Physical Activity among Adolescents in a Swedish Multicultural Area

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Physical Activity among Adolescents in a Swedish Multicultural Area

An Empowerment-Based Health Promotion School Intervention

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To My Family, and In Memory of My Grandfather

Abstract

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The overarching aim of the present thesis was two-fold. The first aim was to describe and critically reflect upon the experiences of developing and implementing an empowerment-based school intervention, focusing on food and physical activity, involving adolescents from a Swedish multicultural area characterized by low socioeconomic status. The second aim was to investigate accelerometer-measured sedentary time and physical activity among the adolescents, and to evaluate the effects of the intervention on these variables. The two-year intervention was continually developed and implemented, as a result of cooperation and shared decision making among researchers and the participating adolescents. Data was collected in seventh, eighth and ninth grade using documentation and observation protocols, accelerometers, and questionnaires. This thesis shows the importance of acquiring a broad and deep understanding of the targeted context and the participants of the intervention, and to be open-minded when it comes to negotiating, adjusting, and reorganizing empowerment-based interventions. This thesis further shows that the participating girls accumulated more sedentary time and less moderate-to-vigorous physical activity than boys, and that approximately half of the adolescents met the physical activity recommendations. The intervention had no positive effects on sedentary time and moderate-to-vigorous physical activity. Finally, this thesis shows that cautiousness is warranted when cross-comparing accelerometer-based studies with different epoch durations and cut-points.

Table of Contents

Tables 1-17

Figures 1-16

List of Original Papers

The four papers which constitute the present compilation thesis are listed below and will be referred to by their Roman numerals throughout the text.

I. Jonsson L,* Fröberg A,* Korp P, Larsson C, Berg C, Lindgren EC. Empowerment Ambitions Challenged during a Health-Promotion School Intervention Developed and Implemented as a Result of Cooperation and Shared Decision Making among Researchers and Adolescents (Manuscript)

II. Fröberg A, Larsson C, Berg C, Boldemann C, Raustorp A. Accelerometer-Measured Physical Activity Among Adolescents in a Multicultural Area Characterized by Low Socioeconomic Status. Int J Adolesc Med Health. 2016; Aug 29

III. Fröberg A,* Jonsson L,* Berg C, Lindgren EC, Korp P, Lindwall M, Raustorp A, Larsson C. Effects of an Empowerment-Based Health-Promotion School Intervention and Two-Year Changes in Physical Activity and Sedentary Time among Adolescents in a Multicultural area (Manuscript)

IV. Fröberg A, Berg C, Larsson C, Boldemann C, Raustorp A. Combinations of Epoch Durations and Cut-Points to Estimate Sedentary Time and Physical Activity among Adolescents. Meas Phys Educ Exerc Sci. 2017;21(3):154-60

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Abbreviations

BMI	Body Mass Index
DMP	Decision-Making Processes
ET	Exercise Training
FB	Facebook
FV	Fruits and Vegetables
HC	Health Coaching
HP	Health Promotion
HPS	Health Promotion Sessions
LPA	Light Physical Activity
MET	Metabolic Equivalents
MPA	Moderate Physical Activity
MVPA	Moderate-to-Vigorous Physical Activity
NWT/-A	Non-Wear Time/Non-Wear Time Algorithm
PA	Physical Activity
RECE-a	Reflective Equilibrium Community Empowerment Approach
RG	Research Group
SB	Sedentary Behavior
SDM	Shared Decision Making
SE	Socioeconomic
SED	Sedentary Time
SEM-1-4	Semester 1 (SEM-1), Semester 2 (SEM-2), Semester 3 (SEM-3), and Semester 4 (SEM-4)
SES	Socioeconomic Status
SGHCS	Structured Group Health Coaching Sessions
T1-T3	Baseline, Time 1 (T1), Midpoint, Time 2 (T2), and Endpoint, Time 3 (T3)
TV	Television
VPA	Vigorous Physical Activity
WHO	World Health Organization

Chapter 1: Introduction

Sweden has been identified as a high-performing country with respect to a number of health-related indicators (1). Although Sweden is also among the most equal Organization for Economic Co-operation and Development countries, the relative growth in economic income inequality between the mid-1980s and the early 2010s was the largest of all countries (2). Economic income inequality coincides with health dissimilarities, and a number of health-related behaviors are viewed as economically and socially patterned, thus playing a crucial role in shaping inequalities in population health outcomes. Impoverished and marginalized people living under unfavorable social circumstances tend to have undesirable health-related behaviors (3) and shorter life expectancies (4, 5). Among health-related behaviors (i.e., behaviors positively/negatively affecting health outcomes), several systematic reviews have characterized the importance of certain foods and physical activity (PA) behaviors for favorable immediate and long-term health benefits. Adherence to healthy eating indexes focusing on food quality, including healthy choices, such as fruits and vegetables (FV), greens and beans, and whole grains, significantly lowers the risk for specific and all-cause mortality among adults (6). Moreover, light physical activity (LPA) (7) and particularly moderate-to-vigorous physical activity (MVPA) (8) have been associated with a number of health benefits among adults. A recent meta-synthesis of harmonized data from more than one million adults indicates that MVPA may attenuate and, at high levels (about 60-75 minutes per day), even eliminate some of the deleterious health effects associated with extensive sedentary behaviors (SB) (9).

Early Life Health Inequalities of Food and Physical Activity

Adolescence is a developmental life stage requiring adequate nutrients and PA to meet the rapid physical and cognitive growth. There is a widespread belief that PA has declined among youth during the past decades, often attributed to recent trends in SB such as increased overall screen-time (10). Albeit findings from recent systematic reviews for so-called temporal trends to this end remain

inconclusive, it partly depends on the PA domain where past investigations have incorporated PA measures, such as active transportation (e.g., walking or bicycling to/from school), participation in physical education or organized sports, and overall PA (11). Conflicting results for temporal trends in overall PA have been reported in recent studies using objective activity monitors (12-15). One study with self-reported data even demonstrate a slight overall increase in the prevalence of adolescents meeting the PA recommendations between 2002 and 2010 (16). Nonetheless, looking back at long-lost lifestyles and studies on, for example, Old Order Amish communities, where screen-based technology is strictly prohibited, and many youth engage in active transportation and active play, it becomes evident that youth living in such communities accumulate more PA as compared with their counterparts living contemporary lifestyles (17).

With respect to the two health-related behaviors, food and PA, the global body of health, the World Health Organization (WHO), recommend ≥400 gram per day of FV consumption (18) and ≥60 minutes per day of MVPA (19). At present, quite a few adolescents self-report daily FV consumption (15-49% for fruit and 20-55% for vegetables) (20) and approximately 20% meet ≥60 minutes per day of MVPA (21, 22). Given that adolescence is deemed a life stage during which the foundations for future health behaviors are established (23) it is recognized that adolescents from low socioeconomic (SE) circumstances have dissimilar experiences in establishing health and health-related behaviors with positive effects on health outcomes. The environment in which adolescents grow up and their families, schools, and communities have determinant effects on their vulnerability to poorer health. Low SE has been linked to poorer self-reported health and lower life satisfaction (24), and a systematic review arrived at the conclusion that low SE is also associated with poorer food and PA habits among adolescents (25). Recently, Chzhen and colleagues (26) analyzed a sample of approximately 700000 15-year-old adolescents and found a SE gradient in health-related behaviors, whereas those from less privileged SE circumstances reported less FV consumption and less PA. Moreover, existing data suggests that SE inequalities in some health-related behaviors, including PA, have increased among adolescents during recent years (27) which is of concern as there appears to be a life course relationship between SE position and PA (28). For these reasons, adolescents from low SE circumstances should be provided with support to achieve and maintain healthy

food and PA habits, and intervention among this population early in life should be prioritized in order to tackle SE inequalities in health.

Setting the Scene for the Present Thesis

Data for the present thesis was derived from an empowerment-based school intervention, focusing on food and PA, involving adolescents from a Swedish multicultural area characterized by low SE status (SES) (the 'How-to-Act?' project).

The intervention school and the two control schools were located in the area of Angered, in the municipality of Gothenburg, Sweden. Gothenburg is the second-largest city in Sweden and has experienced, similarly to other large cities, widespread SE segregation due to unequal economic income and educational opportunities across different geographical areas (29). Statistics from 2011 showed that the geographical area with the lowest economic income represented roughly 20% of the area with the highest economic incomes, and the proportion having experiences in post-secondary education ranged between 23% and 74% (29). Moreover, the mean life expectancy differs as much as eight to nine years between geographical areas for women and men respectively. These figures are believed to mirror the diverse SE conditions and social positions observed among the Gothenburg population (29).

Angered is a multicultural area[1] with 72% and 50% of the residents having foreign-backgrounds[2] and being foreign-born,[3] respectively (30, 31). In Sweden, individuals with foreign-born backgrounds generally self-report having poorer health as compared to those with Swedish backgrounds, and these disparities appear to emerge in all health-related questions yet particularly in subjective health (32). Social living conditions such as economic resources appear, however, to be largely responsible for the poorer health reported by foreign-born individuals (32). Immigrants to Sweden are generally exposed to discrimination across a range of contexts, which may result in socially vulnerability. For instance, discrimination in the labor market is a factor for unemployment and low economic income, whereas discrimination in housing, combined with low economic income, may increase the concentration of

[1] Some foreign countries of birth represented are Iraq, Iran, Finland, Bosnia-Herzegovina, Yugoslavia, Somalia, Poland, and Turkey.
[2] Foreign-born individuals and individuals with both parents born outside Sweden.
[3] Foreign-born individuals.

foreign-born residents in low status areas (32). Such discrimination might have consequences and affect individuals' health indirectly through poorer overall living conditions (32).

Moreover, it must be recognized that immigrants to Sweden are a heterogeneous group of individuals as they come to Sweden from different countries, at different points in time, and for varying reasons (32). As immigrants have diverse backgrounds, they also face varying levels of exposure to risk and vulnerability, which partly depend on the circumstances surrounding the migration process (32). Hence, the health of immigrants is shaped by experiences and situations in the residence of origin where, for instance, pre-migratory events such as particularly trauma may lead to increased exposure to health risks and negative health outcomes (32). In the residence of destination, immigrants may also face cultural and social values diverse from the residence of origin.

Moreover, Angered is characterized by low SES with the economic income and educational level among residents considered low when compared to the population in other areas of Gothenburg (30, 31). The proportion of unemployed and the share of households receiving economic assistance is high in comparison to the overall municipality of Gothenburg (30, 31). Along with these characteristics, Angered has been recognized as being among the most vulnerable areas in Sweden due to, for instance, parallel social structures, religious extremism, and reluctance among the residents to participate in judicial processes (33). Due to perceived fear of being attacked, robbed, or otherwise harassed, residents in these areas report a relatively high unwillingness to spend time outside alone (34). Residents in Angered are also among those in Gothenburg who are the least satisfied with their urban environment reflected by their a) housing-situation; b) perceived security; c) the extent of scribble and graffiti; d) vandalization; e) littering; and f) access to parks and public greenery (35).

Against such a backdrop, adolescents living in low SES areas such as Angered might be expected to face extraordinary challenges in obtaining and maintaining healthy food and PA habits.

Adolescence

The term "adolescent" originates from the Latin word *adolescere* with the present participle *adolescens* meaning growing up. The WHO defines adolescents as young people aged 10-19 years (23). The onset of puberty (approximately age 10-14 years) is generally accepted as the beginning of early adolescence. These particular years are characterized by biologically driven physical, cognitive, and socially and emotionally developmental changes (23). In terms of physical development, puberty is characterized by rapid growth of body height and weight and girls develop breasts and hips, and experience the onset of menstruation, whereas boys' voices typically deepen (23). Puberty is further characterized by cognitive changes such as increased capacity of abstract thinking, which continues to develop until transition into young adulthood (23). Also, early adolescence is characterized by great interest in the present with less thought about the future. One's goal-setting capacity increases with age (late adolescence, approximately 15-19 years) (23). Due to all these developmental changes, adolescence might also be a turbulent life stage as they may a) experience increased desire for independence; b) struggle with a sense of identity; c) feel awkward about themselves and their bodies; and d) become increasingly influenced by peer groups (23).

Against the background of these rapid physical and cognitive changes, as well as social-role transitions, investment in adolescent health requires explicit attention and becomes paramount as early establishment of health-related behaviors may cumulatively influence future health outcomes (23, 36).

Consistent with suggestions by the WHO (23), the study population in the present thesis[4] is referred to as "adolescents." The global terms "youth" and "young people" hereafter refers to both children and adolescents.

Socioeconomic Indicators

Evidence points toward SE being among the key variables to understand and predict health-related behaviors and health outcomes. Due to the complexity of the concept, however, a variety of terms and indicators have been employed interchangeably to address the impact of SE on health (37, 38). In health-related research, the following SE indicators have been frequently used: a) education;

[4] Pupils in seventh grade (ages 12-13 years) at baseline and ninth grade (ages 14-15 years) at follow-up.

b) housing tenure/conditions and household amenities; c) economic income; d) occupation-based measures; and e) area-level measures (e.g., indices of deprivation) (37, 38). Because of such heterogeneity, SE should reasonably be regarded as an umbrella term reflecting a large range of indicators with different assumptions and proposed mechanisms connecting SE to immediate and long-term health (37, 38). In agreement with previous studies, single SE indicators merely measure some aspects of SE, and the strength of the relationships with different health outcomes among, for example, adolescents, may differ according to which SE indicators were used (39).

In the current thesis, the terms "SE" (occasionally followed by circumstances, position or group) and "SES" are first and foremost used. In this regard, SE mainly refers to a broad number of family-related SE such as parental education, economic-income and/or occupation. It should be recognized, however, that some synthesis of the literature cited within the present thesis encompasses a wide range of SE indicators, even indicators for area-level SE. Moreover, SES mainly reflects (aggregated) area-level SE and is, for example, used when referring to Angered as an area characterized by low SES. Living in such areas might have consequences for health-related behavior and health-related outcomes. For example, some research indicates that consumers in supermarkets in low SES areas are exposed to a greater amount of shelf space dedicated to energy-dense, nutrient-poor foods and sweetened beverages, potentially influencing not only purchasing and consumption, but also cultural norms in terms of food habits (40). Low SES areas might also be deemed less aesthetically pleasant, and provide limited access to recreational facilities to promote enjoyable PA (41). Albeit essential for allocation and prioritization of resources (e.g., health promotion (HP) interventions), it must, however, be acknowledged that area-level measures of SE are used as proxies for individual-level SE (37).

Moreover, the theoretical origins of education as a SE measure propose that having a higher degree of education might positively influence cognitive functioning, possibly making individuals increasingly receptive to health education messages (38). Further, economic income may have a direct impact on health by allowing access to healthy food choices and specific leisure time PAs (38). In a study addressing SE-related health inequalities among adolescents, the authors argued that cost might limit the opportunities for healthy lifestyles such as eating FV and participating in fee-based PA (24).

Conceptualization and Framework

The intervention developed and implemented within the 'How-to-Act?' project theoretically framed HP and empowerment. As the intention of HP and empowerment is to improve health, the definition of the concept "health" ultimately reflects the way in which HP and empowerment are approached.

Health and the Salutogenic Orientation

A number of different health theories currently co-exist, broadly reflecting the following four categories of states/dimensions:[5]

a) Health as functional normality, meaning that an individual's organs and systems are healthy;
b) Health as balance, meaning a balance between the individual's goals, the capacity, and ability that the individual possesses, and the environment in which the individual acts;
c) Health as feelings of well-being; and
d) Health as ability, broadly meaning abilities to reach desired goals (42).

To outline the meaning of health remains a major challenge although the categories "health as feelings of well-being" and "health as ability" (c and d above) will be discussed later. Similar to health theories, several definitions of health are currently available, including the far-reaching "a state of complete physical, social, and mental well-being, and not merely the absence of disease or infirmity" (p. 351) (43). This definition, as proposed by the WHO in the mid-1940s, has received extensive criticism due to the ambitious yet idealistic phrasing "a state of *complete* physical, social, and mental well-being." This probably (unintentionally) causes most individuals to feel in ill health most of the time (44). Also, the definition appears problematic given that aging with chronic diseases nowadays is a norm (44). Thus, the WHO definition becomes rather counterproductive as individuals with chronic diseases/disabilities are definitively in ill health (44). Despite these shortcomings, the WHO recognized early an important distinction from health as merely the absence of disease and infirmity by further emphasizing a multidimensional conceptualization of health, including physical, social, and mental well-being.

[5] There are also pluralistic theories of health combining two or more states/dimensions.

Although different theories and definitions of health are available, it thus appears reasonable to understand health as a multidimensional concept including its physical, social, and mental dimensions. These health dimensions are qualitatively different, yet interdependent; for instance, positive physical health potentially influences social and mental health and vice versa (45).

As individuals' health is not created or experienced in isolation, health is also the result of an ongoing interaction with the socio-ecological environment (45). These so-called environmental determinants of health encompass social, ecological and economic dimensions of health (45). Depending on resources and capacities, individuals might be able to influence some environmental determinants of health (e.g., through personal choices). Others, however, are challenged to influence these determinants. For example, persisting health inequities across SE groups is partly explained by unequal distribution of economic income (45).

There are two main analytical perspectives on development of health, namely pathogenesis and salutogenesis. Whereas the pathogenic orientation may be described as the origin of and development of diseases, salutogenesis is broadly referred to as the origins of health. Salutogenesis can be viewed from three distinct, although intertwined meanings (46). In the most comprehensive meaning, salutogenesis refers to the extensive salutogenic model that hypothesizes that experiences gathered during the course of a life span formulate individuals' sense of coherence, which influences the ability to mobilize resources to successfully cope with stressors and manage tension (46). These abilities are also assumed to determine individuals' movements on the health ease/dis-ease continuum. In a narrower meaning, salutogenesis refers to the key concept of the salutogenic model, namely the sense of coherence (46). The sense of coherence was initially deemed the possible origin of health and constitutes the sub-dimensions coherence, manageability, and meaningfulness, reflecting the interaction between individuals and their environment (46). In the third, and most general meaning, salutogenesis refers to the salutogenic orientation of health (46) which is the perspective embraced within the current thesis.

The above thoughts about salutogenesis are based on the theories developed by Antonovsky (47). In line with his suggestions, the essence of the salutogenic orientation (in contrast to the pathogenic orientation as noted in parentheses) might be summarized as follows (47):

a) The salutogenic orientation conceptualizes a health/dis-ease continuum (rather than the dichotomous classification of individuals as healthy or not healthy), which suggests that individuals, at any given point in time, are positioned somewhere along the continuum with the possibility of moving backward and forward toward a healthy end;
b) The salutogenic orientation illuminates salutary factors to promote health (rather than focusing on risk factors); and
c) The salutogenic orientation adopts a holistic approach toward individuals (rather than exclusively focusing on diseases).

Although pathogenesis and salutogenesis appear to be distinct analytical perspectives on the development of health, the intention of both perspectives is to improve conditions for health within a given environment. Further, the pathogenesis and salutogenesis analytical perspectives on development of health might be regarded as complementary. For example, health information gathered within the pathogenic analytical perspective informs the salutogenic orientation when, for instance, deciding on effective intervention strategies to facilitate movement toward the healthy end of the continuum. Further, although subject to health care because of chronic conditions and diseases (hence, classified as ill health according to the pathogenic orientation), individuals might cope in the everyday life situation (e.g., through pharmacological treatment) and simultaneously experience mental and social well-being.

In addition to providing distinct analytical perspectives on development of health, pathogenesis and salutogenesis constitute the theoretical basis for the two main public health systems: a) health protection, prevention, and health care; and b) HP. Health protection, prevention and health care arguably depart from the pathogenesis perspective on development of health, and hence predominately emphasize health protection and prevention to reduce risk factors and health care (e.g., pharmacological treatment and rehabilitation) to treat or reduce ill health. On the contrary, HP has the salutogenesis perspective on development of health and predominately emphasizes HP to facilitate resources and to consolidate health.

In the context of HP, both food and PA habits play important roles in promoting health and well-being. The ideas of food and PA being fundamental in HP efforts dates back to the Greek physician Hippocrates (460-370 B.C.) who noted that "food and exercise [...] work together to produce health" (p. 1) (48). Although Hippocrates explicitly utilized the term "exercise," which

nowadays is regarded as purposeful PA to increase and maintain physical fitness (49), there is overwhelming evidence suggesting that lifestyle embedded MVPA (such as brisk walking and cycling) also have immediate and long-term health benefits (50). The WHO recognizes that food and PA are fundamental means of improving health (51) and to promote PA is a public health priority (52).

The following section specifically focuses on HP and one of the guiding principles of the concept, namely empowerment.

Health Promotion

The idea of improving health among individuals through HP efforts is not novel. Some argue, however, that HP as a practice emerged after the mid-1970s government report, "A New Perspective on the Health of Canadians" (occasionally referred to as the Lalonde Report) (53). This report suggested that health care services might not be the key determinant of health; rather, major progress in health would primarily result from improvements in lifestyle habits and the surrounding environment (54). Another major step toward the modern field of HP research was the 1986 WHO Ottawa Charter for Health Promotion (55) emanating from the first international conference on HP. Herein, the concept of HP was defined as "the process of enabling people to increase control over, and to improve, their health" (p. 425) (55). The Ottawa Charter for Health Promotion stipulated that individuals are required to identify and realize aspirations, as well as satisfy needs and modify or cope with the environment to attain health. Essentially, health was understood as a positive concept emphasizing resources for everyday living (55).

The current thesis embraces Tengland's ideas on HP (56). He indicates that the primary goal of HP is health-related quality of life, which is obtained and maintained through health. Partly related to two of the health theory categories mentioned above, health here constitutes the dimensions of a) health-related well-being; and b) health-related abilities (56). *Health-related* well-being means to feel physically and mentally well, and the more well-being, the healthier (56). The emphasis placed on health-related well-being means that feelings of well-being are required to have an immediate result within the individual (instead of being upheld by external events) such as feeling energetic (56). The second dimension, health-related abilities, broadly means that a healthy individual has acquired typical abilities (e.g., understanding basic elements of ethics) and

dispositions (e.g., experienced emotions) and positive states (e.g., acquired a sense of positive self-confidence) that typifies the group with whom the individual belongs. To actually be healthy, an individual must also be able to utilize these abilities, dispositions, and positive states under a variety of circumstances that impose more (although acceptable) or less requirements (56). These *health-related* abilities and dispositions are distinguished from other non-health-related ones in the sense that some abilities require specialized practice (such as learning to ride a bicycle) (42, 56).

As previously mentioned, a recurrent, guiding principle among the many definitions and conceptualizations of HP appears to be empowerment (57). In essence, empowerment is the process through which individuals are given the opportunity to express their needs and present their concerns, formulate strategies for involvement in decision making, and realize actions to meet those needs (43). In the following, empowerment will be conceptualized from the ideas set forth by Tengland (56).

Empowerment – as a Goal and as a Process

According to Tengland, empowerment can be referred to as either a goal or a process (56). As a goal, empowerment concerns an individual's ability to control and change factors in the environment that influence health-related quality of life and, hence health-related well-being and health-related abilities (56). It further concerns increasing self-control (i.e., controlling desires and resultant actions) and avoiding, for instance, health-related behaviors that negatively affect health (56). More narrow empowerment goals include resources such as knowledge (e.g., enhancing self-knowledge and increasingly becoming aware of available means, as well as learning how these means should be utilized to change one's situation) and autonomy (enhancing the ability to determine one's own life) (56). If successful, empowerment might also change one's self-esteem, by enhancing one's self-evaluation in a positive direction, and self-confidence (or self-efficacy), by broadly reflecting the beliefs about one's general abilities to handle specific tasks (56).

As a process, however, empowerment refers to an intervention approach putting specific emphasis on the means (i.e., *how*) (56, 58). In a broad sense, empowerment as a process suggests that individuals themselves possess the internal means to change and develop in a positive health direction (56, 58). As

a consequence, individuals can possess control over the change processes (56, 58). In doing so, HP practitioners[6] mainly act as facilitators, whereas the individuals formulate health-related issues, solutions to bridge them, as well as the decisions on possible actions for change (56, 58). In many ways, empowerment is developed by individuals through cooperation and shared decision-making (SDM), rather than being delivered by HP practitioners. In turn, this means that HP practitioners might be required to (56, 58):

a) Relinquish (or minimize) power and control, and establish mutual, non-hierarchical relationships;
b) Create a climate for change characterized by empathy and genuineness, and non-judgmental attitudes, and continuously recognize the individual's own experiences and perceptions (to the extent possible) in relation to the health-related issues in question; and
c) Enable dialogical conditions (e.g., to allow for communication between individuals and HP practitioners).

Given these presumptions, empowerment as a process appears first and foremost to be applicable at a group or community level because the process involves personal encounters. With connections to the context of the present thesis, Tengland further claims that empowerment as a process is particularly relevant when working with disadvantaged groups of individuals (56).

Empowerment as a process neither means that individuals are responsible for formulating and finding solutions and decisions related to their own health-related issues, nor that the HP practitioners are passive during the change processes. As indicated above, empowerment as a process rather means that formulation of health-related issues and solutions and decisions to bridge them, are within the individual's capacity. HP practitioners put confidence in the individual's ability to do so, and simultaneously (actively) participate as facilitators (56).

Relying entirely on bottom-up approaches might, nonetheless, generate circumstances where the HP practitioners prioritize ineffective and counterproductive interventions (59). To overcome such an ethical dilemma, interventions can be inspired by the reflective equilibrium community empowerment approach (RECE-a) – a combination of bottom-up and top-down approaches. By combining bottom-up and top-down approaches, interventions can involve the participants in decision-making processes (DMP)

[6] HP practitioners refers to individuals delivering an HP intervention.

while simultaneously acknowledging the need for intervention to be guided by health information (59). In this sense, it has been argued that a combination of bottom-up and top-down approaches might be viewed as a prerequisite to realize sustainable changes among individuals (58).

Empowerment and Shared Decision-Making

Empowerment as a process is in line with established perceptions that young people should be included in DMP (60) and have the right to express their opinions and to be heard in matters affecting their own health and well-being (61). With connections to Article 12.1 of the United Nations Convention on the Rights of the Child[7] (61), Shier (60) recognizes the importance of not only listening to young people and supporting them in expressing their views but also taking their opinions into consideration, involving them in DMP, and sharing power and responsibility during decision-making.

Physical Activity

The current thesis is largely delimited to PA. The following section provides a brief historical overview of the modern field of PA research, followed by framework and conceptualization, as well as other perspectives on PA research.

Brief Historical Overview

The modern field of PA research began after World War II when Morris and colleagues (62) studied employees of the London Transport Executive. In the early 1950s, the authors found that less physically active bus drivers had more and severe acute coronary events than conductors of London's double-decker buses. These observations were subsequently reproduced among physically active postal deliverers as compared to desk-seated telephonists and other government workers (62). During the following decades, several studies were conducted to further investigate the relationship between PA and health outcomes, perhaps most notably the comprehensive epidemiological studies by Paffenbarger et al., namely the College Alumni Health Study (including Harvard

[7] Herein defined as young people aged <18 years.

alumni), and the San Francisco Longshoremen study (63). These novel studies brought further insights to the existing knowledge base as to the relationship between PA and non-communicable diseases (63).

As the modern field of PA research evolved, scholars such as Blair and colleagues (64) concurrently investigated the health benefits of cardiorespiratory fitness – an objective measure related to PA, which (although to some degree genetic in origin (65)) was expected to mirror the amount of PA recently undertaken. Mutually, these studies demonstrated a strong association between cardiorespiratory fitness and health (64). In parallel, burgeoning evidence culminated in recommendations for exercise training (ET) for cardiorespiratory fitness launched by, for example, the American College of Sports Medicine in the late 1970s and further, in the 1990s (64). In the mid-1990s, a panel of experts with representatives from the American College of Sports Medicine and Centers for Disease Control and Prevention reviewed the pertinent scientific literature linking PA to beneficial health effects, and the PA recommendations for public health was released in 1995 (66). These newly developed PA recommendations extended the previous ET-fitness recommendations by including a broader PA-health paradigm. The overall public health message was clear and straightforward: ≥30 minutes per day of MVPA have desirable immediate and long-term health effects (66). In the paper, it was specified that MVPA could be achieved by brisk walking and cycling instead of driving short distances, or climbing the stairs instead of taking the elevator, as well as through pedaling a stationary cycle in front of the television (TV) (66). The American College of Sports Medicine and Centers for Disease Control and Prevention public health message was subsequently followed by position stands from several health authorities and organizations including the WHO (67). The landmark report by the United States Surgeon General and the Public Health Service, United States, Department of Health and Human Services was released prior to the 1996 Centennial Olympic Games in Atlanta, Georgia (68).

In this day and age, more than half a century after the seminal studies by Morris and colleagues, it was recently stated in the 2018 Physical Activity Guidelines Advisory Committee Scientific Report (69) that PA might be the "best buy for public health" (p. 19). The authors of the report systematically reviewed and critically appraised up-to-date high-quality evidence for relationships between PA and a wide variety of health and quality of life outcomes. Besides reducing the risk for all-cause mortality, non-communicable

diseases, and some types of cancers, the report demonstrated that PA has the potential to improve sleep quality and duration, executive and physical functions, reduce depressive and anxiety symptoms, as well as improve perceived quality of life (69). Based on these findings, it was stated that "physically active individuals sleep better, feel better, and function better" (p. 20) (69).

Conceptualization and Framework

The total behavior profile of bodily movement can be conceptualized as both SB and PA. Together, SB and PA represent a complex framework of multidimensional human behavior (70).

Sedentary Behavior

Originally, the term "sedentary" was derived from the Latin word *sedere* meaning literally "to sit." Logically, the origin of the word *sedere* implies that the SB is operationalized as sitting activities, yet the historical significance of the term "sedentary" is considerably broader. For instance, the term "sedentary" was also used to describe groups with an absence of PA and ET (71). Currently, however, SB is differentiated and measured independently as a unique and separate concept (71, 72). As recently purposed by the Sedentary Behavior Research Network, SB is defined as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs),[8] while in a sitting, reclining or lying posture" (p. 9) (Figure 1) and is distinct from both PA and physical inactivity[9] (72). Examples of activities corresponding to SB are sitting while reading and watching TV (73-76).

All sitting/reclining/lying activities with low energy expenditure during a 24-hour period can be categorized into non-discretionary (relatively non-optional, e.g., long-distance traveling by motorized vehicle) and discretionary (relatively optional, e.g., watching TV) SB (70). Total time spent in non-discretionary and discretionary SB can be summarized into total SB which also represents sedentary time (SED).[10]

[8] METs refers to the energy costs of activities as multiples of resting metabolic rate.
[9] The term "physical inactivity" reflects those not meeting specific PA recommendations.
[10] The term "SED" will hereafter denote total time spent in SB, often as measured objectively as by an objective activity monitor (see section Measurements Methods).

Physical Activity

PA is typically defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (p. 129) (49). PA may improve physical fitness which is an umbrella term for measurable physical attributes such as cardiorespiratory fitness (maximal aerobic capacity), musculoskeletal fitness (e.g., muscular strength, endurance and power), and physical flexibility (70).

PA increases the energy expenditure above the resting levels (77). An individual's total daily energy expenditure consists of three components: a) resting energy expenditure (~60-75% of total energy expenditure); b) PA-related energy expenditure (~15-30% of total energy expenditure); and c) thermic effect of food (~10% of total energy expenditure) (77). PA is typically quantified in kilocalories and/or by using METs of a specific activity. One MET represents the resting energy expenditure during quiet sitting which equals approximately 3.5 mL $O_2 \times kg^{-1} \times min^{-1}$ of oxygen consumed (or ~1 $kcal \times kg^{-1} \times h^{-1}$ converted to kilocalories) (77). The actual resting energy expenditure may differ between individuals as sex, age, and physiological factors such as body composition affect energy expenditure (78, 79) and, thus also the actual MET level (77). To guide researchers and health practitioners, MET classification systems (the Compendium of Physical Activity) have been developed to assign PAs to specific MET values (73-76, 80).

PA can be expressed in terms of the following four dimensions: a) intensity (see below); b) duration (i.e., time, minutes or hours per day/week); c) frequency (i.e., number of times per day/week); and d) type (i.e., the specific activity performed, e.g., aerobic and/or muscle-strengthening activities) (77).

All different types of PA during a 24-hour day can be categorized into intensities reflecting the MET level. These intensities are a) LPA (1.6-2.9 METs) such as self-care undertakings and casual walking; b) moderate PA (MPA) (3.0-5.9 METs) including brisk walking; and c) vigorous PA (VPA) (≥6.0 METs) such as running (73-76) (Figure 1). MPA and VPA are usually combined into MVPA, as shown in the top section of Figure 1. Furthermore, each PA intensity and corresponding MET value is absolute and can also be expressed as relative intensity, reflecting the level of maximal aerobic capacity and percent of maximal heart rate (77).

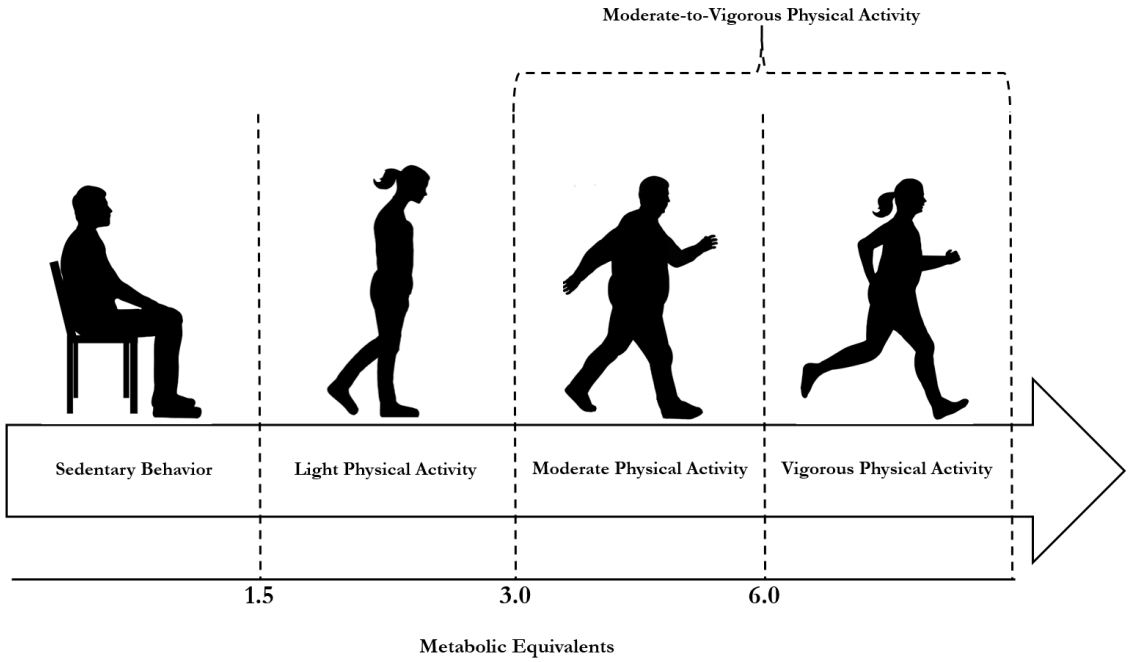

Figure 1. SB (e.g., sitting in a chair), LPA (e.g., causal walking at a relaxed pace), MPA (e.g., brisk walking), and VPA (e.g., running) (and combined MVPA as shown in the top section) positioned at the activity/energy-expenditure continuum. Metabolic equivalents (METs) represent the energy costs of activities as multiples of resting metabolic rate.

MET values derived experimentally from studies with adults may not be suitable for youth. Youth have higher basal metabolic rates than adults, but this progressively decreases as they grow and mature (80). Some proposed MET values to define the lower boundary of MVPA are 3.0-4.0 (81) and 5.0 (82) METs. Although no widespread consensus seems to be reached, some investigations propose that approximately 4.0 METs can define the lower boundary of MVPA among youth (83).

Furthermore, PA can be performed in the following four main domains (70): a) active transportation; b) school-/occupational-related PA; c) leisure time PA (e.g., sport activities); and d) PA in the household/domestic environment. Of importance, PA is not synonymous with ET although some elements are identical (49). Both PA and ET involve bodily movement produced by the skeletal muscles, which increases energy expenditure (49). However, while PA may positively correlate with physical fitness, there is generally a strong positive correlation between ET and physical fitness (49). ET is also planned, structured, and repetitive PA with the overall aim of maintaining or increasing physical fitness (49). This can include muscle-strengthening

activities (e.g., resistance training) and endurance training (e.g., continuous running).

Measurements Methods

Valid and reliable estimates of SB and PA are crucial when studying immediate and long-term health outcomes, enabling cross-cultural comparisons, monitoring temporary trends, and evaluating the effectiveness of interventions (84). There are two broad categories of methods to measure SB and PA, namely a) subjective methods (e.g., questionnaires and diaries/logs); and b) objective methods (e.g., physiological measures such as heart rate monitors and objective activity monitors)[11] (77).

Subjective Methods

Questionnaires

Questionnaires are fairly inexpensive and convenient, making them suitable for large-scale investigations (77). The majority of youth SB questionnaires have been developed to estimate TV time (including video games) and computer time, which are occasionally clustered into screen time (85). Most of these SB questionnaires have acceptable reliability, but their validity is generally unknown (85). Moreover, a wide variety of PA questionnaires are available for youth, although these generally are prone to bias and error due to misreporting (86, 87). One review show that 72% of self-report measures overestimated the objective measured (e.g., by means of objective activity monitors) values (87). Possible explanations for the discrepancies between self-reported and objective measures might be a) the highly complex cognitive task of adequately recalling information of PA performed during the previous day or week; and b) social desirability bias and hence, the attraction of portraying oneself as adhering to desirable health-related behaviors (86, 88).

[11] There is also an approach combining several objective methods (i.e., multisensory approach).

Diaries/Logs

Another subjective method, diaries/logs are used to obtain detailed hour-by-hour information regarding SB and PA (77). When using this method, participants are generally asked to self-record the start/stop time of an activity, perceived rating of its intensity, as well as the type of activity performed on a continuous basis (e.g., each 15-minute period throughout 24 hours) (77). In terms of strengths, PA diaries/logs are rather inexpensive, less susceptible to recall errors as compared to questionnaires, and they can provide data for all four dimensions of PA as well as information regarding PA domain(s) (77). In terms of limitations, however, PA diaries/logs are typically burdensome to the participants (77, 89), and data reduction and analyses are complex and time-consuming (77).

Objective Methods

In recent decades, the introduction of objective methods has improved the ability to accurately measure and estimate SED and PA. Objective methods include physiological measures such as heart rate monitors and objective activity monitors (e.g., pedometers and accelerometers).

Hart-Rate Monitors

Heart rate monitors measure heart rate as the physiological response during cardiorespiratory stress produced by PA via unobtrusive chest straps and wrist worn heart rate monitor receivers (77, 89). Research suggests that heart rate increases relatively linearly and proportionately during MVPA but it is quite challenging to accurately monitor heart rate at relatively lower intensities (e.g., LPA) since it is influenced by other factors stressing the sympathetic reactivity such as emotional state and environmental temperature (77, 89).

Objective Activity Monitors: Pedometers

Pedometers (commonly worn on the hip, attached to the waistband) are objective activity monitors used to estimate free-living ambulatory (walking/running) PA in terms of steps (usually steps/day) (77, 90, 91). They are inexpensive, accurate, practical, and deliver immediate visual feedback for PA levels (77, 90, 91). In terms of limitations, however, pedometers cannot

provide information regarding either SED or PA intensities when worn throughout a whole day (77, 90, 91). If PA intensity is of interest, a recent study found that a heuristic cadence threshold of 110 and 125 pedometer-determined steps per minute correspond to MPA and VPA respectively during ambulatory activities among 12 to 14 year olds (92). Similarly, brisk walking at a pace producing 6600-7000 steps during 60 minutes corresponds to MVPA among adolescents aged 10 to 15 years (93).

Objective Activity Monitors: Accelerometers

The accelerometer is a complex electronical objective activity monitor that measures bodily acceleration/deceleration, which had its breakthrough in research during the early 2000s (94). It has been recognized that accelerometers provide valid and reliable estimates of free living SED (85) and different PA intensities (90, 91, 95, 96) among youth. Among its limitations, accelerometers are costly and cannot account for PAs, such as bicycling, stair climbing, and carrying heavy objects. Furthermore, processing data is time-consuming (77).

At present, accelerometers from several manufacturers[12] are available and they differ in size/weight, battery/data storage capacity, placement (e.g., hip, wrist, and thigh) and outcome measures (e.g., PA-related energy expenditure, body position/posture, and PA intensity) (77). Among these, accelerometers from ActiGraph™ (ActiGraph™ LCC, Pensacola, FL, U.S.) have been employed in numerous studies with adolescents (97, 98).

The ActiGraph™ accelerometer has a profound body of evidence to support its usage. This accelerometer is valid, reliable (90, 91, 95, 96) and feasible (99, 100) and during objective activity, it can monitor estimated SED and PA. In spite of the fact that accelerometers are categorized as an objective method, there is indeed an important and influential subjective dimension which must be recognized. Scholars and practitioners using accelerometers are required to make a number of decisions when processing and analyzing collected accelerometer data. Such decisions include, for example, epoch duration (i.e., the time interval to summarize the accelerometer output), non-wear time (NWT) algorithm (NWT-A) to separate wear time from NWT, and so-called cut-point to define SED, LPA, and MVPA. As the accelerometer outcome varies substantially across different analyzing procedures (101-103),

[12] For example, ActiGraph™, activPAL™ and Actical.

such subjective decisions, as judged by the researchers themselves and/or based on suggestions provided by peer reviewers during the reviewing process, are important. They appear particularly important since there are a number of unresolved issues regarding appropriate data reduction and standardization to provide data quality and consistency.

Potential Health Effects

Sedentary Behaviors

Transition from early pre-industrial lifestyles via mechanization and urbanization of the society to the modern Western lifestyle has likely increased the time devoted to different SB, at least among adults (104). Research on youth such as adolescents suggests relationships between different types of SB and unfavorable health outcomes such as adiposity (105-109), cardiovascular risk factors (105-108), and decreased physical fitness (105-108). However, previous SB research largely relies on self-reported measures for screen time (predominately TV time), which may coincide with obesogenic behaviors (110) such as low intake of FV, and high consumption of energy dense snacks and sweetened beverages (111, 112). Recent technical advances in the research field of accelerometry have enhanced the ability to investigate SED in relation to critical health outcomes. In this regard, the scholarly literature currently lacks clear evidence to support a relationship between SED and overweight/obesity and cardiovascular health (107, 109, 113-116), cardiorespiratory fitness, bone health, motor performance development, psychosocial outcomes, and cognitive outcomes (e.g., academic achievement) among youth (107, 115). A possible explanation for the lack of relationship between SED and health outcomes might be a) research on SED among youth is in its infancy and more longitudinal studies are required to draw robust conclusions; and b) some of these health outcomes (e.g., markers of cardiovascular health) are not easily manifested during the early stages of life. Given the discrepancies between single markers of SB (e.g., screen time) and SED, the relationship with health outcomes might depend on the type of SB rather than solely SED per se.

Physical Activity

A profound body of evidence, reviewed systematically and assessed critically, demonstrates that PA might have wide-ranging health benefits among youth. Among these are a healthier body weight (117-120) and cardiovascular profile (116-118, 121), improved fitness (117, 118, 121), enhanced bone development (e.g., bone density) (117, 118, 121), as well as improved motor performance development (117, 118, 121) and mental health (117, 118, 121). The precise dosage of PA to achieve the abovementioned health benefits is currently unknown and likely varies across health outcomes (117, 121). Regarding the intensity, available evidence supports positive health effects of LPA (118) and particularly MVPA (117, 118, 121). The observed dose-response relationship suggests that the higher the levels of PA, the greater the health benefits (117).

Potential Adverse Health Effects

There is a dose-response relationship between PA participation and likelihood of being injured, although current research is mainly restricted to cross-sectional data (117). These concerns are, however, reasonably outnumbered by the various potential health benefits associated with PA (see above). Among debated types of PA, muscle-strengthening activities such as resistance training for youth has historically been considered unsafe due to perceived increased risk of injuries (122, 123). Current research indicates, however, that resistance training can be a safe (122) and worthwhile method to improve a number of health outcomes on condition that the resistance training programs are well designed and age appropriate (124-126).

Recommendations

A number of health organizations and authorities have developed SB and SED recommendations for youth. Some of these recommendations propose ≤2 hours per day of recreational screen time among youth aged 5-17 years (127, 128) and some distinguish between screen usages related to school/homework and screen time for entertainment, and allows for some day-to-day variation in screen time (127). In addition, some recommendations for limiting extensive periods of SED exist (e.g., break up long periods of sitting) (127, 128). In

Sweden, the Professional Association for Physical Activity[13] (129) does not address any specific recommendations for SB or SED in its newly updated handbook Physical Activity in the Prevention and Treatment of Disease.[14] However, recent Nordic Nutrition Recommendations from the Nordic Council of Ministers (130) advocate youth (including adolescents) to reduce their SB.

One of the first PA recommendations for youth was developed and released during the late 1990s (131). Since that time, several recommendations have been published (121, 127, 131, 132) with global PA recommendations by the WHO advocating that youth (ages 5-17 years) accumulate ≥60 minutes per day of MVPA (19). VPA including muscle-/bone-strengthening PA are recommended to be incorporated ≥3 times per week (19). In Sweden, the Professional Association for Physical Activity basically mirrors these recommendations for youth aged 6-17 years (129). Furthermore, the recommended 60 minutes per day of MVPA is likely to be achieved when accumulating approximately 10000-11700 steps per day among adolescents aged 12-19 years (93).

Physical Activity among Adolescents

The prevalence of adolescents meeting the PA recommendations varies depending on the method of measurement. A systematic review of studies with self-reported measures of PA from across the globe suggested that 9-81% of adolescents aged 10-19 years meet ≥60 minutes per day of MVPA (133). Self-ported data from a representative sample of Swedish adolescents aged 13 years indicate that approximately 10% of girls and 14% of boys respectively meet the PA recommendations (24).

Moreover, in terms of objective measures, accelerometer data is as inspiring as challenging to interpret by reason of diverse methodological approaches. Majorly influenced by the selection of cut-points for MVPA, the prevalence of youth meeting the PA recommendations varies between 1% and 100% (103). For example, Guinhouya and co-workers (101) synthesized European investigations and found that 4-100% of adolescents aged 13-18 years meet the PA recommendations.

Moreover, two systematic reviews also report that fewer girls than boys accumulate ≥60 minutes per day of MVPA (101, 102). An accelerometer-based

[13] Yrkesföreningar för Fysisk Aktivitet (YFA).
[14] Fysisk aktivitet i Sjukdomsprevention och Sjukdomsbehandling (FYSS).

study from the mid-2000s showed that 60% and 70% of Swedish adolescent girls and boys aged 15-16 years respectively met the recommendations (134). More recently, a report by the Swedish Research Council for Sport Science[15] (135) showed that the corresponding figures were 20% and 43% among approximately 14 year-old adolescent girls and boys respectively. A previous study from Sweden showed that adolescent girls and boys accumulated 69 and 81 minutes per day of MVPA respectively (134). As suggested by these figures, adolescent girls are generally less physically active than boys, and some studies indicate that these sex-related differences are larger during adolescence than childhood (136).

It is further presumed that PA decreases throughout the course of life and, particularly, there is a widespread belief that PA decreases markedly during adolescence (137). This might originate in part from a meta-synthesis of longitudinal studies by Dumith et al. (138), which showed an annual decrease in PA by 7% after the age of 10, which would equal a reduction of approximately 60-70% between the ages of 10 and 19 years. One critical aspect to consider, however, is that most (22 of the 26) studies reviewed relied on self-reported measures, whereas few assessed PA by pedometry and accelerometry (138). Further, the review did not specifically address changes in MVPA. Recent investigations relying on accelerometers have shown somewhat shifting results for longitudinal changes in MVPA. Among these, two studies have reported rather negligible changes in MVPA between ages 12 and 15 years (139), and 12 and 16 years (140) respectively. Two other studies found that MVPA decreased annually by approximately four and two minutes per day among boys and girls between ages 10 and 14 years (141) and five and three minutes per day among boys and girls between the ages of 15 and 17 years (142) respectively. As an exception, a study from the U.S. reported a large decrease in MVPA by more than two hours per day between ages 9 and 15 years, although the findings might partly be explained by the usage of age-specific cut-points to define MVPA (143). Moreover, as observed by Metcalf et al. (144), PA progressively declined between ages 9 and 15 years and the reduction in PA was influenced by puberty indicating that it may, to some extent, be under biological control. It should also be mentioned that one follow-up study with accelerometers showed that PA declined progressively between the ages of 7 and 15 years with no substantially greater reduction during adolescence (145). These findings are

[15] Centrum för idrottsforskning (CIF).

further supported by a study pooling standardized cross-sectional accelerometer data from well over 20000 youth aged 3-18 years, which indicates that an age-related decline in PA occurs at the beginning of school entry and continues throughout childhood and adolescence (136). This particular study showed, however, that the annual decline in PA was slightly lower during childhood (~4%/annum) as compared to adolescence (~6%/annum) (136). Collectively, this data reasonably suggests that the widespread notion of PA markedly declining – albeit still declining – during adolescents is not fully supported by recent studies using objective methods (137).

In addition to these demographic factors (i.e., sex and age), a high-level overview of the scientific literature suggests that correlates for PA among adolescents include psychological factors, such as perceived competence and self-efficacy; social and cultural factors, such as social support for PA from family members and peers; and factors in the physical environment including walkability (146).

Adolescents, Socio-Economy and Physical Activity

There is currently a debate as to whether there is a relationship between SE and PA among youth. In a recent high-level synthesis of systematic reviews, O'Donoghue and colleagues (147) found a lack of clear evidence to support a relationship between SE and PA among youth, even if somewhat mixed findings were detected for SE as a correlate for overall PA. Although not entirely uniform, a number of investigations support the hypothesis that adolescents from low SE circumstances are less physically active compared to their counterparts (25, 148). For example, Stalsberg et al. (148) reviewed studies investigating the association between SE/SES (as measured by education, occupation, economic income, and neighborhood-related measures) and PA and found that 58% of the 62 studies reviewed suggested a positive relationship, whereas 42% of the reviewed studies indicated no association or even an association in the opposite direction (148). Two potential explanations for these equivocal results might be that a) a majority of studies relied on self-reported measures of PA which has inherent errors and biases; and b) the heterogeneity in terms of SE indicators. In contrast to self-report measures of PA, a recent study using accelerometer data from more than 12000 adolescents aged 10-18 years found that low SE position was associated with higher levels of PA (149).

Similar to these relatively ambiguous observations, one study with self-reported data for PA showed that Swedish adolescents aged 11-15 years from low SE circumstances had less probability of reaching ≥5 days with ≥60 minutes per day of MVPA compared with peers from the highest SE group (150). In contrast, an accelerometer-based study involving a sample of Swedish youth yielded no relationship between SE and PA; furthermore, it showed no differences in prevalence meeting the PA recommendations (135) Currently, Swedish studies investigating objectively measured PA among adolescents from multicultural areas characterized by low SES are scanty.

Physical Activity Interventions

The wealth of evidence linking PA to potential health benefits among youth (117, 118, 121) is a well-intentioned argument for identifying effective and appropriate interventions to promote PA among adolescents – or at least counteract the age-related decline in PA commonly observed throughout adolescent years. Although generally modest, the impetus to identify effective PA interventions is further encouraged by evidence pointing toward PA tracking over time (151, 152). It has previously been suggested that developing effective interventions to increase PA among youth is the number one priority in the field of PA research (153).

A plethora of PA interventions have been carried out during recent decades. In a high level overview of systematic reviews there was evidence found for the effectiveness of school-based intervention to promote PA among youth (154). Regardless, the intervention effect is in general small, and a number of interventions have been evaluated with self-report measures, which, as previously indicated, have been called into question due to bias and error due to misreporting (86-88). As a consequence, cautiousness might be warranted when interpreting these findings. Nonetheless, meta-analysis including interventions with objective measures for youths' PA points toward the same direction (155, 156). Metcalf and co-workers (155) pooled data from 30 accelerometer-based studies and found a somewhat small intervention effect equivalent to approximately four additionally minutes per day of MVPA among youth. More recently, a meta-analysis of PA interventions exclusively targeting adolescents (aged 11-16 years) reported a nonsignificant effect on accelerometer determined PA (156). It appears, therefore, reasonable to

conclude that previous PA interventions involving youth, irrespectively of PA measures, have had limited success in promoting PA. Similar findings have been observed in systematic overviews solely focusing on PA interventions among youth from low SE circumstances (157-159).

In Sweden, two Stockholm-based interventions involving efforts to increase PA (e.g., 30 minutes of PA integrated into the regular school curriculum) demonstrated no effects on accelerometer determined PA among youth (160, 161). In another intervention conducted in southern Sweden, the intervention group was exposed to daily PA sessions and compared against a control group that received two days per week of physical education and health lessons (162). No differences in terms of accelerometer-measured PA were found between the two groups when analyzing data retrieved from 8-11 year olds (162). Another intervention spanning two years involved a health coach to promote school-based PA among 10-12 year olds. Results showed that participants in the intervention group had not increase their pedometer-determined PA at follow-up (163).

The limited success of previous PA intervention is likely due to a number of reasons. Although speculative, insufficient intervention intensity and duration, and the fact that several studies lack information regarding implementation and quality assurance of the intervention, as well as adherence to the intervention strategies are possible explanations. Another explanation might be the recently debated ActivityStat hypothesis (164). The ActivityStat hypothesis conceptualizes a biological basis for the regulation of PA, proposing that increased PA or energy expenditure in one domain is compensated by an equal decrease in another domain to preserve a PA/energy expenditure set-point (164), thus potentially influencing the possibility to modulate PA (165, 166).

It should further be acknowledged that many previous interventions have implemented predetermined strategies based on the researchers' decisions on reasonable actions for implementation. For example, single- and multi-component interventions targeting adolescents have involved strategies, such as PA breaks, non-competitive PAs organized by school, and provision of pedometers and additional sport-artifacts (156). Overall, it appears rather uncommon to involve adolescents in DMP across different phases of PA interventions.

Greater engagement of adolescents, by being involved in the identification of their health issues and development of suitable solutions, might help to ensure the relevance of interventions (23). Adolescents are a heterogenetic

group of individuals with varying needs who possess unique perspectives on health-related issues, such as goals, wishes, and needs as well as suggestions on activities that could be advantageously incorporated into intervention to improve the strategies in terms of acceptability and appropriateness. In the absence of adolescents' voices in health matters affecting their lives, such worthy contextual perspectives on health-related issues might easily be overlooked. Listening to the voices of adolescents and taking their perspectives into account might, however, provide situations where they perceive that the intervention activities suit their goals, wishes, and needs; further, they may offer suggestions on activities. Therefore, adolescents should reasonably participate in the process of formulating not only health-related issues, but also possible solutions to bridge them, as well as possible actions for change (56, 58). To engage adolescents in meaningful dialogues, HP practitioners should place confidence in their capacity. This might further require HP practitioners to a) relinquish power and control; b) establish mutual, non-hierarchical relationships; and c) create a climate for change characterized by empathy and genuineness (56, 58).

Among previous participatory-based interventions focusing on lifestyle habits such as PA, one of the most common approaches has been to engage participants as peer leaders (e.g., creating so-called healthy buddy systems) to implement somewhat predefined strategies with the intention of encouraging healthy living among their peers (167). In one intervention, adolescent girls participated in a co-creation process and developed PAs such as organized sport sessions (168). Albeit no effects on PA were observed, the participants reported positive experiences about having a voice in developing the PA intervention (168). Caro et al. (169) conducted participatory research exploring perspectives of activity-friendly school playgrounds; the authors reported that adolescents were able to identify barriers for active play that are easily overlooked, unfamiliar, or differently perceived by researchers. In a study by Okely and associates (170), adolescent girls formed committees that were supported by researchers to develop action plans for promoting PA. No positive effects on PA were observed, but the authors concluded that few schools implemented the intervention as per their action plan. Another research group (RG) moving from empowerment ideas to action involved adolescents in DMP and observed a positive effect on self-reported MVPA of five minutes per day in the intervention group. The control group, however, decreased rapidly by approximately 25 minutes per day (171). Although somewhat conflicting results

for PA appear to have been observed among intervention involving adolescents in the co-creation processes, perhaps most importantly, many of these studies, along with others involving participants across different phases of the research process (172), tend to report overwhelmingly advantages in terms of research quality and youth empowerment.

Overarching Aim

The overarching aim of the present thesis was two-fold. The first aim was to describe and critically reflect upon the experiences of developing and implementing an empowerment-based school intervention, focusing on food and PA, involving adolescents from a Swedish multicultural area characterized by low SES. The second aim was to investigate accelerometer-measured SED and PA among the adolescents, and to evaluate the effects of the intervention on these variables.

Specific Aims

Following the overarching aim of this thesis, the specific aims for each paper were as follows:

- The aim of Paper I was to describe the experiences of developing and implementing an empowerment-based school intervention, focusing on food and PA, involving adolescents from a Swedish multicultural area characterized by low SES. In addition, Paper I aim to critically reflect upon the challenges faced during the participatory and empowering ambitions.
- The aim of Paper II was to describe and analyze accelerometer-measured SED and PA among adolescents in a Swedish multicultural area characterized by low SES.
- The aim of Paper III was to investigate whether a two-year, empowerment-based school intervention had any effects on changes in accelerometer-measured SED and MVPA, and self-reported ET frequency and ET duration among adolescents in a Swedish multicultural area characterized by low SES. In addition, Paper III aim to investigate two-year changes in any of these variables among the adolescents.
- The aim of Paper IV was to investigate how combinations of different epoch durations and cut-points affect the estimations of accelerometer-measured SED and PA in adolescents.

Chapter 2: Participants and Methods

The current thesis is written within the discipline of sport science, which spans a broad spectrum of perspectives and approaches to sports. In Sweden, the history of sport research dates back to the 1950s, when the focus was primarily on sport physiology and sports medicine. During the following decades, around the 1970s and 1980s, sport research within the humanities and social sciences began with an orientation toward mainly sport psychology, sport pedagogy, and sport sociology (173).

At the Department of Food and Nutrition, and Sport Science, University of Gothenburg, the general syllabi for the third-cycle program states that the subject of sport science is inferred through an interdisciplinary perspective covering the athletic individual and the physically active individual (174). The syllabi further specify that sport science involves studies of the body, and one point of departure is that PA promotes health and well-being (174). Thus, as sport science concerns PA from an interdisciplinary perspective, it appears reasonable to state that the overall aim and content of the present thesis aligns with the definition of sport science at the Department of Food and Nutrition, and Sport Science, University of Gothenburg.

Moreover, at the University of Gothenburg, the Department of Food and Nutrition, and Sport Science is part of the Faculty of Education. As the author of the present thesis is a certified physical education and health teacher, compulsory school was deemed an ideal domain and social environment to develop and implement an empowerment-based school intervention focusing on food and PA. In the curriculum for the compulsory school, 2011, the Swedish National Agency for Education[16] (175) states that one goal is that each pupil on completing compulsory school "has obtained knowledge about and an understanding of the importance of the individual's own lifestyle and its impact on health" (p. 16). Further, adolescents spend a significant amount of their waking hours within the school environment, and school represents a universal setting to reach virtually all adolescents irrespective of SE group. Consistent with the salutogenic orientation of health, the school system creates situations where HP interventions simultaneously reach adolescents both at risk and not

[16] Skolverket – the central administrative authority for the public school system.

at risk for ill health. Many schools also possess facilities such as home economic kitchens and gyms, which might be an advantage when developing intervention activities focusing on food and PA. For these reasons, school provides a potentially powerful setting for delivering HP interventions.

Data for each paper in the present thesis (Table 1) was derived from the collaborative research project 'How-to-Act?'.

Table 1. Papers I-IV included in the present thesis.

Paper	Type	Main Data	Main Outcome(s)	Main Data Analysis
I	Interventional, descriptive and reflective	Documents, observations and reflection protocols	The experiences of developing and implementing the intervention	Critical reflection
II	Cross-sectional, descriptive	Accelerometer data and questionnaires	SED and PA	ANCOVA, and MANCOVA
III	Interventional, longitudinal	Accelerometer data and questionnaires	SED and PA, and ET frequency and ET duration	LGCA
IV	Cross-sectional, methodological	Accelerometer data	SED and PA	rANOVA

Abbreviations: ANCOVA, Analysis of covariance; ET, Exercise Training; LGCA, Latent growth curve analysis; MANCOVA, Multivariate analysis of covariance; PA, Physical activity; rANOVA, Repeated measurement analysis of variance; SED, Sedentary time.

The 'How-to-Act?' Project

The point of departure in the 'How-to-Act?' project was that the primary challenge may not be to highlight the consequences of different lifestyles, but rather to support individuals (in this case, adolescents) to achieve and maintain healthy food and PA habits. In response, an empowerment-based HP school intervention was planned and prepared, developed, implemented, and evaluated. The overall aim of the intervention was to explore how to support adolescents in achieving and maintaining healthy food and PA habits.

The 'How-to-Act?' project was initiated in January, 2012 when senior researchers at the Department of Food and Nutrition, and Sport Science, University of Gothenburg, discussed the opportunity to design a school intervention theoretically framing HP and empowerment. An interdisciplinary RG emerged in 2012, and doctoral students in the subjects Food and Nutrition,

and Sport Science were recruited for the project in September, 2013. The interdisciplinary RG consisted of senior researchers and doctoral students and featured different educational backgrounds, and the members had practical and theoretical experiences from a number of research fields including HP, food, and PA. More specifically, the RG covered research fields, such as food and nutrition, sport science, physiotherapy, pedagogy, sociology, and psychology.

An overview of the 'How-to-Act?' project and the intervention is provided in Figure 2. The first two and a half year of the project involved planning and preparation, such as theoretical framing and developing the intervention and its components, obtaining permission from the ethics committee, and recruiting schools and the study population. During the following two years, the intervention was continuously developed and implemented through cooperation and SDM between the researchers and the participants. The author of the present thesis partook in the a) planning and preparation of the intervention; and b) development, implementation, and evaluation of the intervention; and c) during three data collection periods: baseline (time 1, T1), midpoint (time 2, T2), and endpoint (time 3, T3). The bottom section of Figure 2 illustrates the involvement of the author of the preset thesis, and where data was collected for Papers I-IV.

Objects of Studies and Knowledge Objects

Following the aims of the present thesis, the object of study (*what* is studied) (176) in Paper I concern developing and implementing an empowerment-based school intervention, focusing on food and PA, involving adolescents from a Swedish multicultural area characterized by low SES. The objects of study in Papers II-IV concern health-related behaviors among these adolescents and, more specifically, it focuses on SED and PA. Moreover, the knowledge object (*how* the object is studied and conceptualized) (176) in Paper I involves the underlying concepts and theories framing the intervention, that is HP and empowerment, and the paper provide experiences and lesson learned when developing and implementing an empowerment-based school intervention focusing on food and PA. In Papers II-IV, objective activity monitors were used to measure SED and PA among the adolescents, and the papers provide knowledge regarding health-related behaviors among adolescents from a Swedish multicultural area characterized by low SES.

Overarching Intervention Design

The overarching intervention design bears a resemblance to a quasi-experimental, non-equivalent group (non-randomized), longitudinal pretest-posttest design (177). The intervention group and the control group were matched with respect to a) school location (i.e., located in the same area); and b) school level data for SE. Participants were longitudinally followed for two consecutive school years from seventh to ninth grade covering four semesters (n = 2 semesters in seventh grade and n = 2 semesters in eighth grade, henceforth referred to as the first semester (SEM-1), second semester (SEM-2), third semester (SEM-3), and fourth semester (SEM-4) respectively. Data was collected in the beginning of each grade; the intervention hence involved a pretest-posttest design as T1 was conducted in seventh grade (September, 2014), T2 in eight grade (September, 2015), and T3 in ninth grade (September, 2016).

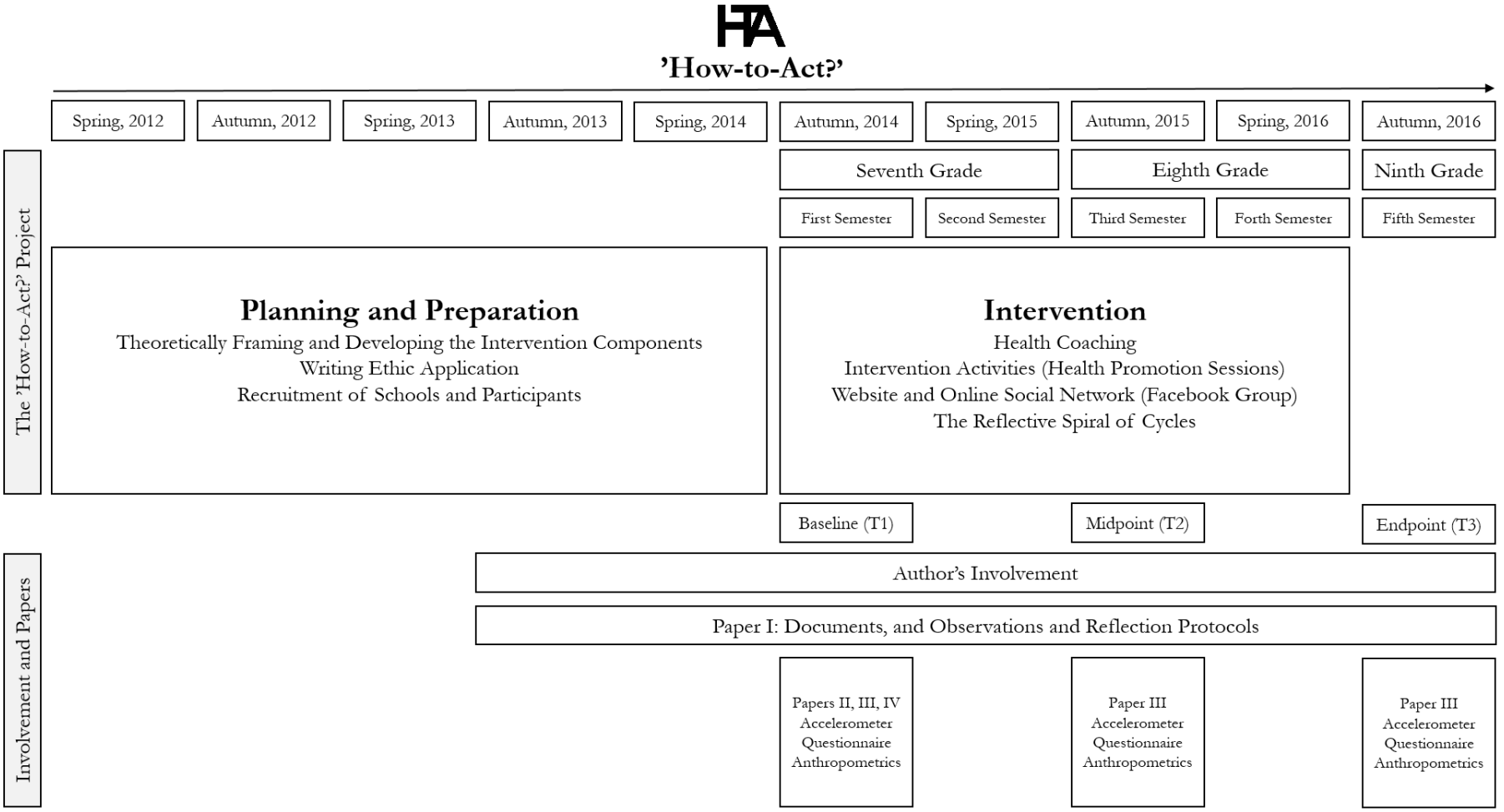

Figure 2. An overview (including planning and preparation) of intervention developed and implemented within the 'How-to-Act?' project (seventh to ninth grade). The involvement of the author of the present thesis, and where data for each paper (I-IV) was collected is shown in the bottom section on the figure.

Participants and Study Population

Recruitment Procedure of Schools

The recruitment procedure of schools carried out within the 'How-to-Act?' project used a purposive sampling approach (177). The study population was recruited from three municipal schools in the multicultural area of Angered. In the first step, the RG contacted the central unit of school health in the area of Angered who had information about schools working toward receiving a health certificate.[17] The RG was invited to a formal meeting in 2013 where the principals and representatives of student health organizations from schools in the area were presented the planned intervention within the 'How-to-Act?' project. During the meeting, the RG expressed their wish to recruit one intervention school located in Angered where the principal and representatives were interested in working with HP, food and PA. In the second step, the principals and representatives from one school showed great interest in working with the RG and were willing to participate as the intervention school. This school was recruited and, subsequently, two schools located in the same area with comparable data for SE (see below) were identified and recruited as control schools.

Participants

The study participants were recruited during August and September of 2014. In the first step, the RG provided the homeroom teachers with oral and written information about the 'How-to-Act?' project. In the second step, these homeroom teachers informed their pupils (oral and written information) about the project, and written information was sent home to the pupils' parent(s) or legal guardian(s). All information was written in Swedish, Arabic and Somali to fit the parents'/legal guardians' first language. A consent form written in one of these three languages was attached with instructions to thoroughly read the information and sign the consent form. Contact information of members in the RG was addressed if the pupils and their parent(s) or legal guardian(s) had any

[17] Health-related criterion as certified by the Network of Health for Young People in Elementary School in Angered (Hälsa för Unga i Grundskolan Angered (HUGA)). HUGA is a collaborative network including the Angered district administration (including representatives from school health and physical education and health teachers), Angered primary care, Angered Dental Service, different compounds, and Angered Hospital, Region Västra Götaland.

questions related to the project. In the third step, the RG provided the pupils with oral information about the project. All participants had the opportunity to address any questions regarding the project and planned intervention. At the intervention school, a parental meeting was held with an interpreter prior to T1 to provide the parent(s) or legal guardian(s) with the opportunity to ask questions regarding the project and the intervention.

In total, 152 pupils in seventh grade attended the three schools and they were all invited to participate in the project. It was emphasized that involvement in the project was voluntarily, and that they could withdraw their participation at any time without providing any further explanation or justification. Prior to T1, six pupils were excluded from the recruitment procedure as they were either transferred to another school or attended introductory school activities for new arrivals to Sweden. The final number of pupils approving participation in the intervention was 114 (n = 66 girls) seventh graders (aged 12-13) with 54 and 60 participants at the intervention school and the two control schools respectively. Except for the period during T3, new pupils who transferred to any of the three participating schools were invited to participate in the project, and they received the same oral and written information and consent form as described above.

Area Characteristics – Setting the Scene for the Intervention

Angered has some 50000 residents and is located in the municipality of Gothenburg, the second largest city in Sweden (~n = 530000 residents) (31). Descriptive data for the area of Angered and the municipality of Gothenburg is summarized in Table 2. As compared to the overall municipality of Gothenburg, the area of Angered is characterized by relatively high proportions of residents with foreign background, and the population has a relatively low economic income and educational level (31). In addition, the area has a relatively high proportion of long-term unemployed, and 14% of the residents received economic income assistance (i.e., social benefits) (31). Perceived social isolation among the residents in Angered is high in comparison to other geographical areas of Gothenburg, as is trust in other people and confidence in the police and other social institutions (178). As for other health-related data, residents in Angered, as compared to other geographical areas of Gothenburg, self-report poorer health, and are among those who self-report being the least physically active (29). As previously mentioned, residents in Angered are also among those in Gothenburg who are least satisfied with their urban environment (e.g.,

housing situation, perceived security, vandalization, and littering as well as access to parks and public greenery) (35).

The area of Angered is among the most vulnerable in Sweden with four minor parts of the area (i.e., Hammarkullen, Hjällbo, Gårdsten, and Lövgärdet) recognized as the most vulnerable. This is revealed by parallel social structures, religious extremism, and reluctance among the residents to participate in judicial processes (33). Further, due to perceived fear of being attacked, robbed, or otherwise harassed, residents in these areas report a relatively high unwillingness to spend time outside alone (34). The intervention school was located in one of these areas, namely Hammarkullen, which has approximately 8000 residents (30). Descriptive data reveals that Hammarkullen, compared to both the overall area of Angered and the municipality of Gothenburg, has a a) higher proportion of residents with foreign backgrounds; b) relatively lower economic income and educational level; and c) relatively higher proportion of the population being unemployed and receiving economic income assistance (Table 2) (30).

The three schools involved in the 'How-to-Act?' project had comparable data for SE (Table 3). Overall, the proportion of pupils with foreign backgrounds was higher at the three schools, relative to the national average. Available data also revealed that these schools received among the highest proportion of newly arrived pupils of all schools in the municipality of Gothenburg (179). From a national perspective, the SES (i.e., parents' educational level), the pupils' educational achievement scores, as well as the proportion of pupils passing all grades were relatively low at all three schools (Table 3).

In terms of setting the scene, it should be further recognized that local and national media covered several severe incidents, such as vandalism (180), outbreak of fire (181), and fights between pupils (182), that occurred at the intervention school during the two consecutive school years participants were followed.

Table 2. Descriptive data for Hammarkullen, the area of Angered, and the municipality of Gothenburg, 2014.

	Hammarkullen	Angered	Gothenburg
Mean economic income	143K SEK	183K SEK	263K SEK
Foreign background (%)	84	72	32
Household with economic assistance[2]	28	18	7
Unemployed[3] (%)	17	14	7
Voter turnout[4] (%)	62	63	79
Post-secondary education with ≥180 credits (%)	14	15	33

Abbreviation: SEK, Swedish Krona.

1. Foreign-born individuals and individuals with both parents born outside Sweden (Göteborgs Stad, available at www.socialhallbarhet.se).

2. Families with economic assistance during the last year (Göteborgs Stad, available at www.socialhallbarhet.se).

3. Registered at Arbetsförmedlingen, a national public agency with coordinating responsibility for labor market integration (Göteborgs Stad, available at www.socialhallbarhet.se).

4. Municipal election in 2010 (Göteborgs Stad, available at www.socialhallbarhet.se).

Table 3. Descriptive data for the schools included in the 'How-to-Act?' project, 2014.

	Intervention	Control 1	Control 2	National
School population (n)	438	293	327	N/A
Grades	4-9th	4-9th	4-9th	N/A
Pupil-teacher ratio[1]	10.3	11.5	8.0	12.1
Socioeconomic status[2]	1.66	1.69	2.15	2.26
Educational achievement score[3]	185	162	212	225
Pass in all grades (%)	45.2	24.5	63.6	77.0
New arrivals[4] (%)	19	27	16	5
Foreign background[5] (%)	92	93	75	21

1. Number of pupils divided by teachers.

2. The mean of the parents education level with 1 point for completed compulsory school; 2 points for completed upper secondary school; and 3 points for ≥20 credits from post-secondary education (The Swedish National Agency for Education, available at www.siris.skolverket.se).

3. The score of 16 subjects in the curriculum ranging between 0 and 320 points with 20 points for grade A, 17.5 for B, 15 for C, 12.5 for D, 10 for E, and 0 for F (The Swedish National Agency for Education, available at www.siris.skolverket.se).

4. Foreign-born pupils with foreign-born parents, arrived to Sweden during the last 4 years with no previous experience of the Swedish compulsory school system (The Swedish National Agency for Education, available at www.siris.skolverket.se).

5. Foreign-born pupils and pupils born in Sweden with both parents born outside Sweden (The Swedish National Agency for Education, available at www.siris.skolverket.se).

Intervention and the Empowerment-Based Approach

The intervention was supported by the idea of empowerment. Herein, empowerment was defined as the "possibilities for one to formulate and

influence opportunities and barriers for change, and procuring motivation and belief in one's own ability." The current thesis embraces the idea of empowerment as both a goal and a process for the following reasons: a) the interventions intended (through the intervention components and the activities performed) to facilitate empowerment goals such as self-control, knowledge, autonomy, self-esteem, and self-confidence (56); and b) the intervention was developed and implemented in cooperation and SDM, where the researchers supported the participants in expressing their goals, wishes and needs, listened to their ideas, and put these suggestions into practice, thus reflecting empowerment as a process (56). Moreover, by combining bottom-up and top-down approaches, the intervention was inspired by the ideas of the RECE-a to involve the participants in DMP while simultaneously acknowledging the need for intervention to be guided by health information (59). To aid participation and support a sense of empowerment, the intervention relied on the following four intervention components:

a) Health coaching (HC);
b) Intervention activities – HP sessions (HPS);
c) Website and online social network (Facebook (FB) group); and
d) The reflective spiral of cycles.

Although four intervention components should be viewed as a single package; each component is presented separately in the below section.

First Component: Health Coaching

As the first intervention component, HC was adopted as an approach and permeated the communication when members of the RG collaborated with participants. Inspired by previous work from other scholars (183), HC was defined as the "process of supporting participation through the communication technique of dialogue, with the purpose of facilitating reflection, confidence in own ability, and strategies for health-promoting action." The overall aim of the HC was to involve the participants in the development and implementation of the intervention by supporting them in expressing their goals, wishes and needs, listening to their ideas, and putting these suggestions into practice. The RG thus regarded the participants as creative, resourceful, and capable of finding unexpected solutions to fulfill their goals and articulate their wishes and needs related to food and PA.

In practice (and consistent with proposed coaching skills),[18] the HC communication technique featured approaches including a) active listening; b) addressing questions about their interests; c) paraphrasing; d) addressing/rephrasing questions if clarification were necessary; and e) frequently summarizing the conversation (184). This non-directive coaching approach (not instructive) was used to assist the participants in understanding and raising awareness about themselves and their current situations and, more specifically, support them in the process of exploring possible options for health promoting actions, reframing health-oriented issues, and working with (short-term and long-term) goal-setting strategies. In addition, the dialogue communication technique also featured a directive approach whereby members of the RG had the opportunity to provide feedback, make suggestions, and give advice during the conversation (184).

Group Health Coaching

Although HC has been conventionally conducted using a one-to-one format (183), the RG further used group HC in a structured manner to identify and discuss participants' shared goals, wishes, and needs, as well as their resources to work toward meeting these goals. The RG anticipated that working with goal-setting strategies could be challenging, although not impossible, given that young adolescents have a greater interest in the present with less thought about the future (23).

With the intention of maximizing effectiveness as well as realizing meaningful results, these structured group HC sessions (SGHCS) were organized according to a resource and goal-oriented conversation technique, T-GROW (184).

The T-GROW Model

In the context of coaching, the terms "coach" and "coachee(s)" reflect the individual(s) carrying out the coaching session (in this case, members of the RG), and those receiving the coaching session (in this case, the participants at the intervention school). These terms will be used in the present section.

The T-GROW model is an acronym representing the following five elements: *topic* (T), *goal* (G), *reality* (R), *options* (O), and *wrap-up* (W) (Figure 3)

[18] The specified skills mentioned are presented in the context of coaching, not necessarily HC. The dialogue communication technique, however, featured these approaches during the HC.

(184). More specifically, each element of the T-GROW model refers to the following:

Topic aims to clarify and explain the topic around which the HC sessions would be organized.

Goal refers to the process of identifying and setting short- and long-term goals as well as goals for the specific session itself. The aim of the element *goal* is to form solid foundations and confirm that the outlined goals are not set prematurely with respect to the broader area of interests. This is important because setting goals before having knowledge regarding the rationale behind them might bring about irrelevant goals, with which the coachees are not committed to work in the longer perspective. Examples of questions addressed by the coach might be a) "What is the aim of the present HC session?" and b) "What outcome from the present HC session would be ideal?"

Reality was addressed for the coach to comprehend where the coachees currently were in relation to their identified short- and long-term goals. The coach thus explored the current situation in order to provide a common sense approach to the present reality. Basically, the reality challenged the coachees to identify restraining factors, and the coach strived to be as objective as possible (although absolute objectivity almost certainly does not exist) and to create a climate where the coach-coachee relationship was non-judgmental. This can, for example, be outlined with support of questions such as a) "At present, where are you in relation to the specified goals?" b) "What steps have you taken toward the specified goals?" and c) "What factors have contributed to realization of the goals so far?"

Option was used to explore possible choices for moving forward and, more specifically, toward the specified goal. Here, the coach compiled a summary of possible options in a non-judgmental manner by posing such questions as a) "What are your possible options?" b) "What have been success factors so far?" and c) "How might you maximize such success factors?"

Based on the options put forward previously, the coach *wrap-up* the HC session. In cooperation with the coachees, appropriate, specific actions to undertake in order to create progression toward the outlined goals were agreed upon. In this final stage, the coach addressed questions such as a) "What actions can you undertake in the very near future that would make sense?" and b) "To what extent are you committed to undertake the specific actions addressed?"

At first glance, the T-GROW model might be regarded as a mechanical process, more or less proposing a straight-forward, linear way of carrying out

the conversation (i.e., transfer from one element to another, from goal to reality to option and so forth). In reality, however, the HC process is generally non-linear because the coachees are given the opportunity to re-prioritize the focus areas of the conversation. For instance, alternative perspectives of reality might be brought into light when exploring possible options to reach specific goals. Hence, as indicated in the center of Figure 3, the conversation can move backward and forward between the elements (e.g., from reality to option to goal to reality, etc.).

In practice, the coach also incorporated the dialogue communication technique approaches mentioned above (i.e., active listening to comprehend; address questions that follows interest; paraphrasing; addressing/rephrasing questions if clarification is necessary; and frequently summarizing the conversation) when carrying out the SGHCS. To the extent possible, the coach strived to enter the SGHCS without preconceived ideas regarding which topics, goals, realities, and options were about to be addressed. Rather, the coach focused on the coachees' agenda and recognized and acknowledged their experiences and perceptions regarding specific issues related to food and PA.

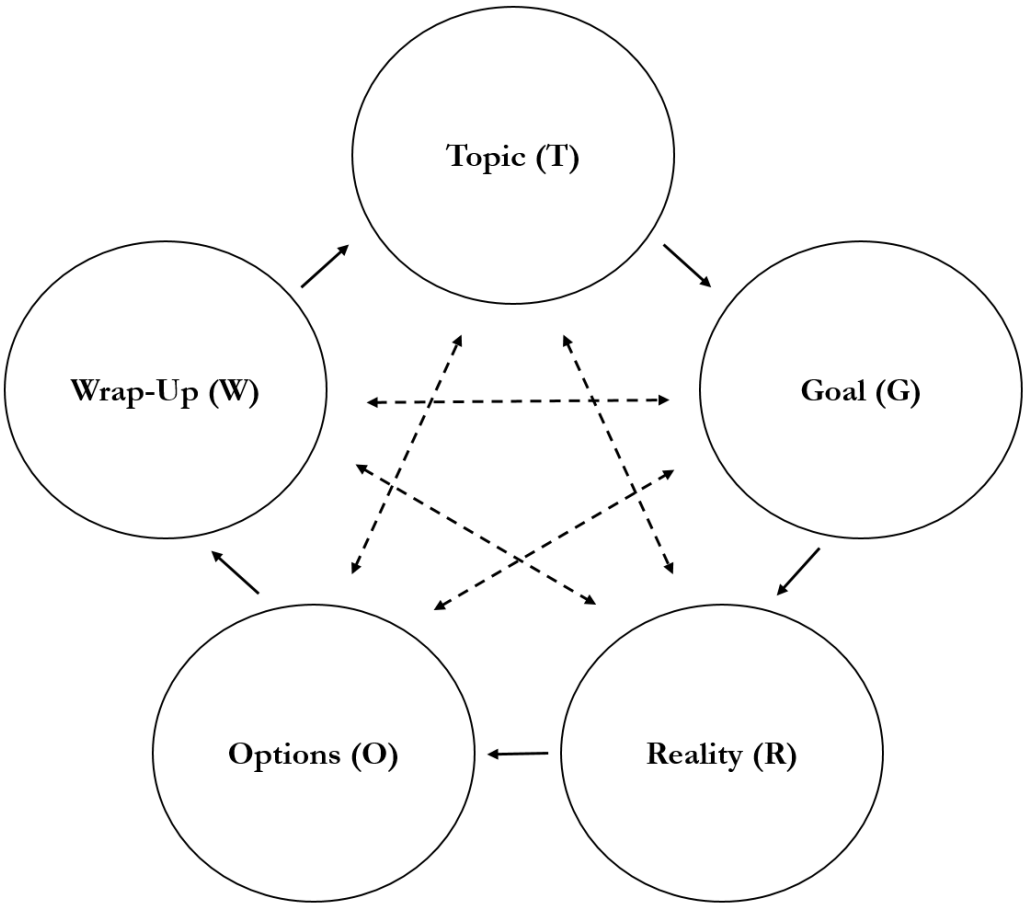

Figure 3. The resource and goal-oriented conversation technique T-GROW with the acronym representing topic (T), goal (G), reality (R), options (O), and wrap-up (W). As indicated in the center of the figure (dashed lines), the HC process might become non-linear because the coachees are given the opportunity to re-prioritize the focus areas of the conversation (184).

Second Component: Health Promotion Sessions

The second intervention component involves intervention activities, which were carried out during school hours and implemented within the school environment and its surroundings. These intervention activities consisted of HPS and were developed and implemented through cooperation and SDM between the researches and the participants. Herein, the RG used the HC approach to support the participants in expressing their goals, wishes and needs, listening to their ideas, and putting these suggestions into practice by developing and implementing HPS.

The ambition was that the theme, aim, and content of each HPS would not only reflect the participants' goals, wishes, and needs, but also the RG's

common experiences and reasonable actions for implementation. The latter meant that the RG reflected upon whether participants' suggestions on activities (e.g., theme and content) fell within the framework of the intervention (i.e., food and PA) and could be delivered within the given timeframe and physical environment of the intervention. The RG thus anticipated that participants also could have suggestions on activities beyond the framework of the intervention. Moreover, the RG further acknowledged the need for the intervention to be guided by health information as the hope was that the activities during HPS would provide opportunities for an engaging experience of *healthy* food and PA (i.e., broadly referred to a balanced diet rich in FV and low in high calorie, low nutrient foods and sugar-sweetened beverage consumption, as well as a physically active lifestyle with less SB). During planning and preparation of the intervention, the RG anticipated that participants' suggestions on activities during HPS could also involve components that the researchers considered to be less healthy (e.g., food containing high amount of added sugar and elements of high calorie, low nutrient foods). In such circumstances, less healthy suggestions could constitute valid grounds and provide sound basis for rewarding discussions and critical reflections regarding a) what constitutes healthy food and PA; and b) what options (e.g., activities, recipes, etc.) might be healthier.

Moreover, the RG had the ambition of providing opportunities to try, learn, and critically reflect upon/appraise health-related behaviors. It was hoped that the HPS would facilitate empowerment goals such as knowledge, self-esteem, and self-confidence/efficacy among the participants (56).

Further, the RG's intention was to divide participants into groups with somewhat similar goals, wishes, and needs to support a feeling of belonging and cooperation among participants. To work with groups of participants was also a way to create conditions for the RG to carry out the HPS in practice. To explore participants' goals, wishes, and needs, individual and focus groups interviews[19] were carried out during SEM-1. The individual interviews were inspired by dialogue communication technique approaches as described previously, and hence, featured active listening, addressing questions that followed their interests, paraphrasing; addressing/rephrasing questions if clarification were necessary, and frequently summarizing the conversation. These individual and focus groups interviews were also supplemented by

[19] Individual interviews: $n = 51$, mean duration: 20 minutes (range: 6-39 minutes); and focus groups interviews: $n = 10$, mean duration: 69 minutes (range: 44-97 minutes).

collecting written statements of participants' individual short- and long-term goals with the intervention.

Third Component: Website and Online Social Network (Facebook Group)

As the third component, a website[20] was launched in August 2014, with the aim of providing the participants and their parent(s)/legal guardian(s), as well as others outside the project, with information about the 'How-to-Act?' project and the intervention. In addition, a closed private group on FB,[21] which is among the world's most popular online social networking sites, was exclusively available to participants at the intervention school. The aim of using the closed FB group was to provide a forum for communication among the researchers and participants.

The FB group provided the RG with the opportunity to post information on upcoming HPS, write feedback and comments with photographs attached from previous HPS, and provide information about events (e.g., opportunities for PA free of charge during school holidays) in the area of Angered and its surroundings. Similarly, participants were encouraged to ask questions about the intervention, write feedback on posts, as well as post their own photographs taken during the HPS. At T1, 91% (n = 49) of the participants reported already had an account on FB. For the remaining non-users, anonymous accounts were created to allow them into the closed group during the intervention. However, they decided for themselves whether or not to join the group.

Fourth Component: The Reflective Spiral of Cycles

The RECE-a involves a process of dialogue between the researchers and the participants involved in an intervention (59). From the RG's point of view, this process of dialogue meant that researchers should be responsive and willing to modify their views regarding effective strategies and which health-related issues to prioritize during the intervention (59). To support this ambition, the RG used what they called the "reflective spiral of cycles" (Figure 4). The aim was to guide the collaborative process of reflecting upon the RG's experiences with participating in the intervention and listening to participants' comments in

[20] iki.gu.se/forskning/forskningsprojekt/pagaende/howtoact.
[21] www.facebook.com/groups/howtoact. Administrated by members of the RG (archived on June 16, 2017).

search of possible actions for implementation. The RG's reflective spiral of cycles consisted of the following five stages:

a) *Acting and observing*, meaning that fieldworkers used HC/SGHCS and HPS, and observed the process;
b) *Reflecting*, meaning that the RG reviewed and summarized protocols to provide a framework to critically reflect over the process related to HC/SGHCS and the HPS;
c) *Re-planning*, meaning that the RG re-structured the intervention based on the lessons learned during the HC/SGHCS and HPS;
d) *Acting and observing*, meaning that the RG used the modified HC/SGHCS and/or HPS, and oversaw the process; and
e) *Reflecting* (see b), and so forth.

These five stages formed an iterative process. The reflecting stages occurred during monthly meetings with the RG, during which protocols from SGHCS and HPS and general observations and reflections (n = 145 protocols, 307 pages, see below) were continually reviewed and summarized to construct a framework for critically reflecting upon lessons learned during the intervention. Since the reflection stages occurred on a recurrent basis, experiences, such as perceived barriers and opportunities from the past SGHCS and HPS, were reviewed and reflected upon. This procedure continued until the RG had reached consensus regarding further actions to take and ways to modify the intervention in order to meet the participants' goals, wishes, and needs.

The RG who participated in the reflection procedure included a multifaceted constellation of collaborators representing different areas of knowledge, including HP, food and nutrition, and sports science. The group collectively possessed broad interdisciplinary knowledge within the research area. A steering-committee, including the principal investigator and senior researchers, provided strategic guidance and made decisions on key issues related to the project in order to realize the overall aim of the intervention.

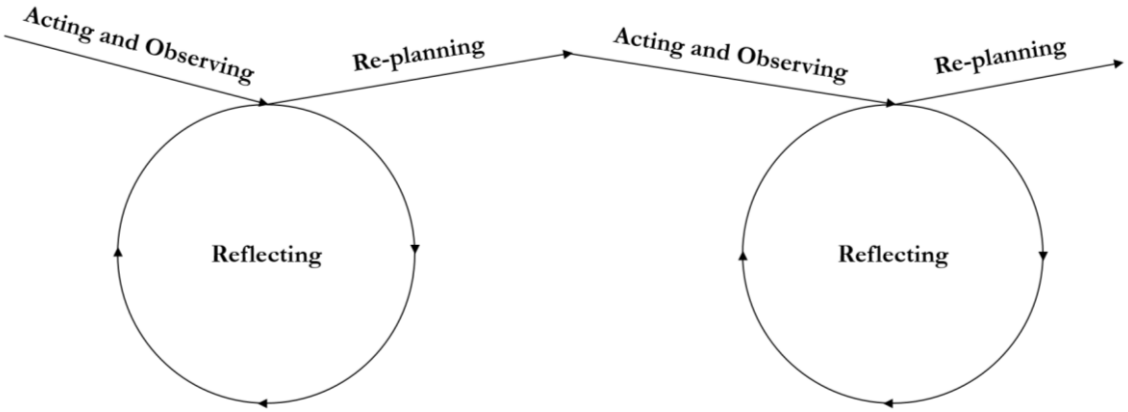

Figure 4 The reflective spiral of cycles formed an iterative process to guide the collaborative process of reflecting upon the RG's experiences with participating in the intervention and listening to participants' comments in search of possible actions for implementation. From the RG's point of view, they should be responsive and willing to modify their views regarding effective strategies and which health related issues to prioritize during the intervention.

Fieldwork

During fieldwork, two doctoral students in sport science (including the author of the current thesis) assumed primary responsibility for conducting the SGHCS as well as HPS, with the support by other researchers during larger events (e.g., full-day workshops). In addition, students attending the Health Promotion Bachelor's Program (specializing in Food and Nutrition or Sport Science) at the Department of Food and Nutrition, and Sport Science, University of Gothenburg, were invited to carry out their practical work experience within the intervention. These students assisted the RG in the work of developing and implementing the HPS, and were supervised by the two doctoral students in sport science. The homeroom teachers were occasionally involved in the HPS as they were included in the school timetable and meetings were carried out during school hours. In these cases, the homeroom teachers were seldom responsible (some exceptions will be noted further on) for the HPS but were rather present in the school classroom, home economic kitchen, gym, etc.

Further, to create a shared foundation of HC (as outlined above), the RG undertook a series of educational sessions during the planning and preparation of the intervention. The series of educational sessions were led by a practicing qualified coach who possessed broad theoretical and practical experience of the coaching processes. Prior to their involvement in the project, the students

attending the Health Promotion Bachelor's Program also completed a course of coaching processes (7.5 ects) and they were instructed by their supervisors to adopt the approach when cooperating with the participants during the intervention.

Data and Data Analysis

Documentation of the Process (Paper I)

To enable reflection on the intervention process, the fieldworkers documented the SGHCS and HPS. The SGHCS protocols consisted of 36 self-evaluation forms (n = 56 pages) where expectations, experiences, and general observations were documented. The HPS protocols contained the theme, aim, content, location, instructions, and attendance rate (n = 52 protocols, 183 pages). Also perceived participation, general observations and reflections (n = 57 protocols, 68 pages) were documented (Table 4).

Table 4. Protocols to document the development and implementation of the intervention within the 'How-to-Act?' project

	Main content	Protocols	Pages
SGHCS	Expectations, experiences, and general observations[a]	36	56
HPS	Theme, aim, content, location, instructions, and attendance rate*	52	183
General	Perceived participation as well as observations and reflections[b]	57	68

Abbreviations: HPS, Health promotion sessions; SGHCS, Structured group health coaching sessions.

[a]Appendix 1.

[b]Appendix 2.

*Attendance was documented as the number of participants who were present during the HPS. The participants were provided with the opportunity to decide for themselves whether they wished to actively or passively (i.e., attending, yet merely observing) take part during the activities.

Sedentary Time and Physical Activity (Papers II-IV)

For the aim of Papers II-IV, small, light-weight accelerometers from ActiGraph™[22] (GT3X/GT3X+) were used to measure SED and PA. Among the available manufactures, accelerometers from ActiGraph™ have been proven valid, reliable (90, 91, 95, 96), and feasible (99, 100). Accelerometers

[22] Formerly known as Computer Science and Applications (CSA) and Manufacturing Technology Inc. (MTI).

from ActiGraph™ have become the de facto standard for measuring SED and PA (185) in both small and large-scale studies with youth (97, 98). These accelerometers measure acceleration/deceleration in the vertical, horizontal, and perpendicular axis. The low-frequency extension was applied to expand the range of the normal filtering algorithm to increase sensitivity at the lower end of the intensity continuum (186).

To reduce some of the possible effects of seasonal variation in PA (187), data collection was carried out during September in 2014 (T1), 2015 (T2), and 2016 (T3). T3 was conducted four months after the last intervention activity was held. Due to restrictions in available accelerometers, the participants from the intervention group and the control group were measured during two different weeks with one to two week(s) in-between.

Figure 5. A small and light-weight accelerometer from ActiGraph™ attached on an adjustable elastic band and worn on the right hip.

Informative Procedures of Accelerometry

Prior to T1, the participants were provided with oral/written instructions and practical demonstrations of how to wear the accelerometer properly (i.e., right hip by means of an adjustable elastic band) as illustrated in Figure 5. These instructions and practical demonstrations were delivered and carried out during school visits where the participants had the opportunity to familiarize themselves (e.g., wearing the device, asking questions about the procedure, etc.) with the accelerometers during workshops. The participants were informed about the cost of the accelerometers (~220 USD each) and that the activity monitors were useless without appropriate computer software. They were instructed to wear the activity monitor during all waking hours for seven consecutive days except when engaging in water-based activities, such as swimming and showering.

Furthermore, strategies to increase compliance, such as placing the accelerometer next to the bed or on the unworn clothes before sleep and showering, were outlined in cooperation with the participants during the workshops. As a reminder, written information was sent home addressing the importance of wearing the accelerometer throughout the whole day. Members of the RG visited the schools in the mornings to check if any of the participants had any problems with, or questions related to the procedure. The procedure of providing oral/written instructions and practical demonstrations, visits to schools, etc. was repeated during T2 and T3.

Due to somewhat lower compliance during T2 (either lost accelerometers or insufficient wear time), text messages (Short Message Service, SMS) were sent to participants' mobile phones as a reminder to put on the accelerometer before the school day during T3; as previously recommended (188).[23] To further encourage compliance at T3, the RG agreed that a movie theater ticket (~12 USD/ticket) would be given to participants who returned their activity device with sufficient data.[24]

Processing Collected Accelerometer Data

For the aim of Papers II-IV, accelerometer data was downloaded via the ActiLife™ software (ActiGraph™ LCC, Pensacola, FL, U.S.) and reviewed

[23] Participants self-selected whether to provide their mobile phone number to receive the reminder SMS.
[24] ≥3 days with ≥8 hours per day of monitoring was required because it was the criteria to be included.

manually to check for monitor malfunctions and spurious data points (189). A summary of accelerometer specifications, and different accelerometer decisions in Papers II-IV is provided in Table 5.

Table 5. Summary of ActiGraph™ accelerometer specifications, and different accelerometer decisions in Papers II-IV.

Specifications/decisions	Paper II	Paper III	Paper IV
LFE	Applied	Applied	Applied
Epoch duration	5 sec	5 sec	1, 5, 10, 15, 30, and 60 sec
NWT-A	≥60 min of 0 counts	≥60 min of 0 counts	≥60 min of 0 counts
Valid data	≥3 d with ≥8 h/d	≥3 d with ≥8 h/d	≥3 d with ≥8 h/d
Cut-point(s)	Eve	Eve	Eve, Tre, Fre, Mat, and Puy

Abbreviations: Eve, Evenson et al. (190); Fre, Freedson et al. (191); LFE, Low-frequency Extension; Mat, Mattocks et al. (192); NWT-A, Non-wear time algorithm; Puy, Puyau et al. (193); Tre, Treuth et al. (194).

Accelerometer Data in Paper II

For the aim of Paper II, T1 accelerometer data was integrated into five-second epoch durations. Such a high frequent sampling interval was chosen to increase the likelihood of detecting the spontaneous and intermittent PA behavior that appears to characterize adolescents (at least boys) (195). Accelerometer wear time was defined by subtracting all time intervals with ≥60 consecutive minutes of zero counts (196) from 24 hours monitoring as supported by a recent study (197). To maximize the sample size, participants with ≥3 days with ≥8 hours per day of monitoring were included in the analysis. Similar criterion has been used in previous accelerometer-based research with youth (97). Mean PA intensity was calculated in two versions: a) the sum of v-axis activity counts divided by recorded minutes (i.e., counts per minute ($CPM_{V\text{-}DATA}$)); and b) the square root of the sum of activity counts squared in each vector (i.e., vector magnitude (VM); $VM = \sqrt{axis1^2 + axis2^2 + axis3^2}$) divided by recorded minutes (i.e., $CPM_{VM\text{-}DATA}$). $CPM_{VM\text{-}DATA}$ was calculated to obtain as much information on PA as possible. In addition, cut-points by Evenson and colleagues (190) were used to translate accelerometer counts into SED, LPA, and MVPA (Table 6) as previously recommended (83).

Daily patterns of SED and PA were calculated according to in-school (08:00 a.m. to 15:00 p.m.) and out-of-school (06:00 a.m. to 08:00 a.m. and 15:00 p.m. to 23:00 p.m.) hours. The time interval for in-school hours was calculated as the mean time of all the school timetables.

In addition, consecutive uninterrupted SED (no tolerance-time) of ≥10, ≥20, ≥30, and ≥40 minutes was calculated. In terms of MVPA, bouts of ≥5, ≥10, and ≥15 consecutive minutes were calculated, and 1-2 minutes below the cut-point for MVPA was allowed to account for adolescents' spontaneous intermittent PA behavior (195).

The prevalence (percentage) meeting the PA recommendations was calculated in two versions: a) a mean of ≥60 minutes per day of MVPA; and b) ≥60 minutes per day of MVPA every day, reflecting the phrasing in previous PA recommendations (117, 121).

Accelerometer Data in Paper III

For the aim of Paper III, accelerometer data from T1, T2, and T3 was used. Similar to the above, accelerometer data was integrated into five-second epoch durations; the NWT-A was set to remove all sequences with ≥60 consecutive minutes of zero counts; ≥3 days with ≥8 hours per day of monitoring were required to be included in the analysis; and cut-points by Evenson et al. (83, 190) were used to estimate SED and MVPA (Table 6).

Accelerometer Data in Paper IV

For the aim of Paper IV, T1 accelerometer data was integrated into six epoch durations (1, 5, 10, 15, 30, and 60 seconds). The epoch duration of one second was selected as it provided the most detailed SED and PA accelerometer data. The longest epoch duration was set to the conventional 60 seconds as it has been frequently used in previous accelerometer-based studies with adolescents (e.g., 63% between 2005 and 2010) (97). The remaining epoch durations of 5, 10, 15, and 30 seconds were decided on because they also had been used in previous studies (97, 98). SED and LPA, MPA, VPA, and combined MVPA were estimated with the five calibrated and validated cut-points as summarized in Table 6 (190-194).

Table 6. Cut-points (CPM) for SED, LPA, MPA, VPA, and combined MVPA.

Reference	SED	LPA	MPA	VPA	MVPA
Evenson et al. (190)	≤100	101-2295	2296-4011	≥4012	≥2296
Freedson et al. (191)	≤100*	101-2391	2392-4382**	>4382**	≥2392
Treuth et al. (194)	≤100	101-2999	3000-5200	>5200	≥3000
Mattocks et al. (192)	≤100*	101-3580	3581-6129	≥6130	≥3581
Puyau et al. (193)	<800	800-3199	3200-8199	≥8200	≥3200

Abbreviations: LPA, Light physical activity; MPA, Moderate physical activity; MVPA, Moderate-to-vigorous physical activity; SED, Sedentary time; VPA, Vigorous physical activity.

*As interpreted by Trost et al. (83).

**METs = 2.757 + (0.0015 × CPM) – (0.08957 × age (y)) – (0.000038 × CPM × age (y)); and 4 and 6 METs were used to define MPA and VPA, respectively

Additional Variables (Papers II-IV)

A self-administered questionnaire was used to measure a) participation in organized sports; and b) ET frequency and ET duration. Prior to T1, the questionnaire was developed and its items were pilot-tested for clarity (e.g., the phrasing was clear and comprehensible) and revised according to the comments. The procedure of pilot testing the questionnaire and its items was carried out in June 2014, in cooperation with a sample of adolescents attending seventh grade at the intervention school during school year 2013-2014.

The questionnaire was answered by the participants in the home classroom during T1, T2, and T3, and members from the RG were present during the procedure to provide information and answer any questions related to the questionnaire.

Organized Sports Participation (Paper II)

For the aim of Paper II, the participants self-reported participation in organized sports (possible options were dichotomous: yes/no). The term "organized sport" was defined as structured and repetitive sport activities guided by a coach (e.g., playing soccer on a team, boxing, and martial arts).

Exercise Training Frequency and Duration (Paper III)

As accelerometers might be impractical to wear during some types of PAs such as contact sports (99), two questions were taken from the WHO collaborative cross-national survey "Health Behavior in School-aged Children" to measure

ET frequency and ET duration (198). These two questions have demonstrated acceptable reliability and validity among adolescents (199, 200).

The question for ET frequency was formulated as follows: "Outside of school hours, how often do you usually exercise in your free time so much that you get out of breath or sweat?". The following seven possible options were available: "never," "less than once a month," "once a month," "once a week," "2-3 times a week," "4-6 times a week," and "every day." In the analysis (see below), the responses for ET frequency were coded as follows: 1 = "never," 2 = "less than once a month," 3 = "once a month," 4 = "once a week," 5 = "2-3 times a week," 6 = "4-6 times a week," and 7 = "every day."

ET duration was measured with the following question: "Outside of school hours, how many hours a week do you usually exercise in your free time so much that you get out of breath or sweat?". The six possible options were: "none," "about 30 minutes," "about 1 hour," "about 2-3 hours," "about 4-6 hours," and "about 7 hours or more." In the analysis (see below), the six possible responses for ET duration were coded as follows: 1 = "none," 2 = "about 30 minutes," 3 = "about 1 hour," 4 = "about 2-3 hours," 5 = "about 4-6 hours," and 6 = "about 7 hours or more."

Anthropometrics (Papers II-IV)

Data for the participants' anthropometrics was collected during school visits in September 2014 (T1) and 2016 (T3). Anthropometrics for pupils transferred to the intervention/control school(s) were collected continuously after parent(s) or legal guardian(s) provided signed, written and informed consent. Body weight was measured in duplicate with electronic portable weighing scales (Beurer GS 27, CE Utrecht) to the nearest 0.1 kilo while the participants wore light-clothing. Height was measured in duplicate (while shoeless and without coiffure) to the nearest 0.1 centimeter using portable stadiometers (Seca 217, UK, Birmingham). A third measure of body weight and height was collected in cases where the two first measures differed. Data for body weight and height were used to calculate body mass index (BMI) ($\text{BMI} = \frac{\text{Body weight (kg)}}{\text{Height (m)}^2}$), and classify participants according to sex- and age-specific cut-offs for the weight categories (201).

Statistics (Papers II-IV)

Statistical analyses were performed with SPSS v. 22 and 24 (SPSS Inc., Chicago IL, U.S.). For descriptive statistics, frequencies, means, standard deviation (±SD), and range were analyzed. A summary of main statistics in Papers II-IV is provided in Table 7. The significance alpha-level for all tests was set at $p \leq 0.05$.

Table 7. Summary of main statistics in Papers II-IV.

Statistics	Paper II	Paper III	Paper IV
Analysis of covariance (ANCOVA)	X		
Multivariate analysis of covariance (MANCOVA)	X		
Latent growth curve analysis (LGCA)		X	
Repeated measurement analysis of variance (rANOVA)			X

In Paper II, the Chi-squared test was used to analyze differences between the number of girls and boys, as well as participants involved/not involved in organized sports, meeting the PA recommendations. Sex differences in mean PA intensity, and SED and MVPA bouts were analyzed using analysis of covariance (ANCOVA) controlling for accelerometer wear time and school belonging. Multivariate analysis of covariance (MANCOVA) was used to analyze sex differences in percent of wear-time spent in SED, LPA, and MVPA (controlling for accelerometer wear time and school belonging). ANCOVA and MANCOVA (controlling for accelerometer wear time and sex) was also used to analyze differences in terms of SED and PA variables between participants who were involved/not involved in organized sports, as well as participants from the BMI categories normal-weight and overweight/obese. Multiple post-hoc comparisons were Bonferroni-adjusted. Effect sizes were reported as partial eta-squared (η^2) indicating the proportion (percentage) of variance of the dependent variable explained by the independent variable(s) ranging from 0-1 (0-100%). The η^2 was interpreted with following values as a rule of thumb: small (0.01), moderate (0.06) and large (0.14) (202).

In Paper III, latent growth curve analyses (LGCA) were performed to examine change in the different activity measures.[25] LGCA arrange for opportunities to investigate changes among individuals and groups over time.

[25] $n = 1$ outlier (participant in the control group) was removed.

These LGCA analyses were performed using the Bayesian estimator in Mplus 8.0 (203). Regarding accelerometer-measured SED and MVPA:

a) In the first step (Model 1), an intercept (i.e., starting point) and a slope (i.e., change) between T1 and T3 was specified in the latent growth curve analyses.
b) In the second step (Model 2), average accelerometer wear time was included as a predictor for both the intercept and the slope.
c) In the third step (Model 3), intervention condition (i.e., intervention group vs. control group) was added as a predictor on both the intercept and the slope.
d) In the fourth step (Model 4), sex was included as a predictor on both the intercept and the slope.

Moreover, for self-reported ET frequency and ET duration:

a) In the first step (Model 1), an intercept (i.e., starting point) and a slope (i.e., change) between T1 and T3 was specified in the latent growth curve analyses.
b) In the second step (Model 2), intervention condition (i.e., intervention group vs. control group) was included as a predictor on both the intercept and the slope.
c) In the third step (Model 3), sex was added as a predictor on both the intercept and the slope.

For both accelerometer-measured SED and MVPA, and self-reported ET frequency and ET duration, sensitivity analyses showed that the results were unchanged when performing the analyses with participants providing data for all three data collection periods. Based on these findings, all participants with data from at least one data collection period were included in the models.

Model fit was evaluated using the posterior predictive *p* (PP*p*) value along with a 95% confidence interval. An excellent fit model is expected to have a PP*p*-value around 0.5 in combination with a symmetric 95% confidence interval centering on zero. For each parameter in the model, a credibility interval (CI) was calculated. The CI indicates the probability that the parameter lies between two values given the observed data, and in cases where the 95% CI did not involve zero, the parameter estimate was considered credible (i.e., the null hypothesis was rejected as improbable). To evaluate which model demonstrated the best fit to data, model comparisons were evaluated with the deviance information criterion (DIC), where a lower DIC value indicates a better-fit model (204).

In Paper IV, the repeated measurement analysis of variance (rANOVA) was used to explore within subject differences regarding SED, LPA, MPA, VPA, and combined MVPA between the six epoch durations. Post-hoc analyses (rANOVA, Bonferroni-adjusted) were used to pairwise compare differences between epoch durations (i.e., 1 vs. 5 seconds, 1 vs. 10 seconds and so forth). In this case, one second epoch duration was used as a reference because it provides the most detailed accelerometer data. Moreover, extreme differences between cut-point per epoch duration (i.e., comparing the lowest and highest estimates) were analyzed with rANOVA. The Greenhouse-Geisser procedure was applied (to adjust the degrees of freedom) in cases when the Mauchley's test indicated that the assumption of sphericity had been violated ($p < 0.05$). Effect size for rANOVA was reported as η^2 and interpreted as defined above.

Ethical Considerations

The organization and performance of the research conducted in the present thesis concur with guidelines for research provided by the Swedish Research Council[26] (205). These guidelines describe the research criterion (i.e., the research involved is important and relevant) and the criterion of protection of the participants involved in the research (205). Involving adolescents in research might be deemed problematic as their judgment regarding, for example, potential consequences might be limited. Available data suggests, however, that adolescents in general are able to comprehend the purpose of research participation, as well as the voluntariness nature of research (206).

All participants received oral and written information, and their parents/legal guardians received written information (in Swedish, Arabic, and Somali to fit the parent's/legal guardian's first language) about the project/planned intervention. The RG strived to formulate and deliver the oral/written information in an understandable manner appropriate for the participants and their parents/legal guardians. All participants and their parents/legal guardians were also provided with the opportunity to ask any questions regarding the project. In addition, they were guaranteed confidentiality (e.g., pseudo-anonymized[27] and labelled with unique identification code/number) and it was continuously clarified that involvement

[26] Vetenskapsrådet.
[27] Meaning that the RG used identification code/number keys to link information to specific participants.

in the project was voluntarily, and that they could withdraw their participation at any moment without providing any further explanation or justification. As adolescents might be concerned whether their information would be shared with the parents/legal guardians (206), it was clarified to participants that data collected during the project would be available only to the responsible researchers, and that any results would be presented at a group level, thus leaving information on an individual level unattainable. Nonetheless, if conditions requiring any kind of treatment were discovered by the RG during the intervention, they had the opportunity to support participants and parents/legal guardians to contact the central unit of school health in the area of Angered.

The identities of the participants were never explicitly mentioned when fieldworkers documented the development and implementation of the intervention by protocol. The individual and focus group interviews, as well as the SGHCS, and occasionally the HPS, were voice recorded to permit post-verification of information throughout the intervention. Permission (oral consent by participants) to voice record the interviews, SGHCS and HPS was obtained prior to each occasion. The participants were guaranteed confidentiality, and it was clarified that the voice recordings would be used only for the purpose of research.

Moreover, because the data collection procedure might be deemed relatively extensive (individual and focus groups interviews, wearing accelerometers, answering questionnaires, etc.), it is imaginable that some participants experienced some violation of integrity. In counterbalance, participants were provided with the opportunity to express their opinions and to be heard in matters affecting their health and well-being, and they were given opportunities to influence and decide on content related to the HPS.

The reasons for choosing a closed group at FB were the following: a) the vast majority of the participants already reported having an account at T1; and b) closed groups at FB allow the inclusion of members who (according to the application) are not registered as "friends" (i.e., not having accepted a so-called "friend request" from each another). The RG considered the latter relatively harmless compared to some other types of online platforms where two users might be required to be "friends" or "follow" each other in order to interact.

All participants and their parent(s) or legal guardian(s) provided signed, written, and informed consent prior to their involvement in the project. The research protocol for the 'How-to-Act?' project was reviewed and evaluated

and approved by the Regional Ethical Review Board of Gothenburg (registration: #2014/469-14). Collected data was archived and stored in a locked metal cabinet (with the unique identification code/number stored in another) at the Department of Food and Nutrition, and Sport Science, University of Gothenburg.

Additional ethical issues and dilemmas attributable to the nature of the intervention, such as the paradox of being inspired by the RECE-a and the risk of HP interventions becoming normative enterprises, are addressed in Chapter 4: Discussion.

Chapter 3: Results

The following chapter summarizes the results for the four papers that constitute the present thesis.

Flow of Participants (Papers I-IV)

The distribution of participants across the total sample, intervention group and the control group at T1, T2, and T3, respectively is illustrated in Figure 6. During T1, 114 participants were involved in the project with 54 being from the intervention group. At T2 and T3, 110 (n = 53 intervention group) and 101 (n = 54 intervention group) participants were involved in the project, respectively.

New pupils who were transferred to any of the three participating schools were invited to participate in the project except for at T3. Across the two years, a total of 135 participants were involved in the project during at least one data collection period (i.e., T1, T2 and/or T3). Of these, 61 were participants from the intervention group (n = 46 participated during all three data collection periods, n = 7 during two data collection periods, and n = 8 during either T1, T2 or T3). In the control group, the corresponding figures were as follows: 74 participants were involved in the project during at least one data collection period (n = 24 during all three data collection periods; n = 24 during two data collection periods; and n = 26 during either T1, T2 or T3). Loss of participants to follow-up (T1 to T3) was 29% (intervention group: 13% and control group: 43%).[28]

[28] Predominately reflected by participants changing schools.

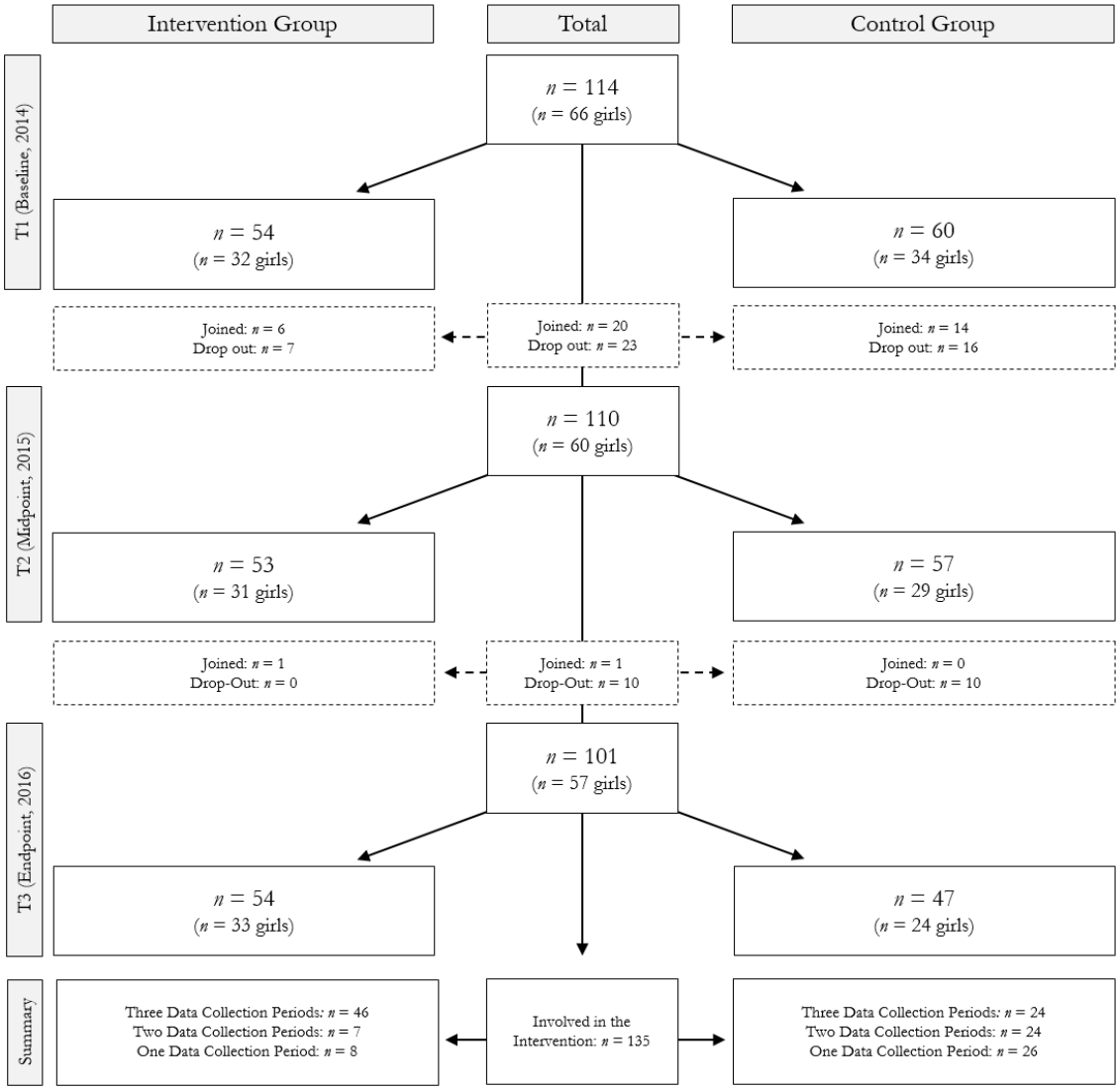

Figure 6. The distribution of participants (total sample, and the intervention group and control group) involved in the project at T1, T2, and T3, respectively. The number of participants who joined (e.g., new pupils transferred to any of the schools) or those who dropped out (e.g., pupils who changed school to one outside the project) prior to each data collection period are noted in dashed boxes. A summary of the number of participants involved during one, two and three data collection period(s) respectively is provided in the bottom of the figure.

The Development and Implementation of the Intervention (Paper I)

The intervention was developed and implemented during SEM-1-4 as overviewed in Figure 7. The development and implementation of the

intervention is presented below and in the following order: Firstly, the process related to HC and the reflective spiral of cycles is presented and, occasionally, the themes and contents of the HPS are mentioned for clarification purposes. In addition, the utilization of FB during the intervention is described.[29] Secondly, the themes, contents, aims, and locations of the HPS are summarized. Although the present thesis was largely delimited to PA, aspects related to food are also mentioned and discussed as the author of the present thesis developed and implemented HPS with a focus on food as well.

Health Coaching and the Reflective Spiral of Cycles

Semester 1 (Participants Attended Seventh Grade)

The information produced from the interviews (i.e., individual and focus groups), together with written statements of participants' goals for the intervention, guided the framework construction. The RG divided the participants into six groups of 6-8 participants each based on what they perceived were their shared goals, wishes, and needs in relation to food and PA. Although each group addressed components of food and PA, the chief focus in Groups 1–3 was food and in Groups 4–6 it was PA (Figure 7).

[29] The website with information about the 'How-to-Act?' project, its design and protocol was not utilized in an interactive way; rather, it was a one-way communication. It is, therefore, not further discussed in relation to the development and implementation of the intervention. The website location was, however, addressed in the written information (letters/brochures) provided to the participants and their parents/legal guardians during, for example, the procedure of inviting them to participate in the project and prior to T1, T2, and T3.

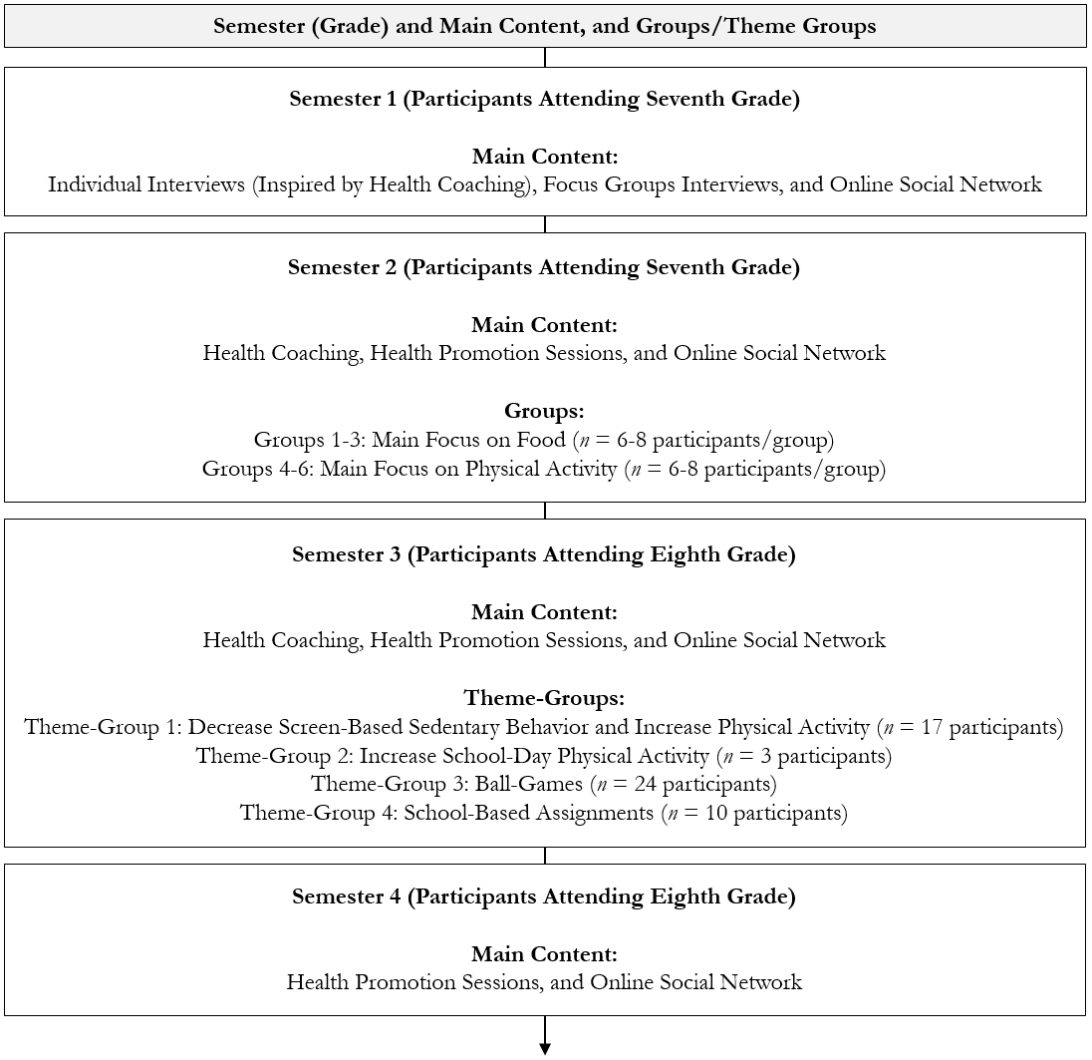

Figure 7. Overview of the intervention (SEM-1-4) developed and implemented within the 'How-to-Act?' project, and the number of participants in each group/theme group during SEM-2-4.

Semester 2 (Participants Attended Seventh Grade)

At the onset of SEM-2 the fieldworkers used SGHCS to identify goals within each groups of participants as well as the activities they were willing to focus on during the HPS. Through a collaborative process involving the fieldworkers and participants, each group first created a regulatory framework to agree upon rules of conduct during the SGHCS such as "Show respect for the opinions of others" and "Do not interrupt". Albeit each group had created a regulatory framework, the fieldworkers experienced that several participants tended to interrupt others, and a substantial part of some SGHCS was spent focusing on organizing and structuring the session instead of the content of the dialogue.

Participants also expressed disappointment with discussing goals related to food and PA, theoretical sessions which shared features with their everyday school work. During the SGHCS, fieldworkers also felt that participants remained focused on the present and had limited interest in formulating goals and working with goal-setting strategies. Those participants who the fieldworkers perceived being motivated to work with goal-setting strategies explicitly expressed their concern of being challenged with recalling their goals from one occasion to the next.

Participants suggested that, as an alternative, the SGHCS should be replaced by practical activities, such as preparing food and playing sports. In response, the RG reflected over the participants' suggestions and decided to modify the HC component of the intervention. Instead of conducting the group HC sessions in a structured manner, the RG agreed to end each HPS with brief HC to reflect upon participants' experiences and to discuss potential benefits of certain food and PA habits, as well as strategies to implement activities promoting those habits outside the school environment. By increasingly focusing on practical, hands-on activities, both the modified version of the HC component of the intervention and the HPS improved as the participants became increasingly involved in the activities.

Although the reality presented barriers during SGHCS, 15 HPS were developed and implemented which reflected participants' suggestions and the RG's common experiences of reasonable actions for implementation. Participants were in general curious about the HPS and had a number of suggestions on activities in relation to food and PA. Participants particularly appreciated practical, hands-on HPS. The fieldworkers also experienced that participants appreciated collaborating with peers, and that they took responsibility in co-developing and implementing the intervention.

Moreover, the fieldworkers experienced barriers in relation to the context of the intervention (i.e., the school environment) as it generally was chaotic. Participants sometimes acted hostile toward each other, and during the course of the intervention, incidents involving not only vandalism and fire, but also physical assaults of participants occurred. Such a chaotic environment contributed to the occasional inattention among participants during the HPS.

To further identify obstacles and opportunities posed by the intervention, prior to the SEM-3, the two doctoral students who had the chief responsibility for conducting the fieldwork participated in a coaching session led by the qualified coach-in-practice who also led the series of educational sessions

during planning and preparation of the intervention. During the coaching session, the perception of having created homogeneous groups based upon participants' shared goals, wishes and needs reflected upon observations and experiences that suggested otherwise. As part of this, groups of participants became highly influenced by the work of others. For instance, when one group engaged in activities, such as preparation and cooking of food and swimming, participants in other groups expressed their wishes of doing similar activities, ultimately leading to most groups having the same suggestions on activities to perform during HPS.

The RG discussed alternative actions within the intervention and determined that participants would perhaps benefit from choosing between four theme groups, the content of which the researchers believed reflected participants' wishes and needs identified during both SEM-1 and SEM-2. Theme Group 1 with 17 participants, adopted the goal of decreasing screen-based SB and increasing PA, whereas Theme Group 2, with three participants, adopted the goal of increasing school day PA (Figure 7). Within those two theme groups, the RG supported participants in determining the theme, aim, content, and location of the HPS. Other than Theme Groups 1 and 2, the RG also gave participants the opportunity to choose between theme groups focusing on ball games (Theme Group 3, $n = 24$) or school-based assignments such as doing homework (Theme Group 4, $n = 10$) given their requests (Figure 7). For practical reasons, the homeroom teachers assumed chief responsibility for the activities performed in Theme Groups 3 and 4.

Semester 3 (Participants Attended Eighth Grade)

Given the belief that more homogenous groups had been created by participants' choosing which group to join, the fieldworkers used SGHCS to further identify activities to focus on during SEM-3. A number of suggestions were presented during the SGHCS and the fieldworkers experienced some competing interest among participants. Although not entirely consistent with initial suggestions, Theme Group 1 managed to identify a goal of interest which was to prepare and perform a whole-day workshop that addressed food and PA for all participants in all four theme groups. During the participants' preparation, the fieldworkers put effort into encouraging and supporting them to comply with arguments for their decisions for choosing specific content related to each activity included in the full day workshop. Theme Group 1

agreed upon activities, such as preparing vegetarian food, healthy snacking (e.g., FV-based smoothies), and doing PAs (e.g., playing sports) and the activities were supported by arguments suggesting the health-related benefits of FV consumption and PA. In Theme Group 2, which was also supported by the fieldworkers, participants created individualized food and PA programs as they wished to increase their FV consumption and increase their school day PA (e.g., walking with pedometers and ET). Compared to SEM-2, and in addition to the initial work of identifying an area of interest in Theme Group 1, the fieldworkers experienced that the SGHCS improved during SEM-3, possibly because more homogenous groups had been created and considerably more attention was paid to identifying shared interests within the group. The fieldworkers further perceived that participants in Theme Group 1-2 took responsibility and cooperated in planning and organizing the intervention activities.

The RG reviewed and summarized the experiences gathered during SEM-3. The review process resulted in their reflection that the intervention would benefit from implementing a HPS focusing on health in terms of bodies and body ideals in relation to food and PA. These health issues had been requested by some participants, although not yet put into practice since participants had collectively prioritized and agreed on other activities to perform during the HPS. In addition, the RG discussed strategies to support the school in completing additional tasks related to HP. As a result, the RG invited the school's principal, teachers, and other school personnel to participate in an all-day workshop at the University of Gothenburg.

Semester 4 (Participants Attended Eighth Grade)

Three HPS were developed and implemented during SEM-4. In addition, the school's principal, teachers, and other school personnel accepted the invitation to attend the whole-day workshop during SEM-4. The workshop involved the presentation of preliminary results from the intervention, an introduction to the basic principles and concepts of the intervention (i.e., empowerment and HP), and discussions about opportunities and challenges for sustaining the HP actions in the school once the intervention had ended.

Online Social Network (Facebook Group)

During the course of the intervention, the majority (63%, *n* = 31[30]) of the participants at the intervention school joined the closed FB group and the attrition rate was low (*n* = 2 participants left the group during the course of the intervention).

The fieldworkers used the FB group to post information on upcoming HPS (e.g., content and location), provide feedback (written comments and/or attached photographs) from previously implemented HPS, and to communicate information on events (e.g., opportunities to participate in PAs, ET and organized sport free of charge during school holidays) in the area of Angered.

Across SEM-1-4, the fieldworkers encouraged participants to use the FB group to ask any question related to the intervention as a whole, as well as for specific questions related to the HPS. Participants were also encouraged to post photographs during intervention activities such as preparation (e.g., recipes) and cooking of food and different PAs.

At the end of SEM-4, there were 69 posts in the closed FB group. These posts were distributed as follows: a) status updates on information related to HPS (*n* = 39); b) media uploads such as photographs from previous implemented HPS (*n* = 25); and c) shared links to inform about upcoming events in the area of Angered (*n* = 5).

Health Promotion Sessions (Semesters 2-4)

Examples of themes, content, aims, and locations of the 31 HPS carried out across SEM-2-4 are summarized in Table 8-10 (Appendix 3-5). Across SEM-2-4, the themes of the HPS were food, PA and/or health (the theme health reflected body and body ideals in relation to food and PA). The HPS were carried out both in the school environment and its surroundings (e.g., classroom, home-economic kitchen, and gym) and outside the school environment (other places in Gothenburg).

[30] The percentage of those already at T1 reporting having a FB account (*n* = 49). No participant used the anonymous accounts created to allow non-users into the closed FB group.

Semester 2 (Participants Attended Seventh Grade)

The 15 HPS developed and implemented during SEM-2 were carried out during school hours (included in the school timetable, 90 minutes/session and week)[31] (Table 8). Of these, seven HPS were carried out with all participants (irrespectively of group belonging) because the themes and contents reflected suggestions by all groups of participants. The themes and contents of the remaining eight HPS depended on each group's shared wishes and needs, and suggestions on activities. The HPS implemented during SEM-2 involved activities, such as preparation and cooking of healthy snacks (e.g., FV-based smoothies), playing sports and doing other PAs (e.g., brisk walking with pedometers). In also involved trying and learning body weight-based resistance training exercises, and online searches (via computer tablets) and compilation of health benefits of a balanced and healthy diet and PA. Among others, the aims of the HPS were to provide opportunities to learn and practice preparing healthy snacks; to be physically active through presumably inspiring, positive experiences; to learn and enact resistance training exercises not requiring any equipment; and to critically reflect upon and appraise health-related information.

[31]Apart from two sessions: 180 and 360 minutes respectively (Appendix 3).

Table 8. Examples of themes, aims, contents, and location of the HPS during SEM-2.

Example of content	Aim	Location
Theme: Food, PA and Health		
Half-day with food-related activities (e.g., identifying the amount of added sugar in common foods) and PA (e.g., playing sports)[a]	To provide an opportunity for an engaging experience related to food and PA	Outside the school environment
Whole day of preparation (e.g., searching online with computer tablets for recipes) and cooking of vegetarian food and exhibition concerning health and HP[a]	To provide an opportunity for an engaging experience related to healthy eating	Outside the school environment
Theme: Food		
Online searches with computer tablets and compilation of health-related benefits of a balanced, healthy diet as well as recommendations and guidelines[a]	To provide an opportunity to critically reflect upon and appraise health-related information	School classroom
Preparation of healthy snacks such as smoothies containing FV[a]	To provide an opportunity to reflect upon daily recommendations of FV consumption and to learn and practice preparing healthy snacks	Home-economic kitchen
Workshops to identify desired changes in food served at school subsequently formulated into questions and presented to representatives of the school cafeteria[a]	To provide an opportunity to identify and discuss desires for changes in the school cafeteria	School classroom
A week of documenting whole-day dietary habits with a photo diary on smartphones	To provide an opportunity to identify and discuss food habits	In- and outside the school
Theme: PA		
Resistance training exercises focused on body-weight[a]	To provide an opportunity to learn and enact resistance training exercises not requiring any equipment	School classroom and gym
Online searches with computer tablets and compilation of health benefits of PA as well as recommendations and guidelines (e.g., steps and minutes per day)[a]	To provide an opportunity to critically reflect upon and appraise health-related information	School classroom
Playing sports and other PAs (e.g., soccer, basketball, jogging or running, martial arts, brisk walking with a pedometer, dancing, and swimming)	To provide opportunities to be physically active, predominately in the school's surrounding, by inspiring, positive experiences	School classroom, school surroundings, and outside the school environment

Abbrevations: FV, Fruits and vegetables; HP, Health promotion; PA, Physical activity.

[a]All participants irrespectively of group.

Semester 3 (Participants Attended Eighth Grade)

During SEM-3, totally 13 HPS (included in the school timetable, 60 minutes/session and week)[32] were carried out in Theme Groups 1-4 (Table 9). Theme group 1 agreed on activities to include during the whole-day workshop such as preparation and cooking of vegetarian food/healthy snacking and playing sports, and the activities were supported by arguments suggesting health benefits of FV consumption and PA. The aim of the HPS was to identify and reflect upon opportunities and actions to prepare and practice activities related to healthy eating and PA. Furthermore, Theme Group 2 created individualized food and PA programs, walked with pedometers and performed ET. The aim of these HPS was to provide an opportunity to create and organize individualized food and PA programs and to be physical active during the school day.

Besides the work within these two theme groups, the researchers also invited a representative from community programs to participate in a workshop discussing opportunities for PAs (e.g., information regarding ET and involvement in sport compounds in the area of Angered). The discussion was summarized by the participants in the Theme Groups 1-2 and exposed to all participants through posters in the school environment.

As for Theme Groups 3 and 4, they focused on ball games and school-based assignments, with the aim to provide an opportunity for an engaging experience with PA, and doing home-works, etc. respectively. These HPS were generally led by the homeroom teachers who received information regarding the themes, aims, and contents of the HPS prior to each occasion.

[32] Apart from one session: 360 minutes (Appendix 4).

Table 9. Examples of themes, aims, contents, and location of the HPS during SEM-3.

Example of content	Aim	Location
Theme: Food and PA		
Preparation and execution of a whole day of cooking vegetarian food and healthy snacks, and PA (e.g., playing sports) (Theme Group 1)	To identify and reflect upon opportunities and actions to prepare and practice activities related to healthy eating and PA, as well as to provide an opportunity for an engaging experience with healthy eating and PA	School classroom and outside the school environment
Creation and organization of individualized food and PA programs aimed to increase FV consumption and decrease the consumption of energy-dense snacks and sweetened beverages, as well as to increase PA (e.g., by dancing, walking with pedometers, and ET), during the school day (Theme Group 2)	To provide an opportunity to create and organize individualized food and PA programs and to be physical active during the school day	School classroom and outside school environment
Ball games (Theme Group 3)	To provide an opportunity for an engaging experience with PA	Gym

Abbrevations: ET, Exercise training; FV, Fruits and vegetables; PA, Physical activity.

Semester 4 (Participants Attended Eighth Grade)

During SEM-4, three relatively longer HPS (120-180 minutes/session) were developed and implemented (Table 10). These included workshops that exposed all participants and included Sapere to utilize sensory awareness to explore and increase the awareness of food sensations and preferences, and discussions of body and body ideals. The aims of these workshops were to provide opportunity to a) reflect upon food preferences and try different foods (Sapere); and b) discuss and critically reflect upon body ideals in today's society (body and body ideal).

Attendance Rate

The attendance rate per session and per participant across SEM-2-4 are summarized in Table 11 (Appendix 3-5).

Table 10. Examples of themes, aims, contents, and location of the HPS during SEM-4.

Example of content	Aim	Location
Theme: Food		
Sapere workshop on exploring and increasing awareness of food-related senses and preferences[a]	To provide an opportunity to reflect upon food preferences and try different foods	School classroom
Theme: Health		
Workshop involving video clips to discuss bodies and body ideals[a]	To provide an opportunity to discuss and critically reflect upon body ideals in today's society	School classroom

[a]All participants irrespectively of group.

Table 11. Number and duration, and attendance rate during the 31 HPS (including SGHCS) developed and implemented across SEM-2-4.

		Attendance rate*	
Semester	**Number (duration)**	**Per session, mean (range)**	**Per session, mean (range)**
2	15 (90 min/session and week)	83% (69-89%)	20-100%
3	13 (60 min/ session and week)	86% (80-95%)	61-100%
4	3 (120-180 min/session)	87% (85-89%)	33-100%

*Attendance was documented as the number of participants who were present during the HPS. The participants were provided with the opportunity to decide for themselves whether they wished to actively or passively (i.e., attending, yet merely observing) take part during the activities.

Sedentary Time and Physical Activity (Papers II-IV)

Characteristics (Papers II-IV)

For Papers II-IV, descriptive data for the participants' characteristics (number of participants, age, and anthropometrics) at T1 and T3 respectively are summarized in Table 12.

Table 12. Descriptive data for the participants in the total sample, intervention group and the control group, respectively at T1 (baseline, 2014) and T3 (endpoint, 2016).

								BMI Categories		
			n	**Age**, years ($\bar{x}$±SD)	**Height**, cm ($\bar{x}$±SD)	**Weight**, kg ($\bar{x}$±SD)	**BMI** ($\bar{x}$±SD)	**Underweight**, %	**Normal weight**, %	**Overweight**, %	**Obese**, %
Total				*n* = 114 (*n* = 66 girls)	*n* = 106 (*n* = 61)	*n* = 106 (*n* = 61 girls)	*n* = 106 (*n* = 61 girls)	n = 10 (*n* = 6 girls)	n = 59 (*n* = 33 girls)	*n* = 26 (*n* = 13 girls)	*n* = 11 (*n* = 9 girls)
	T1	Total	114	12.8 (±0.5)	160.0 (±7.4)	53.8 (±12.6)	20.9 (±4.4)	9.4	55.7	24.5	10.4
		Girls	66	12.8 (±0.4)	158.5 (±6.7)	54.6 (±13.3)	21.6 (±4.7)	9.8	54.1	21.3	14.8
		Boys	48	12.8 (±0.5)	162.0 (±8.0)	52.6 (±11.6)	20.0 (±3.9)	8.9	57.8	28.9	4.4
				n = 98 (*n* = 55 girls)	*n* = 94 (*n* = 53 girls)	*n* = 93 (*n* = 51 girls)	*n* = 93 (*n* = 51 girls)	*n* = 5 (*n* = 2 girls)	*n* = 55 (*n* = 28 girls)	*n* = 22 (*n* = 15 girls)	*n* = 11 (*n* = 6 girls)
	T3	Total	98**	14.8 (±0.5)	166.3 (±8.5)	63.2 (±15.0)	22.8 (±4.8)	5.4	59.1	23.7	11.8
		Girls	55	14.8 (±0.4)	161.2 (±6.3)	60.9 (±13.7)	23.4 (±4.7)	3.9	54.9	29.4	11.7
		Boys	43	14.8 (±0.5)	172.5 (±6.5)	66.1 (±16.2)	22.1 (±4.9)	7.1	64.3	16.7	11.9
Intervention Group				*n* = 54 (*n* = 32 girls)	*n* = 54 (*n* = 32 girls)	*n* = 54 (*n* = 32 girls)	*n* = 54 (*n* = 32 girls)	*n* = 5 (*n* = 3 girls)	*n* = 26 (*n* = 17 girls)	*n* = 16 (*n* = 7 girls)	*n* = 7 (*n* = 5 girls)
	T1	Total	54	12.8 (±0.5)	159.7 (±7.6)	55.7 (±13.0)	21.7 (±4.4)	9.3	48.1	29.6	13.0
		Girls	32	12.8 (±0.4)	158.1 (±6.6)	55.1 (±12.9)	21.9 (±4.5)	9.4	53.1	21.9	15.6
		Boys	22	12.8 (±0.6)	161.9 (±8.5)	56.5 (±13.5)	21.4 (±4.4)	9.1	40.9	40.9	9.1
				n = 51 (*n* = 31 girls)	*n* = 51 (*n* = 31 girls)	*n* = 51 (*n* = 31 girls)	*n* = 21 (*n* = 31 girls)	*n* = 3 (*n* = 1 girls)	*n* = 25 (*n* = 16 girls)	*n* = 14 (*n* = 10 girls)	*n* = 9 (*n* = 4 girls)
	T3	Total	51**	14.8 (±0.5)	165.3 (±8.5)	65.2 (±8.5)	23.7 (±5.1)	5.9	49.0	27.5	17.6
		Girls	31	14.8 (±0.4)	160.7 (±6.0)	61.0 (±13.3)	23.5 (±4.5)	3.2	51.6	32.3	12.9
		Boys	20	14.8 (±0.5)	172.5 (±6.7)	71.6 (±19.9)	23.9 (±6.0)	10.0	45.0	20.0	25.0
Control Group				*n* = 60 (*n* = 34 girls)	*n* = 52 (*n* = 29 girls)	*n* = 52 (*n* = 29 girls)	*n* = 52 (*n* = 29 girls)	*n* = 5 (*n* = 3 girls)	*n* = 33 (*n* = 16 girls)	*n* = 10 (*n* = 6 girls)	*n* = 4 (*n* = 4 girls)
	T1	Total	60	12.8 (±0.5)	160.4 (±7.3)	51.9 (±11.9)	20.1 (±8.3)	9.6	63.5	19.2	7.7
		Girls	34	12.8 (±0.4)	158.9 (±6.9)	54.2 (±13.9)	21.3 (±4.9)	10.3	55.2	20.7	13.8
		Boys	26	12.9 (±0.5)	162.1 (±7.6)	49.0 (±8.3)	18.6 (±2.8)	8.7	73.9	17.4	0.0
				n = 47 (*n* = 24 girls)	*n* = 43 (*n* = 21 girls)	*n* = 42 (*n* = 20 girls)	*n* = 42 (*n* = 20 girls)	*n* = 2 (*n* = 1 girls)	*n* = 30 (*n* = 12 girls)	*n* = 8 (*n* = 5 girls)	*n* = 2 (*n* = 2 girls)
	T3	Total	47	14.8 (±0.5)	167.4 (±8.4)	60.9 (±12.1)	21.8 (±4.1)	4.8	71.4	19.0	4.8
		Girls	24	14.8 (±0.4)	161.9 (±6.7)	60.8 (±14.5)	23.2 (±4.9)	5.0	60.0	25.0	10.0
		Boys	23	14.9 (±0.5)	172.6 (±6.5)	61.1 (±9.8)	20.5 (±2.7)	4.5	81.8	13.6	0.0

Abbrevation: BMI, Body Mass Index.

***n* = 3 did not provide any descriptive data for T3.

Table 13. Mean (±SD) accelerometer wear time during T1, T2, and T3, across the total sample, the intervention group, and the control group, respectively.

	Total*			**Intervention Group****			**Control Group*****		
	Total	**Boys**	**Girls**	**Total**	**Boys**	**Girls**	**Total** [a]	**Boys**	**Girls**
T1 (Baseline, 2014)	*n* = 101	*n* = 38	*n* = 63	*n* = 49	*n* = 19	*n* = 30	*n* = 52	*n* = 19	*n* = 33
Days	6.0 (±1.3)	5.6 (±1.5)	6.3 (±1.2)	6.5 (±0.9)	6.5 (±0.9)	6.5 (±0.9)	5.6 (±1.5)	4.7 (±1.4)	6.1 (±1.4)
Hours per day	14.0 (±1.8)	13.7 (±1.9)	14.2 (±1.7)	14.2 (±1.7)	14.5 (±2.0)	14.0 (±1.4)	13.8 (±1.9)	12.8 (±1.5)	14.3 (±1.9)
T2 (Midpoint, 2015)	*n* = 72	*n* = 25	*n* = 47	*n* = 41	*n* = 16	*n* = 25	*n* = 31	*n* = 9	*n* = 22
Days	5.3 (±1.5)	5.0 (±1.3)	5.4 (±1.6)	5.7 (±1.5)	5.3 (±1.4)	5.9 (±1.5)	4.7 (±1.3)	4.6 (±0.9)	4.7 (±1.5)
Hours per day	14.0 (±2.4)	13.4 (±2.3)	14.4 (±2.4)	14.6 (±2.5)	14.0 (±2.5)	14.9 (±2.5)	13.3 (±2.1)	12.3 (±1.2)	13.8 (±2.3)
T3 (Endpoint, 2016)	*n* = 84	*n* = 32	*n* = 52	*n* = 48	*n* = 18	*n* = 30	*n* = 36	*n* = 14	*n* = 22
Days	5.5 (±1.4)	5.3 (±1.3)	5.6 (±1.5)	5.7 (±1.3)	5.4 (±1.3)	5.9 (±1.3)	5.1 (±1.5)	5.1 (±1.3)	5.2 (±1.7)
Hours per day	13.8 (±2.6)	13.6 (±2.8)	14.0 (±2.4)	14.0 (±2.7)	13.7 (±2.9)	14.2 (±2.6)	13.6 (±2.4)	13.4 (±2.7)	13.6 (±2.2)

**n* = 66 participants provided accelerometer data at T1 and T3 (*n* = 50 for all three data collection periods); *n* = 18 at T1 and T2 or T2 and T3; and *n* = 39 for T1, T2 or T3.

***n* = 41 participants provided accelerometer data at T1 and T3 (*n* = 34 for all three data collection periods); *n* = 6 at T1 and T2 or T2 and T3; and *n* = 10 for T1, T2 or T3.

****n* = 25 participants provided accelerometer data at T1 and T3 (*n* = 16 for all three data collection periods); *n* = 12 at T1 and T2 or T2 and T3; and *n* = 29 for T1, T2 or T3.

[a]In Paper III one outlier was removed.

Accelerometer Data (Papers II-IV)

A flowchart (Figure 8) illustrates a) the number of eligible participants (i.e., those who agreed to wear the accelerometer), b) collected accelerometers, and c) the number of participants included (i.e., those who provided the minimum requirements of monitoring) across T1-T3. At T1, 114 participants wore the accelerometer, and 101 (n = 63 girls) provided the minimum requirements of monitoring (n = 2 lost and n = 11 insufficient wear time). At T2, 108 participants agreed to wear the accelerometer and 72 (n = 47 girls) provided the minimum requirements of monitoring (n = 13 lost, n = 1 broken, n = 2 mechanical malfunctions, and n = 20 insufficient wear time). Finally, at T3, 101 participants wore the accelerometer with 84 (n = 52 girls) providing the minimum requirements of monitoring (n = 3 lost and n = 14 insufficient wear time).

Mean accelerometer wear time during T1, T2, and T3 across the total sample, and intervention group and the control group respectively is summarized in Table 13.

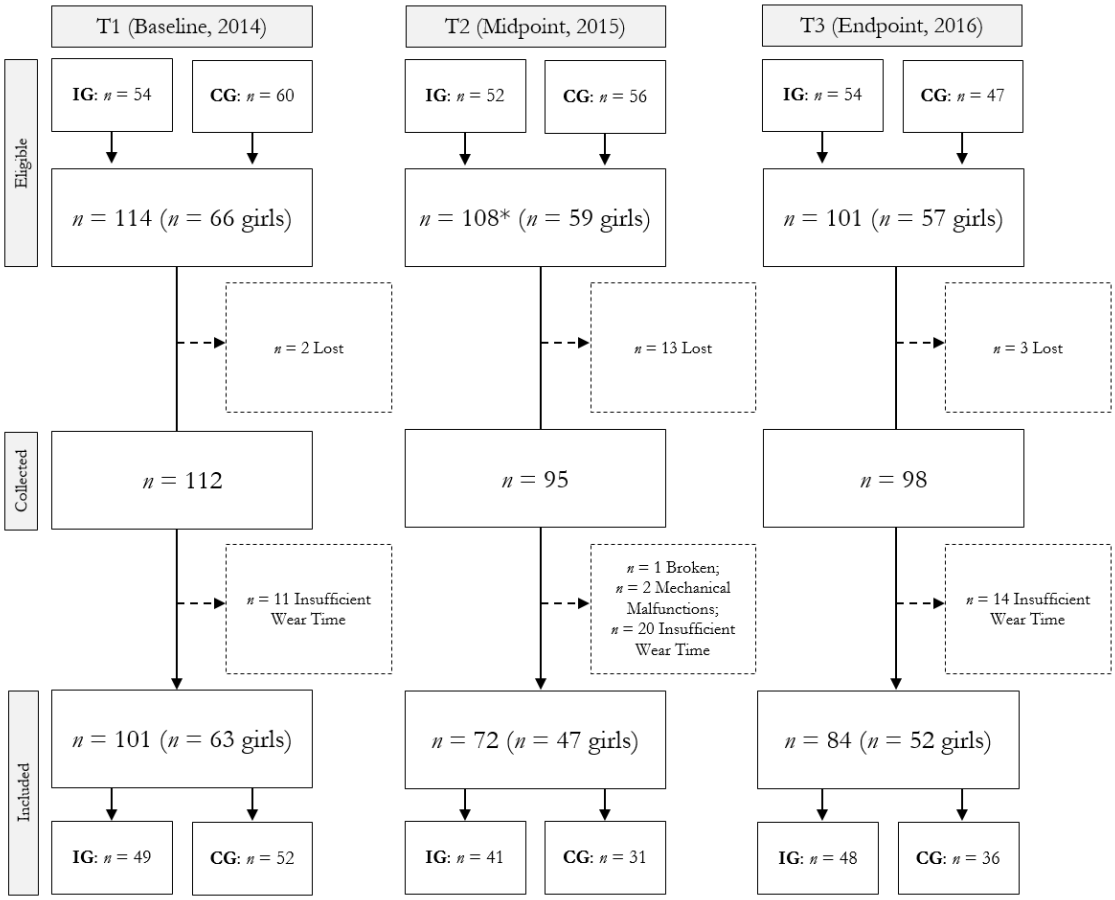

Figure 8. Flowchart illustrating the number of eligible participants (i.e., those who agreed to wear the accelerometer), collected accelerometers, and the number of participants included (i.e., those who provided the minimum requirements of monitoring) across T1, T2, and T3, respectively. The dashed boxes show the number of accelerometers lost or broken, having mechanical malfunctions, as well as the number of participants having insufficient wear time. **Abbreviations**: CG, Control group; IG, Intervention group. **n* = 2 did not agree to wear the accelerometer.

Paper II

For the aim of Paper II, T1 accelerometer data (n = 101 participants, n = 63 girls) was analyzed with five-second epoch durations and cut-points by Evenson et al. to describe and analyze (by sex, organized sport participation, and BMI) accelerometer-measured SED and PA among the participants.

SED, LPA, and MVPA across total wear time, in-school hours, and out-of-school hours are shown in Figure 9 and presented in Table 14. During total wear time, the participants spent 70 (±6)% in SED, and 22 (±5)% in LPA and

8 (±3)% in MVPA. Mean PA intensity ($CPM_{V\text{-}DATA}$ and $CPM_{VM\text{-}DATA}$) is shown in Figure 10.

Moreover, the participants spent a mean of 65 (±24) minutes of MVPA per day. The prevalence meeting the PA recommendations was 53% when analyzed as a mean of ≥60 minutes per day of MVPA (Figure 11) and 13% when analyzed as ≥60 minutes per day of MVPA every day.

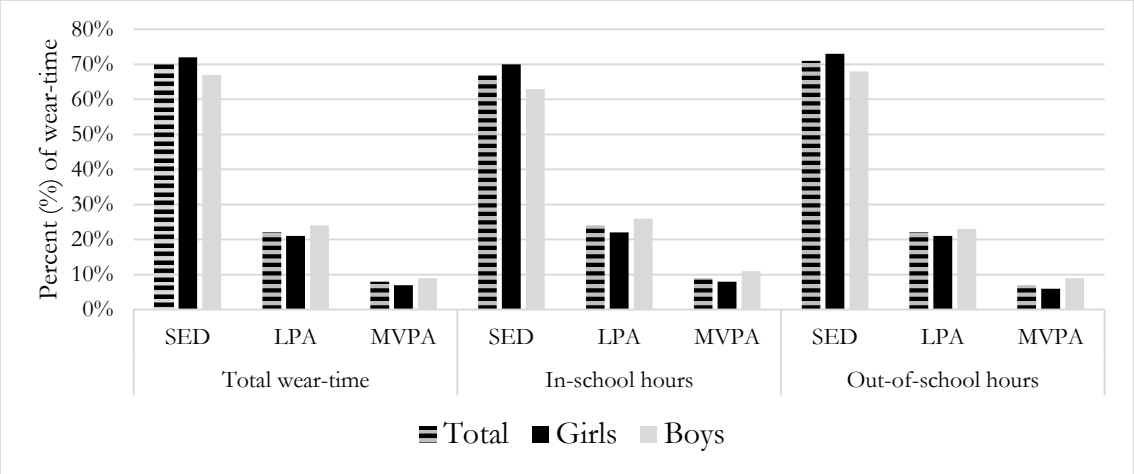

Figure 9. SED, LPA, and MVPA across total wear time, in-school hours, and out-of-school hours among the total sample (grey black horizontal line bars) and girls (black bars), and boys (grey bars) respectively.

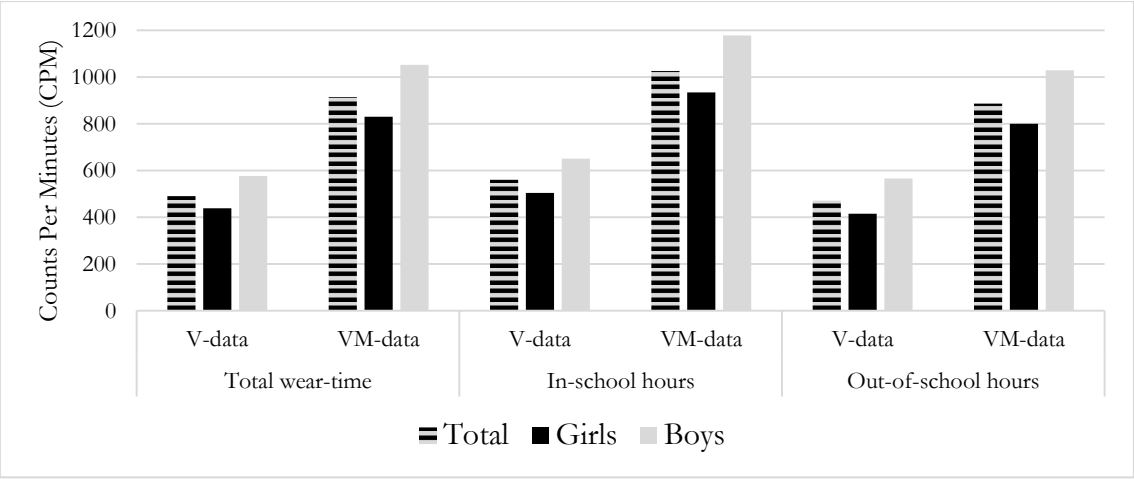

Figure 10. Mean PA (expressed as $CPM_{V\text{-}DATA}$ and $CPM_{VM\text{-}DATA}$) across total wear time, in-school hours, and out-of-school hours among the total sample (grey black horizontal line bars) and girls (black bars), and boys (grey bars) respectively.

Virtually no SED bouts of ≥20, ≥30, or ≥40 minutes were shown for girls or boys. As shown in Table 14, the participants accumulated 6 (±4) SED bouts of ≥10 minutes per day. Similarly, virtually no MVPA bouts of ≥10 and ≥15 minutes were observed; the participants accumulated on average 5 (±3) MVPA bouts of ≥5 minutes per day (Table 14).

Table 14. Mean (±SD) percent (rounded values) of wear time spent in SED, LPA and MVPA, and mean (±SD) number (rounded values) of SED and MVPA bouts.

		Total (*n* = 101)	**Boys (*n* = 38)**	**Girls (*n* = 63)**	**P-value**	**ES (η^2)**
Total wear time	SED%	70 (±6)	67 (±6)	72 (±5)	< 0.001	0.144
	SED bouts ≥10 min	6 (±4)	5 (±3)	7 (±4)	0.007	0.074
	LPA%	22 (±5)	24 (±5)	21 (±4)	0.003	0.091
	MVPA%	8 (±3)	9 (±3)	7 (±3)	0.001	0.111
	MVPA bouts ≥5 min	5 (±3)	6 (±3)	4 (±3)	0.001	0.104
In school hours	SED%	67 (±7)	63 (±7)	70 (±5)	< 0.001	0.238
	SED bouts ≥10 min	2 (±1)	2 (±1)	3 (±1)	0.001	0.116
	LPA%	24 (±5)	26 (±5)	22 (±4)	< 0.001	0.152
	MVPA%	9 (±3)	11 (±3)	8 (±3)	< 0.001	0.143
	MVPA bouts ≥5 min	3 (±2)	4 (±2)	3 (±1)	< 0.001	0.174
Out of school hours	SED%	71 (±8)	68 (±9)	73 (±7)	0.002	0.092
	SED bouts ≥10 min	4 (±2)	3 (±2)	4 (±2)	0.009	0.070
	LPA%	22 (±5)	23 (±6)	21 (±5)	0.019	0.056
	MVPA%	7 (±4)	9 (±4)	6 (±3)	0.002	0.093
	MVPA bouts ≥5 min	2 (±2)	3 (±2)	2 (±2)	0.113	

Abbrevations: ES, Effect size; LPA, Light physical activity; MVPA, Moderate-to-vigorous physical activity; SED, Sedentary time.

Physical Activity by Sex

During total wear time, there were sex differences ($p < 0.001$, $\eta^2 = 0.151$) with more SED ($p < 0.001$) and less LPA ($p = 0.003$) and MVPA ($p = 0.001$) among girls. Similar results for SED, LPA, and MVPA were shown during in- and out-of-school hours (Figure 9 and Table 14). As further shown in Figure 10, girls' mean PA intensity during total wear time was lower relative to boys for both $CPM_{V\text{-}DATA}$ ($p < 0.001$, $\eta^2 = 0.151$) and $CPM_{VM\text{-}DATA}$ ($p < 0.001$, $\eta^2 = 0.157$). Similar sex differences were shown during in- and out-of-school hours (both $p < 0.001$).

Girls had fewer minutes of MVPA per day than boys (58 (±22) and 76 (±22) minutes per day for girls and boys respectively, $p = 0.001$, $\eta^2 = 0.106$). Fewer girls also met the PA recommendations when analyzed both as a mean of ≥60 minutes per day of MVPA (girls: 43% and boys: 68%, $p = 0.013$) (Figure

11) and as ≥60 minutes per day of MVPA every day (girls: 6% and boys: 24%, p = 0.012).

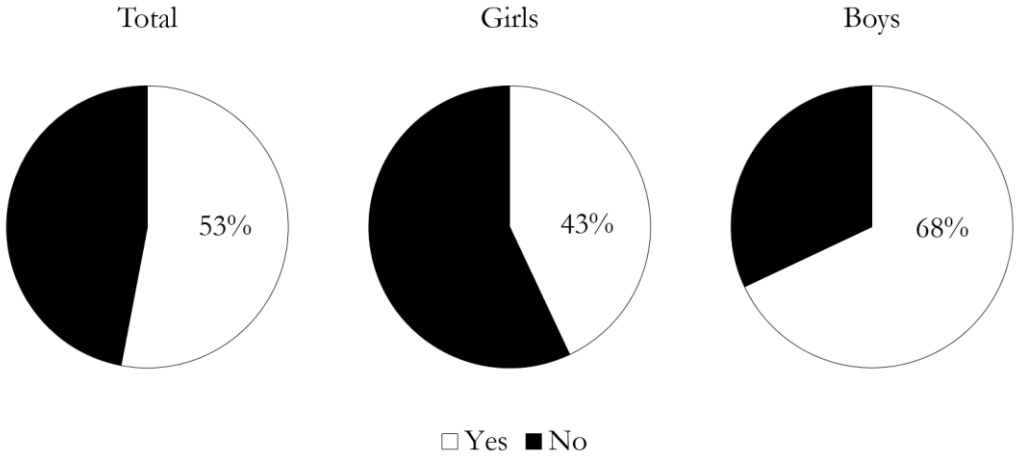

Figure 11. The prevalence (%) meeting the PA recommendations (mean of ≥60 min per day of MVPA) across the total sample (*n* = 101), and girls (*n* = 63) and boys (*n* = 38) respectively.

During total wear time, girls accumulated more SED bouts of ≥10 minutes per day (p = 0.007, η^2 = 0.074) and fewer MVPA bouts of ≥5 minutes per day (p = 0.001, η^2 = 0.104) than boys (Table 14).

Physical Activity and Organized Sport Participation

Those who self-reported involvement in organized sports (frequently reported as soccer and boxing) accumulated more daily MVPA (75 (±24) vs. 59 (±22) minutes per day, p = 0.009, η^2 = 0.069) and more MVPA bouts (p = 0.013, η^2 = 0.062) than those not involved. In addition, more participants involved in organized sports met the PA recommendations (expressed as a mean of ≥60 minutes per day of MVPA, p = 0.008; and as ≥60 minutes per day of MVPA every day, p = 0.049) compared to non-participants.

Physical Activity by Body Mass Index

There were no differences between participants categorized as normal-weight and overweight/obese with respect to mean PA intensity ($CPM_{VM\text{-}DATA}$, p = 0.952) and relative wear time of SED, LPA, and MVPA (p = 0.385).

Paper III

Changes in Sedentary Time and Moderate-to-Vigorous Physical Activity between T1 and T3

For the aim of Paper III, accelerometer data were analyzed with five-second epoch durations and cut-points by Evenson et al.

In the total sample, 65 participants provided accelerometer data at T1 and T3 (n = 49 for all three data collection periods); 18 at T1 and T2 or T2 and T3; and 39 at T1, T2 or T3. In the intervention group, 41 participants provided accelerometer data at T1 and T3 (n = 34 for all three data collection periods); 6 at T1 and T2 or T2 and T3; and 10 at T1, T2 or T3. Finally, in the control group, 24 participants provided accelerometer data at T1 and T3 (n = 15 for all three data collection periods); 12 at T1 and T2 or T2 and T3; and 29 at T1, T2 or T3 (Appendix 6).

Drop-out analyzes showed no differences between participants who dropped out of the study compared with those who were retained with respect to T1 BMI ($p > 0.05$) and T1 SED and PA ($p > 0.05$).

Changes in accelerometer-measured SED between T1 and T3 are illustrated in Figure 12. SED increased with 17.5 minutes per day (β = 17.5 [95% CI = 0.81; 34.00]) and year, equivalent to 35 minutes per day more of SED during a two-year follow-up. Comparing the DIC values of the three additional models with the DIC value for Model 1 showed that Model 4, including both accelerometer wear time, intervention condition, and sex as predictors, demonstrated best fit to data (Appendix 7). In this model, accelerometer wear time was a credible predictor on both the intercept (β = 0.81 [95% CI = 0.61; 0.96]) and slope (β = 0.51 [95% CI = 0.16; 0.84]). The intervention group showed a lower level of SED at T1 (β = 0.26 [95% CI = 0.08; 0.43]) but there was no credible effect of intervention condition on the slope (β = -0.19 [95% CI = -0.55; 0.15]). Furthermore, boys showed lower levels of SED at T1 (β = -0.22 [95% CI = -0.39; -0.04]) but no credible effect of sex was observed on the slope (β = 0.13 [95% CI = -0.19; 0.46]).

Moreover, changes in accelerometer-measured MVPA between T1 and T3 are illustrated in Figure 12. MVPA decreased with approximately 6.6 minutes per day (β = -6.58 [95% CI = -8.64; -4.49]) and year, equal to approximately 13 minutes per day less MVPA during a two-year follow-up. Comparing the DIC values of the four models showed that Model 4, including both accelerometer wear time, intervention condition, and sex as predictors, showed best fit to data

(Appendix 7). This model demonstrated that accelerometer wear time was not a credible predictor on either the intercept (β = -0.08 [95% CI = -0.27; 0.12]) or slope (β = -0.22 [95% CI = -0.60; 0.18]). The intervention group had a higher level of MVPA at T1 (β = -0.20 [95% CI = -0.37; -0.01]). There was no credible effect of intervention condition on the slope (β = 0.18 [95% CI = -0.18; 0.56]). Furthermore, boys had higher levels of MVPA at T1 (β = 0.34 [95% CI = 0.16; 0.50]) but no credible effect of sex was observed on the slope (β = -0.01 [95% CI = -0.37; 0.34]).

Changes in Self-Reported Exercise Training Frequency and Exercise Training Duration between T1 and T3

In the total sample, 81 participants provided data for self-reported ET frequency at T1 and T3 (*n* = 69 for all three data collection periods); 18 at T1 and T2 or T2 and T3; and 32 at T1, T2, or T3. In the intervention group, 48 participants provided data for ET frequency at T1 and T3 (*n* = 45 for all three data collection periods); 3 at T1 and T2 or T2 and T3; and 6 at T1, T2 or T3. Finally, in the control group, 33 participants provided data for ET frequency at T1 and T3 (*n* = 24 for all three data collection periods); 15 at T1 and T2 or T2 and T3; and 24 at T1, T2 or T3 (Appendix 6).

Drop-out analyzes showed no differences between participants who dropped out of the study compared with those who were retained with respect to T1 BMI ($p > 0.05$) and T1 ET frequency ($p > 0.05$).

Descriptive data for ET frequency is provided in Table 15 and changes in ET frequency between T1 and T3 are shown in Figure 13. There were no credible changes observed for ET frequency (β = -0.20 [95% CI = -0.43; 0.20]). Model 3 showed best fit to data (Appendix 7). This indicates that the inclusion of intervention condition and sex as predictors improved the model. Model 3 showed that intervention condition was not a credible predictor on either intercept (β = 0.10 [95% CI = -0.10; 0.30]) or slope (β = 0.03 [95% CI = -0.25; 0.33]), meaning that changes in ET frequency were similar among participants in the intervention group and control groups respectively. The model further showed that boys had higher levels of ET frequency at T1 (β = 0.42 [95% CI = 0.22; 0.62]) yet no credible effect of sex was observed on the slope (β = 0.01 [95% CI = -0.27; 0.30]).

Table 15. Descriptive data (rounded mean-values) for ET frequency in the total sample, intervention group, and control group across T1-T3, respectively.

		T1 (Baseline, 2014)			T2 (Midpoint, 2015)			T3 (Endpoint, 2016)		
		Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
	ET frequency	*n* = 114 (*n* = 66 girls)			*n* = 89 (*n* = 47 girls)			*n* = 94 (*n* = 51 girls)		
Total	Every day%	14	21	9	7	9	4	9	14	4
	4-6 times a week%	30	42	21	24	35	14	25	35	16
	2-3 times a week%	26	25	27	36	44	29	29	33	26
	Once a week%	12	4	18	5	2	8	16	9	22
	Once a month%	4	2	5	7	5	8	3	2	4
	Less than once a month%	3	0	5	5	0	10	5	2	8
	Never%	11	6	15	16	5	27	14	5	22
	ET frequency	*n* = 54 (*n* = 32 girls)			*n* = 48 (*n* = 27 girls)			*n* = 51 (*n* = 31 girls)		
Intervention Group	Every day%	11	18	6	8	14	3	8	15	3
	4-6 times a week%	28	41	19	22	38	10	29	40	23
	2-3 times a week%	22	27	19	32	43	24	18	20	16
	Once a week%	19	9	25	6	0	10	14	15	13
	Once a month%	4	0	6	8	0	14	2	0	3
	Less than once a month%	4	0	6	4	0	7	6	0	10
	Never%	13	5	19	20	5	31	24	10	32
	ET frequency	*n* = 60 (*n* = 34 girls)			*n* = 41 (*n* = 20 girls)			*n* = 43 (*n* = 20 girls)		
Control Group	Every day%	17	23	12	5	5	5	9	13	5
	4-6 times a week%	32	42	24	26	32	20	19	30	5
	2-3 times a week%	30	23	35	41	46	35	42	44	40
	Once a week%	7	0	12	5	5	5	19	4	35
	Once a month%	3	8	3	5	9	0	5	4	5
	Less than once a month%	2	0	3	7	0	15	5	4	5
	Never%	10	8	12	12	5	20	2	0	5

Abbrevation: ET, Exercise training.

For self-reported ET duration, a total of 82 participants provided data at T1 and T3 (n = 69 for all three data collection periods); 17 at T1 and T2 or T2 and T3; and 31 at T1, T2, or T3. In the intervention group, 48 participants provided data for ET duration at T1 and T3 (n = 45 for all three data collection periods); 3 at T1 and T2 or T2 and T3; and 8 for T1, T2 or T3. Finally, in the control group, 34 participants provided data for ET frequency at T1 and T3 (n = 24 for all three data collection periods); 14 at T1 and T2 or T2 and T3; and 23 at T1, T2 or T3 (Appendix 6).

Similar to above, drop-out analyzes showed no differences between participants who dropped out of the study compared with those who were retained with respect to T1 BMI ($p > 0.05$) and T1 ET duration ($p > 0.05$).

Descriptive data for ET duration is provided in Table 16. Changes in ET duration between T1 and T3 are shown in Figure 13. There were no credible changes observed for ET duration ($\beta = 0.14$ [95% CI = -0.04; 0.34]). Model 3

showed best fit to data (Appendix 7). In this model, the intervention condition was not a credible predictor on intercept (β = -0.10 [95% CI = -0.30; 0.12]). However, intervention condition was a credible predictor on slope (β = 0.27 [95% CI = 0.01; 0.60]), where the control group, in comparison to the intervention group, had a more positive trajectory in ET duration between T1 and T3. Furthermore, boys had higher levels of ET duration at T1 (β = 0.33 [95% CI = 0.11; 0.58]), but no credible effect of sex was observed on the slope (β = 0.24 [95% CI = -0.02; 0.56]).

Table 16. Descriptive data (rounded mean-values) for ET duration in the total sample, intervention group, and control group across T1-T3, respectively.

		T1 (Baseline, 2014)			T2 (Midpoint, 2015)			T3 (Endpoint, 2016)		
		Total	**Boys**	**Girls**	**Total**	**Boys**	**Girls**	**Total**	**Boys**	**Girls**
	ET duration	*n* = 113 (*n* = 66 girls)			*n* =89 (*n* = 47 girls)			*n* =94 (*n* = 51 girls)		
Total	About 7 hours or more%	3	4	2	7	12	2	11	21	2
	About 4-6 hours%	14	19	11	15	21	10	14	19	10
	About 2-3 hours%	22	31	15	35	42	29	23	28	20
	About 1 hour%	29	27	30	12	12	12	21	19	24
	About 30 min%	18	8	24	10	9	10	13	9	16
	None%	15	10	18	22	5	37	18	5	29
	ET duration	*n* = 54 (*n* = 32 girls)			*n* = 48 (*n* = 27 girls)			*n* = 51 (*n* = 31 girls)		
Intervention Group	About 7 hours or more%	6	9	3	8	14	3	12	25	3
	About 4-6 hours%	15	27	6	8	14	3	12	10	13
	About 2-3 hours%	22	27	19	30	38	24	20	25	16
	About 1 hour%	32	32	31	10	10	10	18	20	16
	About 30 min%	11	0	19	16	14	17	10	10	10
	None%	15	5	22	28	10	41	29	10	42
	ET duration	*n* = 59 (*n* = 34 girls)			*n* = 41 (*n* = 20 girls)			*n* = 43 (*n* = 20 girls)		
Control Group	About 7 hours or more%	0	0	0	5	9	0	9	17	0
	About 4-6 hours%	13	12	15	24	27	20	16	26	5
	About 2-3 hours%	22	35	12	41	46	35	28	30	25
	About 1 hour%	27	23	29	14	14	0	26	17	35
	About 30 min%	23	15	29	2	5	15	16	9	25
	None%	15	15	15	14	0	30	5	0	10

Abbrevation: ET, Exercise training.

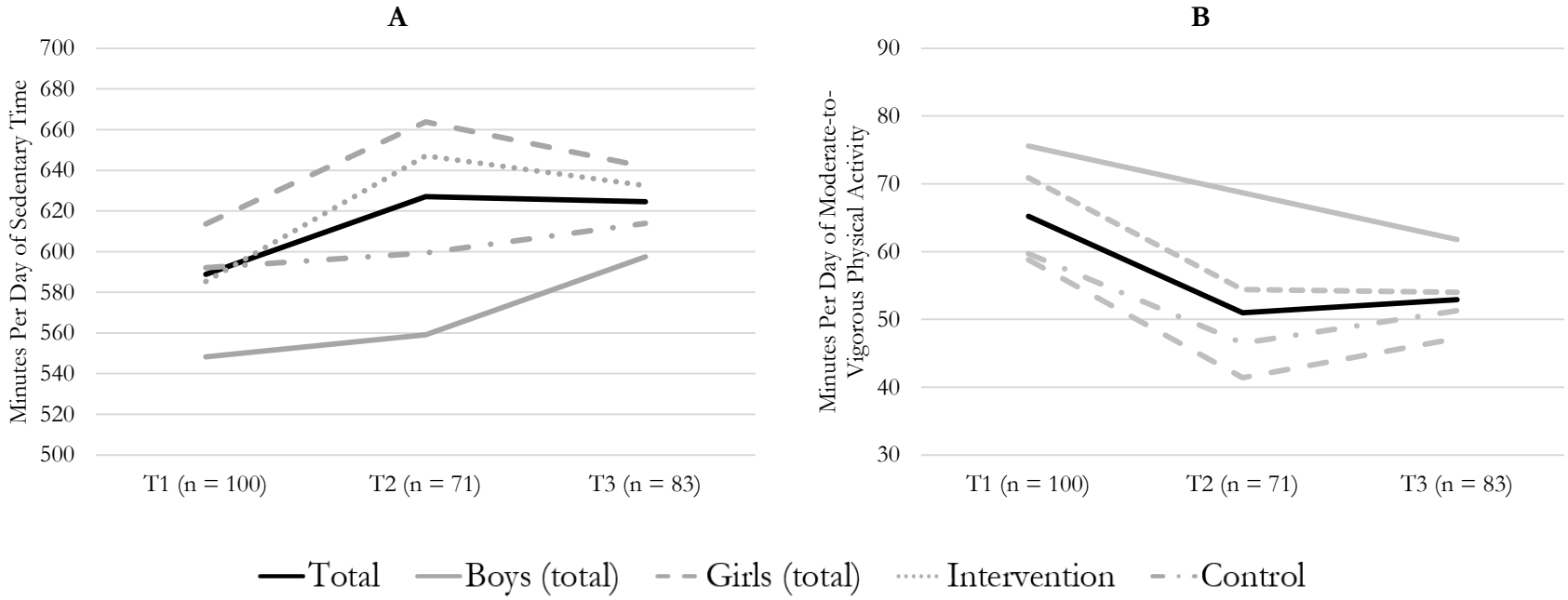

Figure 12. A and B depict changes in minutes per day of accelerometer-measured SED and MVPA between T1 (baseline, 2014) and T3 (endpoint, 2016), respectively. The figure shows mean group level of changes for the total sample, boys (total sample), girls (total sample), and intervention group and control group, respectively.

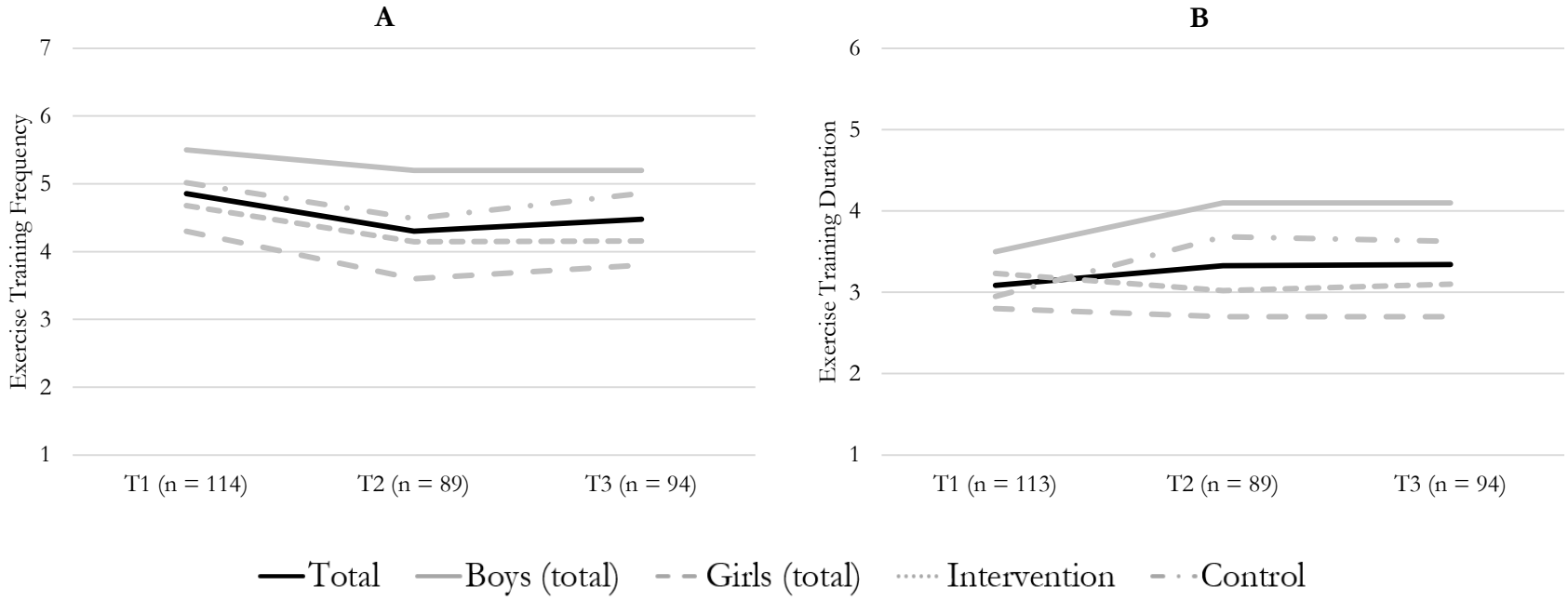

Figure 13. A and B depict changes in self-reported ET frequency and ET duration between T1 (baseline, 2014) and T3 (endpoint, 2016), respectively. The figure shows mean group level of changes for the total sample, boys (total sample), girls (total sample), and intervention group and control group, respectively. Possible responses for ET frequency were coded as follows: 1 = "never," 2 = "less than once a month," 3 = "once a month" 4 = "once a week," 5 = "2-3 times a week," 6 = "4-6 times a week," and 7 = "every day." Possible responses for ET duration were coded as follows: 1 = "none," 2 = "about 30 min," 3 = "about 1 hour," 4 = "about 2-3 hours," 5 = "about 4-6 hours," and 6 = "about 7 hours or more."

Paper IV

For the aim of Paper IV, T1 accelerometer data (n = 101 participants, n = 63 girls) was used to investigate how combinations of different epoch durations and cut-points impacted the estimation of SED and PA. As summarized in Table 17, comparisons between the combinations of epoch durations per cut-points showed that mean minutes per day of SED and LPA ranged between 471 and 713 minutes and 82 and 348 minutes, respectively. The corresponding figures for MPA, and VPA were 20 and 43 minutes and 0 and 29 minutes, respectively. Combined MVPA ranged between 21 and 67 minutes.

Table 17. Lowest and highest (the epoch duration in parentheses) mean minutes per day (all values are rounded) of SED, LPA, MPA, VPA, and combined MVPA according to different cut-points.

		SED	LPA	MPA	VPA	MVPA
Evenson et al.	Highest	640 min (1 s)	315 min (60 s)	40 min (10 s)	29 min (1 s)	67 min (1 s)
	Lowest	471 min (60 s)	132 min (1 s)	38 min (1 s)	14 min (60 s)	54 min (60 s)
Freedson et al.	Highest	640 min (1 s)	319 min (60 s)	43 min (1 s)	22 min (1 s)	65 min (1 s)
	Lowest	471 min (60 s)	134 min (1 s)	41 min (60 s)	10 min (60 s)	50 min (60 s)
Treuth et al.	Highest	640 min (1 s)	335 min (60 s)	35 min (1 s)	14 min (1 s)	49 min (1 s)
	Lowest	471 min (60 s)	150 min (1 s)	30 min (60 s)	4 min (60 s)	34 min (60 s)
Mattocks et al.	Highest	640 min (1 s)	348 min (60 s)	28 min (1 s)	9 min (1 s)	36 min (1 s)
	Lowest	471 min (60 s)	163 min (1 s)	20 min (60 s)	2 min (60 s)	21 min (60 s)
Puyau et al.	Highest	713 min (1 s)	117 min (60 s)	40 min (1 s)	4 min (1 s)	44 min (1 s)
	Lowest	693 min (60 s)	82 min (1 s)	29 min (60 s)	0 min (60 s)	29 min (60 s)

Abbrevations: LPA, Light physical activity; MPA, Moderate physical activity; MVPA, Moderate-to-vigorous physical activity; SED, Sedentary time; VPA, Vigorous physical activity.

Sedentary Time and Light Physical Activity

SED and LPA across the combinations of epoch durations and cut-points are shown in Figure 14. Irrespectively of cut-point, SED varied significantly between epoch durations (all $p < 0.0001$; η^2 range: 0.255 – 0.888). Relative to one second epoch duration, SED progressively decreased with longer epoch durations. Similar results were shown for LPA (all $p < 0.0001$; η^2 range: 0.601 – 0.930) although it progressively increased with longer epoch durations.

Extreme absolute differences (minutes/day) between means for cut-points per epoch duration increased with longer epoch durations for SED (from 73 to

222 minutes/day for 1 and 60 seconds respectively) and LPA (from 81 to 231 minutes /day for 1 and 60 seconds respectively).

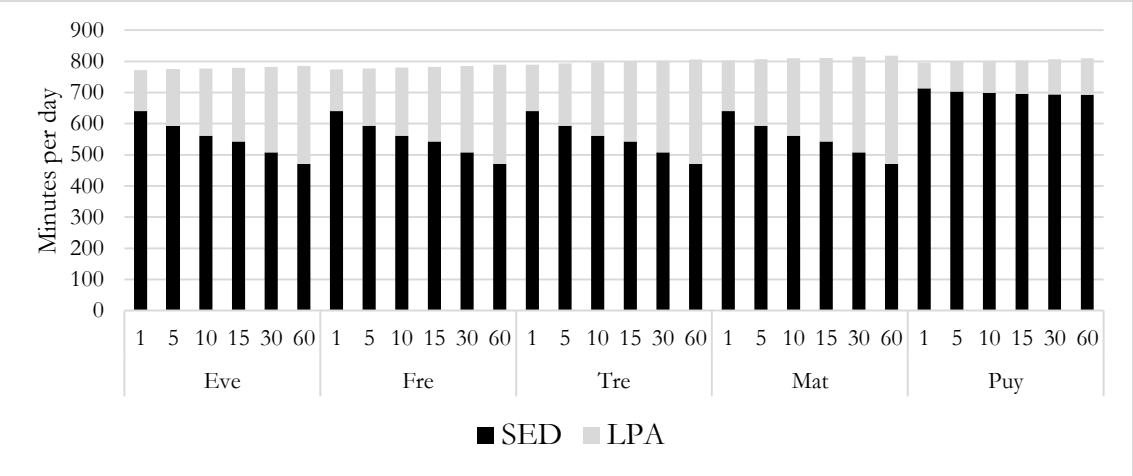

Figure 14. Minutes per day of SED and LPA according to different combinations of epoch durations (1, 5, 10, 15, 30, and 60 sec) and cut-points (Eve, Evenson et al.; Fre, Freedson et al.; Tre, Treuth et al.; Mat, Mattocks et al.; and Puy, Puyau et al.).

Moderate, Vigorous, and Combined Moderate-to-Vigorous Physical Activity

Relative to one second epoch duration, MPA generally decreased (mostly $p < 0.0001$; η^2 range: 0.031 – 0.434) with longer epoch duration except for cut-points by Evenson and associates. Similarly, VPA (all $p < 0.0001$; η^2 range: 0.564 – 0.696), and combined MVPA (all $p < 0.0001$; η^2 range: 0.340 – 0.583) significantly varied by epoch duration and decreased with longer epoch durations (Figure 15).

Similar to SED and LPA, extreme absolute differences (minutes/day) increased with longer epoch durations for MPA (from 15 to 21 minutes/day for 1 and 60 seconds respectively), and combined MVPA (from 31 to 33 minutes/day for 1 and 60 seconds respectively). In contrast, extreme differences for VPA decreased with longer epoch durations (from 26 to 14 minutes/day for 1 and 60 seconds respectively).

Prevalence Meeting the Physical Activity Recommendations

As minutes per day of MVPA differed across the combinations of epoch durations and cut-points (combined black and gray bars in Figure 15), the

prevalence met the PA recommendations (a mean of ≥60 minutes/day of MVPA) ranged between 3% and 54% (Figure 16).

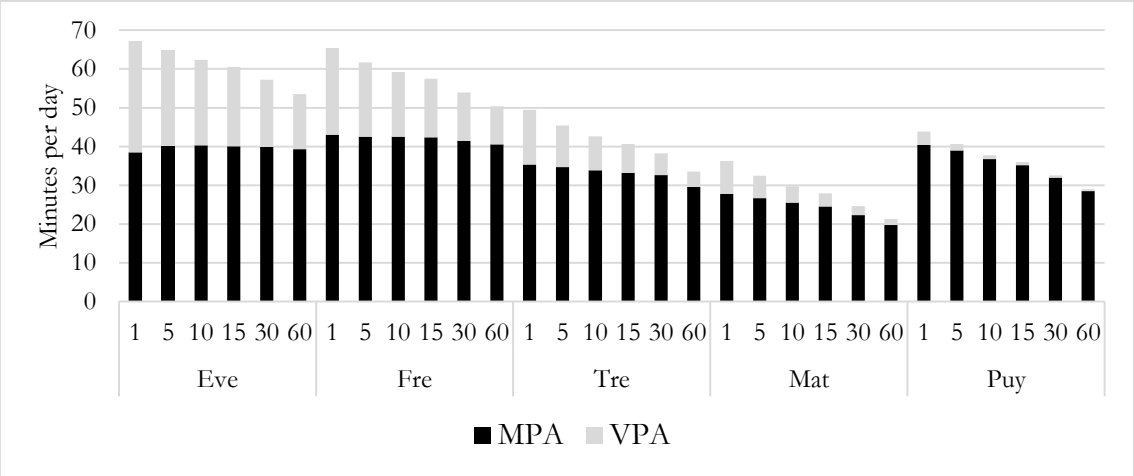

Figure 15. Minutes per day of MPA (black bars), VPA (gray bars), and combined MVPA (combined black and gray bars) according to different combinations of epoch durations (1, 5, 10, 15, 30, and 60 sec) and cut-points (Eve, Evenson et al.; Fre, Freedson et al.; Tre, Treuth et al.; Mat, Mattocks et al.; and Puy, Puyau et al.).

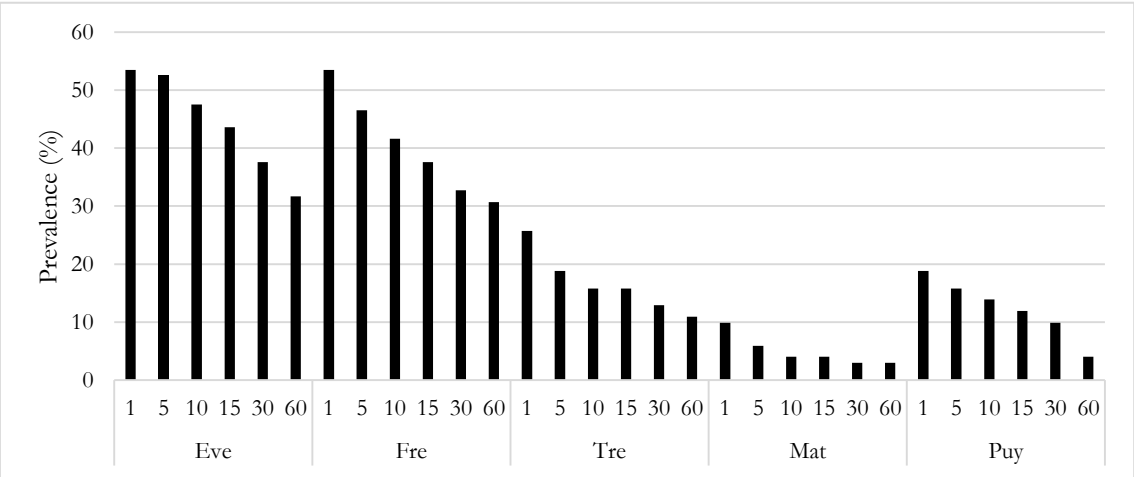

Figure 16. Prevalence (%) meeting the PA recommendations (mean of ≥60 min/day of MVPA) across combinations of epoch durations (1, 5, 10, 15, 30, and 60 sec) and cut-points (Eve, Evenson et al.; Fre, Freedson et al.; Tre, Treuth et al.; Mat, Mattocks et al.; and Puy, Puyau et al.).

Chapter 4: Discussion

In the following chapter, the results from the four papers are discussed.

The Development and Implementation of the Intervention (Paper I)

The RG's ambition was that the intervention be continually developed and implemented as a result of cooperation and SDM among the RG and the participants. The reality presented a number of barriers that challenged the RG's ambition of aiding participation and supporting a sense of empowerment during the development and implementation of the intervention. The reality particularly challenged the RG's ambition to use SGHCS and work with goal setting in groups of participants with shared wishes and needs in relation to their food and PA. Below is a critical reflection upon these challenges along with some ethical dilemmas the RG encountered during the intervention.

Health Coaching and Health Promotion Sessions

The intervention involved a complex process as it was continually developed and implemented as a result of cooperation and SDM among the researchers and participants. As part of this complex process, the intervention's success was attributable to the extent that SGHCS worked according to the RGs' intentions. As mentioned in Paper I, this was not always the case as the field-workers experienced barriers during SGHCS; participants tended to interrupt others, and they expressed their disappointment with discussing goals related to food and PA habits.

Further, participants were adolescents in the seventh grade at the onset of the intervention, and this is recognized as a turbulent life phase when young people generally experience increased desire for independence, become increasingly influenced by peers, and have more interest in the present with less thought about the future (23). Due to these characteristics, the RG anticipated that it would be challenging, although not impossible, to work with goal-setting

strategies during the intervention. Nonetheless, the fieldworkers experienced that participants seemed to live for and act in the present and had limited interest in formulating goals or working with short- and long-term goal-setting strategies. Also, those participants who were perceived as motivated were challenged to recall their goals from one occasion to the next. Participants also suggested that, as an alternative, the SGHCS should be replaced by practical activities such as preparing food and playing sports. This issue was further deliberated during T3 focus group interviews,[33] and participants mentioned that practical HPS, such as preparing food, playing sports, and participating in workshops involving video clips, were engaging, enjoyable, and perceived to facilitate skill development (207). They expressed their desire to participate in these activities rather than goal-oriented discussions similar to SGHCS. By providing opportunities for trying and learning different activities related to food and PA, the participants perceived themselves as having removed barriers to engage in similar activities outside the intervention, such as preparation of food in the home environment and visiting the gym (207). In essence, this may connect to Tengland's conceptualization of empowerment goals, as it might reflect changes in one's self-esteem and self-confidence and thus, the beliefs about one's general abilities to handle specific tasks (56). During T3 focus group interviews, the participants further mentioned, in positive terms, the workshops including interactive media (e.g., online search of health information related to food and PA) as well as the usage of video clips to inform about issues related to food and PA (207). Another appreciated feature of the intervention were the tools/objective activity monitors included to visualize and provide feedback and reflect health-related behaviors. For example, during SEM-2, some participants conducted a photo diary by documenting (through smartphones) their full-day food habits, which seemed to facilitate reflections and increase awareness regarding food (207). Similarly, pedometers were valued as they visualized/enabled feedback for PA behavior (207). On the one hand, the participants suggested that future interventions preferably should incorporate practical, hands-on HPS instead of goal-oriented discussions (207). On the other hand, participants' experiences also suggested that acquiring health-related information (e.g., the amount of added sugar in common food and the procedure of preparing healthy food) facilitated awareness and inspiration to, for instance, increase FV intake (207). A suitable strategy to facilitate

[33] Conducted post-intervention, autumn 2016.

participants' healthy food and PA habits might hence be to predominately focus on practical, hands-on HPS, while simultaneously involving *some* health-related information.

Despite the barriers encountered, the RG believes that future HP interventions might consider using SGHCS if older adolescents are involved. Capacities for goal setting increase with age (23) and SGHCS might, therefore, be a fruitful way of identifying participants' goals, wishes, and needs when cooperating with older adolescents. Based on the RG's experiences, it is, however, recommended that considerable effort should be devoted to establishing frameworks of the SGHCS, such as agreeing on the group's rules of conduct, as well as putting considerable effort into identifying goals, wishes, and needs within each group of participants. As an alternative to SGHCS, individual HC, despite being more resource intensive, might also be worth considering in future HP interventions. Individual HC creates opportunities to work with more individualized goals and activities adopted accordingly (e.g., individualized food and PA programs with aims such as to increase FV consumption or increasing PA). In addition, individual HC may present fewer challenges such as group dynamics, which, as observed in Paper I, may engender competing interests among participants. Such competing interests might have contributed to the sense among participants that their suggestions on activities were not fully realized because group members were required to compromise with each other as part of their cooperation. Experiences obtained from T3 focus group interviews also suggest that some participants occasionally were left feeling obligated (although continuously informed about the voluntariness) to partake in certain activities as suggested by their peers (207). Such ethical dilemmas might thus be the drawback of creating/cooperating in heterogenic groups where the participants have conflicting wishes and needs in regard to food and PA. From the RG's perspective, the intention of working in groups was to: a) facilitate feelings of belonging and cooperation; and b) create conditions for the RG to develop and implement the intervention in practice. It is acknowledged that some participants greatly appreciated working/interacting and cooperating with peers as it exceeded their initial expectations and lowered perceived barriers to try diverse activities related to food and PA (in which none had previous experience) (207).

The Framework of the Intervention

The way in which the RG used the ideas of the RECE-a arguably presents a paradox. Although the researchers had the ambition to aid participation and support a sense of empowerment, the framework of the intervention in advance, and as determined by the RG, dictated that it would revolve around food and PA. Suggestions on activities beyond the framework of the intervention were thus dismissed. The RG was, however, aware of the ethical dilemma of exclusively focusing on food and PA in an area characterized by low SES and whose characteristics would rather require attention to other health issues and concerns. Adolescents from low SE circumstances might have less favorable food and PA habits (25), which, from the researchers' perspective, founded a well-intentioned argument to focus on these two health-related habits despite the anticipated challenges. These two health-related behaviors were paramount, because early establishment of healthy food and PA habits might cumulatively effect future health-related behaviors and health outcomes. Moreover, the RG's intents were that the HPS would facilitate skills in making preparations for and executing activities related to food and PAs, and that the participants would be provided with opportunities to critically reflect upon and appraise health-related information and recommendations. Health-related skills and awareness of food and PA recommendations might be a prerequisite to achieving and maintaining healthy food and PA habits. As suggested by the fieldworkers' protocols, they also noticed significant gains in participants' knowledge about the health-related benefits of a balanced diet and adequate PA. For example, participants in Theme Groups 1 and 2 established well-founded arguments for their decisions for choosing specific content related to food and PA in preparing for the full-day workshop during SEM-3. Nonetheless, as the RG had previously dictated that the intervention would revolve around food and PA, this might explain why participants in general appeared to be less motivated to work with goal setting in regard to these topics.

Furthermore, the theme, aim, and content of each HPS reflected the participants' suggestions on activities and the researchers' pre-set values of what they considered to be healthy food and PA. As determined by the researchers, the framework for the intervention thus dictated that it would not only revolve around food and PA, but also *healthy* food and PA. As predicted, this occasionally led to circumstances where participants' suggestions on activities also involved less healthy elements. Their suggestions mainly concerned food

and, for instance, participants occasionally suggested activities, such as preparing cookies and cakes. The researchers further believe that their way of combining participants' suggestions on activities with their pre-set values of what constitute healthy food and PA shares some features with the RECE-a. If the researchers had relied entirely upon a bottom-up approach, where participants would have had possessed control over all aspects of the intervention, the RG probably would have been in a position of prioritizing activities that they believed to be rather counterproductive (59). Instead, the HPS were developed and implemented based on both participants' suggestions on activities and the researchers' pre-set values where they also acknowledge the need for the intervention to be guided by health information. On occasion, when participants had suggestions on activities the researchers considered to be less healthy, the fieldworkers had the opportunity to engage them in discussions to critically reflect upon what constitutes healthy food and PA, and what options might be healthier. As an ethical dilemma of doing so, however, the intervention might have become a normative enterprise because it thoroughly recognized beneficial health-related habits and both acceptable and unacceptable risks (208). By the same token, it is possible that the intervention contributed to the moralization and blaming of participants who did not adhere to culturally appropriate health-related habits (208).

As an important part of Tengland's conceptualization of empowerment (56, 58), the researchers intended to create a climate for change characterized by empathy and genuineness. Further, the RG's intents were that participants' experiences and perceptions of the health-related issue(s) in question would be recognized in a non-judgmental manner. With the assistance of the intervention components, it was hoped that a) the participants would experience themselves as being provided with the opportunity to express their opinions and to be heard in matters affecting their health and well-being; and b) that the researchers would listen to their suggestions and put them into practice. Data from T3 focus groups interviews indicate that the participants perceived themselves having had the opportunity to create a dialogue (communicate and receive directions) and being able to influence and decide, for example, group constellations and the content of the intervention (e.g., themes and content of the HPS) (207). Among the opportunities to facilitate a dialogue between each other as well as with the researchers, some participants also mentioned positive experiences of using the closed FB group, as it enabled access to information

on upcoming HPS and allowed for asking questions related to the intervention in general (207).

Moreover, the intervention was implemented during school hours and the HPS were integrated into the school schedule to occur on a predominately weekly basis. As a consequence, participants might have felt obliged to actively participate in intervention activities because attendance is compulsory at elementary school. At the same time, all invited seventh graders in attendance at the intervention school approved participation, and the researchers continually informed them about the voluntariness of the intervention and that they were not required to actively participate in SGHCS or the HPS. Some participants were also passive (e.g., attended but only observed) on occasion. To handle some of this ethical dilemma, during SEM-3, in accordance with their suggestions, participants also received the opportunity to choose theme groups focused on school-based assignments (e.g., doing homework) instead of HPS addressing healthy food and PA. The RG also experienced that the school principal and homeroom teachers treated the intervention positively, which was necessary for its development and implementation. Given that the researchers' empowerment ambition was quite challenged when meeting the reality of the situation, it is reasonable to assume that without such positive treatment, the RG would have encountered even greater challenges during the intervention. Moreover, although the context of the intervention generally was chaotic, the fieldworkers felt that participants were curious about the intervention as demonstrated by an eagerness to learn about, for instance, HPS and to get involved in DMP. As this curiousness evolved over time, the RG believe that cultivating relationships and trust is pivotal to the success of interventions such as the one described in Paper I.

Sedentary Time and Physical Activity (Papers II-IV)

Paper II

The main result of Paper II showed that the participants spent 70% of their total accelerometer wear time in SED, with 22% and 8% devoted to LPA and MVPA respectively. These figures are quite similar to those shown in a recent report by the Swedish Research Council for Sport Science (135) which involved

a large sample of Swedish youth. In this report, accelerometer data was analyzed with the same epoch duration and cut-points for SED and MVPA and is hence, reasonably comparable to the findings reported within the current thesis. Furthermore, Paper II showed that the participants accumulated short durations of SED bouts (virtually none ≥20 minutes) and MVPA (virtually none ≥10 minutes), which aligns with previous research involving youth aged 10-13 years (209-211).

Given that a high proportion of accelerometer wear time was spent in SED, adolescents from this multicultural area characterized by SES would probable benefit from increasing their PA. Findings from T1 focus group interviews conducted among participants in the intervention group might provide insights regarding facilitators of PA. As a main theme, qualitative data suggests that the possibility for enjoyment emerged as a key facilitator of PA among these participants (212) which harmonizes with previous PA research (213). Being provided with the opportunity to engage in different activities until finding personal preferences, possessing appropriate skills and competencies, and being physical active with peers, contributed to the sense of enjoyment (212). These participants further mentioned social support (encouragement from family and peers) and supportive school environments (e.g., longer durations of scheduled recess and increased number of physical education and health lessons) as perceived facilitators of PA (212).

Moreover, the participants accumulated on average 65 minutes per day of MVPA, with 58 and 76 minutes per day for girls and boys, respectively. These figures are lower than those reported by Ortega and co-workers (134) (i.e., 69 and 81 minutes/day among 15-16 years old girls and boys, respectively), and somewhat higher compared to the figures presented in the report by the Swedish Research Council for Sport Science (46 and 59 minutes/day for girls and boys, respectively) (135).

At a group level, 53% of the participants in the 'How-to-Act?' project met the recommended ≥60 minutes per day of MVPA, with fewer girls than boys being sufficiently physically active. As expected, the prevalence meeting the PA recommendations was higher when calculating the more liberal interpretation of a mean of ≥60 minutes per day of MVPA (53%) as compared to the strict ≥60 minutes per day of MVPA every day (13%). Overall, it is challenging to compare these findings against previous research due to the inconsistences in terms of epoch durations and cut-points for MVPA. Guinhouya and colleagues (101) synthesized studies among European adolescents aged 13-18 years and

found that approximately 9%, 66%, and 100% met the PA recommendations when using cut-points for MVPA of >3000 CPM, >2000 CPM, and >1000 CPM respectively (101). As the cut-point for MVPA proposed by Evenson and colleagues is slightly higher than >2000 CPM, the proportion of adolescents sufficiently physically active appears to be similar as in Paper II compared to other European studies. In Sweden, the report by the Swedish Research Council for Sport Science shows that 20% and 43% of Swedish adolescent girls and boys respectively meet the PA recommendations (135). Hence, the prevalence of sufficiently active adolescents was slightly higher among the participants in the present thesis, although the small sample size used in Paper II calls for caution when interpreting the findings.

Of note, however, despite the common practice of calculating those meeting the PA recommendations by means of accelerometer data (101, 102), it must be recognized that current recommendations are consensus statements mainly based on self-reported data which might not be comparable to objective measures of PA. The findings presented in Paper II should, therefore, be interpreted accordingly. In addition, the PA recommendations further advocate incorporating ≥3 times per week of VPA including muscle-/bone-strengthening PA (19) and these dimensions of PA were not taken into account when calculating the number of sufficiently active participants in Paper II.

Physical Activity by Sex

Sex differences were observed with girls accumulating more SED and less PA (i.e., lower mean PA intensity ($CPM_{V\text{-}DATA}$ and $CPM_{VM\text{-}DATA}$), and less LPA and MVPA) than boys. This finding aligns with previous research, such as the comprehensive study from the International Children's Accelerometry Database, in which Cooper and colleagues (136) analyzed accelerometer data from ten countries (n = 27637 youth) and found that girls on average engaged in less PA than boys across all age groups including adolescents. The sex-related differences in PA observed among the participants in the 'How-to-Act?' project have several potential explanations. During T1 focus group interviews, the participating girls mentioned that PA is primarily an activity for boys, and that girls might be afraid of embarrassing themselves due to lack of appropriate sport skills and competencies (214). The participating girls further expressed that they had fewer options to be physical active, with explicit references to soccer being considered as a sport mainly for boys (214). Among other barriers

of PA, the participants suggested that girls generally have greater expectations than boys to work in the household (e.g., doing chores such as cooking and cleaning, as well as caring for their siblings), and such family-related obligations might be specific to adolescent girls from low SE circumstances (214). In addition, girls indicated that they had relatively greater demands in terms of educational achievement, which was perceived as inhibiting PA (214). Accordingly, strategies to overcome such barriers of PA among adolescent girls from low SE circumstances should be considered in future interventions.

Physical Activity and Organized Sports Participation

Paper II further yield that self-reported participation in organized sports was associated with more MVPA. Sport participation might be a good predictor of PA among adolescents (215), and two studies reveal that those who self-report being involved in organized sport (216) and participate in sport and exercise clubs (217) accumulated more accelerometer determined MVPA. Similar results have been reported in a Swedish study (135). This suggests that organized sport might be of importance in accumulating MVPA, as well as meeting the PA recommendations. Previous research in Sweden show that youth from low SE circumstances are less involved in organized sports, and that girls with foreign-born parents/legal guardians being least involved (218, 219). In addition, research also indicates that youth from low SE groups engage in less ET (220, 221). As such, adolescents from low SE groups might benefit from being encouraged to participate in organized sports, and girls might be the target of priority because they appear to accumulate less MVPA. However, as a barrier of PA, the girls who participated in the 'How-to-Act?' project perceived themselves to have a lack of appropriate sport skills and competencies (214) and, therefore, supporting strategies might be required to facilitate their involvement in organized sports. In addition, listening to these adolescents, they mostly referred to PA as spontaneous, non-competitive/performance-based activities (212) suggesting that these perspectives should be taken into account as well.

Physical Activity by Body Mass Index

In this fairly small sample of adolescents, there were no differences between normal weight and overweight/obese participants for either SED or different

PA intensities. These findings are interesting because many cross-sectional studies demonstrate a relationship between proxy markers of adiposity, such as BMI and objectively measured PA levels, as predominately determined by accelerometry and pedometry (222, 223).

Paper III

Intervention Effect

Paper III shows that there were no positive intervention effects on accelerometer-measured SED and MVPA, self-reported ET frequency or ET duration. These results for accelerometer-measured MVPA are similar to those presented in a recent systematic review and meta-analysis (156) indicating that PA interventions on average has been unsuccessful in promoting MVPA among adolescents. Similar findings have been observed in reviews of interventions involving youth from low SE circumstances (157-159).

There might be several potential explanations for these findings. Apart from the fact that some of the RG's ambition to aid participation and support a sense of empowerment was challenged when meeting the reality (see Paper I), the 31 HPS encompassing a wide-range of PAs, such as brisk walking with pedometers, jogging and running, swimming, dancing, and playing sports, were spread over SEM-2-4. Further, not all of these HPS featured PA as they also contained activities related to food, and involved non-active HPS such as online search and compilation of health benefits of PA (Tables 8-10). Thus, it is possible that the intervention duration and intensity was insufficient to bring about a change in PA. It is also possible that the SE conditions that characterized the participants' everyday lives affected them to a larger extent than what HP school interventions, similar to the one reported here, might produce.

Furthermore, the intervention was individual and group centered with the vast majority of the HPS conducted in the school environment such as classroom, gym, etc. Perhaps the intervention would have benefited from involving parent(s) or legal guardian(s) to cooperate and develop and implement family-based strategies to further support the adolescents in achieving and maintaining healthy food and PA habits. A meta-analysis by Brown and co-workers (224) demonstrated that family-based interventions combining goal setting and reinforcement techniques, along with interventions

focusing on further benefits of spending time being physically active as a family, were effective in increasing PA among youth ages 5-12 years. Involvement of family members in this particular intervention might have been important as T1 focus group interviews reveal that girls perceived themselves as having great expectations of working the household such as doing chores, which they perceived as inhibiting their leisure time PA (214). Thus, developing and implementing workshops to emphasize the importance of PA as well as outlined strategies to spend time being physically active as a family may have been a successful way to promote PA among participants. However, experiences addressed by the school principal and the homeroom teachers suggested a number of challenges in engaging families in projects similar to the 'How-to-Act?' such as language barriers and lack of interest/time. The RG therefore decided to exclusively acknowledge and recognize the participating adolescents' experiences and perceptions related to their food and PA habits, by using HC and developing and implementing HPS within the school environment.

Moreover, T3 was conducted approximately four months after the last intervention activity was held. One meta-analysis with accelerometer data measured before/immediately after the end of the intervention found an average of four additional minutes of accelerometer-measured MVPA among youth (155). Another meta-analysis involving studies with follow-up measurement data at least six months post-intervention showed a non-significant effect on MVPA (225). Perhaps an intervention effect would have been detected if T3 was conducted either before or immediately after the end of the intervention; yet, in the longer term, the effect might have disappeared.

A further possibility is that weather conditions might have influenced the results observed in Paper III. Since participants at the intervention school and the two control schools were measured during two different weeks (with one to two weeks in-between), weather data[34] showed that the amount of precipitation (mm) was higher during the week the intervention group was measured at both T2 and T3. For example, the amount of precipitation was higher at T3 with 20.6 mm for the intervention group and 0.0 mm and 6.1 mm for the two control schools, respectively. Some previous research suggests that higher precipitation might be associated with less PA (226) thus leading to the

[34] Obtained from the Data obtained from the Swedish Meteorological and Hydrological Institute (SMHI).

assumption that differences in weather conditions during data collection periods might have influenced the results.

Two-Year Changes in Sedentary Time and Moderate-to-Vigorous Physical Activity

Moreover, the results in Paper III showed an annual increase in accelerometer-measured SED of 18 minutes per day. The increase in SED as observed in Paper III was somewhat anticipated given what previous longitudinal investigations have shown (113). Among investigations specifically examining changes during adolescence, one study (142) found no differences in SED among adolescents between the ages of 15 and 17 years. In contrast, another study reported that SED increased annually with 11 minutes per day from age 10 to 14 years (141). Another study found that SED increased by 32 and 25 minutes between the ages of 12 and 15 years during in- and out-of-school hours respectively (139). In the U.K., Mitchell and colleagues (140) reported an annual increase in SED of approximately 20 and 23 minutes per day between ages 12 and 16 years among boys and girls respectively. As compared to some of these studies, the changes in SED as observed in Paper III appears to be slightly smaller.

Moreover, in terms of MVPA, this study showed an annual decrease of seven minutes per day. These findings appear to be somewhat larger when compared to previous investigations using accelerometry. Some studies have reported that MVPA remained relatively stable among boys and girls between the ages of 12 and 16 years (139, 140). Two other studies found that MVPA decreased by approximately four and two minutes per day annually among boys and girls from age 10 to 14 years (141) and five and three minutes per day annually among boys and girls between ages 15 and 17 years (142) respectively.

Moreover, in Paper III, changes in MVPA over time were similar among boys and girls (although boys had higher MVPA at both T1 and T3). The review and meta-synthesis by Dumith and co-workers (138) suggested that PA decreased more steeply among boys than girls, with reference of baseline ages 13-16 years (138) which is further supported by an accelerometer-based study showing that MVPA decreased more among boys than girls between ages 10 and 14 years (141).

No changes were observed for either self-reported ET frequency or ET duration during the two years the adolescents were followed. Although these

self-reported data might be referred to as PA at an intensity corresponding to moderate or vigorous PA, it should be noted that self-reported measures of ET frequency and ET duration do not necessarily capture unstructured MVPA. This perhaps explain the fact that MVPA decreased by seven minutes per day annually when measured objectively with accelerometers, whereas no changes were observed for ET frequency and ET duration according to self-reporting. Another possibility for this discrepancy may be recall bias when self-reporting ET or that hip-worn accelerometers inadequately capture ET such as those focusing on activity in the upper extremities (e.g., seated position in RT machines).

The findings in Paper III calls for effective interventions to promote PA during adolescence. As previously noted, however, findings from the International Children's Accelerometry Database suggest that PA begins to decrease during school entry and continues throughout adolescence (136). Thus, interventions to promote PA should reasonably begin at early ages. Nonetheless, as PA generally decreases from transition from adolescence to early adulthood (227), interventions to promote PA during adolescence to counteract further decrease during adulthood might have important implications.

Paper IV

As the accelerometer outcomes vary substantially across different analyzed procedures, the results presented in Paper II can be somewhat nuanced with respect to the combinations of epoch durations and cut-points as presented in Paper IV.

Sedentary Time and Light Physical Activity

Paper IV showed that shorter epoch durations largely increased SED and vice versa. More specifically, relative to the shortest epoch duration of one second, SED decreased with approximately 26% or 169 minutes per day when using the lower cut-point (≤100 CPM) and 60 second epoch duration. In contrast, longer epoch durations progressively increased LPA up to approximately 183 minutes per day for cut-points by Evenson et al. Although the analysis indicated that a

substantial proportion of SED becomes re-classified as LPA when using longer epoch durations, some MPA and VPA appeared to be misclassified as LPA.

Moderate and Vigorous Physical Activity

Moreover, MPA, VPA, and combined MVPA generally increased when using shorter epoch durations for all cut-points (some exceptions were observed). For instance, relative to 60 second epoch duration, MVPA increased by approximately 13 and 15 minutes per day when using cut-points by Evenson et al. and Treuth et al., respectively. The result is somewhat consistent with previous studies investigating the effect of different epoch durations with the shortest epoch durations set at one (228), three (229), and five seconds (230) respectively. This is probable explained by the intermittent PA behavior which characterizes adolescents – at least boys (195). For example, Sanders and co-workers (195) have reported mean durations of approximately three seconds for MPA and VPA respectively among adolescent boys aged 14 years. Overall, the results in Paper III indicate that one second epoch durations might be required to accurately register VPA. Therefore, it appears logical to agree with previous recommendations of using short epoch durations to accurately register adolescents' spontaneous intermittent PA behavior (230). Worth mentioning, differences were observed between one and five second epoch durations, indicating that rather small changes in epoch duration might have implications for researchers and practitioners when estimating VPA. In circumstances where the outcome of interest concerns VPA, short epoch durations such as one second might be required to adequately estimate VPA, although it is ambiguous that such sporadic VPA has meaningful implications for health among adolescents.

Moreover, cut-point is acknowledged to considerably alter accelerometer outcomes and is thus one of the most critical aspects when analyzing accelerometer data. Comparing the five cut-points (per epoch duration) revealed large differences in combined MVPA. For instance, comparing the extremes, the absolute difference when using 1 and 15 second epoch duration was 31 and 33 minutes per day for combined MVPA respectively. Such large differences were expected, and in agreement with previous research by, for instance, Vanhelst and co-workers (231) who analyzed accelerometer data with six different cut-points and observed inter-cut-point differences of 136% and 2780% for MPA and VPA respectively.

The Prevalence Meeting the Physical Activity Recommendations

The decision on epoch duration and cut-points further affected the prevalence of meeting the PA recommendations, which ranged between 3% and 54%. Across virtually all cut-points, the highest prevalence meeting the PA recommendations was observed for shorter epoch durations. This is consistent with findings from Aibar and co-workers (229) who reported that 41% and 24% of adolescents aged 14 years were sufficiently active when accelerometer data was analyzed with 3 and 60 second epoch durations respectively (identical cut-point for MVPA). Thus, the decision on epoch duration alter the prevalence meeting the PA recommendations, and, consequently, cross-comparisons of studies using different epoch durations require careful consideration.

Logically, the prevalence who were sufficiently physically active among the participating adolescents decreased with higher cut-points for MVPA; for example, 6%, 19%, and 53% when using 5 second epoch durations and cut-points for MVPA of ≥3581 CPM, ≥3000 CPM, and ≥2296 CPM respectively. Consistent with such figures, one review show that 20-71% of adolescents meet the PA recommendations with a cut-point of 2000 CPM for MVPA, and that the prevalence decreases to approximately <10% when using >3000 CPM (101).

Method Discussion (Papers I-IV)

Papers I-IV

The loss of participants to follow-up (29% in total and 13% and 43% in the intervention group and control group respectively) is acknowledged as a limitation. This was, however, beyond the control of the RG, as a great proportion of participants (particularly in the control group) changed schools during the two-years of intervention.

Moreover, adolescence is a challenging life stage to define based on chronological age because maturation rates – timing and tempo of progressive change – varies among young people. In terms of maturation, adolescents refer to young people who, for instance, begin to develop secondary sex characteristics such as external genitalia, breast, and pubic hair. It is acknowledged that no scale was used to systematically determine physical development. Rather, the study population in the present thesis was referred to

as adolescents based on the chronological age; this was consistent with suggestions by the WHO (23).

It is acknowledged that area level measures of SES are merely used as proxies for individuals' SE (37). Hence, the lack of detailed information on SE at an individual level is a limitation in Papers I-IV. At an area level, however, SE data suggests that residents in Angered, as compared to the overall population in Gothenburg, have relatively low incomes and educational levels (30). As Angered is a multicultural area with the majority of the residents having foreign-backgrounds (30, 31), it should further be recognized that the implication of educational level might vary across countries (38). This may be problematic in multicultural areas such as Angered as residents might have obtained their education outside their country of residence.

Paper I

The strengths of Paper I, particularly when observed from a moral and ethical perspective, might be that participants were invited to develop and implement the intervention in cooperation with researchers. The current thesis embraced the ideas on HP and empowerment as both a goal and a process (perhaps first and foremost as a process) as reasoned by Tengland (56). These ideas on HP and empowerment were deemed to harmonize with the perceptions that young people who partake in HP interventions should be included in DMP (60) and have the right to express their opinions and to be heard in matters affecting their health and well-being (61). As involvement in HP efforts might come in different forms – from merely being listened to and supported in expressing their views to sharing power and responsibility for decision making (60) – the RG recognized the importance of not only listening to participants and encouraging them to express their views, but also to take their views into account, involve them in DMP, and share power and responsibility during decision making. Although the researchers were faced with a number of barriers that challenged their ambition to aid participation and support a sense of empowerment, participants reported a number of positive experiences from taking part in the intervention, such as being listened to and treated with respect, and being taken seriously. They perceived themselves as having had the opportunity to influence and decide on content related to, for example, the HPS (207).

The homeroom teachers were occasionally involved in the HPS, as they were held during school hours. They were, however, seldom responsible for the HPS but were rather present in the school classroom, home economic kitchen, gym, etc. Although these homeroom teachers were informed about the shared foundation of HC, and were provided with information regarding the theme, aim, and content prior to each HPS, it should be acknowledged that these homeroom teachers were not systematically trained to deliver the HPS. This might be a limitation, particular during SEM-3 when the teachers led the Theme Group 3 who focused on ball games, as the implementation quality of these HPS were not assured and might have differed from the initial intention (although the RG received no such indicators).

Incorporating online social media such as FB groups as an intervention component, as well as using computer tablets to search (online) for health-related information, might encourage screen-based SB, thus potentially increasing SED. As the intervention intended to promote PA, this might be perceived as rather counterproductive. Nonetheless, assuming the positive experiences expressed by the participants (e.g., accessing information and allowing for asking questions) (207), online platform and social media components might be a suitable strategy for enabling dialogical conditions and facilitating communication between researchers and participants during HP interventions.

Papers II-IV

The strengths of Papers II-IV included the usage of accelerometers to estimate SED and PA among participants. However, the fairly small sample size, as well as the loss of participants to follow-up were limitations in Papers II-IV. The findings regarding accelerometer-measured SED and PA (cross-sectional and longitudinal) should be interpreted with caution with regard to wider populations such as adolescents living in other Swedish multicultural areas characterized by low SES.

Despite the fact that accelerometers from ActiGraph™ have been proven valid and reliable (90, 91, 95, 96), the lack of standardized recommendations to proceed and analyze accelerometer data needs consideration. With respect to the findings presented within this thesis, a number of issues and limitations are acknowledged and discussed below.

The lack of standardized recommendations to define NWT is apparent through systematic reviews summarizing a total of six (range: 10-180 minutes) (97) and seven (98) (range: 10-90 minutes) NWT-A, respectively used in previous accelerometer-based studies with youth. The NWT-A of ≥60 consecutive minutes of zero counts (196) considered in Papers II-IV was supported by a recent study (197). However, such long NWT-A might increase SED (232).

The determination of epoch duration affected the estimated SED and different PA intensities. Although it was the case in Paper II and Paper III, using shorter epoch duration (5 seconds) for cut-points calibrated and validated for longer epoch duration (15 seconds, as in the case of cut-points by Evenson et al.) might be inappropriate (98). Nonetheless, the application of short epoch durations is nowadays a common practice and recommended (230) to capture adolescents' spontaneous and intermittent PA behavior (195). Albeit different from the epoch duration used in the calibration and validation study, previous research also indicates that five second epoch durations more adequately estimate MVPA compared to relatively longer epoch durations (233).

It was recently proposed that approximately ≥4 days with ≥10 hours per day of wear time would be adequate to obtain reliable estimates of SED and different PA intensities among youth aged 9-11 years (234). Nonetheless, many previous accelerometer-based studies have required ≥3-4 days with ≥8-10 hours per day of monitoring to be included in the analysis (97). To maximize the sample size, ≥3 days with ≥8 hours per day of monitoring was the wear time criterion in the current thesis, and such relatively low requirement is acknowledged as a limitation. As school-aged youth generally engage in more PA during weekdays than weekend days (235), another limitation is the lack of requirements of including ≥1 weekend day(s) within the wear time criterion.

The cut-point of <100 CPM has shown to provide valid estimates of SED (236, 237). Nonetheless, the ActiGraph™ accelerometer models measure acceleration/deceleration and cannot differentiate sitting and reclining from standing upright with minimal movement, which might lead to LPA being misclassified as SED. Further, with regard to MPA, VPA and combined MVPA, multiple sets of cut-points currently circulate and the lack of standardization suggests that the results in Papers II-IV should be interpreted with caution. The decision on cut-points in Paper II and Paper III was based on a previous validation study (83) concluding that the cut-point purposed by Evenson et al. (190) provides the most valid estimates of SED and different PA intensities

among youth aged 5-17 years. In addition, a recent systematic review suggested a tendency among scholars to use cut-points by Evenson and colleagues among youth (98, 102).

In retrospect, the decision to not include tolerance time when analysing SED bouts might have been too strict because minor bodily movements in the hip-part of the body might occur while sitting, reclining or lying. Nonetheless, recommendations suggest not including tolerance-time when defining SED bouts (238) because the underlying hypothesis of adverse health effects of prolonged bouts of uninterrupted SED includes absence of muscle contraction (239, 240). Furthermore, allowing 1-2 minutes below the cut-point when calculating MVPA bouts might be regarded as a common practice to account for adolescents' spontaneous and intermittent PA behavior (195).

The accelerometers were hip-worn and certain types of PA where the vertical acceleration of the center of the body is limited (e.g., bicycling) and has an irregular gait might, therefore, have been underestimated. ET with focus on increased activity in the upper extremities, and other physiological demanding tasks, such as carrying heavy objects, and the fact that the accelerometer might be deemed less feasible to wear during contact sports (99), further lead to the assumption that some MVPA were unrecorded by the accelerometer. Because of the abovementioned limitations with accelerometers, it is preferable to include a complementary diary/log to include such PA. These diaries/logs were not included in the current thesis because of the RG's intention of lowering the burden for participants. A logical consequence of such an approach is that MVPA might have been underestimated (241).

Another concern, beyond the control of the RG (as the accelerometer was worn all day) was that T3 focus groups interviews (data not shown) indicated that the accelerometers occasionally were worn/handled improperly. For instance, some participating adolescents mentioned that they had tampered with the accelerometers, and such errors had for obvious reasons (lack of information of whoever executed such tasks) been uncontrolled for.

The potential role of the reactivity, occasionally referred to as the "Hawthorne effect" (242), requires some attention. Basically, the concept of reactivity suggests that individuals may change behavioral patterns due to knowledge that they are being monitored. The underlying psychosocial mechanisms appear to be unknown, yet might occur by reason of elevated motivation toward being physically active, as a reaction to the attention given by the researcher/practitioner, and/or the enthusiasm of receiving an objective

activity monitor (243). Some researchers have speculated that the reactivity phenomenon might be prominent among young people as they intrinsically might be competitive and curious, and change their behavior because of intentions to compete or due to social desirability (243). Reactivity specifically related to youth and accelerometry has received limited attention in the scholarly literature with available data for accelerometery showing somewhat inconsistent findings (243, 244). With the intention of reducing reactivity, workshops were held prior to T1 to allow for familiarization. It is conceivable, nevertheless, that the incentive to encourage compliance during T1-T3, such as recurrently visiting the schools during mornings and text messaging reminders to wear the accelerometer at T3, triggered reactivity among participants.

Also, some shortcomings with the questions for ET frequency and ET duration should be mentioned. Although the questions had previously demonstrated acceptable reliability and validity among adolescents (199, 200), neither test-retest reliability nor validation of the questionnaire used in Paper III were conducted among the sample of participants involved in the current thesis. This is acknowledged as a limitation because questionnaires might be required to be population- and culture-specific (77).

Experiences and Conclusions

Firstly, in describing and critically reflecting upon the experiences of developing and implementing an empowerment-based school-intervention, focusing on food and PA, involving adolescents from a Swedish multicultural area characterized by low SES, the experiences are (Paper I):

- That participants had several suggestions for activities related to food and PA, raised the value of collaborating with peers, and that they took responsibility in developing and implementing the intervention, such as planning and organizing intervention activities.

- That the reality presented a number of barriers that challenged the researchers' intentions to aid participation and support a sense of empowerment.
    - More specifically, the reality challenged the aim to use SGHCS and to work with goal setting in groups of participants with somewhat shared goals, wishes, and needs related to food and PA.

- That it is the important to acquire a broad and deep understanding of the targeted context and the participants of the intervention, and to be open-minded when it comes to negotiating, adjusting, and reorganizing empowerment-based interventions.

Secondly, after investigating accelerometer-measured SED and PA among the adolescents, and evaluating the effect of the intervention on these variables, the conclusions are (Papers II-IV):

- Among adolescents from this Swedish multicultural area characterized by low SES (Paper II):
    - Approximately half of the adolescents met the PA recommendations.
    - Girls accumulated more SED and less LPA and MVPA than boys.

  - Involvement in organized sports was associated with more MVPA.

- The intervention had no positive effects on SED and MVPA, or ET frequency and ET duration (Paper III).

- SED increased and MVPA decreased during the two-year follow-up. ET frequency and ET duration did not change during the two-year follow-up (Paper III).

- Among adolescents, cautiousness is warranted when cross-comparing accelerometer-based studies with different epoch durations and cut-points because (Paper IV):
  - Short epoch durations generally increased SED and MVPA (particularly VPA), while LPA decreased, and vice versa.
  - Differences were observed between cut-points per epoch duration for SED and all PA intensities.

Future Perspectives

For future perspectives, it might be interesting to:

- Further investigate whether HC might be an appropriate approach to involve adolescents in developing and implementing empowerment-based interventions. More specifically:
  - Investigate whether individual HC (one-to-one format) might be more appropriate than SGHCS among adolescents.
  - Investigate whether SGHCS might be more appropriate among older adolescents in, for instance, upper secondary school (~ages 16-20 years).

- To incorporate family-based strategies into empowerment-based interventions to support adolescents in Swedish multicultural areas characterized by low SES in achieving and maintaining healthy food and PA habits. For example, to develop and implement workshops to emphasize the importance of PA as well as outlined strategies to spend time being physically active as a family.

- Further investigate accelerometer-measured SED and PA among adolescents in other Swedish multicultural areas characterized by low SES.

- Further investigate interventions strategies to promote PA among adolescents in Swedish multicultural areas characterized by low SES. Perhaps most importantly, investigate intervention strategies to increase PA among adolescent girls as they voiced themselves generally having greater expectations than boys to bring effort into the household and having relatively greater demands in terms of educational achievement which perceived to inhibit their PA.

- Further investigate which decision on epoch duration and cut-point is most appropriate to estimate accelerometer-measured SED and PA among adolescents. Ultimately, this will provide opportunities to more accurately cross-compare accelerometer-based studies.

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Gothenburg, May, 2018
Andreas Fröberg

Sammanfattning (Swedish Summary)

Fysisk aktivitet bland ungdomar i ett svenskt multikulturellt område

En hälsopromotiv skolintervention med fokus på egenmakt

Övergripande Syfte

Det övergripande syftet med denna avhandling var två-delat. Det första syftet var att beskriva och kritiskt reflektera över utvecklingen och implementeringen av en skolintervention med fokus på egenmakt, kost och fysisk aktivitet som involverade ungdomar från ett svenskt multikulturellt område kännetecknat av låg socioekonomisk status. Det andra syftet var att undersöka objektivt mätt stillasittande och fysisk aktivitet hos ungdomarna, samt utvärdera effekten av interventionen på dessa variabler.

Deltagare och Metod

Data för de fyra delstudier som utgör denna avhandling samlades in under en tvåårig skolintervention ('How-to-Act?' projektet) med fokus på egenmakt, kost och fysisk aktivitet. Vid baslinjen rekryterades 114 ungdomar i årskurs 7 från tre skolor ($n = 1$ interventionsskola och $n = 2$ kontrollskolor) i Angered, Göteborg. Angered är ett svenskt multikulturellt område där populationen har lägre medelinkomst och utbildningsnivå jämfört med övriga Göteborg.

Interventionen utvecklades och implementerades genom samarbete och delat beslutsfattande mellan forskargruppen och ungdomarna. Fyra interventionskomponenter utvecklades för att stödja delaktighet och känslan av egenmakt: 1) Hälsocoaching med syftet att involvera ungdomarna i utvecklingen och implementeringen av interventionen genom att stödja dem till att uttrycka sina målsättningar, önskemål och behov kring kost och fysisk aktivitet, samt lyssna till deras förslag och idéer och omsätta dem i praktiken; 2) Interventionsaktiviteter där tematik, syfte och innehåll vägleddes av

ungdomarnas uttryckta målsättningar, önskemål och behov kring kost och fysisk aktivitet, men också forskargruppens gemensamma erfarenheter och rimliga åtgärder för genomförande (bland annat att innehållet var möjligt att genomföra inom den givna tidsramen och den fysiska miljön, samt att aktiviteterna skulle vara hälsofrämjande). Dessa interventionsaktiviteter genomfördes tillsammans med ungdomarna under skoltid och i skolmiljön (bland annat i skolans klassrum, hem- och konsumentkunskapskök, idrottshall och på skolgården); 3) Privat (sluten) grupp på den sociala nätverkstjänsten Facebook med syfte att främja delaktighet och möjliggöra kommunikation mellan forskargruppen och ungdomarna under interventionen; samt 4) En reflektionsmodell som forskargruppen använde för att reflektera över erfarenheter, såsom utmaningar och möjligheter, från hälsocoaching och interventionsaktiviteter. Baserat på dessa erfarenheter nåddes konsensus inom forskargruppen kring insatser och/eller modifieringar av interventionskomponenterna för att möta deltagarnas målsättningar, önskemål och behov kring kost och fysisk aktivitet. Fältarbetare dokumenterade utvecklingen och implementeringen av interventionen via protokoll och dessa utgjorde ett ramverk under reflektionsprocessen.

Data för delstudie I bestod av 145 protokoll som samlades in under utvecklingen och implementeringen av interventionen. I protokollen dokumenterade fältarbetarna: 1) förväntningar inför, erfarenheter av och övergripande observationer under hälsocoaching; 2) information relaterat till interventionsaktiviteter, såsom tematik, syfte, innehåll och närvaro; samt 3) upplevt deltagande och generella observationer och reflektioner under utvecklingen och implementeringen av interventionen. I delstudierna II-IV användes avancerade rörelsemätare (accelerometrar från ActiGraph™) och frågeformulär för att mäta: 1) stillasittande och fysisk aktivitet; respektive 2) involvering i organiserad idrottsverksamhet, samt träningsfrekvens och träningsduration. Data för dessa variabler samlades in under tre mättillfällen, i början av årskurs 7, 8 respektive 9.

Resultat och Diskussion

Delstudie I syftade till att beskriva och kritiskt reflektera över utvecklingen och implementeringen av skolinterventionen med fokus på egenmakt, kost och fysisk aktivitet. Interventionen utvecklades och implementerades genom samarbete och delat beslutsfattande mellan forskargruppen och ungdomarna.

Ungdomarna hade flera förslag och idéer på aktiviteter kring kost och fysisk aktivitet, uppskattade att samarbeta med varandra och tog ansvar för att utveckla och implementera interventionen genom att planera och organisera interventionsaktiviteter. Under tre skolterminer genomfördes 31 interventionsaktiviteter innehållande bland annat tillagning av hälsosam mat, muskelstärkande aktivitet med kroppen som belastning, promenad med stegräknare, jogging/löpning, dans och fotboll, samt sökning (online via läsplattor) och sammanställning av hälsovinster av regelbunden fysisk aktivitet. Sammanfattningsvis konstateras dock att processen med att utveckla och implementera interventionen var förenat med en del hinder som utmanade forskargruppens initiala intentioner att stödja delaktighet och känslan av egenmakt. Bland annat önskade ungdomarna praktiska interventionsaktiviteter snarare än hälsocoaching, och förhållandevis få var intresserade av att arbeta med målsättning i relation till kost och fysisk aktivitet.

Delstudierna II-IV syftade till att undersöka objektivt mätt stillasittande och fysisk aktivitet hos ungdomar, samt utvärdera effekten av interventionen på dessa variabler. Delstudie II visade att majoriteten av den vakna tiden tillbringades stillasittande med mindre tid ägnat åt lätt fysisk aktivitet och fysisk aktivitet på måttlig till hög intensitet. Ungefär hälften av ungdomarna nådde rekommendationen om fysisk aktivitet, det vill säga 60 minuter eller mer per dag av fysisk aktivitet på måttlig till hög intensitet. Flickor var överlag mer stillasittande och mindre fysiskt aktiva på lätt och måttlig till hög intensitet jämfört med pojkar. Ungdomar involverade i organiserad idrottsverksamhet var mer fysiskt aktiva på måttlig till hög intensitet. Delstudie III visade att interventionen inte hade några positiva effekter på stillasittande, fysisk aktivitet på måttlig till hög intensitet, träningsfrekvens eller träningsduration. Stillasittande ökade och fysisk aktivitet på måttlig till hög intensitet minskade mellan årskurs 7 och 9. Under samma tidsperiod observerades inga förändringar i varken träningsfrekvens eller träningsduration. Vidare visade resultatet i delstudie IV att stillasittande och fysisk aktivitet på olika intensitetsnivåer varierade beroende på val av tidsperiod för summering av rörelse. Korta tidsperioder för summering av rörelse ökade stillasittande och fysisk aktivitet på måttlig till hög intensitet, samt minskade fysisk aktivitet på lätt intensitet och vice versa. Resultaten visade också att stillasittande och fysisk aktivitet på olika intensitetsnivåer varierade beroende på val av skärningspunkt för att definiera stillasittande och fysisk aktivitet på lätt, måttlig och hög intensitet.

Forskargruppens erfarenheter och lärdomar från interventionen betonar vikten av att förvärva en bred och djup förståelse kring det sammanhang som interventioner med fokus på egenmakt utvecklas och implementeras. Likaså betydelsen av att vara öppensinnad när det kommer till att förhandla, justera och omorganisera interventioner för att möta deltagares önskemål och behov. Denna avhandling visar också att ungdomar i ett svenskt multikulturellt område kännetecknad av låg socioekonomisk status tillbringar majoriteten av den vakna tiden stillasittande och att ungefär hälften når rekommendationerna om fysisk aktivitet. Resultaten tyder också på att stillasittande ökar och fysisk aktivitet på måttlig till hög intensitet minskar över tid. Avhandlingen visar också att resultaten bör tolkas med försiktighet eftersom stillasittande och fysisk aktivitet på olika intensitetsnivåer varierar beroende på val av tidsperiod för summering av rörelse och skärningspunkt för att definiera stillasittande och fysisk aktivitet på lätt och måttlig till hög intensitet.

Denna avhandling bidrar med erfarenheter vid utveckling och implementering av en skolintervention med fokus på egenmakt, kost och fysisk aktivitet som involverade ungdomar från ett svenskt multikulturellt område kännetecknat av låg socioekonomisk status. Avhandlingen är också ett bidrag till den befintliga kunskapen kring stillasittande och fysisk aktivitet hos ungdomar i dessa områden, såväl som ett bidrag till kunskapen kring tolkning av accelerometerdata.

Appendix 1.

Självutvärderingsprotokoll – Hälsocoaching

Datum:

Coach:

Grupp (närvarande):

Före coaching-samtalet:

Vad vill du fokusera på under samtalet?

Hur känner du inför samtalet?

Efter coaching-samtalet:

Vad fungerade bra under samtalet?

Vad fungerade mindre bra under samtalet?

Vad behöver du utveckla/göra annorlunda nästa gång?

Vilka tekniker/modeller/metoder använde du dig av?

Vad vi kom fram till:

Appendix 2.

Datum: **Grupp:** **Aktivitet:** **Aktivitetsledare:**

Tema	Koppling till förgående aktivitet/hälsocoaching	Delaktighet	Övriga reflektioner	Koppling till nästkommande aktivitet/hälsocoaching	Koppling till delaktighet och egenmakt

Appendix 3

An overview of the *n* = 15 health promotion sessions during semester 2 (SEM-2) (mean attendance rate: 83%)

No	Main Content (Group)	Duration	AR* (%)
1	Half-day with physical activity (e.g., playing sports) and food-related activities (e.g., identifying the amount of added sugar in common foods) (Groups 1-6).	180	87%
2	Resistance training exercises focused on body-weight (Groups 3-4), online searches with computer tablets and compilation of health benefits of physical activity as well as recommendations and guidelines (e.g., steps and minutes per day) (Groups 1, 2, 5, 6).	90	85%
3	Resistance training exercises focused on body-weight (Groups 5-6), online searches with computer tablets and compilation of health benefits of physical activity as well as recommendations and guidelines (e.g., steps and minutes per day) (Groups 3-4), and preparation of healthy snacks such as smoothies containing fruits and vegetables (Groups 1-2).	90	81%
4	Structured group health coaching (Groups 3, 5), and online searches with computer tablets and compilation of health-related benefits of a balanced, healthy diet as well as recommendations and guidelines (Groups 1, 2, 4, 6).	90	83%
5	Structured group health coaching (Groups 1, 2, 4, 6), and online searches with computer tablets and compilation of health-related benefits of a balanced, healthy diet as well as recommendations and guidelines (Groups 3, 5).	90	87%
6	Resistance training exercises focused on body-weight (Groups 1-2), and preparation of healthy snacks such as smoothies containing fruits and vegetables (Group 3), playing soccer (Groups 4-5), and jogging/running (Group 6).	90	69%
7	Preparation of healthy snacks such as smoothies containing fruits and vegetables (Group 5), playing basketball (Groups 3-4), dancing (Group 1), and martial arts (Groups 2, 6).	90	89%
8	Preparation of healthy snacks such as smoothies containing fruits and vegetables (Group 6), martial arts (Groups 3, 5), and walking with pedometers (Groups 1, 2, 4).	90	83%
9	Preparation of healthy snacks such as smoothies containing fruits and vegetables (Group 4), dancing (Group 1), playing soccer (Group 5), and workshops to identify wishes for change in the school canteen which, subsequently, were formulated into questions and presented to representatives from the school canteen (Groups 2, 3, 6).	90	85%
10	Workshops to identify desired changes in food served at school subsequently formulated into questions and presented to representatives of the school cafeteria (Groups 1, 4, 5) and swimming (Groups 2, 3, 6).	90	87%
11	Swimming (Groups 1, 4, 5) and brisk walking with pedometers (Groups 2, 3, 6).	90	77%
12	Choosing between walking, jogging/running, and playing soccer (Groups 1-6).	90	89%
13	Preparation of a whole day (e.g., search online via computer tablets for recipes of vegetarian food) (Groups 1-6).	90	77%
14	Structured group health coaching (Groups 1-6).	90	77%
15	Whole day of preparation (e.g., searching online with computer tablets for recipes) and cooking of vegetarian food and exhibition concerning health and health promotion (Groups 1-6).	360	87%

Abbreviation: AR, Attendance rate

*All mean-values are rounded

Appendix 4.

An overview of the *n* = 13 health promotion sessions during semester 3 (SEM-3) (mean attendance rate: 86%)

No	Main Content (Group)	Duration	AR* (%)
1	Preparation of a whole day of physical activity (e.g., playing sports) and cooking vegetarian food and healthy snacks (Theme Group 1). Creation and organization of individualized food and physical activity programs aimed to increase fruit and vegetable consumption and decrease the consumption of energy-dense snacks and sweetened beverages, as well as to increase physical activity (e.g., by dancing, walking with pedometers, and exercise training), sometimes during the school day) (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	90%
2	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	85%
3	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	80%
4	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	80%
5	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	85%
6	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	85%
7	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	80%
8	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	90%
9	Continuing the preparation of the whole day (Theme Group 1), creation and organization of individualized food and physical activity programs (Theme Group 2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	86%
10	Execution of the whole day with physical activities (e.g., playing sports) and cooking vegetarian food and healthy snacking (Theme Groups 1-4).	360	95%
11	Dancing (Theme Groups 1-2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	95%
12	A representative from community programs was invited to participate in a workshop discussing opportunities for physical activities (e.g., information regarding exercise training and involvement in sport compounds in the area of Angered) (Theme Groups 1-2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	80%
13	The previous workshop discussing opportunities for physical activities was summarized and exposed to all participants through posters in the school-environment (Theme Groups 1-2). Ball games (Theme Group 3). School-based assignments (Theme Group 4).	60	85%

Abbreviation: AR, Attendance rate

*All mean-values are rounded

Appendix 5.

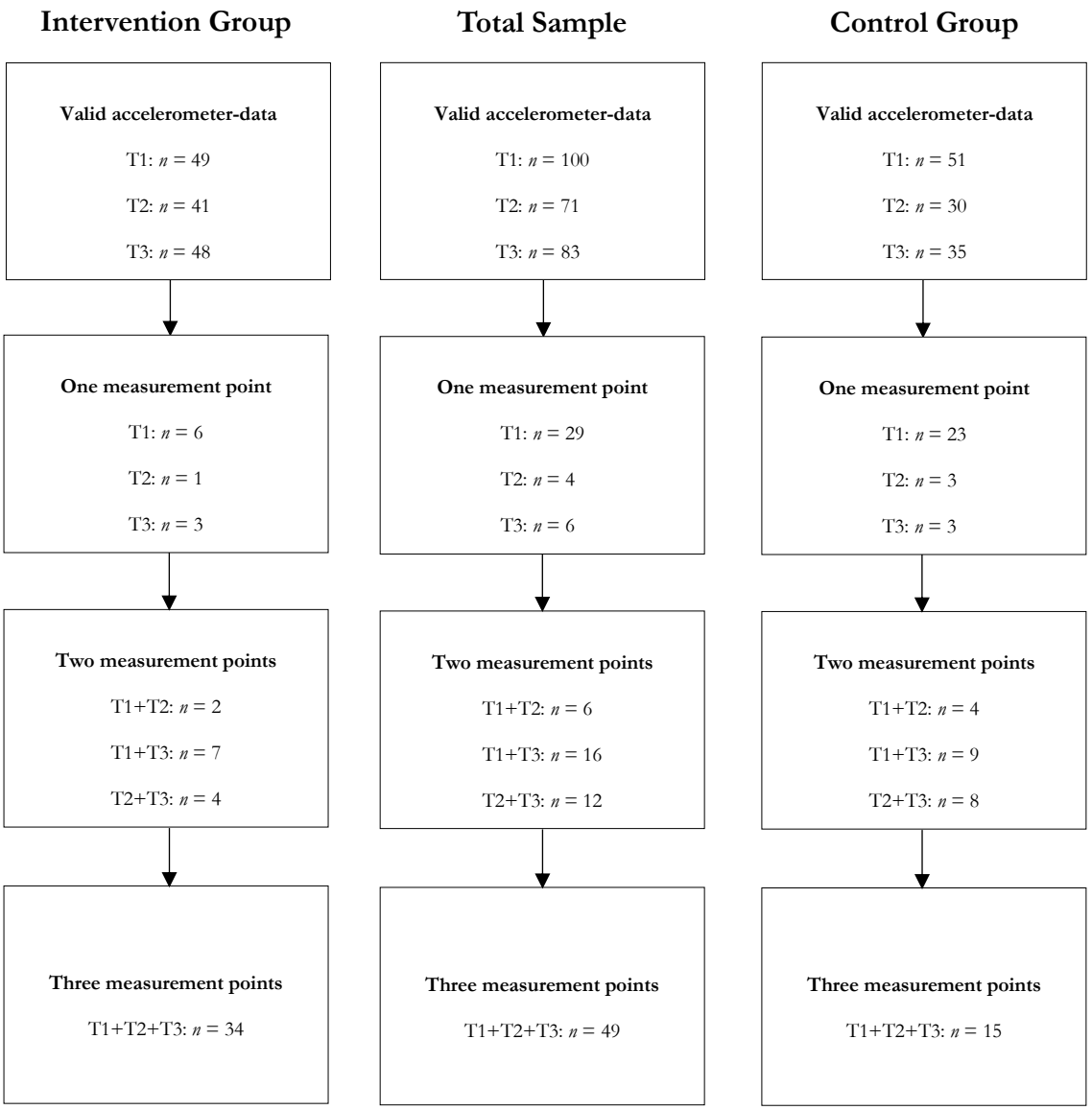
An overview of the *n* = 3 health promotion sessions during semester 4 (SEM-4) (mean attendance rate: 87%)

No	Main Content	Duration	AR* (%)
1	Sapere workshop on exploring and increasing awareness of food-related senses and preferences.	120	85%
2	Workshop involving video clips to discuss bodies and body ideals.	120	89%
3	Visiting exhibition addressing health and health promotion.	180	87%
**	A whole-day workshop involving presentation of preliminary results from the intervention, introduction to the basic principles and concepts of the intervention (empowerment and health promotion), and discussions about opportunities and challenges for sustaining the intervention.	360	N/A

Abbreviation: AR, Attendance rate
*All mean-values are rounded
**Held for the school's principal, teachers and other school personnel

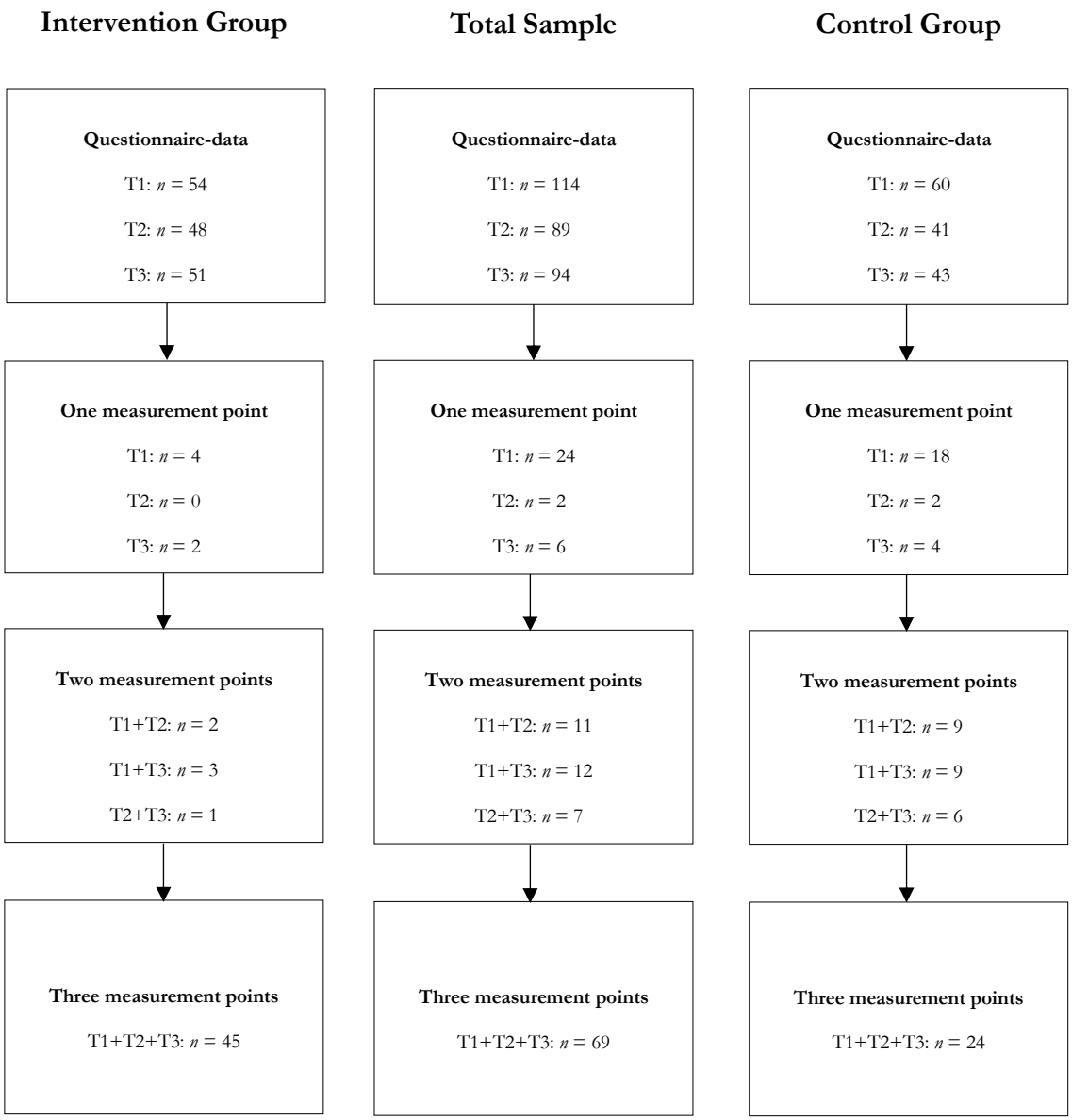
Appendix 6.

Accelerometer-data for SED and MVPA at T1, T2, and T3.



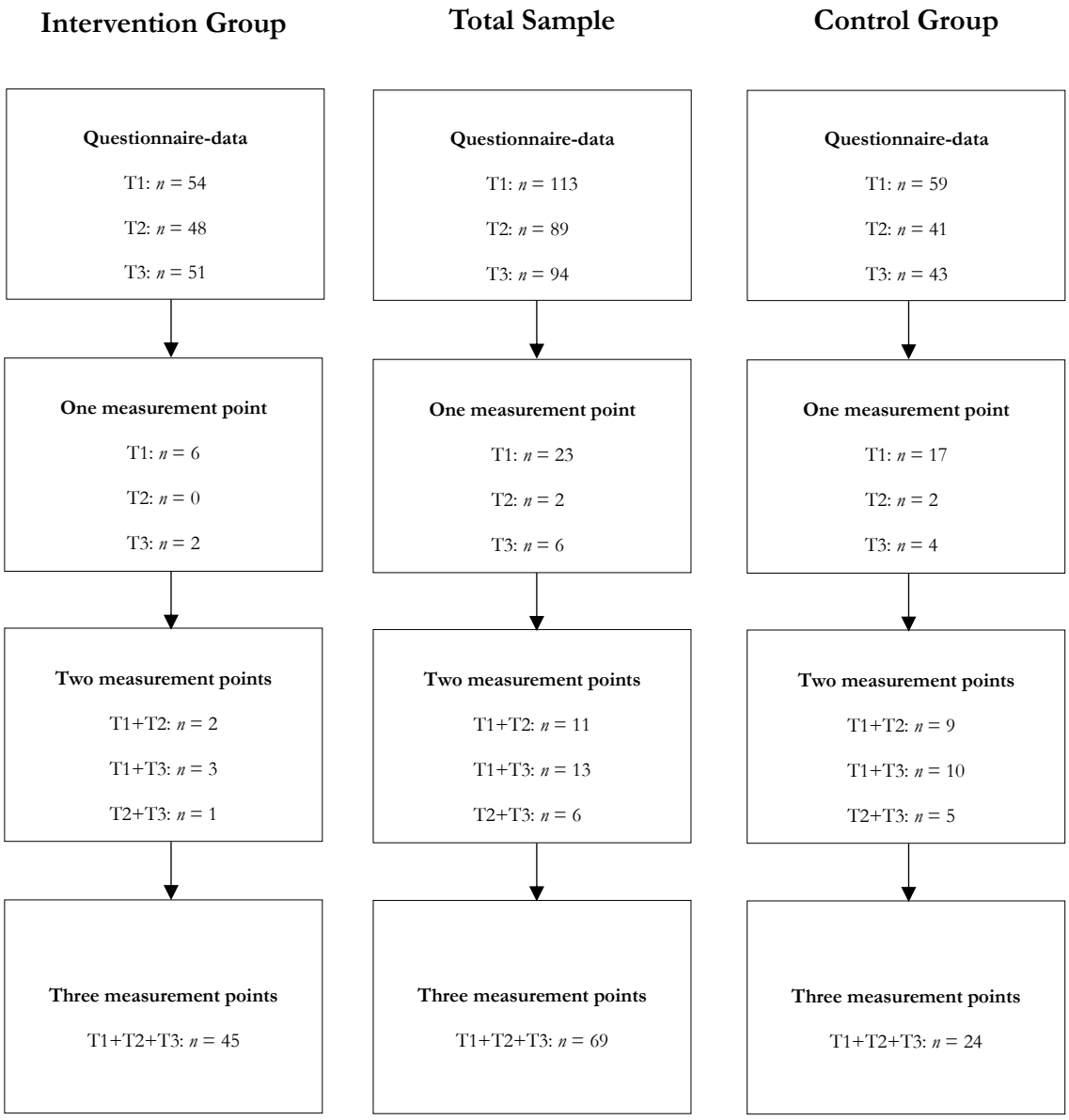
Note: **T1:** baseline, 2014; **T2:** midpoint, 2015; and **T3:** endpoint, 2016.

Self-reported data for ET frequency at T1, T2, and T3.



Note: **T1:** baseline, 2014; **T2:** midpoint, 2015; and **T3:** endpoint, 2016.

Self-reported data for ET duration at T1, T2, and T3.



Note: **T1:** baseline, 2014; **T2:** midpoint, 2015; and **T3:** endpoint, 2016.

Appendix 7.

Model 1-4 for changes in SED between T1 and T3.

Parameters of the model	Model 1	Model 2	Model 3	Model 4
Means				
Level of sedentary time	588.50 (567.30; 609.80)	NA	NA	NA
Change in sedentary time	17.50 (0.81; 34.00)	NA	NA	NA
Regression weights				
Wear-time – intercept		0.80 (0.58; 0.97)	0.87 (0.67; 1.00)	0.81 (0.61; 0.96)
Wear-time – slope		0.59 (0.24; 0.91)	0.47 (0.11; 0.81)	0.51 (0.16; 0.84)
Intervention vs control – intercept			0.29 (0.11; 0.46)	0.26 (0.08; 0.43)
Intervention vs control - slope			-0.21 (-0.57; 0.13)	-0.19 (-0.55; 0.15)
Sex – intercept				-0.22 (-0.39; -0.04)
Sex - slope				0.13 (-0.19; 0.46)
Model fit				
DIC	3153.75	3048.60	3042.50	3039.30
PPp	0.45	0.22	0.22	0.25

Note: Credible predictors indicated as bolded

Model 1: No predictors added

Model 2: Added predictors: accelerometer wear-time

Model 3: Added predictors: accelerometer wear-time and intervention group-belonging

Model 4: Added predictors: accelerometer wear-time, intervention group-belonging, and sex

DIC: Deviance information criterion

PPp: Posterior predictive p

Model 1-4 for changes in MVPA between T1 and T3.

Parameters of the model	Model 1	Model 2	Model 3	Model 4
Means				
Level of MVPA	65.15 (60.83; 70.05)	NA	NA	NA
Change in MVPA	-6.58 (-8.64; -4.49)	NA	NA	NA
Regression weights				
Wear-time – intercept		-0.09 (-0.28; 0.11)	-0.17 (-0.36; 0.04)	-0.08 (-0.27; 0.12)
Wear-time – slope		-0.26 (-0.64; 0.12)	-0.18 (-0.57; 0.20)	-0.22 (-0.60; 0.18)
Intervention vs control – intercept			-0.22 (-0.40; -0.02)	-0.20 (-0.37; -0.01)
Intervention vs control – slope			0.19 (-0.16; 0.56)	0.18 (-0.18; 0.56)
Sex – intercept				0.34 (0.16; 0.50)
Sex - slope				-0.01 (-0.37; 0.34)
Model fit				
DIC	2235.44	2233.22	2223.20	2217.18
PPP	0.24	0.26	0.26	0.20

Note: Credible predictors indicated as bolded

Model 1: No predictors added

Model 2: Added predictors: accelerometer wear-time

Model 3: Added predictors: accelerometer wear-time and intervention group-belonging

Model 4: Added predictors: accelerometer wear-time, intervention group-belonging, and sex

DIC: Deviance information criterion

PPp: Posterior predictive p

Model 1-3 for changes in ET frequency between T1 and T3.

Parameters of the model	Model 1	Model 2	Model 3
Means			
Level of ET frequency	4.81 (4.48; 5.14)	NA	NA
Change in ET frequency	-0.20 (-0.43; 0.20)	NA	NA
Regression weights			
Intervention vs control – intercept		0.11 (-0.10; 0.32)	0.10 (-0.10; 0.30)
Intervention vs control – slope		0.07 (-0.21; 0.35)	0.03 (-0.25; 0.33)
Sex – intercept			0.42 (0.22; 0.62)
Sex – slope			0.01 (-0.27; 0.30)
Model fit			
DIC	1171.93	1172.00	1149.52
PPP	0.32	0.38	0.39

Note: Credible predictors indicated as bolded

Model 1: No predictors added

Model 2: Added predictors: intervention group-belonging

Model 3: Added predictors: intervention group-belonging and sex

DIC: Deviance information criterion

PPp: Posterior predictive p

Model 1-3 for changes in ET duration between T1 and T3.

Parameters of the model	Model 1	Model 2	Model 3
Means			
Level of ET duration	3.10 (2.84-3.35)	NA	NA
Change in ET duration	0.14 (-0.04; 0.34)	NA	NA
Regression weights			
Intervention vs control – intercept		-0.10 (-0.30; 0.12)	-0.10 (-0.30; 0.12)
Intervention vs control – slope		0.32 (0.06; 0.66)	0.27 (0.01; 0.60)
Sex – intercept			0.33 (0.11; 0.58)
Sex – slope			0.24 (-0.02; 0.56)
Model fit			
DIC	1054.47	1052.01	1027.27
PPP	0.52	0.41	0.38

Note: Credible predictors indicated as bolded

Model 1: No predictors added

Model 2: Added predictors: intervention group-belonging

Model 3: Added predictors: intervention group-belonging and sex

DIC: Deviance information criterion

PPp: Posterior predictive

Reference List

1. Lim SS, Allen K, Bhutta ZA, Dandona L, Forouzanfar MH, Fullman N, et al. Measuring the health-related sustainable development goals in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1813-50.
2. Organisation for Economic Co-operation and Development. Divided we stand: why inequality keeps rising. Paris: OECD Publishing; 2011.
3. Bleich SN, Jarlenski MP, Bell CN, LaVeist TA. Health inequalities: trends, progress, and policy. Annu Rev Public Health. 2012;33(1):7-40.
4. Stringhini S, Carmeli C, Jokela M, Avendaño M, Muennig P, Guida F, et al. Socioeconomic status and the 25 × 25 risk factors as determinants of premature mortality: a multicohort study and meta-analysis of 1.7 million men and women. Lancet. 2017;389(10075):1229-37.
5. Chetty R, Stepner M, Abraham S, Lin S, Scuderi B, Turner N, et al. The association between income and life expectancy in the United States, 2001-2014. JAMA. 2016;315(16):1750-66.
6. Onvani S, Haghighatdoost F, Surkan PJ, Larijani B, Azadbakht L. Adherence to the Healthy Eating Index and Alternative Healthy Eating Index dietary patterns and mortality from all causes, cardiovascular disease and cancer: a meta-analysis of observational studies. J Hum Nutr Diet. 2017;30(2):216-26.
7. Fuzeki E, Engeroff T, Banzer W. Health benefits of light-intensity physical activity: a systematic review of accelerometer data of the National Health and Nutrition Examination Survey (NHANES). Sports Med. 2017;47(9):1769-93.
8. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012;380(9838):219-29.
9. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-

analysis of data from more than 1 million men and women. Lancet. 2016;388(10051):1302-10.
10. Bucksch J, Sigmundova D, Hamrik Z, Troped PJ, Melkevik O, Ahluwalia N, et al. International trends in adolescent screen-time behaviors from 2002 to 2010. J Adolesc Health. 2016;58(4):417-25.
11. Booth VM, Rowlands AV, Dollman J. Physical activity temporal trends among children and adolescents. J Sci Med Sport. 2015;18(4):418-25.
12. Colley RC, Carson V, Garriguet D, Janssen I, Roberts KC, Tremblay MS. Physical activity of Canadian children and youth, 2007 to 2015. Health Rep. 2017;28(10):8-16.
13. Kolle E, Steene-Johannessen J, Klasson-Heggebo L, Andersen LB, Anderssen SA. A 5-yr change in Norwegian 9-yr-olds' objectively assessed physical activity level. Med Sci Sports Exerc. 2009;41(7):1368-73.
14. Dalene KE, Anderssen SA, Andersen LB, Steene-Johannessen J, Ekelund U, Hansen BH, et al. Secular and longitudinal physical activity changes in population-based samples of children and adolescents. Scand J Med Sci Sports. 2018;28(1):161-71.
15. Cameron C, Craig CL, Bauman A, Tudor-Locke C. CANPLAY study: Secular trends in steps/day amongst 5-19 year-old Canadians between 2005 and 2014. Prev Med. 2016;86:28-33.
16. Kalman M, Inchley J, Sigmundova D, Iannotti RJ, Tynjala JA, Hamrik Z, et al. Secular trends in moderate-to-vigorous physical activity in 32 countries from 2002 to 2010: a cross-national perspective. Eur J Public Health. 2015;25 Suppl 2:37-40.
17. Tremblay MS, Esliger DW, Copeland JL, Barnes JD, Bassett DR. Moving forward by looking back: lessons learned from long-lost lifestyles. Appl Physiol Nutr Metab. 2008;33(4):836-42.
18. World Health Organization. Food and Agriculture Organization of the United Nations. Diet, nutrition, and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation. Geneva: World Health Organization; 2003.
19. World Health Organization Guidelines Approved by the Guidelines Review Committee. Global Recommendations on Physical Activity for Health. WHO Guidelines Approved by the Guidelines Review Committee. Geneva: World Health Organization; 2010.

20. Vereecken C, Pedersen TP, Ojala K, Krolner R, Dzielska A, Ahluwalia N, et al. Fruit and vegetable consumption trends among adolescents from 2002 to 2010 in 33 countries. Eur J Public Health. 2015;25 Suppl 2:16-9.
21. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012;380(9838):247-57.
22. Sallis JF, Bull F, Guthold R, Heath GW, Inoue S, Kelly P, et al. Progress in physical activity over the Olympic quadrennium. Lancet. 2016;388(10051):1325-36.
23. Sawyer SM, Afifi RA, Bearinger LH, Blakemore SJ, Dick B, Ezeh AC, et al. Adolescence: a foundation for future health. Lancet. 2012;379(9826):1630-40.
24. World Health Organization. HBIS-ACH. Growing up unequal: gender and socioeconomic differences in young people's health and well-being. HBSC Study; Vol. 7; Geneva, Switzerland; WHO Press; 2016.
25. Hanson MD, Chen E. Socioeconomic status and health behaviors in adolescence: a review of the literature. J Behav Med. 2007;30(3):263-85.
26. Chzhen Y, Moor I, Pickett W, Toczydlowska E, Stevens G. International trends in 'bottom-end' inequality in adolescent physical activity and nutrition: HBSC study 2002-2014. Eur J Public Health. 2018: doi: 10.1093/eurpub/ckx237.
27. Elgar FJ, Pfortner TK, Moor I, De Clercq B, Stevens GW, Currie C. Socioeconomic inequalities in adolescent health 2002-2010: a time-series analysis of 34 countries participating in the Health Behaviour in School-aged Children study. Lancet. 2015;385(9982):2088-95.
28. Juneau CE, Benmarhnia T, Poulin AA, Cote S, Potvin L. Socioeconomic position during childhood and physical activity during adulthood: a systematic review. Int J Public Health. 2015;60(7):799-813.
29. Lundquist Å. Skillnader i livsvillkor och hälsa i Göteborg [Inequality in living conditions and health in Gothenburg, 2014]. Göteborg: Göteborgs Stad; 2014.
30. Statistik och analys – Göteborg Stad (Angered) [Statistics and analysis – the City of Gothenburg (Angered)] [Internet]. Gothenburg. [2018-05-03]. Available from: http://statistik.goteborg.se/Statistik/Faktablad/Goteborgsbladet/Goteborgsbladet-2014.
31. Statistik och analys – Göteborg Stad [Statistics and analysis – the City of Gothenburg, Gothenburg] [Internet]. Gothenburg. [cited 2018 May 5].

Available from: http://statistik.goteborg.se/Statistik/Faktablad/Goteborgsbladet/Goteborgsbladet-2014.

32. Hjern A. Migration and public health: health in Sweden: the National Public Health Report 2012. Chapter 13. Scand J Public Health. 2012;40(9 Suppl):255-67.
33. Nationella operativa avdelningen (NOA) [Operational Department (NOA)]. Utsatta områden - sociala risker, kollektiv förmåga och oönskade händelser [Exposed areas – social risks, collective capacity, and unwanted events] [Internet]. Stockholm; 2017. [cited 2018 May 5]. Available from: https://polisen.se/siteassets/dokument/ovriga_rapporter/utsatta-omraden-social-ordning-kriminell-struktur-och-utmaningar-for-polisen-2017.pdf.
34. Göteborgs stad [City of Gothenburg]. De senaste tio årens utveckling i Göteborg: ett samarbete mellan Göteborgs stad, Polisområde Storgöteborg och Göteborgs universitet [The last ten years of development in Gothenburg: a collaboration between the City of Gothenburg, Police Area Gothenburg and the University of Gothenburg]. Göteborg: Göteborgs stad; 2014.
35. Björnsson J, Jeppsson M, Wahlman A. Stadsmiljöenkäten 2014 – Göteborgs Stad [The urban environment survey – the City of Gothenburg] [Internet]. Scandinfo Marketing Research AB; 2014. Available from: http://www.enkater.goteborg.se/2014/2__rapporter/Rapport%20Stadsmilj%C3% B6unders%C3%B6kning%202014.pdf.
36. World Health Organization. Health for the world's adolescents – a second chance in the second decade. Geneva, Switzerland; WHO Press; 2014.
37. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 2). J Epidemiol Community Health. 2006;60(2):95-101.
38. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). J Epidemiol Community Health. 2006;60(1):7-12.
39. Elgar FJ, McKinnon B, Torsheim T, Schnohr CW, Mazur J, Cavallo F, et al. Patterns of socioeconomic inequality in adolescent health differ according to the measure of socioeconomic position. Soc Indic Res. 2016;127(3):1169-80.

40. Cameron AJ, Thornton LE, McNaughton SA, Crawford D. Variation in supermarket exposure to energy-dense snack foods by socio-economic position. Public Health Nutr. 2013;16(7):1178-85.
41. Ball K. Traversing myths and mountains: addressing socioeconomic inequities in the promotion of nutrition and physical activity behaviours. Int J Behav Nutr Phys Act. 2015;12:142.
42. Tengland PA. A two-dimensional theory of health. Theor Med Bioeth. 2007;28(4):257-84.
43. Nutbeam D. Health promotion glossary. Health Promot Int. 1998;13(4):349-64.
44. Huber M, Knottnerus JA, Green L, van der Horst H, Jadad AR, Kromhout D, et al. How should we define health? BMJ. 2011;343:d4163.
45. Bauer G, Davies JK, Pelikan J. The EUHPID Health Development Model for the classification of public health indicators. Health Promot Int. 2006;21(2):153-9.
46. Mittelmark MB, Sagy S, Eriksson M, Bauer GF, Pelikan JM, Lindström B, et al. The handbook of salutogenesis: Cham: Springer International Publishing: Springer; 2017.
47. Antonovsky A. The salutogenic model as a theory to guide health promotion. Health Promot Int. 1996;11(1):11-8.
48. Berryman JW. Exercise is medicine: a historical perspective. Curr Sports Med Rep. 2010;9(4):195-201.
49. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reps. 1985;100(2):126-31.
50. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act. 2010;7:39: doi: 10.1186/1479-5868-7-39.
51. World Health Organization. Global strategy on diet, physical activity and health. Geneva, Switzerland; WHO Press; 2004.
52. World Health Organization. Global action plan for the prevention and control of non-communicable diseases. Geneva, Switzerland; WHO Press; 2013-2020.
53. Lalonde, M. 1974. A new perspective on the health of Canadians. Ottawa, ON: Minister of Supply and Services Canada. Retrieved from Public

Health Agency of Canada website: http://www.phac-aspc.gc.ca/ph-sp/pdf/perspect-eng.pdf.
54. Hancock T. Lalonde and beyond: looking back at "A New Perspective on the Health of Canadians". Health Promot. 1986;1(1):93-100.
55. Ottawa charter for health promotion. Can J Public Health. 1986;77(6):425-30.
56. Tengland PA. Empowerment: a goal or a means for health promotion? Med Health Care Philos. 2007;10(2):197-207.
57. World Health Organization. Regional Office for Europe. Evaluation in health promotion: principles and perspectives. Copenhagen: World Health Organization, Regional Office for Europe; 2001.
58. Tengland PA. Behavior change or empowerment: on the ethics of health-promotion strategies. Public Health Ethics. 2012;5(2):140-53.
59. Braunack-Mayer A, Louise J. The ethics of community empowerment: tensions in health promotion theory and practice. Promot Educ. 2008;15(3):5-8.
60. Shier H. Pathways to articipation: openings, opportunities and obligations: a new model for enhancing children's participation in decision-making, in line with Article 12.1 of the United Nations Convention on the Rights of the Child. Child Soc. 2001;15(2):107-17.
61. United Nations Human Rights. United Nations Convention on the Rights of the Child. Available from: http://www.ohchr.org/EN/Professional Interest/Pages/CRC.aspx.
62. Paffenbarger RS, Blair SN, Lee IM. A history of physical activity, cardiovascular health and longevity: the scientific contributions of Jeremy N Morris, DSc, DPH, FRCP. Int J Epidemiol. 2001;30(5):1184-92.
63. Lee IM, Matthews CE, Blair SN. The legacy of Dr. Ralph Seal Paffenbarger, Jr. – past, present, and future contributions to physical activity research. Pres Counc Phys Fit Sports Res Dig. 2009;10(1):1-8.
64. Blair SN, LaMonte MJ, Nichaman MZ. The evolution of physical activity recommendations: how much is enough? Am J Clin Nutr. 2004;79(5):913S-20S.
65. Bouchard C, An P, Rice T, Skinner JS, Wilmore JH, Gagnon J, et al. Familial aggregation of VO(2max) response to exercise training: results from the HERITAGE Family Study. J Appl Physiol. 1999;87(3):1003-8.
66. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al. Physical activity and public health. A recommendation from the Centers

for Disease Control and Prevention and the American College of Sports Medicine. JAMA. 1995;273(5):402-7.
67. Exercise for health. WHO/FIMS Committee on Physical Activity for Health. Bull World Health Organ. 1995;73(2):135-6.
68. U.S. Department of Health and Human Services. Physical Activity and Health: A Report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.
69. 2018 Physical Activity Guidelines Advisory Committee. 2018 Physical Activity Guidelines Advisory Committee Scientific Report. Washington, DC: U.S. Department of Health and Human Services, 2018.
70. Pettee Gabriel KK, Morrow JR, Woolsey AL. Framework for physical activity as a complex and multidimensional behavior. J Phys Act Health. 2012;9 Suppl 1:S11-8.
71. Pate RR, O'Neill JR, Lobelo F. The evolving definition of "sedentary". Exerc Sport Sci Rev. 2008;36(4):173-8.
72. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act. 2017;14(1):75.
73. Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, Montoye HJ, Sallis JF, et al. Compendium of physical activities: classification of energy costs of human physical activities. Med Sci Sports Exerc. 1993;25(1):71-80.
74. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc. 2000;32(9 Suppl):S498-504.
75. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR, Tudor-Locke C, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Med Sci Sports Exerc. 2011;43(8):1575-81.
76. Ridley K, Ainsworth BE, Olds TS. Development of a compendium of energy expenditures for youth. Int J Behav Nutr Phys Act. 2008;5:45.
77. Strath SJ, Kaminsky LA, Ainsworth BE, Ekelund U, Freedson PS, Gary RA, et al. Guide to the assessment of physical activity: Clinical and research applications: a scientific statement from the American Heart Association. Circulation. 2013;128(20):2259-79.

78. McMurray RG, Soares J, Caspersen CJ, McCurdy T. Examining variations of resting metabolic rate of adults: a public health perspective. Med Sci Sports Exerc. 2014;46(7):1352-8.
79. Herrmann SD, McMurray RG, Kim Y, Willis EA, Kang M, McCurdy T. The influence of physical characteristics on the resting energy expenditure of youth: A meta-analysis. Am J Hum Biol. 2017;29(3): doi: 10.1002/ajhb.22944.
80. Butte NF, Watson KB, Ridley K, Zakeri IF, McMurray RG, Pfeiffer KA, et al. A youth compendium of physical activities: activity codes and metabolic intensities. Med Sci Sports Exerc. 2018;50(2):246-56.
81. Bull FC. and the Expert Working Groups. Physical activity guidelines in the U.K.: Review and Recommendations. School of Sport, Exercise and Health Sciences, Loughborough University, May 2010.
82. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. J Pediatr. 2005; 146(6):732-7.
83. Trost SG, Loprinzi PD, Moore R, Pfeiffer KA. Comparison of accelerometer cut points for predicting activity intensity in youth. Med Sci Sports Exerc. 2011;43(7):1360-8.
84. Wareham NJ, Rennie KL. The assessment of physical activity in individuals and populations: why try to be more precise about how physical activity is assessed? Int J Obes Relat Metab Disord. 1998;22 Suppl 2:S30-8.
85. Lubans DR, Hesketh K, Cliff DP, Barnett LM, Salmon J, Dollman J, et al. A systematic review of the validity and reliability of sedentary behaviour measures used with children and adolescents. Obes Rev. 2011;12(10):781-99.
86. Chinapaw MJ, Mokkink LB, van Poppel MN, van Mechelen W, Terwee CB. Physical activity questionnaires for youth: a systematic review of measurement properties. Sports Med. 2010;40(7):539-63.
87. Adamo KB, Prince SA, Tricco AC, Connor-Gorber S, Tremblay M. A comparison of indirect versus direct measures for assessing physical activity in the pediatric population: a systematic review. Int J Pediatr Obes. 2009;4(1):2-27.
88. Helmerhorst HJ, Brage S, Warren J, Besson H, Ekelund U. A systematic review of reliability and objective criterion-related validity of physical

activity questionnaires. Int J Behav Nutr Phys Act. 2012;9:103: doi: 10.1186/1479-5868-9-103

89. Sylvia LG, Bernstein EE, Hubbard JL, Keating L, Anderson EJ. Practical guide to measuring physical activity. J Acad Nutr Diet 2014;114(2):199-208.
90. De Vries SI, Bakker I, Hopman-Rock M, Hirasing RA, van Mechelen W. Clinimetric review of motion sensors in children and adolescents. J Clin Epidemiol. 2006;59(7):670-80.
91. De Vries SI, Van Hirtum HW, Bakker I, Hopman-Rock M, Hirasing RA, Van Mechelen W. Validity and reproducibility of motion sensors in youth: a systematic update. Med Sci Sports Exerc. 2009;41(4):818-27.
92. Tudor-Locke C, Schuna JM, Han H, Aguiar EJ, Larrivee S, Hsia DS, et al. Cadence (steps/min) and intensity during ambulation in 6-20 year olds: the CADENCE-kids study. Int J Behav Nutr Phys Act. 2018;15(1):20.
93. Tudor-Locke C, Craig CL, Beets MW, Belton S, Cardon GM, Duncan S, et al. How many steps/day are enough? for children and adolescents. Int J Behav Nutr Phys Act. 2011;8(1):78.
94. Troiano RP, McClain JJ, Brychta RJ, Chen KY. Evolution of accelerometer methods for physical activity research. Br J Sports Med. 2014;48(13):1019-23.
95. Plasqui G, Bonomi AG, Westerterp KR. Daily physical activity assessment with accelerometers: new insights and validation studies. Obes Rev. 2013;14(6):451-62.
96. McClain JJ, Tudor-Locke C. Objective monitoring of physical activity in children: considerations for instrument selection. J Sci Med Sport. 2009;12(5):526-33.
97. Cain KL, Sallis JF, Conway TL, Van Dyck D, Calhoon L. Using accelerometers in youth physical activity studies: a review of methods. J Phys Act Health. 2013;10(3):437-50.
98. Migueles JH, Cadenas-Sanchez C, Ekelund U, Delisle Nystrom C, Mora-Gonzalez J, Lof M, et al. Accelerometer data collection and processing criteria to assess physical activity and other outcomes: a systematic review and pactical considerations. Sports Med. 2017;47(9):1821-45.
99. Audrey S, Bell S, Hughes R, Campbell R. Adolescent perspectives on wearing accelerometers to measure physical activity in population-based trials. Eur J Public Health. 2013;23(3):475-80.

100. Van Coevering P, Harnack L, Schmitz K, Fulton JE, Galuska DA, Gao S. Feasibility of using accelerometers to measure physical activity in young adolescents. Med Sci Sports Exerc. 2005;37(5):867-71.
101. Guinhouya BC, Samouda H, de Beaufort C. Level of physical activity among children and adolescents in Europe: a review of physical activity assessed objectively by accelerometry. Public Health. 2013;127(4):301-11.
102. Van Hecke L, Loyen A, Verloigne M, van der Ploeg HP, Lakerveld J, Brug J, et al. Variation in population levels of physical activity in European children and adolescents according to cross-European studies: a systematic literature review within DEDIPAC. Int J Behav Nutr Phys Act. 2016;13(1):70.
103. Ekelund U, Tomkinson G, Armstrong N. What proportion of youth are physically active? Measurement issues, levels and recent time trends. Br J Sports Med. 2011;45(11):859-65.
104. Ng SW, Popkin BM. Time use and physical activity: a shift away from movement across the globe. Obes Rev. 2012;13(8):659-80.
105. Tremblay MS, LeBlanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. Int J Behav Nutr Phys Act. 2011;8:98.
106. Chinapaw MJ, Proper KI, Brug J, van Mechelen W, Singh AS. Relationship between young peoples' sedentary behaviour and biomedical health indicators: a systematic review of prospective studies. Obes Rev. 2011;12(7):e621-32.
107. Van Ekris E, Altenburg TM, Singh AS, Proper KI, Heymans MW, Chinapaw MJ. An evidence-update on the prospective relationship between childhood sedentary behaviour and biomedical health indicators: a systematic review and meta-analysis. Obes Rev. 2016;17(9):833-49.
108. Carson V, Hunter S, Kuzik N, Gray CE, Poitras VJ, Chaput JP, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. Appl Physiol Nutr Metab. 2016;41(6 Suppl 3):S240-65.
109. Biddle SJ, Garcia Bengoechea E, Wiesner G. Sedentary behaviour and adiposity in youth: a systematic review of reviews and analysis of causality. Int J Behav Nutr Phys Act. 2017;14(1):43.
110. Boulos R, Vikre EK, Oppenheimer S, Chang H, Kanarek RB. ObesiTV: how television is influencing the obesity epidemic. Physiol Behav. 2012;107(1):146-53.

111. Hobbs M, Pearson N, Foster PJ, Biddle SJ. Sedentary behaviour and diet across the lifespan: an updated systematic review. Br J Sports Med. 2015;49(18):1179-88.
112. Pearson N, Biddle SJ. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. Am J Prev Med. 2011;41(2):178-88.
113. Tanaka C, Reilly JJ, Huang WY. Longitudinal changes in objectively measured sedentary behaviour and their relationship with adiposity in children and adolescents: systematic review and evidence appraisal. Obes Rev. 2014;15(10):791-803.
114. Froberg A, Raustorp A. Objectively measured sedentary behaviour and cardio-metabolic risk in youth: a review of evidence. Eur J Pediatr. 2014;173(7):845-60.
115. Cliff DP, Hesketh KD, Vella SA, Hinkley T, Tsiros MD, Ridgers ND, et al. Objectively measured sedentary behaviour and health and development in children and adolescents: systematic review and meta-analysis. Obes Rev. 2016;17(4):330-44.
116. Ekelund U, Luan J, Sherar LB, Esliger DW, Griew P, Cooper A, et al. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. JAMA. 2012;307(7):704-12.
117. Janssen I, Leblanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. Int J Behav Nutr Phys Act. 2010;7:40:doi.org/10.1186/1479-5868-7-40.
118. Poitras VJ, Gray CE, Borghese MM, Carson V, Chaput JP, Janssen I, et al. Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. Appl Physiol Nutr Metab. 2016;41(6 Suppl 3):S197-239.
119. Ramires VV, Dumith SC, Goncalves H. Longitudinal association between physical activity and body fat during adolescence: a systematic review. J Phys Act Health. 2015;12(9):1344-5.
120. Reichert FF, Baptista Menezes AM, Wells JC, Carvalho Dumith S, Hallal PC. Physical activity as a predictor of adolescent body fatness: a systematic review. Sports Med. 2009;39(4):279-94.
121. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. J Pediatr. 2005;146(6):732-7.

122. Faigenbaum AD, Myer GD. Resistance training among young athletes: safety, efficacy and injury prevention effects. Br J Sports Med. 2010;44(1):56-63.
123. Faigenbaum AD, Myer GD. Pediatric resistance training: benefits, concerns, and program design considerations. Curr Sports Med Rep. 2010;9(3):161-8.
124. Lloyd RS, Faigenbaum AD, Stone MH, Oliver JL, Jeffreys I, Moody JA, et al. Position statement on youth resistance training: the 2014 international consensus. Br J Sports Med. 2014;48(7):498-505.
125. Faigenbaum AD, Kraemer WJ, Blimkie CJ, Jeffreys I, Micheli LJ, Nitka M, et al. Youth resistance training: updated position statement paper from the national strength and conditioning association. J Strength Cond Res. 2009;23(5 Suppl):S60-79.
126. Behm DG, Faigenbaum AD, Falk B, Klentrou P. Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents. Appl Physiol Nutr Metab. 2008;33(3):547-61.
127. Tremblay MS, Carson V, Chaput JP, Connor Gorber S, Dinh T, Duggan M, et al. Canadian 24-hour movement guidelines for children and youth: an integration of physical activity, sedentary behaviour, and sleep. Appl Physiol Nutr Metab. 2016;41(6 Suppl 3):S311-27.
128. Okely AD, Salmon J, Vella SA, Cliff D, Timperio A, Tremblay M, et al. A systematic review to inform the Australian sedentary behaviour guidelines for children and young people. Report prepared for the Australian Government Department of Health, June 2012.
129. Yrkesföreningar för fysisk aktivitet [Professional Associations for Physical Activity]. FYSS 2017: fysisk aktivitet i sjukdomsprevention och sjukdomsbehandling [Physical Activity in the Prevention and Treatment of Disease]. 3 ed. Stockholm: Läkartidningen förlag AB; 2016.
130. Becker W, Anderssen SA, Fogelholm M, Gunnarsdottir I, Hursti UKK, Meltzer HM, et al. NNR 2012: nordic nutrition recommendations – integrating nutrition and physical activity. Ann Nutr Metab. 2013;63:897-897.
131. Janssen I. Physical activity guidelines for children and youth. Can J Public Health. 2007;98 (Suppl 2):S109-21.
132. Kahlmeier S, Wijnhoven TM, Alpiger P, Schweizer C, Breda J, Martin BW. National physical activity recommendations: systematic overview and

analysis of the situation in European countries. BMC Public Health. 2015;15:133: doi.org/10.1186/s12889-015-1412-3.

133. De Moraes AC, Guerra PH, Menezes PR. The worldwide prevalence of insufficient physical activity in adolescents; a systematic review. Nutr Hosp. 2013;28(3):575-84.
134. Ortega FB, Ruiz JR, Sjöstrom M. Physical activity, overweight and central adiposity in Swedish children and adolescents: the European Youth Heart Study. Int J Behav Nutr Phys Act. 2007;4:61: doi.org/10.1186/1479-5868-4-61.
135. Centrum för idrottsforskning [The Swedish Research Council for Sport Science]. De aktiva och de inaktiva: om ungas rörelse i skola och på fritid [The active and the inactive: about the youth's movement in school and at leisure]. Stockholm: Centrum för idrottsforskning; 2017. Avaliable from: https://centrumforidrottsforskning.se/wp-content/uploads/2017/06/ De -aktiva-och-de-inaktiva_komp.pdf.
136. Cooper AR, Goodman A, Page AS, Sherar LB, Esliger DW, van Sluijs EM, et al. Objectively measured physical activity and sedentary time in youth: the international children's accelerometry database (ICAD). Int J Behav Nutr Phys Act. 2015;12:113: doi.org/10.1186/s12966-015-0274-5.
137. Reilly JJ. When does it all go wrong? Longitudinal studies of changes in moderate-to-vigorous-intensity physical activity across childhood and adolescence. J Exerc Sci Fit. 2016;14(1):1-6.
138. Dumith SC, Gigante DP, Domingues MR, Kohl HW. Physical activity change during adolescence: a systematic review and a pooled analysis. Int J Epidemiol. 2011;40(3):685-98.
139. Harding SK, Page AS, Falconer C, Cooper AR. Longitudinal changes in sedentary time and physical activity during adolescence. Int J Behav Nutr Phys Act. 2015;12(1):44.
140. Mitchell JA, Pate RR, Dowda M, Mattocks C, Riddoch C, Ness AR, et al. A prospective study of sedentary behavior in a large cohort of youth. Med Sci Sports Exerc. 2012;44(6):1081-7.
141. Corder K, Sharp SJ, Atkin AJ, Griffin SJ, Jones AP, Ekelund U, et al. Change in objectively measured physical activity during the transition to adolescence. Br J Sports Med. 2015;49(11):730-6.
142. Collings PJ, Wijndaele K, Corder K, Westgate K, Ridgway CL, Sharp SJ, et al. Magnitude and determinants of change in objectively-measured physical activity, sedentary time and sleep duration from ages 15 to 17.5y

in UK adolescents: the ROOTS study. Int J Behav Nutr Phys Act. 2015;12:61: doi.org/10.1186/s12966-015-0222-4.
143. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-vigorous physical activity from ages 9 to 15 years. JAMA. 2008;300(3):295-305.
144. Metcalf BS, Hosking J, Jeffery AN, Henley WE, Wilkin TJ. Exploring the adolescent fall in physical activity: a 10-yr cohort study (EarlyBird 41). Med Sci Sports Exerc. 2015;47(10):2084-92.
145. Farooq MA, Parkinson KN, Adamson AJ, Pearce MS, Reilly JK, Hughes AR, et al. Timing of the decline in physical activity in childhood and adolescence: Gateshead Millennium Cohort Study. Br J Sports Med. 2017:0:1-6: doi:10.1136/bjsports-2016-096933.
146. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW, et al. Correlates of physical activity: why are some people physically active and others not? Lancet. 2012;380(9838):258-71.
147. O'Donoghue G, Kennedy A, Puggina A, Aleksovska K, Buck C, Burns C, et al. Socio-economic determinants of physical activity across the life course: A "DEterminants of DIet and Physical Activity" (DEDIPAC) umbrella literature review. PloS one. 2018;13(1):e0190737.
148. Stalsberg R, Pedersen AV. Effects of socioeconomic status on the physical activity in adolescents: a systematic review of the evidence. Scand J Med Sci Sports. 2010;20(3):368-83.
149. Sherar LB, Griffin TP, Ekelund U, Cooper AR, Esliger DW, van Sluijs EM, et al. Association between maternal education and objectively measured physical activity and sedentary time in adolescents. J Epidemiol Community Health. 2016;70(6):541-8.
150. Borraccino A, Lemma P, Iannotti RJ, Zambon A, Dalmasso P, Lazzeri G, et al. Socioeconomic effects on meeting physical activity guidelines: comparisons among 32 countries. Med Sci Sports Exerc. 2009;41(4):749-56.
151. Telama R. Tracking of physical activity from childhood to adulthood: a review. Obesity Facts. 2009;2(3):187-95.
152. Craigie AM, Lake AA, Kelly SA, Adamson AJ, Mathers JC. Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. Maturitas. 2011;70(3):266-84.
153. Gillis L, Tomkinson G, Olds T, Moreira C, Christie C, Nigg C, et al. Research priorities for child and adolescent physical activity and sedentary

behaviours: an international perspective using a twin-panel Delphi procedure. Int J Behav Nutr Phys Act. 2013;10(1):112: doi.org/10.1186/1479-5868-10-112.

154. Kriemler S, Meyer U, Martin E, van Sluijs EM, Andersen LB, Martin BW. Effect of school-based interventions on physical activity and fitness in children and adolescents: a review of reviews and systematic update. Br J Sports Med. 2011;45(11):923-30.
155. Metcalf B, Henley W, Wilkin T. Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). BMJ. 2012;345:e5888.
156. Borde R, Smith JJ, Sutherland R, Nathan N, Lubans DR. Methodological considerations and impact of school-based interventions on objectively measured physical activity in adolescents: a systematic review and meta-analysis. Obes Rev. 2017;18(4):476-90.
157. Wijtzes AI, van de Gaar VM, van Grieken A, de Kroon ML, Mackenbach JP, van Lenthe FJ, et al. Effectiveness of interventions to improve lifestyle behaviors among socially disadvantaged children in Europe. Eur J Public Health. 2017;27(2):240-7.
158. Kornet-van der Aa DA, Altenburg TM, van Randeraad-van der Zee CH, Chinapaw MJ. The effectiveness and promising strategies of obesity prevention and treatment programmes among adolescents from disadvantaged backgrounds: a systematic review. Obes Rev. 2017;18(5):581-93.
159. Cleland CL, Tully MA, Kee F, Cupples ME. The effectiveness of physical activity interventions in socio-economically disadvantaged communities: a systematic review. Prev Med. 2012;54(6):371-80.
160. Marcus C, Nyberg G, Nordenfelt A, Karpmyr M, Kowalski J, Ekelund U. A 4-year, cluster-randomized, controlled childhood obesity prevention study: STOPP. Int J Obes. 2009;33(4):408-17.
161. Nyberg G, Norman A, Sundblom E, Zeebari Z, Elinder LS. Effectiveness of a universal parental support programme to promote health behaviours and prevent overweight and obesity in 6-year-old children in disadvantaged areas, the Healthy School Start Study II, a cluster-randomised controlled trial. Int J Behav Nutr Phys Act. 2016;13:4: doi.org/10.1186/s12966-016-0327-4.

162. Dencker M, Thorsson O, Karlsson MK, Linden C, Svensson J, Wollmer P, et al. Daily physical activity in Swedish children aged 8-11 years. Scand J Med Sci Sports. 2006;16(4):252-7.
163. Hedström P. Hälsocoach i skolan – en utvärderande fallstudie av en hälsofrämjande intervention [Health coach in school – an evaluation of a case study on a health promotion intervention]. [thesis on the Internet]. Gothenburg: University of Gothenburg; 2016 [cited 2018 May 05]. Available from: http://hdl.handle.net/2077/43372.
164. Gomersall SR, Rowlands AV, English C, Maher C, Olds TS. The ActivityStat hypothesis: the concept, the evidence and the methodologies. Sports Med. 2013;43(2):135-49.
165. Wilkin TJ. Can we modulate physical activity in children? No. Int J Obes. 2011;35(10):1270-6.
166. Reilly JJ. Can we modulate physical activity in children? Int J Obes. 2011;35(10):1266-9.
167. Frerichs L, Ataga O, Corbie-Smith G, Tessler Lindau S. Child and youth participatory interventions for addressing lifestyle-related childhood obesity: a systematic review. Obes Rev. 2016;17(12):1276-86.
168. Verloigne M, Altenburg TM, Chinapaw MJ, Chastin S, Cardon G, De Bourdeaudhuij I. Using a co-creational approach to develop, implement and evaluate an intervention to promote physical activity in adolescent girls from vocational and technical schools: a case control study. Int J Environ Res Public Health. 2017;14(8):doi.org/10.3390/ijerph14080862.
169. Caro HE, Altenburg TM, Dedding C, Chinapaw MJ. Dutch primary schoolchildren's perspectives of activity-friendly school playgrounds: A participatory study. Int J Environ Res Public Health. 2016;13(6): doi:10.3390/ijerph1306052.
170. Okely AD, Lubans DR, Morgan PJ, Cotton W, Peralta L, Miller J, et al. Promoting physical activity among adolescent girls: the Girls in Sport group randomized trial. T Int J Behav Nutr Phys Act. 2017;14(1):81.
171. Lindqvist AK, Mikaelsson K, Westerberg M, Gard G, Kostenius C. Moving from idea to action: promoting physical activity by empowering adolescents. Health Promot Pract. 2014;15(6):812-8.
172. Jacquez F, Vaughn LM, Wagner E. Youth as partners, participants or passive recipients: a review of children and adolescents in community-based participatory research (CBPR). Am J Community Psychol. 2013;51(1-2):176-89.

173. Wiren J. Idrottens akademisering: idrottsvetenskaplig kunskap inom forskning, utbildning och på arbetsmarknaden [The academisation of sport: scientific knowledge within research, higher education and on the labour market]. [thesis on the Internet]. Malmö: Malmö University; 2016 [cited 2018 May 05]. Available from: http://hdl.handle.net/2043/17006.
174. University of Gothenburg. General study plan for doctoral degree in sport science. [Internet]. University of Gothenburg, Department of Food, Nutrition, and Sport Science; 2016. [cited 2018 May 5]. Available from: https://iki.gu.se/digitalAssets/1572/1572275_allma--n-studieplan-mot-doktorsexamen-i-idrottsvetenskap.pdf.
175. The Swedish National Agency for Education. Curriculum for the compulsory school, preschool class and the recreation centre. [Internet]. Stockholm; 2011. [cited 2018 May 5]. Available from: https://www.skolverket.se/publikationer?id=2687.
176. Fransson K, Lundgren UP. Utbildningsvetenskap - ett begrepp och dess sammanhang [Educational science – a concept and its context]. Stockholm: Vetenskapsrådet; 2003.
177. Salazar LF, Crosby RA, DiClemente RJ. Research Methods in Health Promotion. 2 ed. San Francisco, Calif: Jossey-Bass. 2015
178. Khorramshahi N & Hellberg S. Särskilt utsatta områden i Göteborg [Particularly vulnerable areas in Gothenburg] [Internet]. 2017. [cited 2018 May 5]. Available from: http://www4.goteborg.se/prod/Intraservice/Namndhandlingar/SamrumPortal.nsf/FC71144625FF4722C12580C30039C45E/$File/09B_Bilaga_Analysrapport_Sarskilt_utsatta_omraden_i_Goteborg.pdf.
179. SIRI [Internet]. Stockholm: Skolverket [The Swedish National Agency for Education]. [cited 2016 May 5]. Available from: https://siris.skolverket.se/siris/.
180. Kennedy M. Skola totalt sönderslagen – filmer ska granskas [School totally demolished – movies to be reviewed]. Göteborgs-Posten [Internet]. 2015 Dec 7 [cited 2018 May 5]; Available from: http://www.gp.se/nyheter/g%C3%B6teborg/skola-totalt-s%C3%B6nderslagen-filmer-ska-granskas-1.173415.
181. Grönlund E. Misstänkt anlagd brand på skola i Hammarkullen [Suspected arson attack on the school in Hammarkullen] SVT Nyheter Väst [Internet]. 2016 June 27 [cited 2018 May 5]; Available from:

https://www.svt.se/nyheter/lokalt/vast/misstankt-anlagd-brand-pa-forskola-i-hammarkullen.

182. Fransson D. Storbråk på skolgård i Hammarkullen [Big brawl on the schoolyard in Hammarkullen] [Internet]. 2015 19 Oct [cited 2018 May 5]; Göteborgs-Posten. Available from: http://www.gp.se/nyheter/g%C3%B6teborg/storbr%C3%A5k-p%C3%A5-skolg%C3%A5rd-i-hammarkullen-1.153376.
183. Olsen JM. Health coaching: a concept analysis. Nurs Forum. 2014;49(1):18-29.
184. Downey M. Effective coaching: lessons from the coaches' coach. 2 ed. New York; London: Texere; 2003.
185. Sherar LB, Griew P, Esliger DW, Cooper AR, Ekelund U, Judge K, et al. International children's accelerometry database (ICAD): design and methods. BMC Public Health. 2011;11(1):485:doi.org/10.1186/1471-2458-11-485.
186. Cain KL, Conway TL, Adams MA, Husak LE, Sallis JF. Comparison of older and newer generations of ActiGraph accelerometers with the normal filter and the low frequency extension. Int J Behav Nutr Phys Act. 2013;10(1):51: doi.org/10.1186/1479-5868-10-51.
187. Carson V, Spence JC. Seasonal variation in physical activity among children and adolescents: a review. Pediatr Exerc Sci. 2010;22(1):81-92.
188. McCann DA, Knowles ZR, Fairclough SJ, Graves LEF. A protocol to encourage accelerometer wear in children and young people. Qual Res Sport Exerc Health. 2016;8(4):319-31.
189. Colley R, Connor Gorber S, Tremblay MS. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. Health Rep. 2010;21(1):63-9.
190. Evenson KR, Catellier DJ, Gill K, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. J Sports Sci. 2008;26(14):1557-65.
191. Freedson P, Pober D, Janz KF. Calibration of accelerometer output for children. Med Sci Sports Exerc. 2005;37(11 Suppl):S523-30.
192. Mattocks C, Leary S, Ness A, Deere K, Saunders J, Tilling K, et al. Calibration of an accelerometer during free-living activities in children. Int J Pediatr Obes. 2007;2(4):218-26.
193. Puyau MR, Adolph AL, Vohra FA, Butte NF. Validation and calibration of physical activity monitors in children. Obes Res. 2002;10(3):150-7.

194. Treuth MS, Schmitz K, Catellier DJ, McMurray RG, Murray DM, Almeida MJ, et al. Defining accelerometer thresholds for activity intensities in adolescent girls. Med Sci Sports Exerc. 2004;36(7):1259-66.
195. Sanders T, Cliff DP, Lonsdale C. Measuring adolescent boys' physical activity: bout length and the influence of accelerometer epoch length. PloS one. 2014;9(3):e92040.
196. Chinapaw MJ, de Niet M, Verloigne M, De Bourdeaudhuij I, Brug J, Altenburg TM. From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. PloS one. 2014;9(11):e111205.
197. Aadland E, Andersen LB, Anderssen SA, Resaland GK. A comparison of 10 accelerometer non-wear time criteria and logbooks in children. BMC Public Health. 2018;18(1):323.
198. Currie C, Inchley J, Molcho M, Lenzi M, Veselska Z, Wild F. Health Behaviour in School-aged Children (HBSC) study protocol: Background, methodology and mandatory items for the 2013/14 survey. Child and Adolescent Health Research Unit (CAHRU), 2014.
199. Booth ML, Okely AD, Chey T, Bauman A. The reliability and validity of the physical activity questions in the WHO health behaviour in schoolchildren (HBSC) survey: a population study. Br J Sports Med. 2001;35(4):263-7.
200. Rangul V, Holmen TL, Kurtze N, Cuypers K, Midthjell K. Reliability and validity of two frequently used self-administered physical activity questionnaires in adolescents. BMC Med Res Methodol. 2008;8:47: doi.org/10.1186/1471-2288-8-47.
201. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012;7(4):284-94.
202. Pallant J. SPSS survival manual: a step by step guide to data analysis using IBM SPSS. 5th ed. Maidenhead: McGraw-Hill; 2013.
203. Muthén LK, Muthén BO. (1998-2012). Mplus User's Guide: Statistical Analysis with Latent Variables. 7th ed. Los Angeles, CA: Muthén & Muthén.
204. Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A, Rubin DB. (2014). Byesian data analysis. 3rd ed. Boca Raton: CRC Press.
205. Swedish Research Council. Good Research Practice [Internet]. Stockholm: Swedish Research Council; 2017. [cited 2018 5 May]. Available from: https://publikationer.vr.se/en/product/good-research-practice.

206. Crane S, Broome ME. Understanding ethical issues of research participation from the perspective of participating children and adolescents: a systematic review. Worldviews Evid Based Nurs. 2017;14(3):200-9.
207. Holmberg C, Larsson C, Korp P, Lindgren EC, Jonsson L, Fröberg A et al. Empowering aspects for healthy food and physical activity habits: Adolescents' experiences of a school-based intervention in a disadvantaged urban community. Submitted manuscript.
208. Massé R, Williams-Jones B. Ethical dilemmas in health promotion practice. In Rootman I, Dupéré S, O'Neill M, editors. Health promotion in Canada. Canadian Scholars' Press: Toronto, Canada; 2012. 241-253.
209. Altenburg TM, de Niet M, Verloigne M, De Bourdeaudhuij I, Androutsos O, Manios Y, et al. Occurrence and duration of various operational definitions of sedentary bouts and cross-sectional associations with cardiometabolic health indicators: the ENERGY-project. Prev Med. 2015;71:101-6.
210. Verloigne M, Ridgers ND, Chinapaw MJ, Altenburg TM, Bere E, Van Lippevelde W, et al. Patterns of objectively measured sedentary time in 10- to 12-year-old Belgian children: an observational study within the ENERGY-project. BMC Pediatr. 2017;17(1):147.
211. Mattocks C, Ness A, Leary S, Tilling K, Blair SN, Shield J, et al. Use of accelerometers in a large field-based study of children: protocols, design issues, and effects on precision. J Phys Act Health. 2008;5 (Suppl 1):S98-111.
212. Jonsson L, Berg C, Larsson C, Korp P, Lindgren EC. Facilitators of physical activity: voices of adolescents in a disadvantaged community. Int J Environ Res Public Health. 2017;14(8):839.
213. Martins J, Marques A, Sarmento H, Carreiro da Costa F. Adolescents' perspectives on the barriers and facilitators of physical activity: a systematic review of qualitative studies. Health Educ Res. 2015;30(5):742-55.
214. Jonsson L, Larsson C, Berg C, Korp P, Lindgren EC. What undermines healthy habits with regard to physical activity and food? Voices of adolescents in a disadvantaged community. Int J Qual Stud Health Well-being. 2017;12(1):1333901.

215. Biddle SJH, Atkin AJ, Cavill N, Foster C. Correlates of physical activity in youth: a review of quantitative systematic reviews. Int Rev Sport Exerc Psychol. 2011;4(1):25-49.
216. Marques A, Ekelund U, Sardinha LB. Associations between organized sports participation and objectively measured physical activity, sedentary time and weight status in youth. J Sci Med Sport. 2016;19(2):154-7.
217. Nilsson A, Andersen LB, Ommundsen Y, Froberg K, Sardinha LB, Piehl-Aulin K, et al. Correlates of objectively assessed physical activity and sedentary time in children: a cross-sectional study (The European Youth Heart Study). BMC Public Health. 2009;9(1):322.
218. Sveriges Riksidrottsförbund [The Swedish Sports Confederation]. Idrott och integration: en statistisk undersökning 2010 [Sport and integration: a statistical survey 2010]. Stockholm: Riksidrottsförbundet; 2010. Avaliable from: http://www.rf.se/globalassets/riksidrottsforbundet/dokument/mangfald/idrott_och_integration.pdf.
219. Blomdahl U, Elofsson S, Åkesson M, Lengheden L. Segrar föreningslivet? En studie av svenskt föreningsliv under 30 år bland barn och unga [Will the club activities win? A study of Swedish club activities during 30 years among children and youth] [Internet]. Stockholm: Stockholms stads idrottsförvaltning; 2014. Available from: http://urn.kb.se/resolve?urn=urn:nbn:se:su:diva-110084.
220. Blomdahl U, Elofsson S. Hur många motionerar/idrottar för lite och vilka är dom?: en studie av den unga befolkningen i Stockholm, Haninge, Helsingborg, Jönköping och Lidingö. Stockholm [How many exercise/sports too little and who are they?: a study of the young population in Stockholm, Haninge, Helsingborg, Jönköping and Lidingö]: Stockholms stad – Idrottsförvaltningen, Forskningsenheten; 2006.
221. Statens folkhälsoinstitut [Swedish National Institute of Public Health]. Social health inequalities in Swedish children and adolescents: a systematic review. 2. ed. Östersund: Statens folkhälsoinstitut; 2011.
222. Miguel-Berges ML, Reilly JJ, Moreno Aznar LA, Jimenez-Pavon D. Associations between pedometer-determined physical activity and adiposity in children and adolescents: systematic review. Clin J Sport Med. 2018;28(1):64-75.
223. Jimenez-Pavon D, Kelly J, Reilly JJ. Associations between objectively measured habitual physical activity and adiposity in children and adolescents: systematic review. Int J Pediatr Obes. 2010;5(1):3-18.

224. Brown HE, Atkin AJ, Panter J, Wong G, Chinapaw MJ, van Sluijs EM. Family-based interventions to increase physical activity in children: a systematic review, meta-analysis and realist synthesis. Obes Rev. 2016;17(4):345-60.
225. Sims J, Scarborough P, Foster C. The effectiveness of interventions on sustained childhood physical activity: a systematic review and meta-analysis of controlled studies. PloS one. 2015;10(7):e0132935.
226. Harrison F, Goodman A, van Sluijs EMF, Andersen LB, Cardon G, Davey R, et al. Weather and children's physical activity; how and why do relationships vary between countries? Int J Behav Nutr Phys Act. 2017;14(1):74. doi: 10.1186/s12966-017-0526-7.
227. Corder K, Winpenny E, Love R, Brown HE, White M, Sluijs EV. Change in physical activity from adolescence to early adulthood: a systematic review and meta-analysis of longitudinal cohort studies. Br J Sports Med. 2017;0:1-9. doi:10.1136/bjsports-2016-097330.
228. Banda JA, Haydel KF, Davila T, Desai M, Bryson S, Haskell WL, et al. Effects of varying epoch lengths, wear time algorithms, and activity cut-points on estimates of child sedentary behavior and physical activity from accelerometer data. PloS one. 2016;11(3):e0150534.
229. Aibar A, Bois JE, Zaragoza J, Generelo E, Julian JA, Paillard T. Do epoch lengths affect adolescents' compliance with physical activity guidelines? J Sports Med Phys Fitness. 2014;54(3):326-34.
230. Edwardson CL, Gorely T. Epoch length and its effect on physical activity intensity. Med Sci Sports Exerc. 2010;42(5):928-34.
231. Vanhelst J, Beghin L, Salleron J, Ruiz JR, Ortega FB, Ottevaere C, et al. Impact of the choice of threshold on physical activity patterns in free living conditions among adolescents measured using a uniaxial accelerometer: the HELENA study. J Sports Sci. 2014;32(2):110-5.
232. Toftager M, Kristensen PL, Oliver M, Duncan S, Christiansen LB, Boyle E, et al. Accelerometer data reduction in adolescents: effects on sample retention and bias. Int J Behav Nutr Phys Act. 2013;10:140: doi.org/10.1186/1479-5868-10-140.
233. McClain JJ, Abraham TL, Brusseau TA, Tudor-Locke C. Epoch length and accelerometer outputs in children: comparison to direct observation. Med Sci Sports Exerc. 2008;40(12):2080-7.
234. Barreira TV, Schuna JM, Tudor-Locke C, Chaput JP, Church TS, Fogelholm M, et al. Reliability of accelerometer-determined physical

activity and sedentary behavior in school-aged children: a 12-country study. Int J Obes Suppl. 2015;5(Suppl 2):S29-35.
235. Brooke HL, Corder K, Atkin AJ, van Sluijs EM. A systematic literature review with meta-analyses of within- and between-day differences in objectively measured physical activity in school-aged children. Sports Med. 2014;44(10):1427-38.
236. Fischer C, Yildirim M, Salmon J, Chinapaw MJ. Comparing different accelerometer cut-points for sedentary time in children. Pediatr Exerc Sci. 2012;24(2):220-8.
237. Kim Y, Lee JM, Peters BP, Gaesser GA, Welk GJ. Examination of different accelerometer cut-points for assessing sedentary behaviors in children. PloS one. 2014;9(4):e90630.
238. Altenburg TM, Chinapaw MJ. Bouts and breaks in children's sedentary time: currently used operational definitions and recommendations for future research. Prev Med. 2015;77(0):1-3.
239. Pedersen BK, Febbraio MA. Muscles, exercise and obesity: skeletal muscle as a secretory organ. Nat Rev Endocrinol. 2012;8(8):457-65.
240. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. Diabetes. 2007;56(11):2655-67.
241. De Meester F, De Bourdeaudhuij I, Deforche B, Ottevaere C, Cardon G. Measuring physical activity using accelerometry in 13-15-year-old adolescents: the importance of including non-wear activities. Public Health Nutr. 2011;14(12):2124-33.
242. McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: new concepts are needed to study research participation effects. J Clin Epidemiol. 2014;67(3):267-77.
243. Dossegger A, Ruch N, Jimmy G, Braun-Fahrlander C, Mader U, Hanggi J, et al. Reactivity to accelerometer measurement of children and adolescents. Med Sci Sports Exerc. 2014;46(6):1140-6.
244. Davis RE, Loprinzi PD. Examination of accelerometer reactivity among a population sample of children, adolescents, and adults. J Phys Act Health. 2016;13(12):1325-32.