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Physical activity level and sedentary time in Norwegian adolescents

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Background: Physical activity (PA) is necessary for children and adolescents to obtain a healthy development. The environment, however, facilitates the sedentary lifestyle. World health organization (WHO) defines physical inactivity as the fourth major risk factor for mortality. Still, adolescents in Europe and America are sedentary more than 50 % of their waking hours. Lack of comparability between studies investigating PA level and sedentary time in adolescents creates need for further documentation. **Objective:** The objective was to investigate PA level and sedentary time in Norwegian 15-year olds. In addition, I wanted to study whether sedentary time and moderate-to-vigorous PA (MVPA) were associated with waist circumference (WC) and body mass index (BMI). **Method:** Data was drawn from the cross-sectional part of the PANCS2 (2011). A total of 1046 15-year-old boys and girls were included to represent the Norwegian adolescent population. PA and sedentary time were assessed objectively by ActiGraph accelerometers. Measurements of BMI (in kg/m^2) and WC were taken by trained investigators. The International Obesity Task Force cut-offs were used to define overweight and obese subjects. Analyzes conducted were independent and dependent t-test, Chi-square test, Pearson's correlation, univariat, and multivariate regression. **Results:** The adolescents had a mean (SD) PA level of 456 (160) counts per minute. The mean PA level was higher during the week compared to the weekend. The recommendations of 60 minutes of MVPA were reached by 50.7 %. Boys were significantly more active than girls. The participants spent 71 % of the measured time being sedentary, and girls were more sedentary than boys. Sedentary time was not associated with either WC or BMI, while MVPA was associated with both variables. **Conclusion:** The adolescent's PA level is not favorable, and the

amount of time spent sedentary is concerning. There is a difference in PA level between week and weekend, and between the sexes. Sedentary time was not associated with WC or BMI, while MVPA was associated with both variables.

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Conceptual clarification

There are some terms that are mentioned in the thesis which might need further explanation than what is given in the theory section. These definitions are included in the table below.

Term	Explanation of concept
Acceleration	Change of speed pr time unit, as m/s^2.
Epoch	The length between each accumulated activity registration that is stored (1).
Counts per minute (Cpm)	Indicates how many count the accelerometer register every minute by acceleration in the limb of the body (1).
MET	Metabolic Equivalent of Task (MET) is a physiological expression of how much energy above the resting metabolic rate is needed to perform a certain activity. One MET is the energy needed when at total rest (2).
Intensity level	In this study, the intensity level is defined by amount of counts the accelerometer register per minute. The minutes in each intensity level is added to define how much time is spent in each intensity level throughout the total measuring period (2). *Sedentary behavior*: 1.0-1.5 METs <100 cpm *Light intensity*: 1.6-2.9 METs 100-1999 cpm *Moderate intensity*: 3.0-6.0 METs 2000 cpm *Vigorous intensity:* >6 METs 5999 cpm
CVD risk factors	Factors increasing the risk of developing one or more of diseases such as; Coronary heart disease, cerebrovascular disease, peripheral arterial disease, deep vein, thrombosis and pulmonary embolism (3).
Clustering of CVD risk factors	The accumulation of more than two CVD risk factors. One risk factor could increase the risk of developing CVD, but when the number of factors establishes, the risk will be multiplied, not just added (4).
Overweight and obesity	Cole and colleagues have developed a tool to define overweight and obesity among children and adolescents, by applying national datasets on overweight and obesity in young people to the original cut-offs for adults. A scale was created that compares the child/adolescent's BMI to the adult cut-off for overweight and obesity, and is based on age and sex. The scale describes which BMI for each age and sex can be compared to the adult cut-off for overweight; BMI >25 and obesity; BMI >30 (5).

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1.0 Background

Although the health benefits of PA are obvious (6;7), evidence based results regarding the dose-response relationship between physical activity (PA) including sedentary time and health effects are lacking (4;8). Still, evidence state that PA is important for a normal development of physiological and psychological functions of young people (6;7). In adults, lack of PA can increase the risk of diabetes, obesity, some cancer diagnoses, and cardio-vascular disease (6). Those inactivity related diseases develop over decades and adolescents rarely have these diseases. Thus, the majority of studies focusing on lack of activity and the development of diseases mainly include adult persons (9).

For decades, we have tried to understand how to increase the PA level in adolescents. As years have passed, an environment, a society, and a mentality have developed which in their own way works against this need of behavior change (10). The environment makes activity a conscious choice, not a natural part of dealing with the surroundings. A sedentary lifestyle has become the easiest and most accessible choice for both adults and adolescents (10).

Worlds Health Organization (WHO) has proposed that physical inactivity is the fourth major risk factor for mortality (11). Physical inactivity causes approximately 3.2 million deaths each year globally, and one million deaths in the European region alone (6).

At the same time, studies show that the prevalence of childhood and adolescent obesity has tripled during the past three decades (12). The estimated number of overweight and obesity in adolescents is 10 % worldwide, 25 % in the USA, 5-25

% in Europe, and 14 % in Norway (13-15). Overweight and obesity seem to be related to sedentary time, lack of PA and an unhealthy diet (16).

Children and youth who meet the recommended levels of PA have plenty of waking hours left of the day, where they can engage in sedentary behaviors. These individuals will not be defined as inactive according to the recommendations (17-19). Studies in Europe and America measuring PA objectively show that adolescents devote 50-70 % of waking hours pursuing sedentary behaviors (20-25). It has been reported that adolescents aged 16-19 years and adults older than 60 years are the most sedentary group (23).

Kolle and colleagues (2010) conducted a study on Norwegian children and adolescents, called PANCS1 (The Physical Activity among Norwegian Children Study) and one of the objectives was to assess PA objectively in adolescents (26). In 2011, The Norwegian directorate of Health gave Kolle and colleagues (2012) the task to conduct a new cross-sectional study and a follow-up based on the PANCS1 (2008) (see Fig 3.1).

The majority of studies investigating PA level and sedentary time have used subjective methods to assess the behaviors (27;28). Over the recent years, the number of studies using objective methods to assess PA and sedentary time has increased. However, there is and will always be a need for studies tracking and monitoring PA and sedentary time on a regular basis. Regularly monitoring allows us to determine changes in PA and time spent sedentary over time. Lack of studies using the same study design, methods and targeting the same population, are also reasons for further research.

1.1 Study objectives

The following study objectives were developed:

- *Describe the Norwegian 15-year-olds physical activity level and sedentary time*
- *Examine if there is an association between;*
  a) *Sedentary time and waist circumference and sedentary time and BMI*
  b) *MVPA and waist circumference and MVPA and BMI*

2.0 Theory

PA is necessary for young people to assure the best foundation for development. The muscular-skeleton system, cardio-vascular system, and the cognitive function, specifically benefits from daily PA (6). As for all ages, adolescents need regular PA to maintain a healthy energy expenditure throughout the day, which normally leads to energy balance and weight control (29).

In adults, sedentary time is associated with increased risk of all-cause mortality, obesity and CVDs (30). In adolescents, sedentary time has been associated with BMI (16;24;25;31) and obesity (16;31;32).

Furthermore, there is an on-going discussion on whether high amount of sedentary time have an inverse effect on time spent in MVPA. Studies report weak (r= -0.23) to moderate (r= -0.34) correlation between the two intensity levels (33;34). The correlation between sedentary time and light intensity is however reported higher (r= - 0.89) (22).

2.1 Physical activity

WHO defines physical activity as; "Any bodily movement produced by skeleton muscles that requires energy expenditure" (6).

There are five dimensions which are important when characterizing and describing PA. *Frequency* describes how often the activity is performed during a specific time period. *Intensity* refers to the amount of physiological responses that occur. *Duration* describes the amount of time spent on the activity. Together, frequency, intensity, and duration, explains the total volume of PA. Other dimensions of PA are activity type and context. *Type* of PA can refer to both the physiological characteristics of the activity (aerobic, anaerobic, strength, flexibility) and the type of behavior (swimming, running, jumping, or walking). The *context* of the activity represents the setting in which the activity is performed (Physical education, travel, play, sports, work) (6;8).

2.1.1 Physical activity recommendations

WHO has created specific PA recommendations for different age-groups (35). For children and adolescents (age 5-17 years), the recommendations state (table 2.1):

Table 2.1: WHO's recommendations on physical activity

"Physical Activity should include play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers and reduce symptoms of anxiety and depression the following are recommended;"

1. Accumulate at least 60 minutes of moderate to vigorous- intensity Physical Activity daily
2. Physical Activity of amount greater than 60 minutes will provide additional health benefits
3. Most of daily Physical Activity should be aerobic. Vigorous- intensity activity should be incorporated, including those that strengthen muscle and bone, at least three times pr. week

(35)

The Norwegian PA recommendations state that children and adolescents should perform at least 60 minutes of MVPA every day. The activity can be accumulated during the day, and it is emphasized that the activity should be varied (36).

2.2 Sedentary time

A group of researchers has suggested that sedentary behavior should be defined as activities characterized by sitting or reclined position, requiring an energy expenditure <1.5 METs (2;37). Light activity is defined as activity resulting in an energy expenditure of 1.6-2.9 MET, and examples are; standing, cooking food, and slow walking (2;37).

2.2.1 Sedentary time recommendations

Canada and Australia have published recommendations on sedentary time (table 2.2). Both recommendations are focusing on a reduction of time spent in sedentary behaviors;

Table 2.2: Canadian and Australian recommendations on sedentary time

"Youth (12-17) should minimize time spent being sedentary each day. This might be achieved by:

1. Limit recreational screen time to no more than 2 hours per day – lower levels are associated with additional health benefits (Canada & Australia)
2. Limit sedentary transport, extended sitting time, and time spent indoors throughout the day (Canada).

(38;39).

Norway does not have any published recommendations for time spent in sedentary behaviors, neither single recommendations or as part of the recommendations for PA (36).

2.3 Assessing physical activity and sedentary time

Various methods are available for the assessment of PA and sedentary time. The method that is most appropriate to use depends, amongst other, on the objective of the study (8;31). Both PA and sedentary time can be assessed objectively and subjectively, and both types have pros and cons (31;40). In the next sections, those methods most commonly used for both behaviors are described. Table 2.3 describes additional methods that are less common.

Criterion measures

A criterion measure is defined as the "golden-standard" of measurement methods, and is often used to validate other methods. The technique that is characterized as the criterion method depends on the outcome measured. In PA and sedentary time research, indirect calorimetry, double labeled water and direct observation are the criterion measurement techniques (8;31).

2.3.1 Methods measuring physical activity

Accelerometer

An accelerometer is a movement-sensor that objectively registers acceleration of the limbs or body segments during movement (41). The accelerometer time-stamps movements and registers the duration, intensity, frequency and the daily rhythm of the movement. This way, it is possible to monitor the whole range of activity intensities (1). The raw data from the accelerometer is called counts and describes the intensity of the acceleration which the monitor is exposed to. "Counts per minute" (cpm) is the main variable from the accelerometer. This value is a result of how much acceleration that has been developed during the total minutes that have been measured. The data can be stored in time increments (epochs) as small as 1, 5, 10, 15, 30, and 60 seconds (1). The ActiGraph model 7164 (first known as CSA and later MTI) is uniaxial and was designed in 1993 and is an early generation of ActiGraph accelerometers (42). The ActiGraph GT1M was developed in 2009 and is the most frequently used model, measuring two directions. Recent studies use the GT3X model, which is a triaxial monitor.

This model includes a digital filter specifically increasing the ability of capturing very slow movement(43).

The ActiGraph accelerometer is documented as a valid, reliable and feasible tool for PA assessment in both children and adolescents (44). Trost and colleagues (2005) found a moderate to strong correlation (r=0.45-0.93) between cpm and oxygen consumption, PA energy expenditure (PAEE), and MET in adults. Similar findings (r=0.53-0.92) were found in children (45). De Vries and colleagues (2006) reviewed studies investigating reliability and validity in ActiGraph (model 7164) in children and adolescents (44). Reliability was found to range from r= 0.31-0.87, depending on how many days the monitor was worn (46-48). A moderate correlation has been observed when validated against double labeled water (r= 0.39 - 0.58) (49) and indirect calorimetry (r=0.16-0.77 and 0.86) (50;51). Seven days of measuring is preferred, including both weekdays and weekend days (27;52;53). Lower variability and higher interclass correlation in cpm have been reported when amount of measured days increases, and seven days led to low variability (54). Ten hours of measuring have been proposed as criterion for one valid measuring day (55).

Upper body movement, weight lifting, and the increased energy cost by increased grades of the surface are not captured by the accelerometer. The accelerometer does not accurately capture the activity by cycling either. The increased energy cost occurring when running at speed above 9-10 km/hour is not captured (56).

Self-report

Self-reports are subjective methods that involve obtaining data by use of paper-based questionnaires and/or interviews. Assessment involves asking the participant to recall behavior in terms of type, frequency, and duration. Questionnaires are cost and time beneficial, and are appropriate in population-based research. An interviewer would be able to increase the detailed information that might be needed, but this method is more resource demanding (8). The most severe methodological weakness is recall bias thought to be influenced by a cognition which is not fully developed and youth's tendency of answering influenced by social desirable manners (57). People tend to under-or over- report, and high intensity activities are reported easier to remember than light intensity activity (8). In adolescents, few studies have investigated reliability and validity of self-reports against criterion methods. A variation of r = -0.1 to 0.88 has been reported, when validated against direct observation, heart rate monitors, and motion detectors (1). Other studies have shown self-report to have 73.4 % (58) and 86.3 % (59) comparability to direct observation.

2.3.2 Methods measuring sedentary time

Accelerometer

Recently, accelerometers have been used more frequently to measure sedentary time (2;60-62). With the accelerometer, all time spent in activities resulting in <100 cpm, equivalent to <1.5 MET, are registered. The triaxial accelerometer (ActiGraph GT3X) has been suggested to be a better tool than uniaxial accelerometer when investigating time spent sedentary (41).The GT3X holds a special filter, increasing the sensitivity to slow movement (63).

Self-report

Questionnaires are the most applied method in sedentary time research. The questions often refer to time spent in one or few specific behaviors, or the questions might be presented as behaviors in a check list (64-66). TV-watching has been identified as the behavior which occupies most of the sedentary time. This specific behavior is therefore most investigated (67-72). However, TV-watching might not be representative for the time spent sedentary (67;68;73). Over- or under reporting also occur when assessing sedentary time. As mentioned previously, low intensity activities are harder to recall than high intensity activities, which create chance of recall bias (8;68). The more typical challenge when assessing sedentary time is the normality of engaging in several behaviors at the same time (TV, computer, and cellular phone). This will lead to over-reporting of actual total time spent sedentary (68). Even though questionnaires offers an important insight in the behavior practiced during the sedentary time, self-report methods are not studied in terms of reliability and validity when assessing sedentary time in adolescents (68).

Table 2.3: The most applied measuring methods of physical activity and sedentary time *

Type	**Description**	**Pros**	**Cons**
Indirect calorimetry PA	Measures proximally EE during PA by measuring oxygen consumption	Precise	Unnatural setting
Double labeled water PA	Swallowing isotopic tracers to measure total carbon dioxide production and estimate the EE	Precise Enables natural behavior and context	Expensive Few labs are able to take advantage of the method
Direct observation PA and ST time	An observer registers PA/ST by observing the participant(s)	Detailed information Creates understanding of context and type of behavior	Time and resource consuming Reactivity Expectation bias
Accelerometry PA and ST	Measures acceleration in body segments described as cpm. Can define intensity, duration and frequency in total time or as bouts	Can be used in large samples Measures all intensity levels Small and easy to wear Enables a natural behavior and context Long storage ability Can register the sporadic behavior of children and youth	Cannot measure upper body movement, weight lifting, and the increased energy cost when the grades of the surface increase
Pedometer PA	Measures PA by counting steps per given time period	Low cost Easy to wear Enables a natural context	Cannot register non-locomotor movement or intensity Influenced by body size and locomotion speed Low limit of storing data
Heart rate monitors PA	A chip which monitors the physiological response to PA by heart beats per minute	Measures a true physiological response Small device A linear relationship with EE in steady state activity	Reacts to other physiological and psychological factors. Does not capture sporadic activities
Activity diary PA and ST	Continuously report of time spent in PA, registered by adolescent and/or parent/guardian	Continuously report which reduce the recall- bias	Misinterpretation Different perception of type, intensity, duration, frequency, and context
Self-report PA and ST	Participants report their specific behavior either by questionnaires or interviews by answering related questions	Cost-efficient Measures many participants Interviews can create a deeper understanding of type and context	Recall-bias Misinterpretation Not appropriate in children and young adolescents

** Based on documentation by; (8;74-77).*
PA: Physical activity, ST: Sedentary time, EE: Energy expenditure

2.3.3 Objectively measured PA levels in adolescents

In the European Youth Heart Study (EYHS), Klasson-Heggebø & Anderssen (2003) reported that 15-year-old boys and girls living in Oslo had a mean PA level of 622 cpm and 520 cpm, respectively. Further, boys and girls spent 76 minutes and 60 minutes in MVPA, respectively, and the difference between the sexes was significant (78). In the EYHS, Riddoch et al (2004), reported similar findings in his sample of Danish, Estonian, Norwegian, and Portuguese 15-year-olds (79). In PANCS1, Kolle et al (2010) observed a mean PA level of 542 cpm and 487 cpm in 15-year-old boys and girls respectively. A total of 68 and 62 MVPA minutes per day were reported in boys and girls, respectively (26). The AFINOS study (2009) included 13-16- year-old Spanish adolescents, and PA levels of 558 cpm and 433 cpm were observed in boys and girls, respectively. The boys spent 85 minutes in MVPA daily while the corresponding number in girls was 63 minutes per day (80). These findings are supported by the AFINOS study (2012), where similar observations were also done among 13-16- year-old Portuguese in the MALS study (2012) (34;81). In the HELENA study, Ruiz and colleagues (2011) studied 12-17-year-olds from nine different nationalities. They found a lower PA level, with a mean of 464 cpm and 370 cpm in boys and girls respectively. Minutes spent in MVPA per day was 64 minutes in boys and 49 minutes in girls (24). Similar levels of MVPA were observed in Canadian adolescents (21), and even lower PA levels were seen in Hungarian and Dutch adolescents (31).

2.3.4 Objectively measured sedentary time

In the EYHS (2007), it was reported that 15-16- year-old boys and girls spent 71.5 % and 75.8 % of their day being sedentary (22). Their findings were supported by the HELENA study (24). In the NHANES study, 6-19-year-old Americans spent 55.8 % and 59 % of their waking hours being sedentary (23). Sedentary time increased with age above eleven, which is also supported by findings in the HELENA study observed by Ruiz et al (2011). Other studies show similar proportion of sedentary time during a day; 50.8 % (age 6-19) (20) and 62 % (age 15-19) (21).

Table 2.4: Selected studies investigating objectively measured physical activity level and sedentary time in adolescents

Study	Year	Country	Participants characteristics	Accelerometer	Main findings
Klasson-Heggebø & Anderssen (78) **EYHS study**	2003	Norway	N= 350 ♂ + ♀ Age: 15	ActiGraph (model 7164)	Activity level (cpm) ♂: 622* ♀: 520 MVPA (min/day) ♂: 76* ♀: 60 > 60 min MVPA (%): 55.4 Higher activity level during week* compared to weekend*
Riddoch et al (79) **EYHS study**	2004	Denmark, Portugal, Estonia, Norway	N= 2185+ ♂ + ♀ Age: 15	ActiGraph (model 7164)	Activity level (cpm) ♂: 615* ♀: 491 MVPA (min/day) ♂: 99* ♀: 73 > 60 min MVPA (%) ♂: 82* ♀: 62
Ekelund et al (22) **EYHS study**	2007	Denmark, Estonia, Portugal	N= 829 ♂ + ♀ Age: 15-16	ActiGraph (model 7164)	Activity level (cpm): ♂: 594* ♀: 478 MVPA (% of total time) ♂: 6.3 ♀: 4.8 ST (% of total time) ♂:71.5 ♀:75.8**
Matthews et al (23) **NHANES study**	2008	USA	N= 834 ♂ + ♀ Age: 16-19	ActiGraph (model 7164)	ST (% of total time) ♂: 55.8 ♀: 59
Martinez-Gomez et al (80) **AFINOS study**	2009	Spain	N= 214 ♂ + ♀ Aged: 13-16	ActiGraph (model GT1M)	Activity level (cpm) ♂: 558* ♀: 432.5 MVPA (min/day) ♂: 85* ♀: 62.7 ST (min/day) ♂: 496 ♀: 471 > 60 min MVPA (%) ♂: 82.2* ♀: 60.7

Study	Year	Country	Participants characteristics	Accelerometer	Main findings
Kolle et al (26) **PANCS1**	2010	Norway	N= 975 ♂ + ♀ Age: 15	ActiGraph (model 7164)	Activity level (cpm) ♂: 542 ♀:487 MVPA (min/day) ♂: 67.7 ♀: 62.2 > 60 min MVPA % ♂: 54.1 ♀: 49.9 Higher activity level during week* compared to weekend*
Ruiz et al (24) **HELANA**	2011	Greece, Germany, Belgium, France, Hungary, Italy, Sweden, Austria, Spain	N= 2200 ♂ + ♀ Age: 12.5-17.5	ActiGraph (model 7164)	Activity level (cpm) ♂: 464* ♀370* MVPA (min/day) ♂:64*♀:49 ST (min/day) ♂:540 ♀:546** > 60 min MVPA (%) ♂:56.8*♀: 27.5
Colley et al (21) **CHMS**	2011	Canada	N= 395 ♂ + ♀ Age: 15-19	Actical	MVPA (min/day) ♂: 53* ♀: 39 ST (min/day) ♂: 554 ♀: 582*
Carson & Janssen (20) **NHANES**	2011	USA	N= 2527 ♂ + ♀ Age: 6-19	ActiGraph (model 7124)	MVPA (% of wear time) ♂ ♀4.1 ST (% of wear time) ♂ ♀: 50.8
Martinez-Gomez et al (34) **AFINOS**	2012	Spain	N= 183 ♂ + ♀ Age: 13-17	ActiGraph (model GT1M)	MVPA (min/day) ♂: 84.8* ♀: 62.2 ST (min/day) ♂: 534 ♀: 522
Chinapaw et al (31) **ENERGY**	2012	Hungary, The Netherlands	N= 142 ♂ + ♀ Age: 10-13	ActiGraph (model GT1M)	Activity level (cpm) ♂:612* ♀:472 MVPA (min/day) ♂: 41* ♀: 29 ST (min/day) ♂: 468 ♀:502 **
Machado-Rodrigues et al (81) **MALS**	2012	Portugal	N= 362 ♂ + ♀ Age: 13-16	ActiGraph (model GT1M)	Activity level (cpm) ♂: 499 ♀: 393 MVPA (min/day) ♂: 81 ♀: 60.3 ST (min/day) ♂: 676 ♀: 715

♂= boys, ♀= girls, ST: Sedentary time, MVPA: Moderate- to- vigorous physical activity,

** ♂ significantly higher values than ♀ (p<0.005), ** ♀ significantly higher values than ♂ p<0.05*

[+] Total sample including both 9-and 15-year-olds

> 60 min MVPA: % of the participants meeting the recommendations daily

2.4 Metabolic changes due to sedentary time

Sedentary physiology is proposed by researchers to have the same importance but to be separated from PA and exercise physiology (82). The motives for this statement are the biological adaptations and responses to sedentary time which are different from, and not just opposite to, the biological responses to PA (2;10;83-87).

2.4.1 LPL activity

It has been shown that sedentary time increases the risk of metabolic dysfunction in normal-weight persons who did not increase bodyweight during the study period (88;89). The process is thought to start with a reduction of lipo-protein lipase (LPL) activity in the muscle cells. This leads to reduced ability to facilitate the uptake of free-fatty acids from blood to the skeleton-muscles and adipose-tissue. Yanagibori et al (1997; 1998) observed lower levels of high-density lipoprotein (HDL) and increased very-low-density lipoprotein (VLDL) levels in their sample. This resulted in higher levels of triglycerides (TG) in the blood system, which is a well known CVD risk factor (84;88;89). Tremblay and colleagues (2011) support these finding, and report also reduced insulin sensitivity to be associated with sedentary time (88-90).

2.4.2 Carbohydrate metabolism

In adults, sedentary time also interferes with the GLUT4-concentration. This is essential in exercise-induced, insulin-induced, and in basal glucose uptake and thereby affect the carbohydrate metabolism (88;89;91-93). The cause is thought to be the denervation of skeleton muscles (94). Studies have shown a major increase of GLUT4 in participants going from sedentary to light activity, which illustrates the fact that some activity is better than none (95).

2.5 Sedentary time, MVPA and body composition

Studies investigating the relationship between sedentary time, MVPA and body composition vary in designs and method. Table 2.5 shows studies investigating the association between the two intensity levels and body composition. Studies are selected based on methodological comparability to PANCS2 in terms of participant characteristics and measurement methods.

Six studies investigated the relationship between sedentary time and BMI, and three of the studies reported an association (24;25;31). In the ENERGY project, Chinapaw et al (2012) found that 10-13-year- olds with the highest amount of sedentary time had significantly higher BMI than those with lower levels of sedentary time (31). Treyth et al (2005) found however an association in girls only (age 7-19 year) (25). The HELENA study found no association between sedentary time and BMI in boys, while sedentary time decreased as BMI in girls increased (24;25). Three studies reported no association between sedentary time and BMI in 13-17-year-olds (34;80;81). Two studies investigated the association between weight status and sedentary time. In the ALSPAC study, Mitchell et al (2009) reported an association between sedentary time and the odds of being obese, but the association did not exist when adjusted for MVPA (96). Foley and colleagues (2011) reported no difference in sedentary time between the three groups; underweight, overweight and obese (97).

Four studies investigated the association between sedentary time and waist circumference (WC), and only the ENERGY project reported a significant association (31). Three studies found no association between time spent sedentary and WC when adjusting for time spent in MVPA (22;33;80).

Four studies investigated the association between objectively assessed MVPA and WC in adolescents. The EYHS (2007) observed no association in their adolescents (15-16-year old) (22). The AFINOS study (2009) however, reported an association in their 13-16-year-olds (80). The association was supported by the NHANES (2011) and the ICAD study (20;33). The association between objectively assessed MVPA and BMI was investigated by four studies. Treuth et al (2005) observed no association in either boys or girls, which was supported by the EYHS (2007) and the MALS study (22;81). The AFINOS (2009) and the HELENA study observed that lower levels of MVPA were associated with higher BMI (24;80).

Table 2.5 Selected studies investigating the association between objectively measured sedentary time and MVPA and body composition

Study	Objective	Participants	Method	Adjusted for	Main findings
Treuth et al **2005 (25)**	Examine the association between overweight and PA or ST	N= 229 ♂+♀ Age 7-19 USA	Accelerometer (ST<100cpm) Total body fat, fat %, BMI	Not specified	BMI, fat mass and percentage of fat correlated with ST in girls only MVPA was not associated with BMI in boys or girls
Ekelund et al **2007 (22)** **EYHS**	PA levels and metabolic risk factors	N= 829 ♂+♀ Age 15-16 Denmark, Estonia, Portugal	Accelerometer (ST <500cpm), incremental ergometer cycle to exhaustion, BMI, WC, BP, blood sample	Sex, sexual maturity, study location, birth weight, maternal and parental BMI, MVPA	Neither ST nor MVPA were associated with WC or BMI
Mitchell et al **2009 (96)** **ALSPAC**	ST and obesity	N= 5434 ♂+♀ Age 12 United Kingdom	Accelerometer (ST <199cpm), Fat mass from DEXA, BMI	Gender, social factors, early life factors, maturity, MVPA	Positive association between ST and obesity, but not independent of MVPA
Matinez-Gomez et al **2009 (80)** **AFINOS**	Investigate levels of total PA in different intensity levels, analyzed by gender, age and body fat	N=214 ♂+♀ Age 13-16 Spain	Accelerometer (ST<100cpm), skinfold thicknesses, WC, BMI, BP	Gender, age, skinfold thicknesses, BMI, WC, weight, Total PA and different intensities	Adolescents in the higher quartiles of WC and BMI spent less time in MVPA than those in the lower quartiles
Ruiz et al **2011 (24)** **HELENA**	Characterize the objective measured PA level and ST	N= 2200 ♂+♀ Age 12.5-17.5 Greece, Germany, France, Sweden, Belgium, Hungary, Italy, Austria, Spain	Accelerometer (SB <100cpm), Shuttle-run test, BMI	Age, pubertal stage, BMI, center and registered time	Girls with greater BMI had lower levels of ST. For boys, MVPA was lower in those with greater BMI

Study	Objective	Participants	Method	Adjusted for	Main findings
Foley et al **2011 (97)**	Describe ST and examine whether ST differs by BMI status	N=960 ♂+♀ Age: 15-18 New Zealand	Accelerometer (ST<100cpm), BMI	Age, gender, ethnicity, NZ deprivation Index	There was no difference in ST between weight classes
Carson & Janssen **2011 (20)** **NHANES**	The independent association between volume, pattern, and type of ST with cardio-metabolic risk factors	N=2527 ♂+♀ Age 6-19 USA	Accelerometer (ST< 100cpm)WC, BP, blood sample	Age, gender, MVPA, ethnicity, socio-economic status, smoking, total fat, saturated fat, dietary cholesterol, sodium	ST was not associate with WC when adjusted for MVPA MVPA was associated with WC
Chinapaw et al **2012 (31)** **ENERGY**	Independent relationship between objective assessed and self-rated ST and indicators of metabolic health	N= 142 ♂+♀ Age 10-13 Hungary, Netherlands	Accelerometer (ST< 100cpm) WC, BMI, blood sample	Gender, country, number of sedentary bouts, MVPA, WC	In the most ST quartile, levels of WC and BMI were significantly higher than in the lower quartiles
Matinez-Gomez et al **2012 (34)** **AFINOS**	Objective measured ST and TV-viewing with emerging inflammatory and endothelial function markers	N=183 ♂+♀ Age 13-17 Spain	Accelerometer (ST<100 cpm), blood sample, WC, skinfold thicknesses, BMI	Age, sex, pubertal stage, MVPA	No association between ST and body fat measures (BMI, WC, skinfold-thicknesses)
Machado-Rodrigues et al **2012 (81)** **MALS**	Relationship among weight status, CRF, and objectively measured ST	N= 362 ♂+♀ Age 13-16 Portugal	Accelerometer (SB= by cut-points), BMI, shuttle run test	Sex, gender, chronological age, measured time in ST and PA	Neither ST not MVPA were associate with BMI
Ekelund et al **2012 (33)** **ICAD**	Investigate independent and combined association between objective measured MVPA and ST with cardiometabolic risk	N= 6413 Age 4-18 ♂+♀ 14 different studies from; Australia, Brazil, Europe and USA	Accelerometer (ST< 100cpm), WC, BMI, blood sample, BP	Sex, age, monitored wearing time, WC, MVPA, ST	No association between ST and WC MVPA was associated with WC as a cardiometabolic outcome

ST= sedentary time, MVPA= moderate-to-vigorous PA, WC= waist circumference, CRS= cardiometabolic risk score, ♂: Boys, ♀: Girls

3.0 Methods

3.1 Search strategy

For the background research, I used the following databases; PubMed, SPORTDiscus, The Cochrane Library, Brage (a collection of Master thesis, doctoral dissertations and studies, published by Norwegian scientists), and Google Scholar. PubMed was the most important database where the majority of literature was found. The reference lists in the chosen articles worked as a secondary source to find primary sources. The key words that I used in my literature search were; Physical activity, Activity level, Sedentary time, Sedentary behavior, Inactivity, Health outcomes, Risk factors, Health variables, Cardiovascular disease, Metabolism, Body mass index, Adiposity, Fatness, Waist circumference, Weight, Adolescents, and Youth.

Inclusion criteria for the studies were; Age 12-18 years, both sex included, use of objective measured sedentary time/sedentary behavior/physical activity/inactivity.

3.2 The PANCS2 project

PANCS2 has a mixed design, including both cross-sectional and longitudinal data. The follow-up is based on a previous study called PANCS1, conducted in 2005-06 (22;26). PANCS2 was carried out in the period March to December 2011, and was conducted by the Department of Sports Medicine, Norwegian School of Sport Science (NSSS) as an assignment from the Norwegian Directorate of Health. Professor Sigmund A. Anderssen was the project leader, where Post-doc Elin Kolle was the central part in planning and executing the project. Most of the method described in my thesis is based on the method description of the PANCS2, and only the methods concerning my thesis will be included. Further description of the methods is available in the report of the complete project (98).

The participants in our cross-sectional study were recruited by clustered sampling done by Statistics Norway. The primary clustering unit was school. When we invited a school to participate in the study, the principal was asked on behalf of the school, where he/she had to contact NSSS if they wanted to participate. If the school accepted, all students in the specific grade were invited to participate. Both geography and population density were taken into account when Statistics Norway selected the cohort.

In PANCS1, 9- and 15-year-olds were included. The participants who were 9-years-old in PANCS1 (2005-06) were 15-years-old in 2011, and they were invited to participate in PANCS2. We contacted the high schools the students were likely to attend if they still lived in the same area as they did in 2005-06. Class lists were studied, and the participants that we identified from PANCS1 were contacted. Those who we did not find through the high schools were found in the National register and invited by mail. Of the 1306 9-year-olds who participated in PANCS1, 1273 adolescents were found through either class lists or through resident registration. A total of 671 accepted the invitation and were included in the follow-up. Together with 375 new participants included by Statistics Norway, a total of 1046 15-year-olds participated in PANCS2 (Fig 3.1). The participant rate for the total sample was 54.7 %.

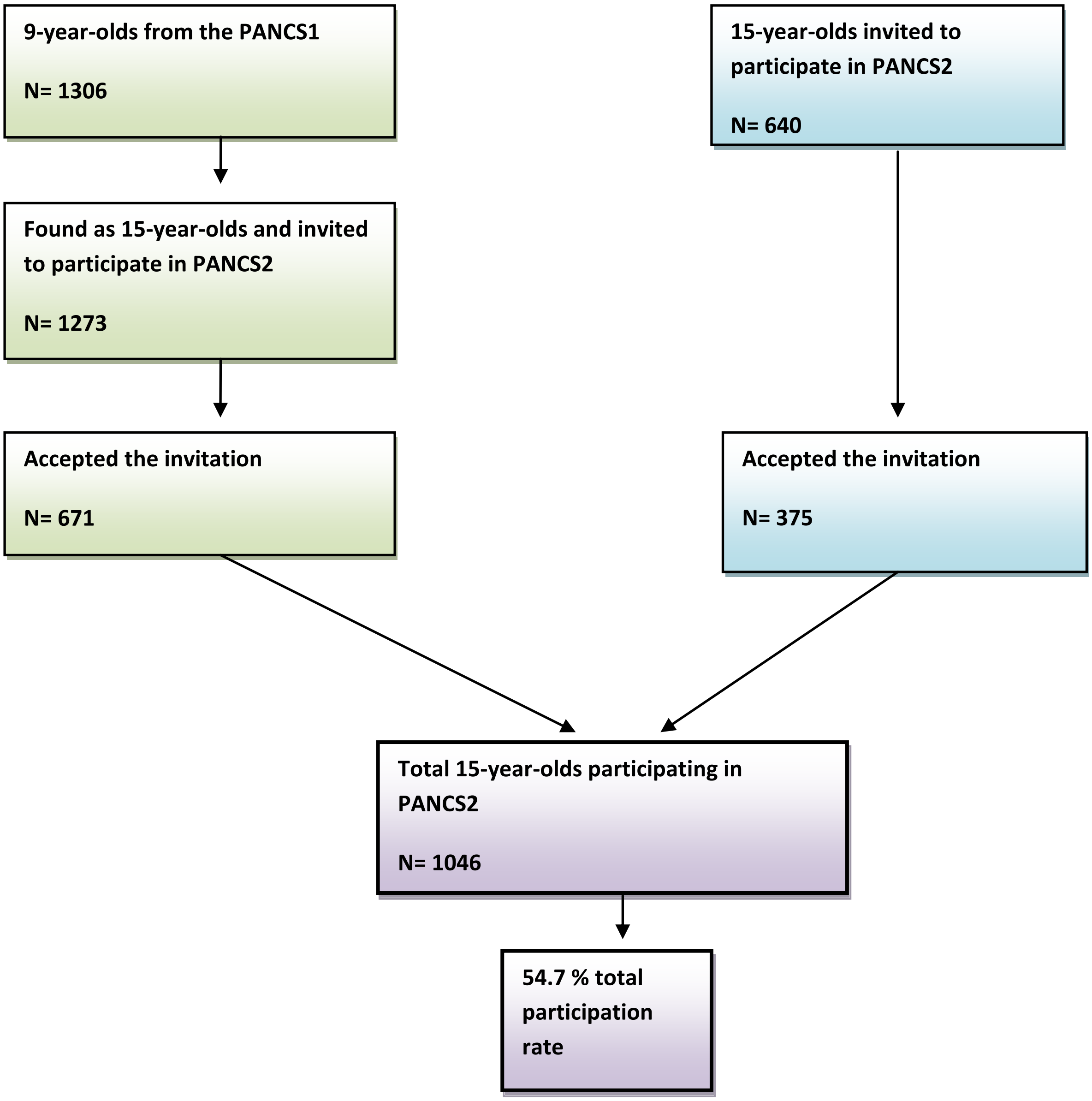

Figure 3.1 Flowchart of 15-year-olds participating in PANCS1, the number of eligible adolescents followed up in PANCS2, new cases of 15-year-olds invited to PANCS2, and total N of all included 15-year-olds in PANCS2

A drop-out analysis was carried out to investigate possible differences between the 9-year-olds from the PANCS1 who also were included (at the age of 15) in PANCS2 and those who were lost to follow-up. Those who were lost to follow-up were slightly heavier (34.4kg vs. 33.4kg p=0.007) and had a higher BMI (17.7 vs. 17.2 p<0.001) compared to those who also participated in PANCS2. There was no difference in height, PA level, or physical fitness.

PANCS2 was conducted in accordance with the rules stipulated by the Helsinki-declaration. The study was reviewed by the Regional committees for medical and health research ethics (REK), and was reported to the Norwegian Social Science Data Services AS (NSD). A signed informed consent from each student and their parent/guardian was handed in before the participant was included in the study (Attachment 1).

3.3 Anthropometric measurements

The NSSS test team visited those schools included in the study, and performed the anthropometrical testing. The participant's weight was measured to the nearest 0.1 kg with a Seca 877 digital weight (SECA, Hamburg, Germany). Height was measured to the nearest 1mm by using a tape measure vertically attached to the wall. WC was measured to the nearest 1mm with a measuring tape. The participants were standing with their arms alongside the body, weight distributed on both legs, and they were asked to breathe normally. The WC was measured between the upper iliac crest and lower rib after exhalation. All measurements were done with light clothing and no shoes in a standing position. Zero point three kilos were subtracted to adjust for clothing. The averages of two measurements were used. BMI was assessed by using this formula; Weight (kg)/ height (m) ^{2}.

Classification of participants as underweight, normal weight, overweight or obese was based on age- and gender-specific BMI-cut-offs developed by Cole and colleagues (5;99). The cut-offs for overweight and obesity correspond with border values for overweight (BMI 25-30) and obesity (BMI >30) in adults (≥18).

3.4 Assessment of physical activity

We used ActiGraph accelerometers, models GT1M and GT3X+ (ActiGraph, LLC, Pensacola, Florida, USA), to assess PA level. For the purpose of this thesis, only GT3X+ and data from the vertical axis by GT1M will be reported.

The NSSS test team helped placing the accelerometer correctly on each participant. Each participant carried an accelerometer in a belt around the waist for seven consecutive days. The participants were told to wear the monitor at all waking hours and only to remove the monitor during showering/bathing and water activities. The accelerometers were initialized and downloaded by the ActiLife software (ActiGraph LLC, Pensacola, FL, USA). The starting time was set to 6.00 on the day following distribution. An epoch period of 10 seconds was used. The accelerometers were collected by the contact person on each school, and returned to the NSSS by mail.

3.5 Analyses of the accelerometer measurements

Sedentary time was defined as all activity below 100 cpm. This cut-off has also been used in previous studies (60-62). Light intensity activity was defined as all activity between 100-1999 cpm. MVPA was defined as all activity at or above 2000 cpm.

Time spent sedentary was determined by summing all minutes below 100 cpm, dividing the amount of minutes on valid measuring days, resulting in average counts across the assessment period (min/day). To define those participants meeting PA recommendations, the total amount of minutes >2000 cpm during the measuring period was summed up. The number was then divided on amount of days with valid registration.

Non-wear time was defined as at least 20 consecutive minutes of zero counts. We excluded all night activity (between 24.00 and 06.00) from each person's recording.

After reduction of data, further inclusion criteria were set; to be included, at least two days of measuring was needed and each day should have at least eight hours of activity measurement.

A total of 914 (87.3 %) adolescents had valid accelerometer data. When describing and analyzing accelerometer data measured during the weekend, 756 participants were included (72.3 %).

3.6 Statistical analyzes

When analyzing data, PASW statistics 18 (2009) was used. Level of significance was set to $p < 0.05$. The frequency, mean, standard deviation (SD) or standard error (SE), and level of confidence (95 % CI) were described when presenting the data. I used independent t-test to study differences between groups on parametric data, such as differences in PA level between boys and girls. When studying time spent at different intensity levels, accelerometer wearing time and school were adjusted for in the analyses. When investigating PA during the week compared to PA during the weekend, a dependent t-test was used. The Chi-square test was used when analyzing categorical data, such as percentage reaching the PA recommendations among boys and girls. Pearson's correlation was used when I investigated associations between numeric variables.

A linear regression was used to study to which degree the independent variables; sedentary time and MVPA could indicate variation in the dependent variables; WC and BMI. Sex was set as a controlling factor, while all analyses were adjusted for school. A univariate analysis was used for both sedentary time and MVPA to see the separate effect on both WC and for BMI. In addition, both independent variables were tested together. Only the independent variable which seemed to explain some variance was included in a multivariate analysis. MVPA was associated with both WC and BMI and was included, while sedentary time was excluded from further analysis.

4.0 Results

4.1 Anthropometric measures

Table 4.1 presents subject characteristics. Large variation within each sex was observed with body weight and height ranging from 33-128 kg and 148-194 cm in boys and 35-91 kg and 137-180 cm in girls. The average (SD) weight was 60.0 (11.0) kg, and boys weighed 5.2 kg more than girls (95% CI: 3.8-6.5; p<0.001). The mean height was 169.0 (8.3) cm, and boys were significantly taller than girls (p <0.001). WC ranged from 55-115 cm in boys and 55-105 cm in girls. The average WC was 71.3 (8.0), where boys had 4.1 cm wider WC than girls (95% CI; 3.1-5.1: p<0.001). There was no sex difference in age or BMI.

Table 4.1: Mean (SD) values of age, weight, height, BMI, and WC.

	Boys		**Girls**	
	N	**Mean**	**N**	**Mean**
Age	543	15.1 (0.5)	503	15.1 (0.5)
Weight (kg)	531	62.4* (11.8)	486	57.3* (9.4)
Height (cm)	505	173.1*(7.8)	460	164.6* (6.2)
BMI (kg/cm^2)	530	20.7 (3.2)	486	21.1 (3.1)
WC (cm)	504	73.2*(8.4)	456	69.1* (6.7)

* Difference between boys and girls with p < 0.001

BMI= Body mass index, WC= Waist circumference

The majority of the adolescents (76 %) were classified as normal weight, 15 % were classified as overweight, and 3 % as obese. A total of 6 % were classified as underweight (table 4.2).

Table 4.2: Frequency and percentage (%) of adolescents in the different BMI classifications

BMI classification	Boys (n=530)	Girls (n=486)
Underweight	27 (5.0)	39 (8.0)
Normal weight	408 (77)	360 (74.0)
Overweight	77 (15)	78 (16.0)
Obese	18 (3.0)	9 (2)

*No significant difference between boys and girls p= 0.96

4.2 Activity level

The adolescents wore the accelerometer for a mean (SD) time of 5.7 (1.5) days, and for a mean (SD) time of 783 (74) minutes per day (table 4.3).

Table 4.3: Mean (SD) measured days and total minutes in all intensities.

		Boys		**Girls**
	N	**Mean amount**	**N**	**Mean amount**
Measuring days	459	5.6* (1.6)	455	5.8 *(1.4)
Total minutes measured in all intensities	459	789** (78.3)	455	777* (71.1)

*significant difference at p= 0.01

** Significant difference at p= 0.05

4.2.1 Time spent in different intensity levels

The adolescents had a mean (SD) PA level of 456 (160) cpm and boys had a higher mean PA level than girls (p<0.001). The mean difference was 72 cpm which translates into a 14.6% difference (95% CI: 12.3-16.9) (table 4.4). Figure 4.1 presents the time spent at the different intensity levels as a percentage of total measuring time. The adolescents were sedentary for a mean (SE) time of 556 (1.4) minutes per day, representing 71% of total measured time. Girls had significantly more sedentary minutes than boys (p= 0.002).

Mean (SE) time spent in light intensity was 154 (1.0) minutes daily. This corresponds to 19.6 % of total time measured, and boys had more light intensity minutes than girls (p<0.001). MVPA occupied a mean (SE) amount of 61.7 (0.8) minutes per day, representing 7.8 % of the measured time. Boys had a significantly higher level of MVPA compared to girls (p<0.001).

Table 4.4: Mean (SE) physical activity level and mean (SE) amount of minutes spent in sedentary intensity, light intensity and MVPA, adjusted for wearing time, and school.

	Boys	**Girls**	**Mean difference**	**95% Confidence interval**	**P-value**
PA level (cpm)	492 (8)	420 (6)	72.3	52.1-92.6	<0.001
Sedentary (min/day)	546 (2.0)	567 (2.0)	-21	-26.5 – (-) 15.4	0.002
Light (min/day)	160 (1.4)	148 (1.4)	12.2	8.3-16.2	<0.001
MVPA (min/day)	66 (1.1)	57 (1.1)	8.7	5.8-11.7	<0.001

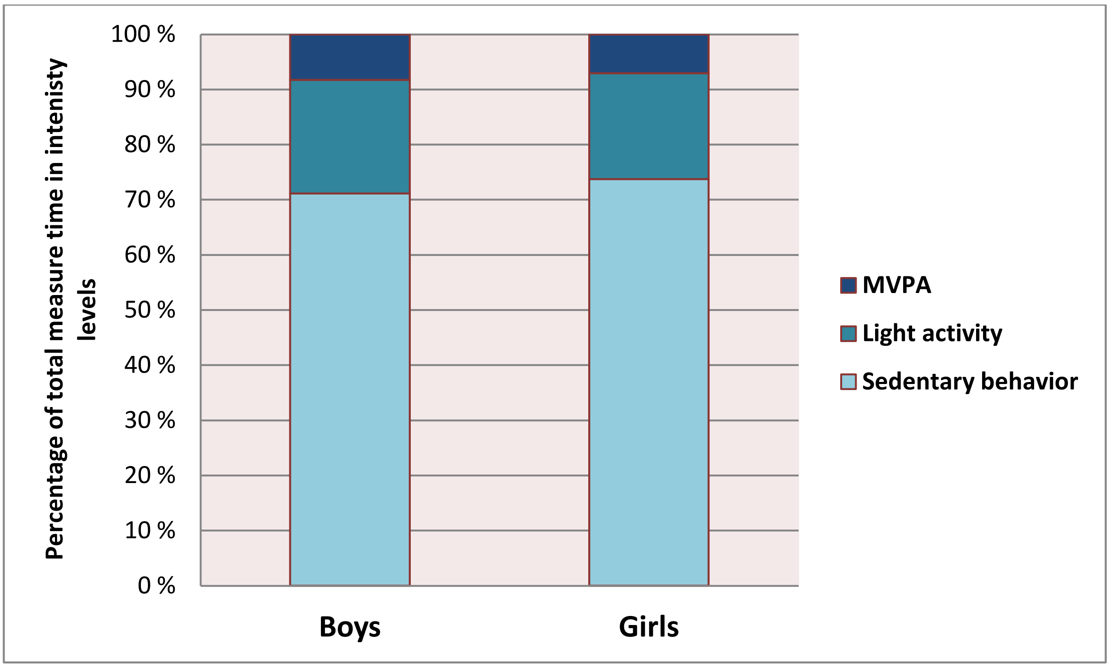

Figure 4.1: Distribution of mean time (minutes) spent at different intensity levels as percentage of total measured time.

The relationship between sedentary time and the other intensities was investigated. There was an inverse correlation between light intensity and sedentary time in boys (r= -0.18: p< 0.001), but not in girls (r= - 0.03: p= 0.52). An inverse correlation between MVPA and sedentary minutes was found in both boys (r= -0.36: p<0.001) and girls (r= -0.18: p<0.001).

4.2.2 Weekday vs. weekend day

Figure 4.2 shows the mean (SD) PA level (cpm) registered in weekdays and weekend days. The adolescents were 12.2 % (95% CI: 9.9-14.5) more physical active during weekdays than during weekend days. During weekdays, boys had a 15.7 % (95% CI: 13.1-18.3) higher PA activity level compared to girls. Boys were 15.5 % (95% CI: 12.9-18.1) more physically active than girls during the weekend.

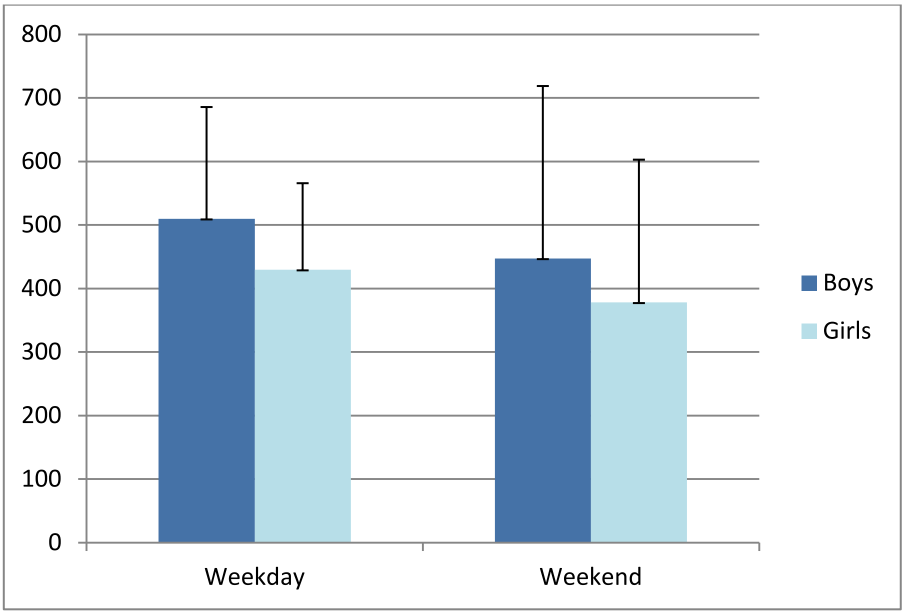

Figure 4.2: Mean (SD) physical activity level (cpm) during weekdays and weekend days in boys and girls.

4.3 Physical activity recommendations

The Norwegian recommendation of at least 60 minutes of MVPA daily was reached by 50.7 % of all participants. More boys (58.1 %) than girls (43.2 %) met the recommendations ($p<0.001$) (figure 4.3).

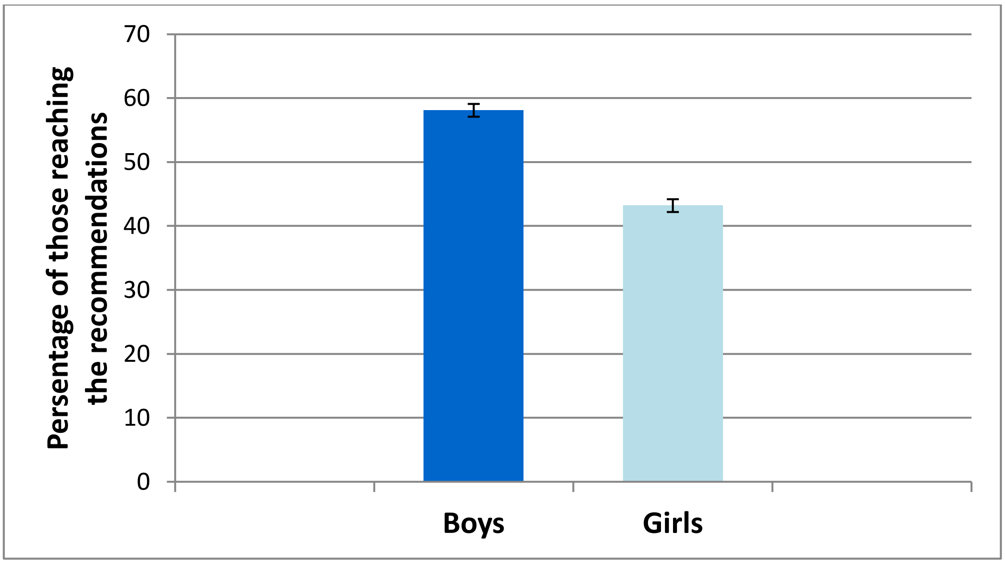

Figure 4.3: Percentage of boys and girls who met the Norwegian recommendations of daily physical activity. Error bars present 95 % CI.

4.4 Difference in sedentary time and light intensity activity between those reaching and not reaching the recommendations

Between the group of adolescents that did not meet the recommendations and the one that did, no difference in time spent sedentary was seen, neither in boys (p= 0.07) or in girls (p= 0.39). Compared to girls who met the recommendations, girls who did not meet the recommendations spent an average of 21 minutes (95% CI: -27.3, -14.7; p: <0.001) less in activity of light intensity daily. The same pattern was also seen in boys, where the average difference in light intensity activity was 35.5 minutes per day (95%CI: -42.5, -28.5; P: <0.001).

4.5 Association between sedentary time, MVPA and WC and BMI

As seen in table 4.5, univariate regression analyses were conducted to test the ability of sex, sedentary time, and MVPA to explain the variation in WC. Sex (p: <0.001) and MVPA (p= 0.01) were associated with WC and were include in multiple regression analysis. Sedentary time was not (p= 0.36) associated with WC and was therefore excluded from further analysis. Sex (p<0.001) and MVPA (p= 0.01) explained 8.4 % of the variation in WC.

Table 4.5: Linear regression analysis for WC, expressed as Expected (B), 95%CI for Expected (B), and P-value

Variable	**Univariate regression analysis**			**Multiple regression analysis**		
	Expected (B)	***95 % CI for expected (B)***	***P-value***	***Expected (B)***	***95 % CI for expected (B)***	***P-value***
Sex	4.13	3.15 – 5.10	<0.001	4.55	3.51 – 5.59	<0.001
Sedentary time	-0.00	-0.01 - 0.00	0.36	_	Excluded for further analysis	_
MVPA	-0.01	-0.03	0.01	-0.03	-0.05 – (-) 0.01	0.01

** All analyses are adjusted for school*

MVPA was associated with BMI (p= 0.018) in the univariate analysis, while sex (p= 0.118) and sedentary time (p= 0.813) were not. Sedentary time was excluded for further analysis. When including MVPA and sex in a multiple regression analysis, only MVPA could explain some of the variance in BMI (p= 0.034) (table 4.6). The model explained the variance by 1.1 %.

Table 4.6: Linear regression analysis for BMI, expressed as Expected (B), 95%CI for Expected (B), and P-value

Variable	**Univariat regression analysis**			**Multiple regression analysis**		
	Expected (B)	***95 % CI for expected (B)***	***P-value***	***Expected (B)***	***95 % CI for expected (B)***	***P-value***
Sex	-0.31	-0.71 – 0.08	0.118	-0.22	-0.64 – 0.20	0.302
Sedentary time	0.00	-0.002 – 0.002	0.813	_	Excluded for further analysis	_
MVPA	-0.01	-0.02 – (-) 0.002	0.018	-0.01	-0.02 – (-) 0.001	0.034

** All variables are adjusted for school*

5.0 Discussion

This thesis is based on data from the PANCS2 (98). The first objective was to investigate PA level and sedentary time in Norwegian 15-year-olds. The second objective was to study whether sedentary time was associated with WC and BMI and to which degree MVPA was associated with WC and BMI.

The adolescents had a mean PA level at 456 cpm, where boys had a 14.6 % higher PA level compared to girls. Approximately fifty percent of the sample met the PA recommendations of at least 60 minutes of MVPA, and more boys compared to girls met the recommendations. Both boys and girls were more active during the week compared to the weekend. The adolescents were sedentary 71 % of their wakening hours daily, and girls were more sedentary than boys. MVPA explained some of the variance in both WC and BMI, while sedentary time did not.

5.1 Methodological considerations

A total of 1046 boys and girls were included in the study. The sample was based on clustered randomization conducted by Statistics Norway and a follow up of participants in PANCS1 (26). Based on the number of clustered randomized participants, the risk of random error was low. When dividing the sample into smaller groups for analysis (BMI classifications), there is an increased risk of error. A prominent low N was however not an issue when dividing other variables. The participation rate in this study was 54.7 %. When compared to other studies, there are both higher and lower rates presented (from 14 – 74 %) (21;26;78;81;100).

The drop out analyses revealed that those lost to follow-up in PANCS2 were somewhat heavier and had a higher BMI than those who were not lost to follow-up. However, no difference was found in PA level and physical fitness (98). Therefore, the prevalence of overweight and obesity might be underestimated, influencing the generalization ability concerning results including these specific variables.

5.2 Study design

The cross-sectional design made it possible to look for associations between sedentary time and WC or BMI and MVPA and WC or BMI by performing correlation and regression analyses (101). However, no causation could be drawn on whether high or low levels of sedentary time and MVPA led to a wider WC and higher BMI. The same issue would be for the opposite direction. Causation would have demanded another type of design. For a pediatric population, a cohort design could have been chosen (40).

5.3 Exclusion and inclusion criteria

5.3.1 Measuring-days

The valid amount of measuring days is considered 3-5 days, where most studies use 3-4 days as criterion (23;27;52;53). In our study, we included those who had at least 2 valid days. There was no significant difference in PA activity level between participants with 2 valid days and those with more than two, and the criteria was therefore set. To amplify, only 48 participants, representing 5 % of the PANCS2 sample had only 2 valid days of activity recordings. The mean (SD) amount of valid days for the sample was 5.8 (1.4) and 5.6 (1.6) in girls and boys, respectively. Our sample does therefore meet the proposed criterion, and we are able to compare our results to other studies concerning measuring days (98).

5.3.2 Criterion for valid measuring day

In PANCS2, the criterion for valid measuring time was at least 8 hours, complying with the proposed criterion of 6-10 hours in children and youth (102;103). The mean (SD) minutes per day was 789 (78.3) in boys and 777 (71.1) in girls, converted to mean (SD) hours per day as 13.2 (1.3) and 13.0 (1.2) in boys and girls respectively. Only 3.6 % of the PANCS2 participants had less than ten hours with valid measurement (98), and mean amount of measuring time is comparable to what is found in other studies (20;22;26;33;34;78-80;100). The amount of valid hours is thought to be acceptable to capture the adolescent's actual time spent active or sedentary during waking-hours. Higher criteria might have given more accurate measurement of time spent in different activity intensities. However, such high criteria might have led to further exclusion of participants.

5.3.3 Non wearing-time

Data measured during 24.00 – 06.00 in the morning was excluded from each person's recording. If the participants were to sleep with the monitor on, an overestimation of sedentary time would occur, and an underestimation of the total PA level would have appeared. For those few who were awake during this period, the total PA level could be affected depending on type of behaviors performed.

Data were excluded when zero counts were recorded for 20 continuous minutes. Adolescents do seldom sit entirely still without moving for longer periods than 20 minutes. The minutes above this threshold is most likely non-wearing time (55). If the non-wearing time was not excluded, total PA level would have been underestimated. Sedentary time is however, equal to 0-100 cpm. Therefore, registration of zero counts, even above 20 minutes, could have been sedentary time assumed to be non-wearing time. However, this would most likely be an issue for a low percentage of the sample, causing no significant influence on the overall mean PA level and sedentary time.

5.3.4 Epoch intervals

An epoch period sums up the counts registered and gives a mean intensity level per period (55). Our epoch period was ten seconds, which is in agreement with the recommended period of storage (67). Previous studies had an epoch period of 15-60 seconds (21;23;78;81;100), while current studies use 10-15 seconds (26;31;34;102;104) . Our epoch period could be collapsed so the comparability is valid for both previous and current studies (55). The short epoch period used in PANCS2 creates the ability to capture details of the measurements which especially relates to sporadic movement (21;55). Therefore, by using 10 seconds instead of 60 seconds, the possibility for capturing a more accurate amount of time spent in the different intensity levels was increased (55).

5.4 Limitations related to the use of the accelerometer

5.4.1 Physical activity level

The adolescents were told to remove the monitor when being in contact with water. Water activities were therefore not registered. The monitor assesses acceleration in the upper body and weight-bearing poorly. Still, data published from the questionnaire part of the PANCS2 show that 47. 5 % of the boys and 29.6 % of the girls report that they are participating in strength training activities. Data published on active travel to and from school show that 24 % boys and 12 % girls cycled both ways (see full report) (98). The total PA level could therefore have been underestimated for those adolescents participating in such activities mentioned above (56;98). Activities and sports often include a variety of intensity and speed. The accelerometer does not differ between intensity above 9-10 km/h, giving no difference in data captured above this speed (56).

Due to the accelerometers inability to register all types of movement, the validity of the PA data might have been influenced. Total PA level and time spent in different intensities could have been slightly underestimated. If this error is present for a large group of participants' data, this would influence the prevalence of adolescents meeting the Norwegian recommendations of PA.

5.4.2 Sedentary time

By measuring time spent sedentary objectively, we could capture all types of activities included in this broad behavior term. This would be in contrast to using self-report. We avoided data being affected by errors such as adolescents engaging in several sedentary behaviors at the same time, recall bias of light and sedentary intensity and misinterpretation of questions asked (8;55;73). The accelerometer can only measure cpm and will not differ between laying, sitting and standing position. Some standing activity will be registered as sedentary time, although the definition does not include that body posture as sedentary despite cpm registered (2;37). In accordance with most other studies (54-56), sedentary time was defined as all activity below 100 cpm. A few studies have higher cut-off (at <199 cpm and <500 cpm) (22;96). Higher cut-off results in more time being registered as sedentary intensity and less time registered in the other intensity levels. Those studies are not comparable with the results from our study (22;96).

5.5 Activity level

5.5.1 Total physical activity level

The adolescents in the PANCS2 study had a mean PA level of 456 cpm. The HELENA study was the only study reporting lower levels of PA in boys and girls compared to the PANCS2 study (24). The MALS study was quite similar to PANCS2, and PA levels of 499 cpm and 393 cpm were reported in boys and girls, respectively (81). Results in the EYHS (2003, 2004 & 2007), the AFINOS (2009) study, PANCS1, and the ENERGY project all reported higher amount of PA in their samples (22;26;31;78-80).

However, there are some methodological differences between the studies that are important to mention. Three different generations of ActiGraph accelerometers were used (CSA/MTI 7164, GT1M and GT3X+). It is highly important to understand differences that can appear by using different accelerometers. Corder et al (2007) found that GT1M recorded 9 % lower output than the 7164 model, while the 7164 model seems to be more sensitive to sedentary intensity (105). The total amount of moderate activity is however not reported to differ between the two models (63). The GT3X model has a filter which increases the sensitivity of the lower intensities. This filter reduces the difference between the 7164 and the GT3X model (106). The same option can however be applied in the GT1M model. The one study which has compared the GT1M model with the GT3X showed no significant differences in the vertical axis (63). Based on current knowledge, the GT1M and the GT3X model are comparable, but when including the 7164, differences existing between the models must be considered when comparing studies.

Six studies could all be compared age-wise to our sample (22;26;34;78-80). Two studies are quite similar to the PANCS2 (31;96), while the MALS study had a wider age-range (81). The difference in the age of the participants creates error for comparability. Studies show that PA level decreases by age. This could result in a higher mean PA level in studies including younger adolescents (22;24;26;98).

Adolescents might modify their activity pattern by knowing the purpose of the monitor (24). When the monitor was placed on the participant, the monitor was set to start the registration from 06.00 the following morning. This decision was taken specifically to reduce the reactivity.

5.5.2 Week vs. weekend

As expected, our results reviled a significant difference in total PA level between week and weekend. This is in accordance with the literature (26;78;81;107;108).

When it comes to explaining the difference in PA level between the week and the weekend, the studies are inconclusive (108). There are however some factors that might be of importance. Geographical location combined with the physical and social environment of the adolescent seem to be of importance (108). During the week, there are certain activities performed almost every day. Physical education contributes to the PA level and is mandatory for most European and North American countries. In addition, recess creates time where they can engage in different activities in adjusted facilities (109;110).

A number of adolescents do active travel to and from school. Data published from the PANCS2 questionnaire show that approximately 50 % of boys and 40 % of girls walked to and back from school. Those who used active transport had a slightly higher total PA level compared to those who used passive transport (see full report) (98). Even though this activity might be replaced by other types of activity in the weekend, active travel in relation to school might have an influence on the difference seen between weekday and weekend PA level.

After-school activities such as unorganized or organized sports might also have influenced the total PA level. Data from the full report show that in boys and girls, 63.9 % and 57.1 % in the PANCS2, were members of a sport club (98). If the main part of the training is scheduled during the weekdays, it is reasonable to suggest that sport participation influences the week and weekend difference.

Furthermore, some of the social and environmental opportunities might not be accessible in the weekend. Some studies have specifically investigated leisure time behaviors, reporting an increase in time spent with TV and computers during leisure time (98;111). More leisure time in the weekend combined with an increase of screen-activity during leisure time, could be a possible explanation for the week and weekend difference.

5.5.3 Sex difference

We found sex differences in PA level and time spent in intensity levels. The results are in accordance with findings from most other studies (24;26;73;78-81;96). The variables explaining these sex differences are not known, but there are some presumed contributing factors. When boys and girls reach puberty, the biological maturation will affect their physiological systems. The onset and speed of maturity will differ between individuals and between the sexes (112;113). Girls increase their estrogen levels; stimulating the body fat production and increasing body-weight. A reduction in relative strength and a plateau or a reduction in VO_2-max can occur (114). Boys increase their level of testosterone which stimulates muscle growth and erythropoietin production. Strength and an increase in VO_2max occur (114). These factors might influence the motivation for PA and sports participation differently if comparing boys and girls. It is reasonable to presume that boys are more motivated for PA and sport participation during this development period compared to girls (115).

Referring to the gender theory (116), boys and girls tend to act upon what is the expected behavior related to their gender. The two different genders have different stereotypical games and activity attractions. By including different movements, the PA level could be influenced. The different organized activities categorized by gender stereotypes might have similar PA requirement, but the self-organize PA has been observed as different between the genders. Boys might engage in more physically demanding activities than girls (117).

5.5.4 Time spent in different intensity levels

The adolescents in the PANCS2 study spent 71 % of the measured time each day being sedentary. Similar observations were supported by three other studies (21;22;24). Only the MALS study reported more minutes spent sedentary (81), while the majority of studies reported lower levels of sedentary time (20;23;31;34;80).

The amount of MVPA represented 7.8 % of the measured time daily in the PANCS2 participants. Similar findings were observations in the PANCS1 (26). While five studies reported a higher amount of time spent in MVPA (34;78-81), five studies reported less time spent in MVPA (20-22;24;31).

With the exception of sedentary time, boys in PANCS2 spent more time than girls in the different activity intensities. These results are in accordance with findings in the majority of studies (21;22;24;31;81). The AFINOS study (2009 & 2012) did however report boys more sedentary than girls (34;80).

When it comes to differences in MVPA between studies, this could probably be explained by cut-off used to define MVPA. The ENERGY (2012) project defined MVPA as all activity above 3000 cpm (31). Based on this, the study is not comparable to our results. Whilst the PANCS1, the EYHS (2007), and the HELENA study used the same cut-offs as PANCS2 (>2000 pm), the majority of studies based their cut-off on the regression equation by Freedson and colleagues (20;34;78-81). The regression equation is comparable to >2000 cpm which is used in the PANCS2 (118). The chosen cut-point for MVPA will also influence the amount of adolescents meeting the recommendations on PA. In the ENERGY project, more activity must be accumulated compared to the other studies to reach the recommendations of > 60 minutes of daily MVPA. Different conclusions on PA level could be drawn from the same set of data by using two different cut-offs. Therefore, comparing results from single studies when it comes to the prevalence of reaching the recommendations is difficult.

5.5.5 Correlation between sedentary time and other intensity levels

In the PANCS2 sample, an inverse correlation between sedentary time and light intensity was observed in boys. Findings might indicate that increased sedentary time in boys leads to a reduction of time spent in light intensity, as for the other way around. In addition, the inverse correlation found between sedentary time and MVPA in both boys (r= -0.36) and girls (r= -0.18) could indicate that the more sedentary adolescents are, the less time is spent in MVPA and vice versa.

In the ICAD study, Ekelund et al (2012) found similar inverse correlation between sedentary time and MVPA (r= -0.34) (33). Carson & Janssen (2011) however, found a stronger correlation for both sedentary time and light intensity (r= -0.9) and sedentary time and MVPA (-0.7) (20). However, the different studies have used different analyses to investigate these relationships, making it impossible to compare the results.

Findings in the PANCS2 study could indicate that time spent sedentary is more related to MVPA than to light intensity. Although the correlations were low, the results could be used in a discussion regarding whether limitation for sedentary time should be included in the recommendations. The main goal by those changes in recommendations is to reduce sedentary time which again, based on their association, could lead to increased time in light intensity and MVPA. However, it should be acknowledged that these suggestions are based on observed associations, not causations.

5.6 Compliance with the recommendations

In the PANCS2, 58.1 % boys and 43.2 % girls met the current Norwegian recommendations of minimum 60 minutes of MVPA. These results differ from findings in other studies (24;26;79;80). In PANCS1, Kolle and colleagues (2010) reported a somewhat lower percentage in boys (54.1 %) but higher percentage in girls (49.9%) (26), while the HELENA study reported lower percentage in both boys (56.8 %) and girls (27.5 %) meeting the criteria (24). The EYHS (2003 & 2004) and the AFINOS study (2009) found however a higher percentage of adolescents meeting the recommendations compared to the PANCS2 (78-80).

The fact that only about 50 % of the PANCS2 participants reach the recommendations is of course a challenge. However, the recommendations are not based on a large body of evidence of dose-response relationship (27;28). Therefore, questions could be raised whether the Norwegian adolescent's PA level is critically low, or if the recommendations are too ambitious.

The development of current recommendations is mainly based on questionnaires (119). There is not enough evidence related to the validity of applying those recommendations when measuring objectively. However, due to lack of knowledge regarding optimal recommendations, the current recommendations should be followed. According to those recommendations, Norwegian adolescents are not physically active enough.

5.6.1 Difference in sedentary time and light activity in those reaching and not reaching recommendations

Boys and girls in PANCS2 who did not meet the PA recommendations spent respectively 35.5 minutes and 21 minutes less in light activity compared to those who met the recommendations. When looking at those meeting and not meeting the recommendations, no difference in time spent sedentary was observed. The observations are rather interesting. It does not seem like meeting the current recommendations of at least 60 minutes MVPA is in any way related to whether the adolescents are sedentary or not.

5.7 Association between intensity levels and body composition

As mentioned earlier, no causation could be drawn based on the study design. We could however observe to which degree sedentary time or MVPA was associated with WC and BMI.

In the PANCS2 sample, sedentary time was not associated with either WC or BMI. Our findings are also supported by other studies (20;22;25;33;80;81;97). The only study contradictory to our findings was the ENERGY project, which observed significantly higher WC and BMI in the most sedentary quartiles of the sample (31).

In the PANCS2 study, MVPA was however associated with both WC and BMI. Studies investigating these associations have contradictory findings. Four studies support our findings (20;24;33;80), while three studies did not observe any association (22;25;81). Contradictory findings could possibly be explained by the difference in data reduction and methodology (120). Difference in study objectives, participant characteristics, measuring methods and cut-offs chosen are some examples that creates critical differences between the studies.

In PANCS2, MVPA explained a more prominent percentage of the variance in WC than what it did for BMI. WC could be suggested as a more appropriate variable to use when investigating the possible effect of PA on different adolescent's health variables.

MVPA could only explain 1.1 % of the variation in BMI, making it clear that BMI is explained by a number of variables in addition to MVPA. We also know that BMI as a measure of body composition does not take into consideration the distribution between lean and fat mass (121-123). Therefore, an adolescent classified as overweight by BMI might not necessarily have a high fat mass, but could have a high percentage of lean mass. Despite limitations, BMI is thought to be valid in epidemiological studies (124). As mentioned, PANCS2 used the age- and gender-specific BMI-cut-offs (5) so that the method of measuring body composition was more appropriate for our sample. The ability of sedentary time or MVPA to explain the variance in BMI might be reduced due to a great number of variables influencing the BMI, including the shortcomings related to BMI (121).

The PANCS2 adolescents are not in a static biological or mental state and do therefore not develop as one heterogeneous group (114). Girls tend to increase their amount of body fat, affecting both WC and BMI values (125). In boys, the BMI might be affected by the growth of muscle mass (114;125). This might lower the predictor ability of sedentary time and MVPA. It might be that at post-puberty, the ability for sedentary time and MVPA to contribute to the explanation of variation in WC and BMI could be more logical. We did not have data on pubertal status and were not able to adjust for this variable, which would have been useful (114;126).

6.0 Perspectives

Based on the finding that only 50.7 % of the participants reached the Norwegian recommendations of 60 minutes of MVPA per day, there is a need for action.

Politicians, with their position and ability to create changes, must take the responsibility. There is a need of introducing strategies making it easier to be physical active and for sports participation to be more accessible. When developing the environment, the importance of reducing the normality of sedentary lifestyle should be stressed (127). Among the important suggestions concerning children and youth is one hour of physical education each day in childhood and adolescents' year, activity included in the school breaks, and to establishing safe and accessible active travel.

As far as research needed, a continuous monitoring of the PA level and sedentary time among adolescents is desired. Research that can increase the knowledge related to the gender differences and research aiming at resolving this issue are also of importance. Finally, research investigating the dose-response relationship between the different intensity levels including sedentary time with the acute and long-term health effects included is necessary. There is a need for consensus related to measuring methods, cut-offs applied, reduction of data, and what to adjust for. All those factors are important when conducting studies aiming to examine questions related to the association between intensity levels and different health variables. Then we can obtain comparable data across studies and across countries.

Validation studies should be conducted, focusing on both assessments of PA and sedentary time specifically in adolescents.

7.0 Conclusion

In this thesis, the PA level and sedentary time was investigated in Norwegian 15-year-olds. Analyses have been conducted to look for association between sedentary time and WC and BMI, and association between MVPA and WC and BMI. The following conclusions were drawn;

The adolescents had a mean (SD) PA level of 456 (160) cpm, where boys had a 14.6 % higher PA level compared to girls. The adolescents were 12 % more active during the week compared to the weekend, and boys were more active than girls both during the week and weekend. The Norwegian recommendations of at least 60 minutes of MVPA were met by 50.7 %. More boys (58.1 %) than girls (43.2 %) met the recommendations.

Among the adolescents, 71 % of the assessment period was spent sedentary, and girls (73 %) were more sedentary than boys (69 %).

Sedentary time was not associated with either WC or BMI, while MVPA however was associated with both WC and BMI.

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Attachments 1-2

NORGES IDRETTSHØGSKOLE

ungKan 2

Forespørsel om deltakelse i "ungKAN2"

– en kartleggingsundersøkelse av fysisk aktivitet blant barn og unge i Norge

Helsedirektoratet

Kjære elev og foreldre/foresatte

På oppdrag fra Helsedirektoratet skal Norges idrettshøgskole i 2011 for andre gang gjennomføre en kartlegging av fysisk aktivitetsvaner, kost og ulike faktorer som har sammenheng med aktivitetsnivå blant barn og unge i Norge. Et landsrepresentativt utvalg av 3400 barn og unge i 1.-, 4.- og 10.-trinn skal delta i undersøkelsen.

Hvorfor "ungKAN2"?

I 2005-06 ble den første landsomfattende undersøkelsen av fysisk aktivitet blant barn og unge i Norge gjennomført. Resultatene fra denne studien har vært sentrale i arbeidet med å målrette og evaluere innsatsen for å øke graden av fysisk aktivitet i befolkningen. Barn og unge er en prioritert målgruppe i det helsefremmende arbeidet, og foreliggende undersøkelse vil gi oss ny verdifull informasjon om barn og unges aktivitetsvaner, samt kunnskap om hvordan disse har utviklet seg de siste årene. Resultatene fra denne undersøkelsen vil bli oppsummert i en rapport fra Helsedirektoratet. Deres barns skole har sagt ja til deltakelse i denne undersøkelsen, og alle undersøkelser skjer i full forståelse med skolens ledelse. Deres barn deltok i undersøkelsen i 2005-06, og vi ønsker med dette å invitere dere til å delta i denne oppfølgingsstudien.

Hva innebærer deltakelse for deg og ditt barn?

1. Aktivitetsregistrering

Vi ønsker å kartlegge barn og unges aktivitetsnivå. Denne registreringen gjøres objektivt ved hjelp av en aktivitetsmåler som barnet skal bæres i et belte rundt livet i sju påfølgende dager. Aktivitetsmåleren er på størrelse med en fyrstikkeske, og blir levert ut på skolen. Registrerningen vil ikke på noen måte påvirke barnets hverdag.

2. Spørreskjema

Elevene skal besvare et spørreskjema vedrørende kost- og aktivitetsvaner. Foresatte har rett til å se spørreskjemaet som skal besvares, og et kort spørreskjema vil også bli gitt foreldre/foresatte vedrørende deres fritids- og mosjonsvaner.

3. Fysisk undersøkelse

Det vil bli gjennomført måling av høyde og vekt. Dette vil foregå på skolen, den dagen barnet får utdelt aktivitetsmåler og spørreskjema. Erfarne prosjektmedarbeidere fra Norges idrettshøgskole vil foreta målingene.

Generell informasjon

Det er frivillig å delta i undersøkelsen. Du kan når som helst trekke deg og kreve personopplysningene som er gitt anonymisert uten å måtte begrunne dette nærmere. Opplysninger som samles om deg vil bli behandlet konfidensielt, og alle medarbeidere i prosjektet har taushetsplikt. Det er ønskelig å innhente opplysninger om foreldrenes/foresatts utdanning, inntekt og etniske bakgrunn. Deltakelse i prosjektet innebærer at vi vil koble de nevnte data med registerdata fra Statistisk sentralbyrå.

Innsamlede opplysninger oppbevares slik at navn er erstattet med en kode som viser til en atskilt navneliste. Det er kun prosjektleder som har adgang til koblingslisten. Det vil ikke være mulig å identifisere deg eller ditt barn i resultatene av undersøkelsen når disse publiseres. Prosjektet er ment som et ledd av et nasjonalt monitoreringssystem av aktivitetsnivået til barn og unge i Norge. Etter prosjektslutt, forventet omkring utgangen av 2012, blir data lagret i et dataregister hvor personopplysningene er avidentifisert. Dette dataregisteret vil bli lagret ved Norges idrettshøgskole og i Helsedirektoratet. Hvis vi får mulighet til å gjøre en ny undersøkelse om noen år vil du selvfølgelig få forespørsel om dette og kunne ta stilling til hvorvidt du ønsker å delta igjen.

Prosjektet er tilrådd av Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste A/S.

Ansvarlig for gjennomføringen av studien er Norges idrettshøgskole, Seksjon for Idrettsmedisinske fag, Oslo. Prosjektledere er postdoktor Elin Kolle og professor Sigmund Anderssen. Dersom dere ønsker ytterligere informasjon er dere velkomne til å kontakte prosjektkoordinator Johanne Støren Stokke på telefon xxxxxx eller e-post johanne.storen.stokke@nih.no. Undersøkelsen er finansiert av Helsedirektoratet.

Bli med i trekningen av to flotte sykler!

Alle 10.-klassinger som deltar i undersøkelsen er med i trekningen av to flotte sykler til en verdi av kr 5000.

Vennligst klipp av og returner samtykkeskrivet nedenfor i svarkonvolutten til klasseforstander.

Med vennlig hilsen

Elin Kolle	**Sigmund Anderssen**
postdoktor	*professor*
Norges idrettshøgskole	Norges idrettshøgskole

SAMTYKKESKJEMA

❑ Ja, jeg bekrefter herved å ha mottatt informasjon om prosjektet. Jeg/vi ønsker å delta og lar min/vår datter/sønn delta i studien.

Vennligst utfyll opplysningene nedenfor: (Skriv tydelig med blokkbokstaver)

Barnets fornavn: ....

Barnets etternavn: ....

Barnets personnummer (11 siffer): ....

Jeg er informert om at deltagelsen er frivillig og at mitt barn kan avstå fra å svare på enkelte spørsmål, eller trekke seg fra deltagelse uten å oppgi grunn. Jeg er også bekjent med at foresatte har rett til å trekke seg/trekke opplysninger om seg selv fra prosjektet.

....	....
Foreldre/verges underskrift	Elevens underskrift

Leveres klasseforstander i vedlagte konvolutt så snart som mulig.

ungKan 2

Helsedirektoratet

NIH

Norges idrettshøgskole | Sognsveien 220 | 0863 Oslo
Telefon: +47 23 26 20 00 | Fax: 22 23 42 20 | www.nih.no

Beta Grafisk AS

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

NSD

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Elin Kolle
Seksjon for idrettsmedisinske fag
Norges idrettshøgskole
Postboks 4014 Ullevål Stadion
0806 OSLO

Vår dato: 27.01.2011 Vår ref: 25870 / 3 / JSL Deres dato: Deres ref:

TILRÅDING AV BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 25.12.2010. Meldingen gjelder prosjektet:

25870	*Nasjonalt overvåkingssystem fysisk aktivitet. Kartlegging av fysisk aktivitet og determinanter for fysisk aktivitet blant barn og unge i Norge - ungKAN2*
Behandlingsansvarlig	*Norges idrettshøgskole, ved institusjonens øverste leder*
Daglig ansvarlig	*Elin Kolle*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 31.12.2012, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Bjørn Henrichsen

Juni Skjold Lexau

Kontaktperson:Juni Skjold Lexau tlf: 55 58 36 01
Vedlegg: Prosjektvurdering

Personvernombudet for forskning

Prosjektvurdering - Kommentar

25870

Formål:
Prosjektet har som formål å kartlegge fysiske aktivitetsvaner og determinanter for fysisk aktivitet blant norske 6-åringer, 9-åringer og 15-åringer.

Utvalg:
Utvalget består av ca 3400 barn - et representativt utvalg av den norske befolknings 6-åringer (1. trinn), 9-åringer (4. trinn) og 15-åringer (10. trinn). Utvalget trekkes på skolenivå av SSB. Utvalget består videre av barnas foreldre og kroppslærere. Elevenes foreldre informeres skriftlig om prosjektet (jf. informasjonsskriv mottatt 20.01.2011) og samtykker skriftlig til barnets deltakelse. Elevene vil informeres skriftlig om prosjektet, og samtykker til deltakelse ved å fylle ut og levere spørreskjemaet. Kroppslærer informeres muntlig om prosjektet (jf. e-post mottatt 26.01.2011). Vi forutsetter at kroppslærer i tillegg får informasjon om navn og kontaktopplysninger til daglig ansvarlig (Elin Kolle) og behandlingsansvarlig institusjon NIH).

Metode og datainnsamling:
Det behandles sensitive personidentifiserende opplysninger om elevenes og foreldrenes helseforhold (jf. pol § 2 nr 8 bokstav c).

Opplysningene samles inn gjennom spørreskjema fra barn og foreldre, intervju med kroppslærer, aktivitetsmåler (akselerometer) fra barna, og måling av barnas høyde og vekt. Datamaterialet vil bli koblet til opplysninger fra SSB om foreldrenes utdanning, inntekt og landbakgrunn. Videre vil det fysiske skolemiljøet kartlegges og observeres.

Det registreres direkte personidentifiserende opplysninger om barna og foreldrene gjennom navn og fødselsnummer. Det registreres indirekte personidentifiserende opplysninger gjennom bakgrunnsopplysninger om foreldrene. Direkte personidentifiserende opplysninger lagres separat fra det øvrige datamaterialet, men kan kobles mot det øvrige datamaterialet ved hjelp av en referansekode som kun prosjektleder har tilgang til.

Det registreres indirekte personidentifiserende opplysninger om kroppslærer, gjennom bakgrunnsopplysninger som stilling, arbeidssted og utdanning.

Prosjektslutt og anonymisering:
Prosjektslutt er satt til 31.12.2012. Opplysninger om kroppslærer vil da bli anonymisert. Det øvrige datamaterialet oppbevares videre etter prosjektslutt i avidentifisert form, i påvente av en mulig oppfølgingsundersøkelse om 3-10 år. Utvalget vil da bli kontaktet igjen. Det avidentifiserte datamaterialet lagres hos Helsedirektoratet og Norges idrettshøgskole, mens koblingsnøkkel til de direkte personidentifiserende opplysningene lagres hos NSD.

Alle innsamlede opplysninger vil bli anonymisert i 2025, ved at direkte personidentifiserende opplysninger slettes, mens indirekte personidentifiserende opplysninger slettes eller grovkategoriseres på en slik måte at de ikke kan tilbakeføres til enkeltpersoner.

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

NSD

Harald Hårfagres gate 29
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Elin Kolle
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Vår dato: 17.03.2011	Vår ref: 25870 JSL/RF	Deres dato:	Deres ref:

ENDRINGSMELDING

Vi viser til endringsmelding mottatt 01.03.2011 for prosjekt:

25870	*Nasjonalt overvåkingssystem fysisk aktivitet. Kartlegging av fysisk aktivitet og determinanter for fysisk aktivitet blant barn og unge i Norge - ungKAN2*

Vi har registrert følgende endringer i prosjektet:

1. Vi har registrert at det vil bli inkludert spørsmål om høyde og vekt i spørreskjemaet til barna.
2. Vi har registrert at det vil bli inkludert spørsmål om utdannelse og fødeland i spørreskjemaet til foreldrene, i stedet for at disse opplysningene skal samles inn gjennom SSB.
3. Vi har registrert at foreldre vil motta informasjon om at de ikke kan fylle ut spørreskjema på vegne av den andre forelderen uten at det foreligger samtykke fra sistnevne til dette. Denne informasjonen vil bli formidlet via lærer.

Vi forutsetter at prosjektet for øvrig er uendret, og viser i den anledning til våre tidligere vurderinger.

Ta gjerne kontakt dersom noe er uklart.

Vennlig hilsen

Bjørn Henrichsen

Juni Skjold Lexau

Kontaktperson: Juni Skjold Lexau tlf: 55 58 36 01