		
Total	1539160.997	315			

a. Dependent Variable: Total screen time on school days

b. Predictors: (Constant), Age, Gender

Table 4 Coefficients school day

	Unstandardized Coefficients		Standardized Coefficients	T	Sig. p-value
	B	Std. Error	Beta		
(Constant)	18.811	27.113		.694	.488
Gender	11.004	9.103	.066	1.209	.228
Age	11.646	2.628	.242	4.431	.001

Dependent Variable: Total screen time on school days

5.3.2 Age, gender association between sedentary behaviour on Weekends

In the analysis of variance (Table 6), there is one dependent variable which is the total screen time on weekends and two predictor variables namely, age and gender. The adjusted R Square of 0.063 indicates that 6.3% of the variance of the dependent variable is explained by the independent variables. Again, the mean squares (106199.564, 9132.288), F = 11.629 and p-value < 0.001 shows that the overall regression is statistically significant as shown in the ANOVA Table (Table 6). Also, as indicated in Table 7, age also is a significant predictor of sedentary behaviour on weekends with a p-value < 0.001 thus, accounting for a significant amount of unique variance in sedentary behaviour on weekends but gender on the other hand was not statistically significant indicating that boys and girls don't differ significantly in the sedentary behaviour on weekends.

However, there is a distinction in the adjusted R values for screentime on weekends and school days. The adjusted R squared of 6.3% for weekend screentime indicates a moderate level of explanatory power with the remaining 93.7% of variation likely attributed to other factors or random sources that the model doesn't capture. Similarly, the adjusted R squared of 5.8% also suggests a low level of explanation with 94.2% of the variation remaining unexplained. This implies a difference in power between the models, where weekend screentime (6.3%) explains slightly more variation in the dependent variable compared to weekday screentime (5.8%).

Table 5 Model summary weekends

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.263	.069	.063	95.563	.069	11.629`	2	313	.001

Predictors: (Constant), Age, Gender

Table 6 Analysis of Variance ANOVA weekends

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	212399.127	2	106199.564	11.626	.001
Residual	2858406.098	313	9132.288		
Total	3070805.225	315			

a. Dependent Variable: Total screen time on weekends

b. Predictors: (Constant), Age, Gender

Table 7 Coefficients weekends

	Unstandardized Coefficients		Standardized Coefficients	T	Sig. p-value
	B	Std. Error	Beta		
(Constant)	27.733	38.194		.726	.468
Gender	11.143	12.823	.047	.869	.386
Age	17.456	3.702	.257	4.715	.001

Dependent Variable: Total screen time on weekends

5.3.3 Association Between Age, Gender, and Sedentary Behaviour on Both Weekends and School Days

Based on the analysis of variance (as shown in Table 9), we have identified one variable which is the total sedentary behavior along, with two predictor variables; age and gender. The adjusted R Square value of 0.073 indicates that 7.3% of the variation in the variable can be explained by these independent variables. Furthermore, looking at the squares (299840.274, 22377.808) and F value of 13.399 with a p value < 0.001 as displayed in Table 9's ANOVA analysis, we can conclude that the overall regression is statistically significant.

Additionally, referring to Table 10, we find that age serves as a predictor for sedentary behavior with a p value < 0.001. This suggests that age explains an amount of variation in sedentary behavior among Finnish children of school age. However, when it comes to gender, there was no difference observed between boys and girls regarding their sedentary behavior.

Table 8 Model summary weekends and school days

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.281	.079	.073	149.592	.079	13.399	2	313	.000

Predictors: (Constant), Age, Gender

Table 9 Analysis of Variance ANOVA weekends and school days

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	599680.548	2	299840.274	13.399	.000[b]
Residual	7004254.059	313	22377.808		
Total	7603934.608	315			

a. Dependent Variable: Total screen time on weekends and school days

b. Predictors: (Constant), Age, Gender

Table 10 Coefficients weekends and school days

	Unstandardized Coefficients		**Standardized Coefficients**	**T**	**Sig. p-value**
	B	**Std. Error**	**Beta**		
(Constant)	46.544	59.788		.778	.437
Gender	22.147	20.072	.060	1.103	.271
Age	29.102	5.796	.273	5.021	.000

Dependent Variable: Total screen time on weekends and school days

5.4 Summary Interpretation of Findings

5.4.1 Gender Analysis

Our study observed a distinct gender disparity, with a significant predominance of males (77.2%). This finding is not merely a numerical observation but carries implications that require deeper exploration.

The many male participants could suggest cultural, social, or psychological factors that make screen-based activities more appealing or accessible to boys. This could be tied to the gaming culture, which may be more popular among boys, or could stem from societal expectations and norms around gender-specific activities. It's also worth considering the types of screen-based activities boys are engaging in, and whether they differ significantly from those of female participants. The lesser representation of females prompts questions regarding their recreational choices. Are females of this age group more engaged in offline activities, or do they have different online preferences? Additionally, it's crucial to understand if the sampling methodology inadvertently contributed to this disparity or if it genuinely represents the broader population's behaviors. Given this gender skew, our findings directly address the aim of exploring age and gender associations with sedentary behaviors (aim 2). This skew may suggest that boys and girls have inherently slightly different screen-time behaviors, even though the analysis in this case shows the difference is insignificant.

5.4.2 Age Dynamics and Sedentary Behavior

Our study focuses on a critical age group (6-12 years), a transitional phase from childhood to adolescence, marked by significant cognitive, social, and emotional development. Navigating through the age-specific data, it’s evident that children aged 9 to 11 are a focal demographic, which can be evaluated as follows:

9-year-olds (23.7%): Representing a critical age where children often gain increased access to technology, understanding the catalysts that drive screen time at this age is crucial. Evaluating if this spike in screen time is due to increased autonomy, peer pressure, or academic factors can provide insights into targeted interventions.
10-year-olds (21.2%): This age group, while slightly less represented, is equally crucial, as it's a transitional phase where academic pressures might increase, potentially influencing

recreational choices. Understanding the balance between academic usage and recreational screen time is vital for crafting balanced, realistic interventions.

11-year-olds (22.5%): As children on the cusp of adolescence, the 11-year-olds might be exploring a diverse range of online activities, including social media, which could inflate screen time. Discerning the nature, content, and context of screen time is paramount to ensure healthy digital literacy and safe online navigation.

- Developmental Milestones: This age range is also when children start forming long-lasting habits, and their screen-time now can set the stage for their adolescent and adult years. Beyond mere recreation, screen time can also play a role in socialization, learning, and relaxation.
- This age-specific breakdown provides a comprehensive understanding of the prevalence and levels of screen-time behaviors among different age cohorts, addressing our aim of examining age associations with sedentary behaviors (aim 2).

5.4.3 Social-Ecological Model

- Individual Layer: The individual layer focuses on personal characteristics. In our study, this translates to the observed preferences and tendencies of children aged 6 to 11 towards screen-based activities.
    - Personal Preferences and Development: Each child, with their unique cognitive, social, and emotional profile, interacts with technology differently. Some may be drawn to complex games that challenge their cognitive skills, while others may prefer passive content consumption.
    - **Aligning with Aim 1**: By linking personal characteristics to sedentary behaviors, we directly address our aim to understand the prevalence and nature of these behaviors.
- Interpersonal Layer: Interpersonal dynamics, especially those with peers and family, play a pivotal role in shaping children's screen-time behaviors.
    - Peer Influence: Children of this age group are highly influenced by their peers. If their friends are engaged in certain online games or platforms, they're likely to follow suit. It's not just about the screen time but also the need for social validation and belonging.
    - Family Dynamics: The role of family, especially siblings and parents, is crucial. Their attitudes, rules, and behaviors around screen time can significantly influence children's habits.

- **Aligning with Aim 1**: This exploration into interpersonal dynamics provides deeper insights into the prevalence and nature of sedentary behaviors among children, directly addressing our research aims.

- Community & Societal Layers: Community and societal norms around screen time can both enable and restrict sedentary behaviors.
  - Community Infrastructure: The kind of technological infrastructure in schools, community centers, and homes can dictate the nature and amount of screen time. For instance, a school that integrates technology heavily into its curriculum might see students with higher screen time.
  - Societal Norms and Regulations: Societal attitudes towards screen time, regulations around its use in public spaces, and its portrayal in media can all subtly shape children's behaviors.
  - **Aligning with Aim 1**: Understanding these layers is crucial to fully grasp the prevalence and nature of sedentary behaviors, directly addressing our research aims.

5.4.4 Technology and Health Behavior Framework

- Delineating Screen Time

Our findings indicate a clear preference for TV over PC, which suggests differing patterns and purposes of engagement with these platforms.

  - TV vs. PC: While TV often offers more passive content consumption, PCs might be used for a range of activities, from gaming to academics. The nature of engagement, whether passive or interactive, influences its impact on the child.
  - **Aligning with Aim 3**: This differentiation in screen time use is critical for developing interventions that are sensitive to children's existing technology use patterns.

- Envisioning Technology-Driven Interventions: The noticeable increase in screen time during weekends highlights a potential area for intervention.
  - Weekend Screen Time: The spike during the weekends might be attributed to increased free time, absence of school, and possibly different family routines. This pattern might also suggest that interventions during this period might be particularly impactful.
  - Integrating Physical and Digital Worlds: Given that technology is a significant part of children's lives, purely reducing screen time might not be a realistic or even a

completely desirable goal. Instead, leveraging technology to foster physical activity can be a viable strategy.

    - Active Gaming: Introducing and promoting games that require physical activity, such as augmented reality games that encourage outdoor exploration or console games that necessitate physical movement, could be a strategic way to intertwine screen time with physical activity.
    - Educational Platforms: Employing platforms that amalgamate learning with physical activity, potentially through interactive, movement-based learning apps or online platforms, can cater to both cognitive and physical development.
- Parental Engagement Platforms**:** Developing platforms that enable parents to engage with, monitor, and even participate in their children's digital activities could foster healthier screen habits. Providing parents with the tools to understand and navigate the digital world alongside their children can ensure safe and healthy engagement.

- **Aligning with Aim 3**: Identifying these patterns and their potential underlying causes is crucial for developing effective interventions, thereby addressing our aim of exploring areas for technology-driven interventions.

These observed patterns of behavior suggest avenues for technology driven interventions. However, implementing and evaluating interventions would require research to ensure their effectiveness in promoting physical activity and reducing sedentary habits. The subsequent sections will discuss these interventions and their evaluation, in detail.

6. Discussion

The main objective of this study was to examine how demographic factors such, as age and gender are connected to behavior, screen time in school aged children from Finland. We used data from the Atherosclerosis Risk Factors in Young Finns also known as the Young Finns Study to shed light on the prevalence of sedentary behavior, how age and gender impact these behaviours, and to identify potential opportunities, for interventions driven by technology.

6.1 Prevalence of Sedentary Behaviour

Our research discovered that a significant number of children engage in sedentary activities particularly involving screen time. During school days children spent an average of around 103.76 minutes watching TV and 38.24 minutes using the computer. On weekends these numbers increased to 151.45 minutes and 54.36 minutes respectively. These figures indicate that a considerable portion of children's waking hours is devoted to sedentary behaviours highlighting the need to address this issue.

These findings are consistent with worldwide trends as documented in many studies; Tremblay et al. (2011) reported an increasing trend in sedentary behavior among children mainly driven by screen time activities. Similarly, Sisson et al. (2009) observed patterns in the United States where children spend a lot of time engaged in sedentary behaviours, particularly those related to screens. It is important to note that this trend is not limited to developed countries; Song et al. (2019) found a high prevalence of sedentary behavior among Chinese children thus, emphasizing its global nature. The high occurrence of sedentary behavior identified in our study aligns with research conducted in Finland too. Tammelin et al. (2007) highlighted the prevalence of sedentary behavior, among Finnish youth underscoring its pervasive nature within this population. Similarly, a recent study conducted by Husu et al. (2022) discovered that a significant proportion of working age individuals, in Finland engage in sedentary behavior. This observation suggests that this behavior may have its roots, in childhood and persist into adulthood.

In comparison, our findings indicate that Finnish children have a high rate of screen time compared to other populations. For instance, Almaqhawi (2022) discovered that children, in Saudi Arabia have low levels of technology usage suggesting that cultural or environmental factors may contribute to differences in screen time habits. Additionally, a study conducted by Sousa (2017) on adolescents in Brazil reported smaller screen time averages, indicating

potential variations in sedentary behaviours across different countries and age groups. The consequences of sedentary behavior particularly related to screen time are well documented; adverse health outcomes such as obesity (Biddle et al., 2011) decreased sleep quality (Cespedes et al., 2014). Reduced physical fitness levels (Hardy et al., 2013) are associated with increased sedentary behavior. Given the prevalence of sedentary behavior observed in our study and these potential negative health impacts, they emphasize the need for effective interventions. The significant prevalence of sedentary behavior among children as discovered in this study is cause, for concern. It underscores the importance of implementing strategies to address sedentary behavior within the school-age population. This could involve promoting activity, limiting screen time usage, and encouraging active behaviours. Future research should focus on identifying interventions and policies that effectively tackle this public health issue.

6.2 Association of Age and Gender with Sedentary Behaviour

The results of our study highlight age, as an indicator of behavior in Finnish children. This conclusion is supported by the regression analysis, which yielded a p-value of less than 0.001. As children get older their chances of engaging in various activities, particularly screen time increase. This finding aligns with research that has observed same trends; For instance, Sallis et al. (2000) observed an escalation in sedentary behavior among children and adolescents as they age. Other studies have also validated this discovery. Nader et al. (2008) for example reported a decrease in physical activity between the ages of 9 and 15 years suggesting a potential rise in sedentary behavior during that period. Telama et al. (2014) discovered that activity patterns established during childhood persist into adulthood indicating that if not addressed appropriately sedentary behavior may continue throughout stages of life.

The escalation of sedentary behavior, with age can be attributed to many factors. As children progress through school, academic demands often increase, leaving less time for physical activity as they dedicate more time to studying (Lee et al., 2019). Additionally older children are more likely to engage in leisure activities that promote sedentary behaviours like playing video games and using social media platforms (Rideout et al., 2010). These different factors interact in a manner involving age, changes in lifestyle, and sedentary habits. This calls for research to fully understand their relationship.

However, in this study we did not find any association between gender and sedentary behavior. This indicates that both the boys and girls had amounts of screen time which goes

against some research findings; For instance, Rideout et al. (2010) suggested that boys might have more screen time than girls. On the hand Lee et al. (2019) also discovered that boys had screen time than girls among adolescents in Canada and Guatemala. Additionally, Serrano Sanchez et al. (2014) found that Spanish adolescent boys were more likely to exceed recommended screen time limits compared to girls. However, these findings might reflect changing trends as digital entertainment and communication become increasingly popular for children of all genders.

Our results align with some studies though; Chen et al. (2018) for example reported no gender differences in the coexistence of physical activity and sedentary behavior among children and adolescents in Shanghai, China. Similarly, Almaqhawi and Albarqi (2022) found no gender differences in the impact of technology use on children's activity in Saudi Arabia.

The variation between these findings and our study could be attributed to cultural, societal factors or differences in methodologies used across the studies.

It could also indicate shifts in behavior as norms regarding gender and technology usage change. Nevertheless, this emphasizes how intricate the connection is, between gender and sedentary habits underscoring the necessity for research to gain an understanding of these dynamics.

6.3 Age Within the Multifaceted Dimensions of the Social-Ecological Model

Understanding the correlation between age and sedentary behavior is enriched when contextualized within the dimensions of the social-ecological model (Bronfenbrenner, 1979): **Individual Dynamics**: Developmental changes, such as cognitive maturation and evolving academic pressures, could lead older children to opt for screen-based activities as a mode of relaxation and information-seeking. **Interpersonal Interactions**: The realm of peer interactions becomes more complex with age. Adolescents might be drawn towards screen-related activities due to peer dynamics, societal trends, or even the digital interests of siblings. **Institutional Context**: As educational institutions integrate technology into their curricula, children's exposure to screens for academic endeavors might inadvertently encourage sedentary habits outside formal learning environments. **Community and Societal Influences**: Larger societal paradigms, including the normalization of screen-time among adolescents and the cultural acceptance of digital gaming or social media, can contribute to the entrenchment of these behaviors.

6.4 Gender Parity in Sedentary Activities: A Reflection of Finnish Societal Values?

Our study's findings, which suggest a lack of pronounced gender disparities in sedentary behaviors, merit a deeper exploration within the cultural and societal context: **Interpersonal Dynamics**: The egalitarian ethos of Finnish families might advocate for uniform treatment of both genders, resulting in analogous recreational inclinations. This egalitarian perspective has been previously explored in research that investigates family dynamics and the overarching Finnish value system (Pulkkinen et al., 1999). **Community Amenities**: Equitable access to community facilities and programs for both genders can standardize screen time behaviors. The role of community structures in fostering physical activity among Finnish youth has been accentuated in prior research (Vuori et al., 2014). **Societal Paradigms**: The Finnish societal structure, globally recognized for its progressive views on gender equality, might be less inclined towards gender-specific norms surrounding digital activities. This aligns with broader insights into health behaviors in regions like Helsinki and investigations into the Finnish education system's approach to physical health (Lahelma et al., 2005; Nupponen 1998).

6.5 Potential Areas for Technology-Driven Interventions

One interesting discovery, from our research is that Finnish children tend to have less activity on weekends compared to school days. This aligns with studies, such as the work by Fairclough et al. (2012) which also noted an increase in sedentary behavior during weekends. This indicates that weekends present an opportunity for interventions aimed at reducing sedentary behavior and promoting more activity.

To tackle this issue one potential approach could involve utilizing technology driven interventions. For instance, active video games have demonstrated their ability to increase activity among children (Baranowski et al., 2012; Staiano et al., 2011). Similarly mobile applications that encourage activities can help spark children’s interest in physical activity and reduce the time spent on sedentary screen-based activities. Supporting this approach is a study by Direito et al. (2017) which conducted a review and meta-analysis of randomized controlled trials and found that mobile health technologies effectively promote physical activity while reducing sedentary behavior. Likewise, He et al. (2021) discovered through their review and meta-analysis that smartphone-based interventions can successfully boost activity levels, in children and adolescents.

However, it is crucial to consider the drawbacks associated with technology driven interventions. For example, according to Ferguson's research in 2017 it was discovered that using screens, in moderation did not lead to issues, in children. However excessive screen use could potentially have impacts. As a result, it is important to create interventions that encourage screen habits than adding to excessive screen time.

Furthermore, it is important to customize technology-based interventions according to the characteristics and needs of the target group. Our research reveals that there are no differences, in sedentary behavior between genders so interventions should be inclusive and appealing to both boys and girls. Additionally considering the relationship between age and sedentary behavior it may be necessary to tailor these interventions based on age appropriateness, employing strategies for children compared to older ones.

When designing these interventions, it is crucial to take other factors into account. As pointed out by Tandon (2012) socioeconomic status can influence children's levels of activity and screen time. Therefore, interventions need to be accessible and attractive to children from all backgrounds.

While technology driven interventions show promise in reducing sedentary behavior and promoting physical activity among children, their development and implementation require careful, thoughtfulness, and thorough evaluation. This involves conducting pretests for the interventions, monitoring their usage and impact, and adjusting based on feedback and results.

Our findings emphasize the effectiveness of implementing interventions during weekends as an opportunity, for reducing sedentary behavior. With planning and consideration of other relevant factors, technology-driven approaches could offer a promising solution to address this issue.

6.6 Weekend Dynamics: Navigating the Interface of Technological Enticements and Environmental Opportunities

The amplified sedentary tendencies during weekends can be scrutinized through the combined lens of the social-ecological model and the technology and health behavior framework (Riley et al., 2011): **Individual and Interpersonal Dimensions**: The absence of school-driven routines during weekends could propel children towards technology as a primary entertainment source, especially if familial patterns or peer engagements endorse such behaviors. **Technological Implications**: The pervasive presence of technology offers a

paradox. While it provides an accessible entertainment avenue, it also presents opportunities for mitigation. Innovative solutions such as gamified physical activity apps, interactive edutainment platforms, and virtual group challenges can transform passive screen time into active engagements. **Community and Societal Initiatives**: Future interventions warrant a twofold approach. Alongside leveraging technology's potential, community-focused strategies like local weekend physical activities, tech-free community days, or even sports events can offset the increasing sedentary tendencies.

7. Recommendations

Building on the results of this study, which focused on screen time as a primary indicator of sedentary behaviour among school-aged Finnish children, we suggest several opportunities for technology-driven interventions. These suggestions are specifically designed to promote activity and reduce screen time considering the sedentary behavior patterns identified in the study;

1. *Television Time*; The study found that a significant amount of time is spent watching television on both school days (an average of 103.76 minutes) and weekends (an average of 151.45 minutes). To make this time more active we can develop TV programs or games that encourage children to stand up move around and engage in activities while watching TV.

2. *Active Computer Use*; On school days children spend an average of 38.24 minutes using a computer, which increases to 54.36 minutes on weekends. We can make this screen time more active by creating games that require movement to play or developing apps that remind and reward children for taking breaks from the screen to engage in activities.

3. *Weekends*; The study revealed that children tend to be more sedentary, on weekends compared to school days. This indicates that interventions targeting weekends could be particularly effective. Technology driven solutions could involve gamified activities or challenges designed to be completed over the weekend as well as apps that encourage outdoor play and track individuals' participation, in various activities.

4. *Mixed Reality (VR/AR)*; As these technologies keep advancing, they have the potential to create captivating activities, for children. This way screen time can be transformed into active time.

5. *Community-Based Tech Initiatives*: Collaborate with local communities to introduce technology-driven sports or activity events, leveraging communal spaces like parks or recreational centres.

6. *Educational Tech Programs*: Integrate technology-driven physical activities into school curriculums, ensuring that children receive structured screen time that promotes health.

It is crucial to consider the interests, capabilities and surroundings of the children when designing any intervention; these interventions should hence be experimented with for their effectiveness in promoting physical activity and reducing sedentary behaviour.

8. Conclusion

The ongoing study contributes to the existing knowledge on the sedentary behaviors of children, with a particular emphasis on the Finnish context. Our findings support the increasing agreement on the necessity to create and execute programs focused on reducing sedentary behaviors and promoting physical activity among young people. We provide new insights on the level of sedentary behavior in this specific group, explaining how it is connected to important demographic factors like age and gender among school-aged children in Finland. This data is crucial for healthcare professionals, policymakers, academics, and other stakeholders to develop specific treatments. Our data shows a significant increase in screen usage and sedentary activities as Finnish children get older; this highlights the need for interventions tailored to certain age groups. Our research did not reveal any significant differences between genders in sedentary behaviors, indicating that intervention techniques should cater to both males and females. The weekend is a favorable time to deploy treatments, especially those that utilize technological improvements to encourage physical activity and reduce sedentary behavior. However, the effectiveness of these suggested solutions needs more empirical investigation. Our mission is to develop healthier habits in children, so ameliorating their overall well-being through evidence-based treatments, research activities, and informed policymaking. This conclusion also highlights the limitations of the study-while our thesis has made significant strides in examining the association between age and gender with sedentary behavior one limitation lies in the fact that our study primarily focused on the individual layer of the SEM framework, with discussions on other layers despite the absence of available variables or data to support them. Again, it is worth noting that even after controlling for age and gender, unmeasured variables such as socio-economic status or parental influence could potentially influence outcomes, indicating avenues for future research. Moving forward, future studies could benefit from exploring these unmeasured variables more comprehensively, thus providing deeper insights into the complexities of sedentary behavior. In Finland, future research should focus on creating and testing interventions that aim to discourage sedentary behavior and encourage physical activity in children. Hence, prospective interventions ought to adopt a holistic approach, targeting multiple contributing elements of sedentary behavior across individual, interpersonal, communal, and societal dimensions.

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Annexes

Annex I. Study Characteristics

Study (Author, Year)	Aim of the study	Design	Participants (Number and Age)	Setting	Outcome Measures	Main Findings
Ana Elisa Messetti Christofoletti et al., 2020. BRAZIL	To analyze the prevalence of and sociodemographic factors associated with SB situations in adolescents of both sexes, in the final years of elementary school (6th to 9th grade) and in high school, from public and private schools in the municipality of Rio Claro-SP.	Cross-sectional epidemiological study	Adolescents in the final years of elementary education and in high school, of both sexes.	Public and private schools in the city of Rio Claro-SP	Sedentary behavior (SB) situations in adolescents, not just screen time. The SB situations considered include smartphone use, TV viewing, computer/tablet use, video game playing, and SB involving obligations.	The variable that most favor high SB among Rio Claro's schoolchildren is smartphone, followed by time spent on computer/tablet and video games, obligations and TV. Sociodemographic factors were not associated with total SB in the present study. The study found no correlation between SB and diseases.
Yolanda Demetriou et al., 2019.	The main objectives of this systematic review are to evaluate the effects of interventions on girls' and boys' PA and SB and to appraise the extent to which the studies have taken sex/gender into account.	Study design based on Cochrane standards			Cochrane Risk of Bias Tool for assessing the risk of bias of the primary studies.	The results of the review will help establish sex/gender guidelines on the development, implementation, and appraisal of physical activity promotion and sedentary behaviour reduction interventions.
Eman Sharara et al., 2018.	To review research on the subject, assess levels and variability in	Systematic review of research published in refereed	172 articles referring to a total of	Various settings including schools (28%),	Various definitions and measures of physical activity. The	Disparities in the available evidence: for some countries there are very

	physical inactivity across countries and social groups, and gain insights into the extent to which social determinants, particularly those related to gender, could explain such unfavorable indicators.	journals and reports of surveys.	157 datasets	health facilities (27%), households (16%), and universities (15%).	most common instruments used were the Global Physical Activity Questionnaire (GPAQ) and the Patient-Centered Assessment and Counseling for Exercise.	few studies (Algeria, Comoros, Djibouti, Iraq, Somalia, Sudan, and Yemen), while for others many more sources are available (for example 40 for Saudi Arabia).
Abdelghaffar El-ammari et al., 2017.	This study aimed to determine prevalence of PI and SB and to explore their potential social-ecological associated factors in school-age adolescents.	Cross-sectional study using a multistage stratified cluster random sampling method	764 adolescents from middle and high secondary schools in Taza city	Middle and high secondary schools in Taza city	Assessment of health behaviors among students aged 13 to 17 years using the Global School-based Student Health Survey (GSHS) questionnaire.	Prevalence of PI was 79.5% and SB was 36.5%. PI and SB occurred more often in girls than in boys.
Chao Song et al., 2019.	The purpose of the study was to describe the PA and sedentary behavior among Chinese children.	Cross-sectional analysis conducted at the homes or schools of the children by trained investigators.		Homes or schools of the children.	Assessment of four PA domains: school-time PA, transportation PA, leisure-time PA, and domestic PA. Leisure-time sedentary behaviors included watching television, using computers, playing video games, reading, and doing homework in leisure time.	Only one in three children participated in leisure-time PA, two in three children went to school by active transport, and about 70% of children did domestic PA. Chinese children spent a long time on sedentary behavior.

Si-Tong Chen et al., 2018. China.	This study has two aims: 1) to investigate the prevalence of PA and SED, and their co-existence, and 2) to examine the associations between PA or SED, or both with gender and age among children and adolescents in Shanghai, China.	Cross-sectional school survey	1st-12th graders in 711 public primary, middle, and high schools	711 public primary, middle, and high schools selected from all 17 districts in Shanghai	Measurement of physical activity (PA) and sedentary behavior (SED) using a self-reported questionnaire derived from the Health Behavior School-aged Children (HBSC) survey questionnaire.	Majority of children and adolescents in Shanghai were both physically inactive and engaged in high levels of sedentary behavior.
Bita Shalani et al., 2021.	This study was done to determine the correlates of Screen Time (ST) in children and adolescents.	Cross-sectional study	268,478 samples, age ranged from 0 months to 19 years		Demographic and family history questionnaire, diet and lifestyle questionnaire, neighborhood, and home environment questionnaire	Factors that correlate with screen time include gender, parental modeling of TV and movie streaming, access to screens, self-efficacy towards limiting TV and movie streaming, perception of safety, and others. Parental education and physical environmental variables were not associated with screen time.
Sunyue Ye et al., 2018.	The study aimed to explore the individual and environmental correlates of screen time (ST) among 8–19-year-old	Cross-sectional study using a mixed-effects model	1063 students aged 8–19 years from five elementary, junior high, or	Five elementary, junior high, or senior high schools	Screen time (ST), media accessibility, presence of parents/others	ST and leisure-based computer use were higher in boys than in girls. ST was positively associated with media accessibility

	students in China.		senior high schools			and negatively associated with the presence of parents/others. Male sex, junior high school students, weekends, presence of parents/others, and media accessibility were significantly associated with prolonged ST.
Zihao He et al., 2021.	This systematic review and meta-analysis aimed to determine the effectiveness of smartphonebased interventions for improving PA in children and adolescents.	Systematic review and meta-analysis of randomized controlled trials (RCTs)	Children and adolescents aged 18 years or younger. The studies included both healthy participants and those with specific health conditions.	Various settings from the included RCTs.	Change in physical activity levels, as measured by steps per day or minutes of moderate to vigorous physical activity per day. Secondary outcomes included body mass index (BMI), waist circumference, and other health-related outcomes.	Smartphone-based interventions significantly increased physical activity in children and adolescents. However, the effects on BMI and waist circumference were not significant.
Abdullah Almaqhawi et al., 2022.	Determine the relationship between technology use and physical activity.	Cross-sectional study using an online questionnaire	Children between 6 to 12 years living in the eastern region of Saudi Arabia	Eastern region of Saudi Arabia	Technology use and physical activity	About half of the children had a low level of physical activity. The number of siblings, ownership of electronic devices, and screen time were the most important predictors of low physical activity.

Thekra Alotaibi et al., 2020.	investigate the relationship between technology use and physical activity level and to measure the association between sociodemographic characteristics of the participants, technology use, and physical activity level among Saudi children.	Cross-sectional study	Parents of typically-developing children between the ages of 6–12 years within Saudi Arabia		Technology use and physical activity level	High use of technology was significantly associated with a low level of activity. Children who spend less than 5 hours each week on their devices tend to have higher levels of physical activity compared to those who spend more than 6 hours. Ownership of a device was significantly associated with higher technology time consumption. The age of the child, educational level of the parents, screen time use, and owning electrical devices significantly predicted the level of physical a...
Jose A. Serrano-Sanchez et al., 2011.	determining whether screen-time is associated with a reduced level of moderate to vigorous physical activity (MVPA) in Spanish adolescents	Cross-sectional survey	4000 adolescents aged 12-18 years from the school population	Schools in Gran Canaria, Spain	Moderate to vigorous physical activity (MVPA) and screen-related behaviors.	Total time accumulated through various screen-related behaviours was negatively associated with MVPA level in boys. Boys who reported 4 hours or more per week to

	living in favorable environmental conditions.					total screen-time showed a 64% increased risk of failing to achieve the recommended adolescent MVPA level.
Gabriel Renaldo de Sousa et al., 2017.	estimate the prevalence of sedentary behavior based on screen time (≥ 2-hour day) and to identify the association with sociodemographic factors among adolescents in a city in southern Brazil.	Part of the Brazilian Guide for Evaluation of Physical Fitness Related to Health and Life Habits	Adolescents aged 14-19 years enrolled in high schools of São José, SC, Brazil	High schools of São José, SC, Brazil	Different sedentary behaviors based on screen time (TV, PC, VG, and total screen time).	Boys of low socioeconomic status were more likely to exceed total screen time. Girls of white skin colour were less likely to watch TV above recommendations, and older girls were less likely to have sedentary behaviour based on total screen and VG time.
Eun-Young Lee et al., 2017.	to compare the levels of physical activity (PA) and sedentary behavior (SB) between Canadian and Guatemalan adolescents, and to examine associations of sociodemographic variables with PA and screen time among adolescents in Canada and Guatemala.	Part of the COMPASS study, a longitudinal hierarchical research platform	In Canada, 42,355 students from 87 schools. In Guatemala, 1277 students from four secondary schools.	Schools in Canada and Guatemala	Physical activity (PA), sedentary behavior (SB), and sociodemographic variables.	Boys of low socioeconomic status were more likely to exceed total screen time. Girls of white skin colour were less likely to watch TV above recommendations and older girls were less likely to have sedentary behaviour based on total screen and VG time.

Annex II. Information Sheets for the Child

LASERI - Lasten Sepelvaltimotaudin Riskitekijät -tutkimus

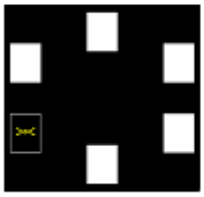
Tiedote lääketieteellisestä tutkimuksesta

Isäsi tai äitisi on aikaisemmin osallistunut LASERI-nimiseen tutkimukseen. Siinä tutkitaan erilaisia ihmisen terveyteen vaikuttavia asioita. Nyt kutsumme tutkimukseen mukaan myös sinut ja sisaruksesi.

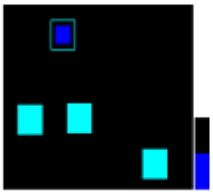
Tutkimukseen kuuluu **kyselyihin vastaaminen ja tutkimuskäynti**. Kyselyihin voit vastata kotona joko tietokoneella tai täyttämällä paperisen lomakkeen. Vanhempasi tai muu aikuinen voi tehdä tämän puolestasi tai auttaa sinua. Tutkimuskäynti kestää noin 2 tuntia. Tutkimuskäynnillä arvioidaan kasvua ja kehitystä sekä mitataan verenpaine, vyötärön ympärys, pituus ja paino sekä otetaan verinäyte. Lisäksi tehdään kivuton ultraäänitutkimus ja tutkitaan muistia ja oppimiskykyä. **Kaikki mittaukset ja tutkimukset ovat turvallisia ja voit itse valita mihin tutkimuksen osiin haluat osallistua**.

Ultraäänikuvaus on kivuton tutkimus, joka tehdään laittamalla kuvassa näkyvä mittalaite ihon pinnalle. Tutkimuksessa mittalaitetta liikutellaan kaulalla ja vatsan päällä. Ultraäänikuvaus kestää noin puoli tuntia. Jos haluat, voit seurata tutkimuksen tekemistä ultraäänilaitteen kuvaruudulta.

Muistia ja oppimista mittaava testi tehdään tablettitietokoneella. Iästäsi riippuen testissä on enintään neljä osaa. Ensimmäisessä osassa etsit kuvapareja laatikoiden alta samoin kuin muistipelissä. Toisessa osassa etsit laatikoiden alle piilotettuja kolikoita. Kolmannessa osassa etsit tabletin näytöllä vaihtuvien numeroiden joukosta sinulle annettuja numeroita. Viimeisessä osassa sinun pitää koskettaa tabletin näytölle ilmestyvää palloa mahdollisimman nopeasti. Koko testi kestää korkeintaan puoli tuntia. Testiä tehdessäsi huoneessa on koko ajan tutkimushoitaja, joka auttaa sinua.



Testi 1



Testi 2

Testi 3

Testi 4

Jotta **verinäytteen antaminen** ei sattuisi, pistoskohdan iholle laitetaan puudutusvoidetta. Voide tekee verinäytteen antamisen kivuttomaksi. Sinun pitää olla syömättä ja juomatta ainakin 4 tuntia ennen verinäytteen antamista (voit juoda pienen lasin vettä, jos sinulla on jano). Tutkimuskäynnillä saat pienen välipalan verinäytteen antamisen jälkeen. Jos haluat, voit ottaa mukaasi myös omat eväät.

Verenpaineen mittauksessa käsivarren ympärille asetetaan leveä vyö (katso kuva yllä). Vyö aiheuttaa käsivarteen pienen puristuksen tunteen, joka kestää vain pienen hetken.

Suoliston bakteerit Ihmisen suolistossa on paljon erilaisia bakteereita. Bakteerien määrä ja se millaisia ne ovat voi vaikuttaa ihmisen terveyteen. Tämän takia suoliston bakteerien tutkiminen on tärkeää. Suoliston bakteereita voidaan mitata ulosteesta. Tutkimuskäynnillä saat mukaasi ohjeet näytteen antamista varten sekä näyteputken ja valmiin palautuskuoren, jossa näyte palautetaan tutkittavaksi.

Rekisteritutkimus Sinusta on elämäsi aikana kerätty tietoja erilaisiin rekistereihin. Esimerkiksi kun olet käynyt lääkärissä, ollut hoidettavana sairaalassa tai sinulle on määrätty jotain lääkettä, nämä tiedot on siirretty rekistereihin. Rekistereissä olevia tietoja voidaan käyttää hyödyksi tutkimuksessa. Näitä rekistereissä olevia tietoja voidaan yhdistää tässä tutkimuksessa sinulta saatuihin tietoihin.

Geenitutkimus Tutkimuskäynnillä antamastasi verinäytteestä tutkitaan perintötekijät eli geenit, jotka olet saanut isältäsi ja äidiltäsi. Geenitutkimuksen tarkoituksena on selvittää, miten erilaiset terveyteen liittyvät asiat siirtyvät vanhemmilta lapsille. Geenitutkimusten tuloksia ei kerrota sinulle, vanhemmillesi tai kenellekään muulle. Tietoja ei kerrota siksi, että geenien vaikutuksesta sairauksien riskiin tiedetään vasta vähän eikä sinulle ja terveydellesi ole sen takia hyötyä tästä tiedosta.

Salassapito Kaikki tässä tutkimuksessa kerätyt tiedot ja näytteet pidetään salassa. Vanhempasi, sisaruksesi, isovanhempasi, opettajasi tai muut ihmiset eivät saa nähdä sinun tietojasi. Tietojasi käsitellään sillä tavalla, että sinun nimesi voidaan yhdistää kerättyihin tietoihin vain monimutkaisen koodiavaimen avulla. Sinun nimesi ja muut tietosi säilytetään lukitussa huoneessa.

Tietojasi käsittelevät ainoastaan sellaiset ihmiset, jotka ovat allekirjoittaneet lupauksen olla kertomatta niitä muille. He antavat sinun antamillesi tiedoille koodin tähän tutkimukseen ja poistavat sen jälkeen tiedoistasi nimet ja osoitteet. Tällä tavalla nimettömiksi tehdyt tiedot ovat tässä tutkimuksessa työskentelevien tutkijoiden käytettävissä. Tutkimuksen tulokset julkaistaan niin, että sinua ei voi mitenkään tunnistaa. Nimettömäksi tehdyt tiedot säilytetään pysyvästi ja niitä käytetään tutkimukseen ja opetukseen.

Osallistuminen tähän tutkimukseen on vapaaehtoista ja voit itse vapaasti valita, mihin tutkimuksen osiin haluat osallistua. Voit myös täysin vapaasti jäädä pois tutkimuksesta koska vain. Sinun ei tarvitse kertoa syytä, jos et halua osallistua tai jatkaa tutkimuksessa. Poisjäämistä ei pidetä epäkohteliaana eikä siitä ole sinulle tai vanhemmillesi mitään haittaa. Jos jäät pois tutkimuksesta, siihen mennessä kerätyt tiedot kuitenkin säilytetään. Vaikka tutkimuksesta ei olekaan sinulle varsinaista hyötyä, saat tiedot verinäytteesi keskeisimmistä tuloksista.

LASERI-tutkimuksen on tarkoitus jatkua vuosikymmenien ajan. Sen vuoksi tutkimukseen osallistuviin ihmisiin, eli myös sinuun, ollaan yhteydessä tulevaisuudessa uudestaan.

Osallistumisesi on tärkeää ja auttaa selvittämään miten vanhempiesi ja isovanhempiesi elintavat ja ympäristössä olevat asiat vaikuttavat sinun terveyteesi. Olemme iloisia, jos saamme sinut ja perheesi mukaan tutkimukseen.

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Annex III. Consents for the Children

LASERI - Lasten Sepelvaltimotaudin Riskitekijät -tutkimus

SUOSTUMUS

Minua on pyydetty osallistumaan LASERI – *kolme sukupolvea* -tutkimukseen, jossa isäni ja/tai äitini on ollut mukana aikaisemmin. Tutkimuksessa selvitetään miten ruoka, liikunta ja ympäristössä olevat asiat vaikuttavat ihmisen terveyteen. Olen saanut ja ymmärtänyt tutkimuksesta kertovan tiedotteen. Tutkimuksessa vastaan kyselylomakkeissa oleviin kysymyksiin. Tiedän, että saan itse valita osallistunko tutkimukseen, ja että saan lopettaa tutkimuksen koska vain. Jos lopetan tutkimuksen, kukaan ei ole minulle siitä vihainen. Voin lopettaa tutkimuksen sanomalla tutkimusta tekevälle aikuiselle tai vanhemmilleni, etten halua enää olla mukana. Minun tietojani pääsevät näkemään vain minä ja tätä tutkimusta tekevät aikuiset.

Kirjoittamalla nimeni alla olevaan kenttään vahvistan osallistumiseni tähän tutkimukseen ja suostun vapaaehtoisesti tutkittavaksi.

Lapsen nimi: _____

Lapsen henkilötunnus: _____

Päivämäärä: _____

Lapsen allekirjoitus: _____

SUOSTUMUS

Minua on pyydetty osallistumaan LASERI – *kolme sukupolvea* -tutkimukseen, jossa isäni ja/tai äitini on ollut mukana aikaisemmin. Tutkimuksessa selvitetään miten ruoka, liikunta ja ympäristössä olevat asiat vaikuttavat ihmisen terveyteen. Tutkija on kertonut minulle sekä vanhemmilleni tästä tutkimuksesta ja olen saanut kysyä mieleeni tulleita kysymyksiä. Tutkimuksen aikana vastaan kysymyksiin ja käyn tutkimuskäynnillä. Ainoa haitta, joka tutkimuksesta voi minulle tulla, on verinäytteen antamiseen liittyvä pieni kipu, jota voidaan estää puudutusvoiteella. Tiedän, että saan itse valita osallistunko tutkimukseen, ja että saan myöhemmin lopettaa tutkimuksen koska vain. Jos lopetan tutkimuksen, kukaan ei ole minulle siitä vihainen. Voin lopettaa tutkimuksen sanomalla tutkimusta tekevälle aikuiselle tai vanhemmilleni, etten halua enää olla mukana. Minun tietojani pääsevät näkemään vain minä ja tätä tutkimusta tekevät aikuiset.

Kirjoittamalla nimeni alla olevaan kenttään vahvistan osallistumiseni tähän tutkimukseen ja suostun vapaaehtoisesti tutkittavaksi.

Nimeni: _____

Allekirjoitukseni: _____

Päivämäärä: _____

_____
Suostumuksen vastaanottajan / tietojen antajan allekirjoitus, nimenselvennys ja päivämäärä

Annex IV. Consents for the Parents

LASERI - Lasten Sepelvaltimotaudin Riskitekijät -tutkimus

LASERI – *kolme sukupolvea* tutkimus

SUOSTUMUS

Olen saanut, lukenut ja ymmärtänyt tutkimuksesta kertovan tiedotteen ja minulle on selvitetty myös suullisesti LASERI – *kolme sukupolvea* tutkimuksen tarkoitus ja suorittamistapa sekä mahdolliset haitat. Olen tietoinen, että huollettavani osallistuminen on vapaaehtoista, ja että hänellä on oikeus keskeyttää tutkimus milloin tahansa ilman, että sillä olisi mitään kielteisiä vaikutuksia.

Huollettavani tietojen käsittelystä on luvattu seuraavasti: tutkimuksessa esille tulevat huollettavaani koskevat tiedot ovat luottamuksellisia. Häneltä itseltään kerättyjä tietoja voidaan täydentää liittämällä niihin tietoja viranomaisrekistereistä, jotka on mainittu tiedotteessa. Mitään tutkimuksessa kerättyjä näytteitä tai tietoja ei luovuteta muille viranomaiselle. Näin ollen huollettavani osallistuminen tutkimukseen tai sen keskeyttäminen eivät vaikuta millään tavalla hänen viranomaisilta saamiinsa palveluihin.

Huollettavani henkilötunnuksen sisältävää aineistoa säilytetään lukitussa tilassa ja sitä käsittelevät ainoastaan tutkimuksen koordinaattori ja tilastoasiantuntijat. He muuttavat henkilötunnukset tutkimuskohtaisiksi tunnistenumeroiksi ja poistavat aineistosta tutkittavien nimet, osoitteet ja henkilötunnukset. Vain näin käsitelty aineisto on LASERI-tutkimuksen tutkijoiden ja yhteistyötahojen käytettävissä.

Tutkittavien henkilötunnukset hävitetään lopullisesti LASERI-tutkimuksen päättymisen jälkeen. Kaikki tulokset julkaistaan tavalla, jossa yksittäisiä tutkittavia ei voi tunnistaa. Tunnisteeton tilastollinen tutkimusaineisto arkistoidaan pysyvästi tieteellisen tutkimuksen ja opetuksen käyttöön.

Allekirjoituksellani annan suostumuksen huollettavani osallistumiselle tähän tutkimukseen.

_____

Huollettavan nimi ja henkilötunnus

_____

Huoltajan nimi ja henkilötunnus

_____

Päiväys ja huoltajan allekirjoitus

LASERI – *kolme sukupolvea* tutkimus

SUOSTUMUS

Olen saanut, lukenut ja ymmärtänyt tutkimuksesta kertovan tiedotteen ja minulle on selvitetty myös suullisesti LASERI – *kolme sukupolvea* tutkimuksen tarkoitus ja suorittamistapa sekä mahdolliset haitat. Olen tietoinen, että huollettavani osallistuminen on vapaaehtoista, ja että hänellä on oikeus keskeyttää tutkimus milloin tahansa ilman, että sillä olisi mitään kielteisiä vaikutuksia.

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Käännä

HALUKKUUS VASTAANOTTAA YLEISIÄ TERVEYSTIETOJA JA GEENITIETOJA

Haluatko vastaanottaa huollettavaasi koskevia LASERI-tutkimuksen yhteydessä määritettyjä yleisiä terveystietoja?

☐ Kyllä ☐ En

LASERI-tutkimuksen yhteydessä määritettyjä geenitutkimusten tuloksia ei tiedoteta tutkittaville, koska geenitieto voi koskea myös lähisukulaisia, eikä tulosten tietämisestä nykytiedon valossa olisi hyötyä tutkittavien terveydelle. Jos kuitenkin tulevaisuudessa geenitiedoista löytyy terveyden kannalta oleellista tietoa, josta on syytä tiedottaa (esimerkiksi geenivirheen aiheuttama parannettavissa oleva sairaus), tiedot varmistetaan ja tutkittava saa halutessaan kyseisen tiedon.

Mikäli geenitutkimusten tuloksia tulevaisuudessa päätetään tiedottaa, haluatko vastaanottaa huollettavaasi koskevia geenitietoja?

☐ Kyllä ☐ En

Allekirjoituksellani annan suostumuksen huollettavani osallistumiselle tähän tutkimukseen. Allekirjoituksellani vahvistan myös vastaukseni halukkuudestani vastaanottaa LASERI-tutkimuksen yhteydessä huollettavastani määritettyjä yleisiä terveystietoja ja geenitietoja.

_____

Huollettavan nimi ja henkilötunnus

_____

Huoltajan nimi ja henkilötunnus

_____

Päiväys ja huoltajan allekirjoitus

_____

Suostumuksen vastaanottajan / tietojen antajan allekirjoitus, nimenselvennys ja päivämäärä

LASERI – *kolme sukupolvea* tutkimus

SUOSTUMUS

Olen saanut, lukenut ja ymmärtänyt tutkimuksesta kertovan tiedotteen ja minulle on selvitetty myös suullisesti LASERI – *kolme sukupolvea* tutkimuksen tarkoitus ja suorittamistapa sekä mahdolliset haitat. Olen tietoinen, että huollettavani osallistuminen on vapaaehtoista, ja että hänellä on oikeus keskeyttää tutkimus milloin tahansa ilman, että sillä olisi mitään kielteisiä vaikutuksia.

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Tutkittavien henkilötunnukset hävitetään lopullisesti LASERI-tutkimuksen päättymisen jälkeen. Kaikki tulokset julkaistaan tavalla, jossa yksittäisiä tutkittavia ei voi tunnistaa. Tunnisteeton tilastollinen tutkimusaineisto arkistoidaan pysyvästi tieteellisen tutkimuksen ja opetuksen käyttöön.

Huollettavaltani itseltään kerättyjä tietoja voidaan täydentää liittämällä niihin tietoja viranomaisrekistereistä, jotka on mainittu alla. **Kiellän alla olevien viranomaisrekistereitä ylläpitävien tahojen tai näiden rekistereiden vastaavat tiedot tutkimushetkellä omaavien tahojen tietojen liittämisen LASERI-tutkimuksessa huollettavaltani kerättyihin tietoihin.**

- ☐ Kansaneläkelaitos (tietoja lääkityksistä, maksetuista etuuksista ja korvauksista)
- ☐ Eläketurvakeskus (eläke-, kuntoutus- ja työsuhdetietoja)
- ☐ Työ- ja elinkeinoministeriö (tietoja työllisyydestä ja työllistämistoimenpiteistä)
- ☐ Terveyden ja hyvinvoinnin laitoksen ylläpitämät hoitotietorekisterit (tietoja sairauksien hoidosta, vastaanottokäynneistä ja toimenpiteistä)
- ☐ Terveyden ja hyvinvoinnin laitoksen ylläpitämä Syntyneiden lasten rekisteri (mm. tietoja synnytyksen ja raskauden kulusta sekä tietoja syntyneiden lasten painosta ja pituudesta)
- ☐ Suomen syöpärekisteri
- ☐ Tilastokeskus (tietoja sosioekonomisesta asemasta ja tutkimuskäyttöön suunnitellusta työntekijä-työnantaja-aineistosta)
- ☐ Mahdolliset muut rekisteritietoja ylläpitävät tahot

- ☐ Kaikki yllä mainitut rekisterit

Käännä

HALUKKUUS VASTAANOTTAA YLEISIÄ TERVEYSTIETOJA JA GEENITIETOJA

Haluatko vastaanottaa huollettavaasi koskevia LASERI-tutkimuksen yhteydessä määritettyjä yleisiä terveystietoja?

☐ Kyllä ☐ En

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Mikäli geenitutkimusten tuloksia tulevaisuudessa päätetään tiedottaa, haluatko vastaanottaa huollettavaasi koskevia geenitietoja?

☐ Kyllä ☐ En

Allekirjoituksellani annan suostumuksen huollettavani osallistumiselle tähän tutkimukseen. Allekirjoituksellani vahvistan myös vastaukseni halukkuudestani vastaanottaa LASERI-tutkimuksen yhteydessä huollettavastani määritettyjä yleisiä terveystietoja ja geenitietoja.

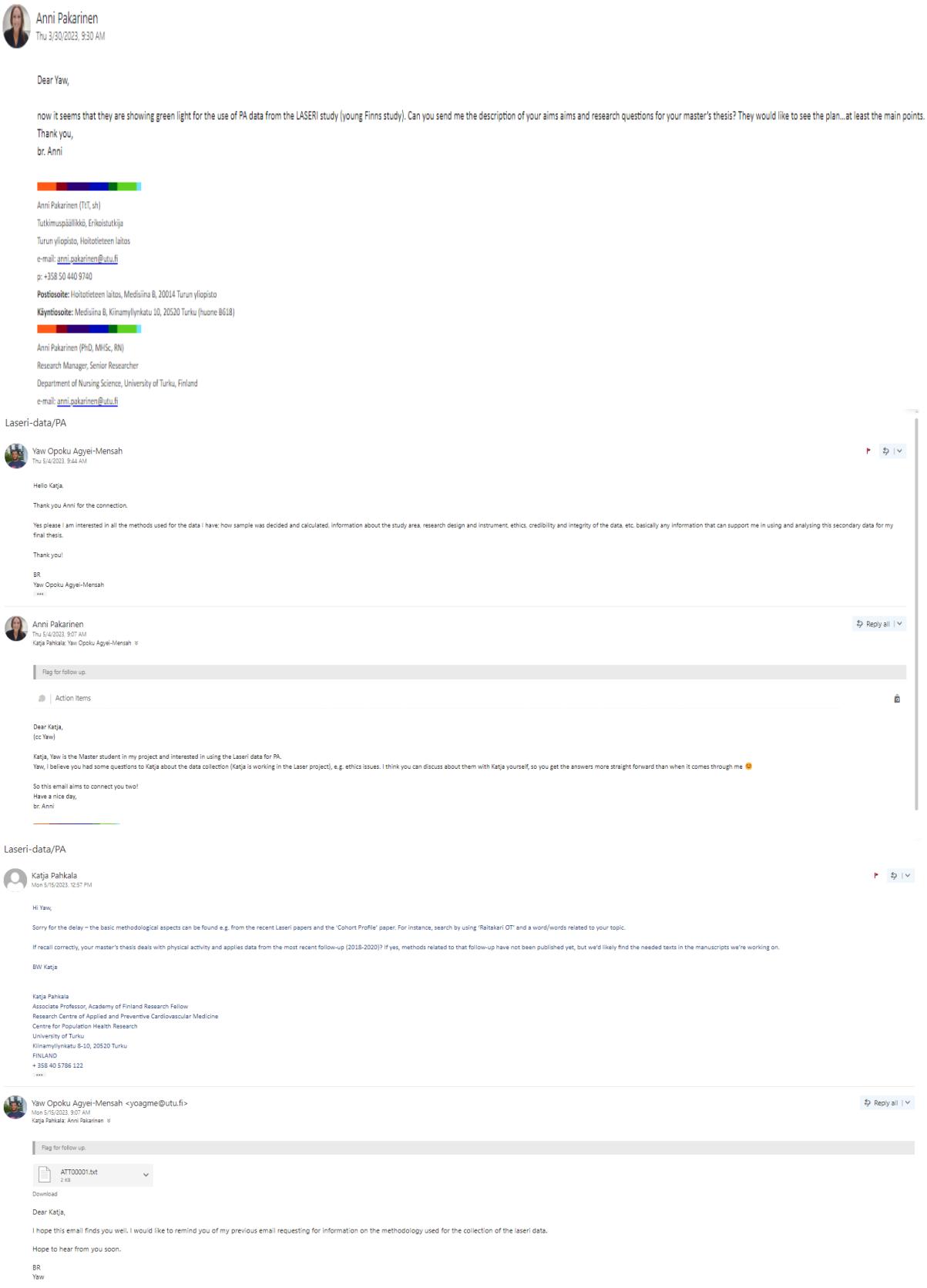
_____
Huollettavan nimi ja henkilötunnus

_____
Huoltajan nimi ja henkilötunnus

_____
Päiväys ja allekirjoitus

_____
Vastaanottajan allekirjoitus, nimenselvennys ja päivämäärä

Annex V. Authors and Authorization Communication



Anni Pakarinen
Thu 3/30/2023, 9:30 AM

Dear Yaw,

now it seems that they are showing green light for the use of PA data from the LASERI study (young Finns study). Can you send me the description of your aims aims and research questions for your master's thesis? They would like to see the plan...at least the main points.
Thank you,
br. Anni

Anni Pakarinen (TkT, sh)
Tutkimuspäällikkö, Erikoistutkija
Turun yliopisto, Hoitotieteen laitos
e-mail: anni.pakarinen@utu.fi
p: +358 50 440 9740
Postiosoite: Hoitotieteen laitos, Medisiina B, 20014 Turun yliopisto
Käyntiosoite: Medisiina B, Kiinamyllynkatu 10, 20520 Turku (huone B618)

Anni Pakarinen (PhD, MHSc, RN)
Research Manager, Senior Researcher
Department of Nursing Science, University of Turku, Finland
e-mail: anni.pakarinen@utu.fi

Laseri-data/PA

Yaw Opoku Agyei-Mensah
Thu 5/4/2023, 9:44 AM

Hello Katja,

Thank you Anni for the connection.

Yes please I am interested in all the methods used for the data I have; how sample was decided and calculated, information about the study area, research design and instrument, ethics, credibility and integrity of the data, etc. basically any information that can support me in using and analysing this secondary data for my final thesis.

Thank you!

BR
Yaw Opoku Agyei-Mensah

Anni Pakarinen
Thu 5/4/2023, 9:07 AM
Katja Pahkala; Yaw Opoku Agyei-Mensah

Reply all

Flag for follow up.

Action Items

Dear Katja,
(cc Yaw)

Katja, Yaw is the Master student in my project and interested in using the Laseri data for PA.
Yaw, I believe you had some questions to Katja about the data collection (Katja is working in the Laser project), e.g. ethics issues. I think you can discuss about them with Katja yourself, so you get the answers more straight forward than when it comes through me

So this email aims to connect you two!
Have a nice day,
br. Anni

Laseri-data/PA

Katja Pahkala
Mon 5/15/2023, 12:57 PM

Hi Yaw,

Sorry for the delay – the basic methodological aspects can be found e.g. from the recent Laseri papers and the 'Cohort Profile' paper. For instance, search by using 'Raitakari OT' and a word/words related to your topic.

If recall correctly, your master's thesis deals with physical activity and applies data from the most recent follow-up (2018-2020)? If yes, methods related to that follow-up have not been published yet, but we'd likely find the needed texts in the manuscripts we're working on.

BW Katja

Katja Pahkala
Associate Professor, Academy of Finland Research Fellow
Research Centre of Applied and Preventive Cardiovascular Medicine
Centre for Population Health Research
University of Turku
Kiinamyllynkatu 8-10, 20520 Turku
FINLAND
+ 358 40 5786 122

Yaw Opoku Agyei-Mensah <yoagme@utu.fi>
Mon 5/15/2023, 9:07 AM
Katja Pahkala; Anni Pakarinen

Reply all

Flag for follow up.

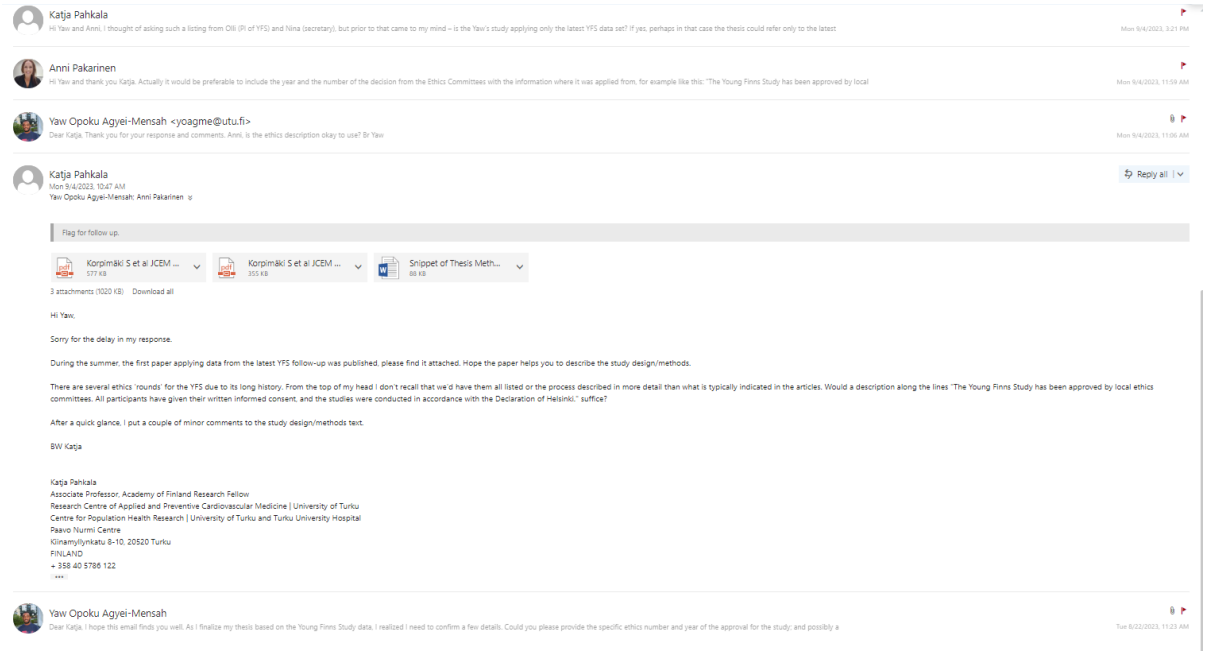
ATT00001.txt
2 KB
Download

Dear Katja,

I hope this email finds you well. I would like to remind you of my previous email requesting for information on the methodology used for the collection of the laseri data.

Hope to hear from you soon.

BR
Yaw



Katja Pahkala
Hi Yaw and Anni, I thought of asking such a listing from Olli (PI of YFS) and Nina (secretary), but prior to that came to my mind – is the Yaw's study applying only the latest YFS data set? If yes, perhaps in that case the thesis could refer only to the latest
Mon 9/4/2023, 3:21 PM

Anni Pakarinen
Hi Yaw and thank you Katja. Actually it would be preferable to include the year and the number of the decision from the Ethics Committees with the information where it was applied from, for example like this: "The Young Finns Study has been approved by local
Mon 9/4/2023, 11:59 AM

Yaw Opoku Agyei-Mensah <yoagme@utu.fi>
Dear Katja, Thank you for your response and comments. Anni, Is the ethics description okay to use? Br Yaw
Mon 9/4/2023, 11:06 AM

Katja Pahkala
Mon 9/4/2023, 10:47 AM
Yaw Opoku Agyei-Mensah; Anni Pakarinen

Reply all

Flag for follow up.

Korpimäki S et al JCEM ... 577 KB
Korpimäki S et al JCEM ... 355 KB
Snippet of Thesis Meth... 88 KB

3 attachments (1020 KB) Download all

Hi Yaw,

Sorry for the delay in my response.

During the summer, the first paper applying data from the latest YFS follow-up was published, please find it attached. Hope the paper helps you to describe the study design/methods.

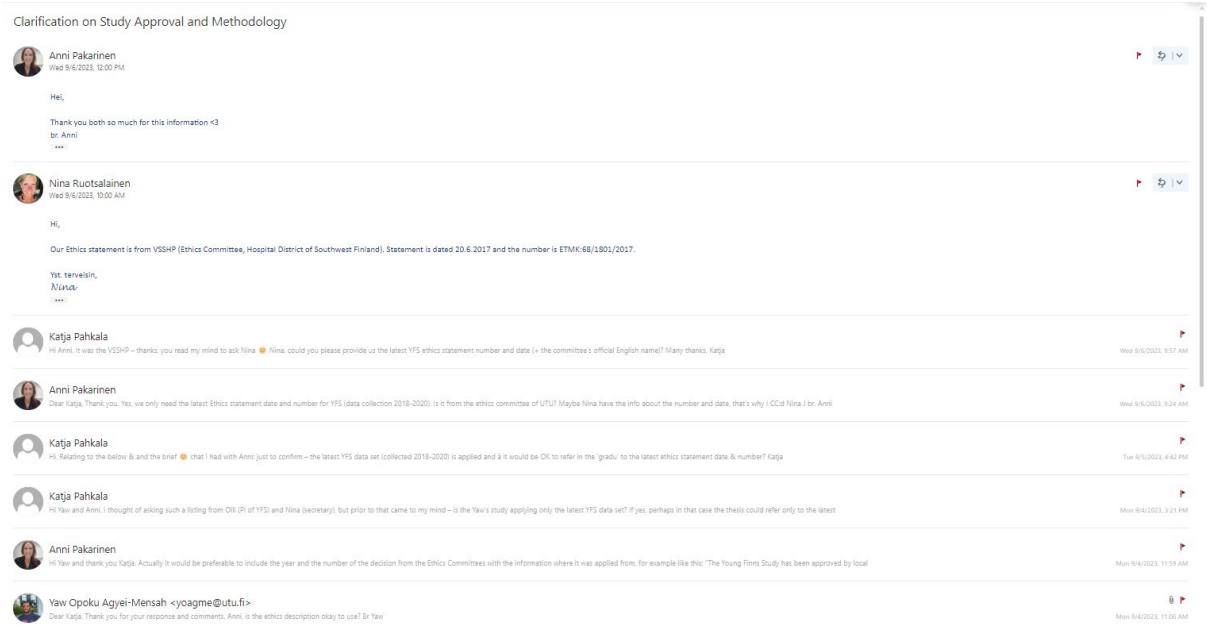
There are several ethics 'rounds' for the YFS due to its long history. From the top of my head I don't recall that we'd have them all listed or the process described in more detail than what is typically indicated in the articles. Would a description along the lines "The Young Finns Study has been approved by local ethics committees. All participants have given their written informed consent, and the studies were conducted in accordance with the Declaration of Helsinki." suffice?

After a quick glance, I put a couple of minor comments to the study design/methods text.

BW Katja

Katja Pahkala
Associate Professor, Academy of Finland Research Fellow
Research Centre of Applied and Preventive Cardiovascular Medicine | University of Turku
Centre for Population Health Research | University of Turku and Turku University Hospital
Paavo Nurmi Centre
Kiinamyllynkatu 8-10, 20520 Turku
FINLAND
+ 358 40 5786 122

Yaw Opoku Agyei-Mensah
Dear Katja, I hope this email finds you well. As I finalize my thesis based on the Young Finns Study data, I realized I need to confirm a few details. Could you please provide the specific ethics number and year of the approval for the study; and possibly a
Tue 8/22/2023, 11:23 AM



Clarification on Study Approval and Methodology

Anni Pakarinen
Wed 9/6/2023, 12:00 PM

Hei,

Thank you both so much for this information <3
br. Anni

Nina Ruotsalainen
Wed 9/6/2023, 10:00 AM

Hi,

Our Ethics statement is from VSSHP (Ethics Committee, Hospital District of Southwest Finland). Statement is dated 20.6.2017 and the number is ETMK:68/1801/2017.

Yst. terveisin,
Nina

Katja Pahkala
Hi Anni, It was the VSSHP – thanks, you read my mind to ask Nina 🙂 Nina, could you please provide us the latest YFS ethics statement number and date (+ the committee's official English name)? Many thanks, Katja
Wed 9/6/2023, 9:57 AM

Anni Pakarinen
Dear Katja, Thank you. Yes, we only need the latest Ethics statement date and number for YFS (data collection 2018-2020). Is it from the ethics committee of UTU? Maybe Nina have the info about the number and date, that's why I CC:d Nina J br. Anni
Wed 9/6/2023, 9:24 AM

Katja Pahkala
Hi, Relating to the below & and the brief 🙂 chat I had with Anni: just to confirm – the latest YFS data set (collected 2018-2020) is applied and à it would be OK to refer in the 'gradu' to the latest ethics statement date & number? Katja
Tue 9/5/2023, 4:42 PM

Katja Pahkala
Hi Yaw and Anni, I thought of asking such a listing from Olli (PI of YFS) and Nina (secretary), but prior to that came to my mind – is the Yaw's study applying only the latest YFS data set? If yes, perhaps in that case the thesis could refer only to the latest
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