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"The association between socioeconomic status and ethnicity on cardiorespiratory fitness and physical activity in Norwegian adolescents"

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SUMMARY

Objective: To study the associations between socioeconomic status and ethnicity on cardiorespiratory fitness and physical activity levels.

Research methods and procedures: The sample size was 707 9th grade adolescents from seven schools in Oslo and surrounding municipalities. 352 males (49,8%) and 355 females (50,2%). All the participants were categorized as either high SES 444 (62,8%) or low SES 263 SES (37,2%), based on Statistics Norway´s numbers on education, income and life-expectancy. All participants were addressed to the districts of their schools. Furthermore, 543 (76,8%) answered sufficiently regarding ethnicity, and were categorized as either Western 361 (66,5%) or Non-Western 182 (33,5%). The dependent variables were both objectively measured. CRF with the Andersen test and PAL with accelerometers.

Results: When all the independent variables are controlled for each other, i.e. ethnicity, SES and gender, significant differences in physical activity levels measured from the accelerometer is only apparent within gender ($p = 0.000$), and not SES ($p = 0.510$) and ethnicity ($p = 0.194$) Cardiorespiratory fitness however is significantly associated by all three independent variables ($p \leq 0.001$).

Discussion: The fact that SES and ethnicity in this study are only associated with CRF and not PAL underlines the complex nature of studying physical activity. Non-Western immigrants are not a homogenous group, and future studies could focus more on the diversity within ethnic groups. Furthermore, earlier studies regarding this topic shows that the disparities may be greater among girls compared to boys. Therefore further studies must continue to look at gender differences within SES and especially ethnicity. Finally, research methods used on SES and PA are not always comparable. One should strive to use objective measures for PA and unite on a better way to measure SES.

Key words: Physical activity, physical activity levels, health, adolescents, accelerometer, Andersen-test, socioeconomic status, overweight, obesity, noncommunicable diseases, cardio vascular deceases, disparities.

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After several years as a student, my time to enter in the ranks of adults has finally come. Over the years I have gained knowledge, memories and lifelong friendships. There has been ups and downs, all leading towards the grand finale. The completion of my master thesis. On that note, there are several individuals who deserve attention!

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Georg Balder Tveten
Oslo, June 2017

ABBREVIATION

BMI:	Body mass index
NCD:	Noncommunicable disease
CVD:	Cardiovascular disease
SES:	Socioeconomic status
LS:	Low Socioeconomic status
HS:	High Socioeconomic status
W:	Western
NW:	Non-Western
CRF:	Cardiorespiratory fitness
PF:	Physical fitness
PAL:	Physical activity level
CPM:	Counts per minute
CI:	Confidence interval

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1.0 INTRODUCTION

Children represent the future. They are our most important resource. Therefore, we have to acknowledge the importance of facilitating the very best health care politics and make sure that we strive to build upon a society that is directed towards ensuring their quality of life. Health care, physical activity, mental health and a good social network are some of the most important factors in order to make a difference (Bøe, T. 2015). Everybody agrees that children should all have the same opportunities in life. However, we know that all over the world, there are huge contrasts when it comes to how the young ones grow up. The goods of society is unfortunately not equally distributed (Bøe, T. 2015).

It is a well-established truth that health and quality of life is interconnected with the social conditions of our childhood (WHO 2008). In 2013, 13,4 % of Norwegian children under the age of eighteen were living at risk of poverty or social exclusion (Helsedirektoratet 2015). Vulnerable and socially disadvantaged people get sicker and die sooner than people of higher social positions. This is partly due to a greater exposure to harmful products such as tobacco and unhealthy food, as well as limited access to health services and physical activity (WHO 2015). In low-resource settings, health-care costs for cardiovascular diseases, cancers, diabetes or chronic lung diseases can quickly drain household resources, driving families into poverty. This is very unfortunate, as they are more vulnerable (WHO 2015). Even though unhealthy diet and poorer lifestyle choices occur in both lower and higher income groups, high-income groups can access services and products that protect them from the greatest risks, while lower-income groups often cannot afford such products and services. Education, enlightenment and the feasibility to both take in, process and use information accumulated about healthy lifestyle differs from those with higher socioeconomic status compared

to low (WHO 2015). Socioeconomic status (SES) can be divided into several different groups, ranging from low to high.

Studies have been carried out worldwide, trying to investigate how ethnicity and socioeconomics influences everyday life, including physical activity and health related problems. We know that these are important factors to recognize and investigate further, when we try to understand different populations - all with their own unique compositions. It is crucial to keep these factors in mind whenever we measure and look at different countries, cities or do intercity comparisons.

Several studies have investigated differences within SES in relation to physical activity, and the relationship is evident in the adult population, i.e higher SES equals higher physical activity patterns (Stalsberg & Pedersen 2010). Fewer consistent findings support the same theory in relation to adolescents. However, findings from a review (Stalsberg & Pedersen 2010) from 2010 states that there is an association between SES and physical activity also for adolescents, and that those with high SES are more active compared to those with lower SES. Nonetheless, the findings are not uniform, and the measurements for both variables are inconsistent. Similar findings from studies in Oslo point the same direction. Both young HUBRO (n=3626), Young in Oslo (n=24000) and UngKan2 (n=3538) supports the evidence that those with lower SES are less active and less satisfied with their own health. (Kolle et al 2012, Andersen & Bakken 2015 and Grøtvedt & Grimmestad 2002)

SES is not the only predictor of health problems. Norway is a multicultural society, and Oslo stands out with its density of immigrants (NOVA 8/15). There is growing evidence that the burden of disease and health problems differs substantially across ethnic groups. Not only between the ethnic Norwegian population and immigrants, but also within immigrant groups themselves (National Institute of Public Health (NIPH) 2008:7).

Results from immigrant health survey in Oslo reveal that in general, immigrant groups are more exposed to chronic and non-communicable diseases and conditions, such as diabetes, cancer and cardiovascular deceases. Furthermore, immigrants showed a higher prevalence of poor self-reported health, higher usage of health services, more musculoskeletal disorders (especially among immigrant women), in addition to being less physically active (NIPH 2008). Similar results are seen in UngKan2 in relation to physical activity. Children and youth with a non-western background are less active compared to those with a western background (Kolle et. al. 2012)

Furthermore, it is worth mentioning that consistent findings in earlier studies, tell us that social inequalities in health are more evident among girls than boys (Bakken, Frøyland og Sletten 2016) The same is seen within groups of non-western immigrants and Norwegians. (FHI - Kumar 2008 & Kolle et al 2010).

This study will focus on health related fitness, it is an important factor to public health issues. Health related fitness is divided into five components; Cardiorespiratory fitness, muscular endurance, muscular strength, body composition and flexibility (Caspersen 1985). Nonetheless, only cardiorespiratory fitness (CRF) out of the five before mentioned components will be studied further, in addition to physical activity level (PAL). The health benefits of being sufficient physically active are indisputable. Therefore, we need to do more extensive research, in order to strengthen our knowledge in relation to disparities caused by SES and ethnicity. Only through research and increased understanding of how these factors affect us, will we be able to facilitate the good health care politics, and thus reduce the inequalities in health we see today.
The purpose of this paper is to investigate the influence of SES and ethnicity in relation to objectively measured PAL and cardiorespiratory fitness in 14 year old adolescents from Oslo.

2.0 THEORY

2.1 Physical activity and intensities

«Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure» (Caspersen 1985). Physical *in*activity is the lack of sufficient physical activity, according to WHOs recommendations. WHO has developed different guidelines for physical activity, depending on different age groups. Seeing as this study is focused on children and adolescents, only these specific guidelines will be presented.

2.1.1 Recommendations for physical activity

For children and young people of this age group (5-17), physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise. This can happen in the context of family, school, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers as well as reduced symptoms of anxiety and depression, the following are recommended:

1. Children and young people aged 5–17 years old should accumulate at least 60 minutes of moderate to vigorous-intensity physical activity daily.
2. Physical activity amounts greater than 60 minutes will provide additional health benefits
3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least three times per week.

Children who meets these recommendations are more likely to develop; 1) healthy musculoskeletal tissues (i.e. bones, muscles and joints), 2) healthy cardiovascular system (i.e. heart and lungs), 3) neuromuscular awareness (i.e. coordination and movement control) and 4) a healthy body weight. (Janssen & LeBlanc 2010)

Sufficient physical activity is associated with several psychological benefits amongst the young population, such as improved control over symptoms of anxiety and depression (WHO 2011). Furthermore, it can assist in social development by facilitating opportunities for self-expression, self-confidence, social interaction and integration.

2.1.2 Physical activity intensities

Intensity refers to the rate at which the activity is being performed or the magnitude of the effort required to perform an activity or exercise (Henriksson & Sundberg 2009). Metabolic Equivalent (MET) is a term commonly used to express the intensity of physical activities. One MET is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml O2 per kg body weight x min (Jette et.al 1990). The MET concept represents a simple, practical, and easily understood procedure for expressing the energy cost of physical activities as a multiple of the resting metabolic rate. The energy cost of an activity can be determined by dividing the relative oxygen cost of the activity (ml O2/kg/min)x by 3.5 (Jette et.al 1990).

Table 1.0 portrays a comprehensive guide of what moderate and vigorous physical activity could be. Keep in mind that the intensity of different forms of physical activity varies between people, and that it depends on an individual's previous exercise experience as well as their relative level of fitness. (Ainsworth et.al. 1993)

Table 1.0 Illustrating examples of different activities, in relation to their intensities.

MODERATE-INTENSITY PHYSICAL ACTIVITY (Approximately 3-6 METs)	**VIGOROUS-INTENSITY PHYSICAL ACTIVITY (Approximately > 6 METs)**
Requires a moderate amount of effort and noticeably accelerates the heart rate	**Requires a large amount of effort and causes rapid breathing and a substantial increase of heart rate.**
Brisk walking	Running
Housework and domestic work	Competitive sports and games
Carrying moving moderate loads	Carrying or moving heavy loads
Bicycling on level terrain, or with few hills and stationary bicycling—using moderate effort	Bicycling more than 10 mph or bicycling on steep uphill terrain and stationary bicycling—using vigorous effort

Table customized from Ainsworth et.al. (1993) & WHO (2017) located at: http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/

2.2 Physical activity and health

The bodies of the modern human has not evolved too much compared to the bodies of our ancestors. However, the society we surround ourselves with today shares no similarities to the old world. The human body is made for movement. Sufficient physical activity in addition to reduced inactivity has a positive effect on the health of both body and mind, and significantly reduces the risk of premature death. (Henriksson & Sundberg 2009). Physical inactivity has been identified as the fourth leading risk factor for global mortality. Only beaten by high blood pressure, the use of tobacco, and high blood glucose.

The cause of obesity is simply an energy imbalance between calories consumed and calories spent. However, obesity problems are a much more complicated matter.

Worldwide we see an increased intake of energy-dense foods (high fat, salt and sugar), in addition to a decrease in physical activity. The decrease in physical activity is due to an increase of several sedentary forms of work, modernization of transportation and urbanization. (Bahr. R 2008). The before-mentioned factors are causing the obesity challenge the world faces today.

Physical inactivity, overweight and obesity often are often related to metabolic risk factors, and to other noncommunicable diseases (NCDs) in adult life, such as cardiovascular disease (CVD), musculoskeletal disorders and several forms of cancers. The risk of these NCDs are proven to increase with an increased BMI (WHO 2016) Furthermore, childhood obesity is associated with a higher risk of obesity, premature death, and disabilities in adulthood. This is all in addition to the current problems occurring, i.e. breathing difficulties, increased risk of fractures, hypertension, early markers of CVD, insulin resistance and physiological effects (WHO 2016). On that note, it is crucial that we teach children and adolescents about the severe consequences of being physically inactive (Telama et.al 2005)

Both overweight and obesity, and their related NCD have one thing in common. They are all largely preventable. Societal changes and politics need to take place in order to facilitate individual changes in the population.

Individual responsibility will only have a significant effect when the population have access to a healthy lifestyle. Therefore, society is responsible for making physical activity and healthy dietary choices available, affordable and easily accessible to everyone, particularly to those of low social position.

2.3 Race/Ethnicity, Socioeconomic Status, and Health

Socioeconomic status is related to almost all health outcomes (Crimmins et al 2004). Numerous studies have investigated this relationship, and substantial amounts of evidence indicates that ethnical differences in morbidity and mortality are connected to socioeconomic resources (Williams et al 2016). As mentioned earlier in this paper, low income families, and those of lower education are more likely to suffer from diseases, impairments- both cognitively and physically, in addition to experiencing higher mortality rates (ibid). SES is considered as one of the best determinants of variation in health. Whether it is measured by income, education or occupational status (ibid).

Researchers strive to understand the complex ways of how race, ethnicity and SES uniquely and in combination affects health outcomes, as it is a critical for addressing the inequalities across the socioeconomic spectrum and in different ethnical groups. Poorly immigrated families will often end up with low SES. Still, SES is not the only reason for the disparities seen in health. Income and education are not race-equivalent. Caucasians have higher income at the same level of education and are more wealthy across all different levels of income. Minority groups are also more likely to have experienced lower SES through childhood and adolescence. Psychological and economical adversity during childhood might affect health in adulthood (Williams 2012). *«We have many miles to go in better understanding and maximizing the levers of change but our greatest need is to begin in a systematic and integrated manner, to use all of the current knowledge that we have.»* (ibid)

2.4 Physical activity and measurements

Physical activity could be hard to measure. Especially in children, as it is a complex and highly variable behavior: Children and young adolescents activity pattern often differs substantially from that of adults. Within just a minute, it is not unusual for a child to reach vigorous intensity, pause and then return to being active, all whilst playing.

The younger population does not think of physical activity the same way adults do. They perceive it more as playing (Hagströmer & Hassmén 2009). However, there are several ways to monitor and measure physical activity in children and adolescents. Whichever method being used, it is important that the chosen tools are both valid and reliable (ibid). Ensuring that the tools measure correctly, and that they provide similar results under the same conditions. Lastly, a third and just as important factor is feasibility. Are the chosen methods cost-effective, do they demand any extra competence from the test personnel, are they easy to use and do they not burden the participants more than necessary?

The variation and diversity of different tools for measurements illustrates the complexity of physical activity, and how to measure it. Nevertheless, the different measurements are usually described as either subjective or objective. (Sirard & Pate 2001)

2.4.1 Subjectively measured physical activity

Anything subjective is subject to interpretation. Usually, subjective means influenced by emotions or opinions. The sporadic and spontaneous activity patterns of children and young adolescents makes it difficult for them to recall, quantify and categorize it (Sirard & Pate 2001). In addition, their cognitive abilities are not fully developed, which means they will have further difficulties recalling frequency, intensity and duration of varies activities (ibid).

Examples of subjective methods measuring physical activity are self-report questionnaires, interviews, proxy reports and diaries. Subjective methods were often chosen when studying large populations, as they are easy and cost-effective to use (Troiano, R.P 2005). During the last decades, there has been a large increase of objective methods, especially accelerometers (Troiano, R.P 2005). Self-report questionnaires are the preferred subjective method, as diaries with all its specifics often are considered too demanding for young adolescents (Ward. et al. 2005).

Proxy reports could quite easily require too much from the respective adults when larger populations are studied. Children, with their spontaneous and diverse activity patters are very hard to keep track of and observe in satisfactory way. Moreover, questionnaires can provide information regarding activity type and context. However, seeing as young adolescents cognitive abilities are not fully developed, there are several issues regarding the use of subjective methods for this age group.

2.4.2 Objectively measured physical activity

To be objective is to be unbiased. If you are objective towards something, you have no personal feelings about it. Examples of objective methods in relation to physical activity includes; Direct observation, Doubly labeled water (DLW), indirect calorimetry, heart rate monitors, pedometers and accelerometers. (Sirard & Pate 2001)

2.4.2.1 Doubly labeled water

DLW is often considered the golden standard when it comes to measurements of energy expenditure (Sirard & Pate 2001). Furthermore, it can easily be used in free living participants, i.e, the participants are able to continue their normal routines of life. However, there are some considerable challenges related to this method. It is very expensive and not feasible for large scale studies. Secondly, although it measures exact results of energy expenditure, it cannot say anything about

daily or hourly activity patterns, along with intensity, duration and frequency of physical activity or sedentary behavior (ibid).

2.4.2.2 Indirect calorimetry

Open-circuit indirect calorimetry measures energy expenditure from oxygen consumption and carbon dioxide production (Sirard & Pate 2001).It is considered an accurate and valid method for measuring energy expenditure. Nevertheless, indirect calorimetry is not suitable for larger population based studies, as it requires substantial amounts of equipment. The studied population would not be able to be «free living», therefore making it unsuitable for measuring physical activity for several days with participants doing what they usually do (ibid).

2.4.2.3 Direct observation

Direct observation is considered one of the most practical and appropriate objective measure of physical activity and patterns (Sirard & Pate 2001). Direct observation could be done overt, i.e. the observed subject knows the purpose of the observation. It can also be done covert, which means the subject does not know the purpose of the observation. Furthermore, it could be done in a systematic way, by using standardized observational systems, resulting in quantitative data - as opposed to unstructured observation, which can investigate natural occurrences and provide qualitative data (Mckenzie, T. L. 2010). Some of the disadvantages of direct observation, are that it is quite expensive and time consuming. It also calls for a well-qualified and a trained observer in order to not affect the behavior of the participants(Mckenzie, T. L. 2010).

2.4.2.4 Hart rate

A heart rate monitor relies on the linear relationship between heart rate and oxygen consumption (Sirard & Pate 2001). However, there are some pitfalls. The relationship is not as good when it comes to lower intensities of physical activity (Iannotti et.al 2004). Sedentary behavior and light intensity activities can be affected by other physiological factors including, stress, caffeine, medications and anxiety (Sirard & Pate 2001).

Still, heart rate monitors are a proper and valid way to assess physical activity and activity patterns in free-living adolescents. It is discreet and small, lays a small burden upon both subjects and researchers, and is relatively cost effective for use in small to moderate population studies.

2.4.2.5 Pedometer

Pedometers are small devices often worn on the subject's hip. The pedometer gathers information about mileage walked or step counts. It has been tested for validity and reliability in several studies (Sirard & Pate 2001). Results indicate that pedometers could be suited for large scale population based studies of physical activity. They are relatively cheap, reusable and objective. However, they do not assess different intensities nor patterns of physical activity (ibid). Subjects could be used to take note of the number displayed on the pedometer several times a day in order to get more insight on physical activity patterns. This would, however, decrease objectivity as it relies on accurate transcription.

2.4.2.6 Accelerometer

The use of accelerometers has increased drastically over the last decades (Troiano, R.P 2005). The accelerometers are more advanced and sophisticated electronic devices that measure acceleration produced by bodily movement. Accelerometers have the ability to filter out all movements that appear non-human like. It uses piezoelectric transducers and microprocessors that convert recorded

accelerations to a quantifiable digital signal referred to as counts (Sirard & Pate 2001).

The accelerometer provides an objective, easy, relatively cost effective and reusable method for measuring of physical activity and patterns. It has the ability to identify intensity, duration and frequency (Hills, Mokhtar,& Byrne 2014). Furthermore, it does not require any specific effort from the subjects, only that they remember to wear it. Being small and robust, it ensures that children can carry on as usual.

The accelerometer has been tested for validity with positive results (Eklund et al 2001). However, there are things to consider when using accelerometers. One major weakness is the assessment of movement in the upper extremity such as throwing or weight lifting, in addition to cycling and swimming. Furthermore, when comparing old and new studies done with accelerometers, the modernization of the equipment may make them incomparable. Still, the three most recent Actigraph series of accelerometers are comparable (Robusto & Trost 2012).

2.5 Measuring cardiorespiratory fitness

Cardiorespiratory fitness could be defined as the ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity (Nieman, D. 2011). As mentioned earlier in this paper, CRF is considered health related, as low leves have been linked with a clear risk of premature death from all causes, especially hear disease later in life (ibid). Various methods for measuring CRF are developed. Which one to use, will depend on available resources, technology, participants and what kind of study is bein carried out. Direct measurements of oxygen uptake during max effort at a laboratory are considered as the best and most accurate method for measuring CRF. These test are most commonly completed on a treadmill or bicycle. However these methods are very time-consuming, expensive, and sets high demands for the professionals executing the tests. Luckily, several other tests has been developed for measuring CRF, which includes maximal

and submaximal testing on treadmills and bicycles, stair-climbing tests, regression equations and field testing. There are a wide number of different available tests for each of the before mentioned categories, however I will not go in detail on each and every one of them. However, the specific field test used un this study, was the Andersen-test, which is described in detail later.

2.6 Physical activity in adolescents

In order to better understand the factors influencing physical activity, ongoing research is essential. Wider understanding of the factors influencing physical activity, could assist in the development of new and more effective interventions. Individual determinants influencing physical activity includes; Biological/ genetic and psychological/behavioral. Furthermore the interpersonal determinants would include; Cultural, social and environmental factors (Stierlin et al 2015). All these determinants should be investigated more in depth.

Several studies have investigated the relationship between SES and Ethnicity and how it affects physical activity among adolescents. (Presented in table 2.0). However, Uijtdewilligen et al. review from 2011 conclude that too many studies investigating this, in general had poor methodological quality. (Uijtdewilligen et al. 2011). Therefore, more studies that objectively measure physical activity are needed. This will help strengthen the evidence base, and maybe bring forward new knowledge.

When looking at the existing evidence regarding SES and physical activity in adolescents, the findings are inconclusive. Still, one might say that there is a clear tendency leading towards the fact that higher SES is positively related with physical activity.

To strengthen and further establish the impact of SES, more studies conducted with high quality methodology are needed.

Ethnicity is another factor influencing physical activity. There are several studies conducted in this

area, and the evidence suggest that there is an association between ethnicity and reduced physical activity. (Uijtdewilligen et al 2011). Studies on both ethnicity and SES are provided in table 2.0

Table 2.0 Overview of studies conducted on SES/Ethnicity and physical activity.

Studies	Design	Sample and country	SES	Ethnicity	Physical activity measures	Results
Riddoch et al. (2007)	Cross-sectional	N = 5595 11 years England	Mothers education	NA	Actigraph accelerometer	Inconclusive evidence regarding SES and PA levels.
Borraccino et al. (2009)	Cross-sectional	N = 160 976 11 years 13 years 15 years 32 counties	FAS	NA	Questionnaire	SES was significantly associated with the amount of reported MVPA.
Jekauc et al. (2012)	Cross-sectional	N = 4529 4-17 years Germany	Education, income and profession	Questionnaire regarding nationality, country of birth, year of immigration of both parents.	Questionnaire	Socioeconomic status and ethnicity were significant predictors for compliance in girls, and residential area for compliance in boys
HUBRO (2002)	Cross-sectional	N = 7343 15 years Norway	Estimated economical standing	Questionnaire regarding parents country of birth	Questionnaire	Families with low income had higher prevalence of sedentary behavior. Minority girls were less active compared to Norwegian girls
Ung i Oslo (2015)	Cross-sectional	N = > 24 000 14-17 years Norway	Set score of several socioeconomic factors	Questionnaire regarding parents country of birth	Questionnaire	Ethnicity strongly affects PA. SES affects PA

Kolle et al (2012)	Cross-sectional / longitudinal	N = 3538 6 years 9 years 15 years Norway	Education, income,	Questionnaire regarding parents country of birth	Actigraph accelerometer	Ethnicity significantly affects PA. Inconclusive results regarding SES and PA
Brodersen et al (2006)	Longitudinal	N = 5863 11-12 years 15-16 years Englad	Area-based measure, the Townsend Index, derived from postal code information	Self-report as either; white, black or mixed black, Asian or mixed Asian	Questionnaire	Ethnic and SES differences are observed in physical activity and sedentary behaviour
Stalsberg & Pedersen (2010)	Systematic review	62 articles 13-18 years	Various assessments. Income, education, profession.	NA	Activity monitors and questionnaires	Support the hypothesis that there is an association between SES and physical activity among adolescents, and that adolescents with higher SES are more physically active than those with lower SES

FAS; Family affluence scale, SES; Socioeconomic status, PA; Physical activity, NA; Not Available, PAGL; Physical activity guidelines.

Evidence points in the direction that both SES and ethnicity plays a significant role in adolescents' everyday life, and especially physical activity patterns. Poorly integrated families could often end up with low SES. Physical activity and sports could and should be used as contributors for inclusion and integration. However, we still need to investigate this area further. Objectively measured PF and PAL will further strengthen the evidence base. Which in turn could be used as a theoretical background when future public health reforms are being prepared.

3.0 Methodology

This paper is based on data collected from an ongoing pilot study through the Norwegian school of sport sciences. (Testing and evaluation of models for physical activity for students in middle school). The study is carried out as a cross-sectional study, as it is the best way to map and describe status quo and for answering the research question. Differences in PAL and CRF amongst 9th graders, are the two factors which this paper is built upon. The cross-sectional study could and should quite easily provide representative data, as it opens up for substantial amounts of participants and good response rate. The use of standardized measuring methods ensuring reliability, and the selected population, if done correctly, validity. Moreover, it opens up for the use of sophisticated statistical computer software, such as SPSS. Which is a very useful tool for complex analyzing of data.

However, there are some pitfalls, as in any other methods. It is not possible to say anything about causality, as the study is done at a specific point in time. Furthermore, it is important to make sure that the studied population is properly defined, and that the selected participants were included in a satisfying way. Do the non-responders stand out in any way from the responders, and are the right measurement methods being used for what is being measured.

3.1 Material

As a part of my master I have participated in teams that field-tested adolescents in 9th grade, in both pre- and post-tests. Seven schools were invited to take part in the study, and a total of 707 students participated. Only data from the pre-tests are used for the results. The seven schools included in the study were spread out across Oslo and surrounding municipalities. Four out of seven schools were inside the municipality of Oslo, whereas Ski, Gjerdrum and Ramstad are located in the municipalities of; Ski, Gjerdrum and Bærum respectively.

3.1.1 Socioeconomic status, Andersen test & CPM

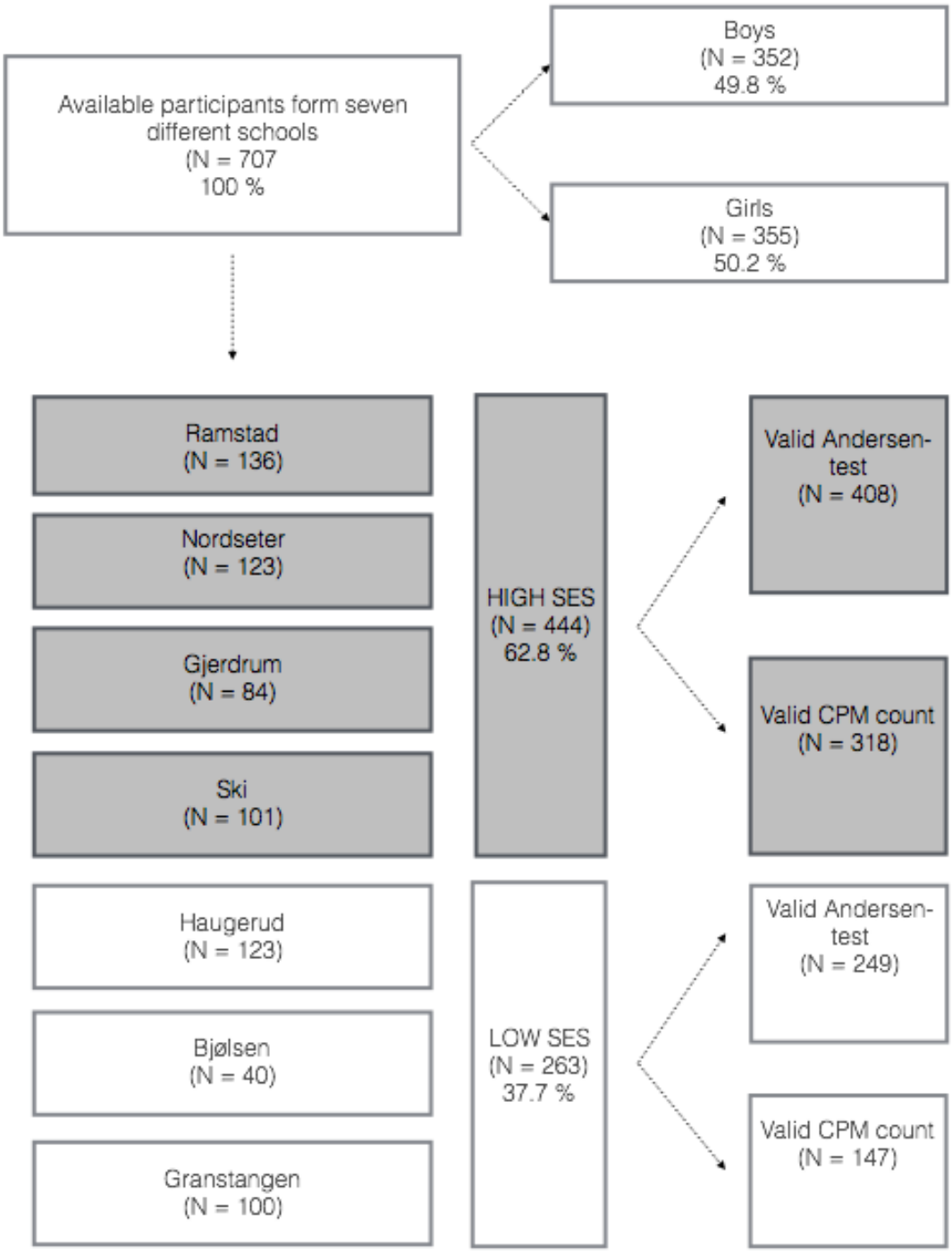

Figure 1.0 Flow chart displaying available participants relative to SES, and valid results on the Andersen-test and accelerometer data.

3.1.2 Ethnicity, Andersen-test and CPM

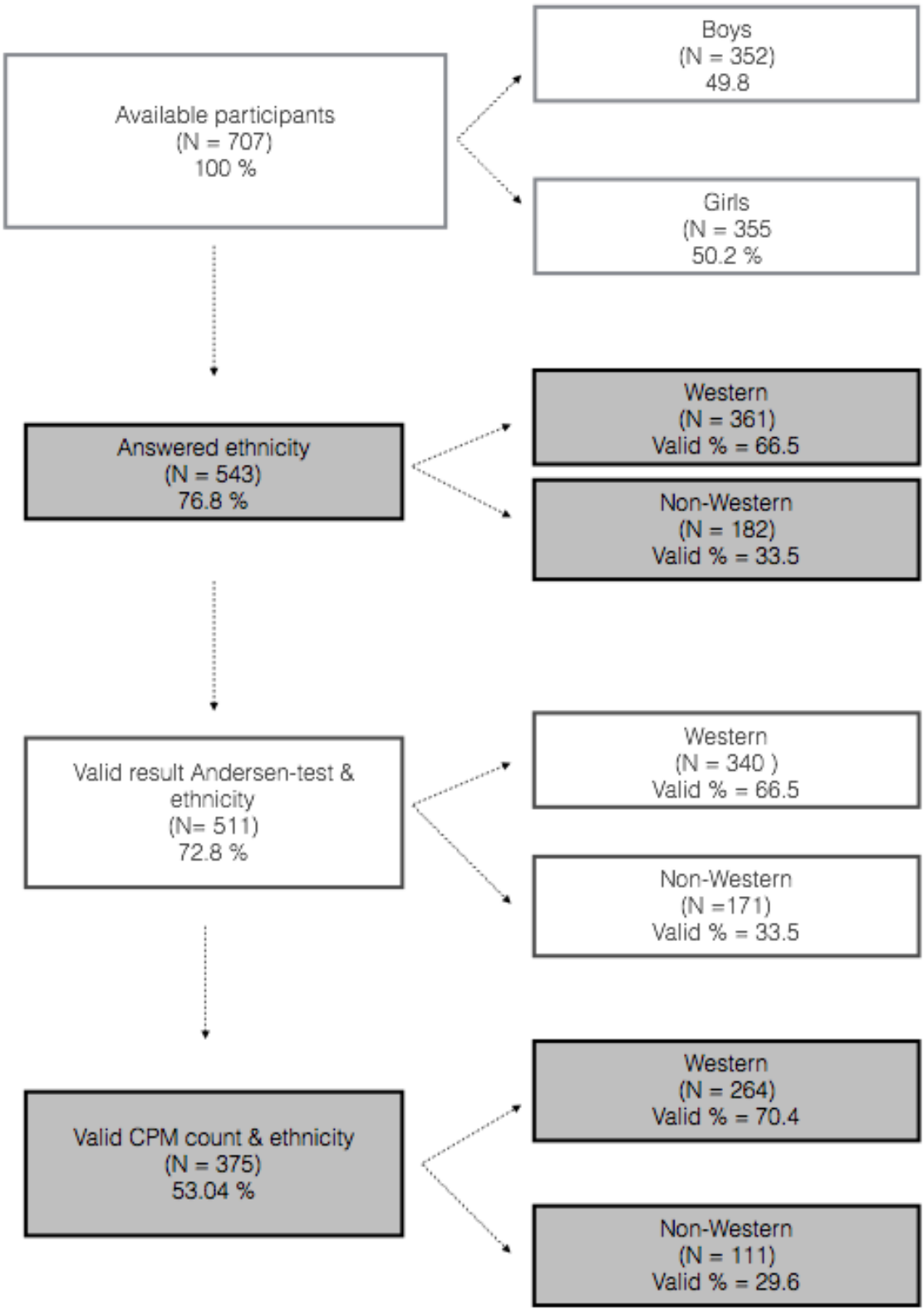

Figure 2.0 Flow chart displaying available participants relative to Ethnicity, and valid results on the Andersen-test and accelerometer data.

3.2 Inclusion criteria

To ensure that the participants in this study end up in the four right target groups, some inclusion criteria had to be met.

- Identified ethnicity on the questionnaire
- Valid result on the Andersen-test.
- Minimum one valid day with the accelerometer.
- Written consent

Only data from pre-tests from the pilot study are analyzed in this paper. Out of all the available participants, four groups were created (figure 1.0 & 2.0). Two groups formed on the basis of socioeconomic status (high & low), and two more based on ethnicity (western & non-western). From now on referred to as high socioeconomic status (HS), low socioeconomic (LS), western ethnicity (W) and non-western ethnicity (NW).

3.3 Collection of data

All included tests in this study are school based, and were completed during schools hours in all the respective schools. Several experienced testers were sent out to the schools in order to gather data and monitor the tests, ensuring that everything worked out accordingly. The included population for this project had to undergo three different tests:

- Accelerometer
- Andersen-test
- Questionnaire regarding ethnicity

These tests will be elaborated on next.

3.3.1 Accelerometer data (Actigraph gt3x+)

For the objective measurement of physical activity levels, accelerometers was used. All participants were given an accelerometer, and asked to wear them for one week, or at least as much as possible.

The Actigraph (Pensacola, FL) activity monitors have been, and are, widely used in large population studies for the objective assessment of physical activity. It is a better way of collecting date compared to self-report methods. Self-report methods will often have limitations such as problems of recall and reporting bias. During the past decades, activity monitors have developed, with changes made to hardware and firmware, making in a suitable option. Therefore, accelerometers have been the preferred measuring instrument in large population based studies for objective measurement of physical activity for years. Technology has rapidly evolved over time, leading to the continuous development of different activity monitors (Ried-Larsen. Et al 2012). To obtain and measure physical activity levels in this study we have chosen the ActiGraph accelerometer (modell GT3X+) (ActiGraph, LLC, Pensacola, Florida, USA). All the participants were asked to wear it for seven complete days from morning to night, only taking it off during showers. In order for data to be considered valid and used, the participants had to wear the accelerometer for at least one day.

Accelerometer-based activity monitors are small devices most often worn on a person's hip or wrist to quantify physical activity. In this study, the participants were asked to place it on the right hip. Experienced test personnel handed out the accelerometers, with detailed explanations regarding the usage. The GTX3+ is small and robust, ensuring that the participants can wear it without it interrupting their natural activity patterns. The accelerometer picks up on all movements, and even filters out what would be considered inhuman.

The ActiGraph GT3X+ is a triaxial accelerometer capable of sampling up to 100 Hz. It provides access to the raw triaxial acceleration data, allowing for analysis of accelerations not only in the vertical direction but also in the anterior/posterior direction. (Neugebauer et al 2014). In brief the mechanical set up consists of two rotational wheels rotating in the vertical plane at a constant angular velocity. The wheels are connected with a connection rod (CR) and driven by an electric motor. The CR is attached away from the center of the rotational wheels. The monitors were firmly secured on a plate attached to the CR. This produces positive and negative accelerations in the vertical plane. (Grydeland et al 2014)

Raw data from the accelerometer are called counts, and the measurement for PAL in this paper is counts per minte (CPM). CPM is the sum of all acceleration the accelerometer has been exposed to, divided on minutes it has been used. I.e. a high number of CPM reflects a high mean PAL. Whereas lower CPM indicate a lower PAL.

The actual treatment of raw accelerometer data was done by experienced members of the original pilot study, with custom software (Propero, Southern Denmark University, Denmark)

3.3.2 Andersen-test & Cardiorespiratory fitness.

Health related physical fitness is in this study measured by aerobic capacity. When measuring aerobic capacity for the participants the Andersen-test was applied. The test is validated for this age group (Andersen et.al 2008 & Aadland et.al 2014). At the same time, the Andersen-test is cheap, requires small amounts of equipment and can handle a considerable amount of individuals per testing (Aadland et.al 2014). Finally, young participants seem to like the test. Direct VO2peak/max measurements are often not feasible for younger adolescents, making indirect tests such as the Andersen-test more suitable (Aadland et.al 2014). The intermittent type of work and the knowledge of how quickly it is finished, may motivate them. Considering motivation is an important part of collecting reliable test results, this is a big advantage.

In order to implement the test you only need a regular gymnasium. The test procedure is described next.

Two parallel lines are measured up, twenty meters apart in an ordinary gym hall. The participants run back and forth from one line to the other touching the floor behind the line with one hand, at the same time ensuring both of their legs crosses the line in every «lap». The test goes on for ten minutes, with fifteen seconds of running and fifteen seconds of rest. Every time the test leader whistles they start and stop running as fast as possible. (The actual stopping usually takes a couple of steps, therefore they were asked to take two steps back every time they stopped.) The participants are encouraged to run as fast as possible (in meters) during the ten minutes of the test. This final distance is also the test result.

The participants receive no encouragement the first six minutes of the test, nevertheless they are encouraged by the test crew the final four minutes.

3.3.3 Questionnaire and Ethnicity

Information about the participants ethnicity was collected through a questionnaire developed for the original study. The participants were asked where they were born, and the same question regarding their parents. Immigrants was defined as participants with two parents born outside of Norway. For the purpose of this paper ethnicity were divided into two groups, western and non-western. Immigrants from Asia, Africa, Latin-America and Eastern Europe outside the EU are described as non-western. The rest were referred to as westerners, given that they responded sufficiently on questions regarding ethnicity.

3.3.4 Socioeconomic status

SES is derived from earlier developed sociodemographic data from different neighborhoods in the municipality of Oslo and surrounding areas. Furthermore, the participants where addressed to the districts of their respective schools

The basis for the separation of socioeconomic status is portrayed in table 3.0. The results are seen in table 4.0. Family income, education and life-expectancy are all factors associated with SES.(d ´Errico. A 2017), and are therefore used in the following grouping of SES.

Table 3.0 Description of socioeconomic factors from the areas of the respective schools

	inhabitants (2015)	Median Income (2014) Mean income (2014)	Education at University. short/long. (2015)	Life expectancy (2001-2015) + (2011-2015)	Non western immigrants** (2015)
Bærum	120 685	Median 593 000	short = 31.2 %* long = 19.9 %*	**M = 80.4** **F = 84.3**	**9 %**
Nordstrand	49 428	Mean 543 000 Median 523 000	short = 30.79 %* long = 16.70 %*	**M = 79.5** **F = 83.6** M = 81.6 F = 84.4	**8 %**
Gjerdrum	6 326	Median 599 000	short = 22.4 %* long = 7.0 %*	**M = 80.0** **F = 83.2**	**3 %**
Sagene	39 918	Mean 421 000 Median 390 000	short = 35.65 %* long = 24.41 %*	**M = 72.5** **F = 79.5** M = 74.8 F = 81.2	**15 %**
Stovner	31 669	Mean 349 000 Median 436 000	short = 16.97 %* long = 6.08 %*	**M = 77.4** **F = 81.7** M = 79.6 F = 83.3	**46 %**
Alna	48 770	Mean 358 000 Median 420 000	short = 20.73 %* long = 7.96 %*	**M = 77.6** **F = 81.2** M = 78.7 K = 82.2	**44 %**
Ski	29 775	Median 575 000	short = 25.6 %* long = 9.7 %*	**M = 79,9** **K = 83.5**	**7 %**

Data extracted from «Oslo kommune - statistikkbanken». Located at http://statistikkbanken.oslo.kommune.no/webview/index.jsp?catalog=http%3A%2F%2F192.168.101.44%3A80%2Fobj%2FfCatalog%2FCatalog57&submode=catalog&mode=documentation&top=yes, https://www.ssb.no/statistikkbanken & http://khs.fhi.no/webview/

*percent calculated from numbers of inhabitants over 16 years of age in 2015.

** Immigrants from; Asia, Africa, Latin-America and eastern Europe outside the EU.

Table 4.0 Overview of schools (areas) relative to socioeconomic status

High socioeconomic status areas (HS)	Low socioeconomic status (LS)
Ski	Sagene
Nordseter	Stovner
Gjerdrum	Alna
Bærum	

3.4 Ethics

The Helsinki declaration is a set of ethical guidelines developed in 1946 by the world medical association. (WMA 2013). The purpose of the guidelines are to ensure that studies conducted on humans are done in a correct way. Furthermore the guidelines ensures protection of the studied participants. This research has been conducted in accordance with the Helsinki declarations guidelines.

All who participated in this study, did so by their own free will. Due to the adolescents' young age, a written consent from their parents was needed in order to be included in the project. They were told that they could withdraw from the project at any time, without having to explain themselves. Every step of the project was then thoroughly explained, ensuring the participants knew what they were committing to and how the procedures would work. Information regarding the participants' identity were treated confidentially.

The before mentioned project executed by the Norwegian school of sports sciences got all the data form the Norwegian Centre for Research Data

3.5 Processing of data material

For data processing and statistical analysis in this paper, the software package SPSS (Statistical Package for Social Sciences), version 24.0 was used.

3.5.1 Statistical analysis

First the two variables, Andersen-test and CPM, were tested for normal distribution within the categories Ethnicity and SES using the Kolmogorov-Smirnov test of normality. Despite the fact that all the variables was not normal distributed, the data was treated as if they were. This is due to the central limit theorem (CLT). The CLT states;

«that for non-normal data, the distribution of the sample means has an approximate normal distribution, no matter what the distribution of the original data looks like, as long as the sample size is large enough (usually at least 30) and all samples have the same size. According to Central Limit Theorem (CLT), even if the distribution of the variable x is not normal, when the sample size is 30 or greater, the distribution of the sample mean x is normally distributed» (O´Donoghue 2013)

Independent sample t-tests were used for the comparisons of means and finding significant differences within the two groups and their respective subgroups (HS, LS, NW & W). Cross tabulation was used to investigate the distribution of sex amongst the four groups. Additionally, multiple regression analysis were done in order to estimate the relationship between the variables. I.e, ethnicity, SES and gender relative to CRF and PA. The results are presented as mean (SD).

4.0 RESULTS

4.1 Selection

The participants in this study are adolescents currently in 9th grade from seven different schools in Oslo and surrounding regions. The total amount of participants were 707, with 352 boys and 355 girls. After sorting out those who did not answer the questionnaire about ethnicity, nor participated in the Andersen-test or wore the accelerometer sufficiently, 511 & 375 participants remained as the fulfilled study population, for respectively the Andersen-test and CPM count. In the group based on SES, 657 and 465 participants remained fulfilling the inclusion criteria for the Andersen-test and CPM count respectively. The results will be presented under two different topics. Starting with the results from the Andersen-test, followed by the accelerometer data. Bar graphs will illustrate mean meters (SD) within, and between the groups, supplied with additional results from the t-test which identifies the mean differences. Finally, results from the multiple regression analysis and an overview of how number of valid days with the accelerometer influences the results will be presented. Ethnicity is divided into two groups, Western (W) and Non-Western (NW). The same is done with socioeconomic status, high SES (HS) and low SES (LS). In addition sex is included for in all the analyses.

4.2 Cross tabulation. Gender within the groups.

The gender distribution within both groups of SES and ethnicity is more or less evenly divided. A small majority of girls is observed in the LS and NW group, while a majority of boys was seen in the HS and W. The precise distribution of gender within the different groups studied in this paper is presented in table 5.0 and 6.0.

Table 5.0 The distribution of sex within the different groups of socio economic status

			SES		
			HS	**LS**	**Total**
Gender	F	Count	197	131	328
		% within SES	48,2 %	52,4 %	49,8 %
	M	Count	212	119	331
		% within SES	51,8 %	47,6 %	50,2 %

SES, socioeconomic status; HS, high socioeconomic status; LS, low socioeconomic status; F, female; M, male.

Table 6.0 Showing the distribution of sex within the different groups of ethnicity

			Ethnicity		
			W	**NW**	**Total**
Gender	F	Count	168	87	255
		% within ethnicity	49,3 %	50,6 %	49,7 %
	M	Count	173	85	258
		% within ethnicity	50,7 %	49,4 %	50,3 %

W, western; NW, non-western; F, female; M, male.

4.3 Cardiorespiratory fitness, socioeconomic status and ethnicity

Presented in figure 3.0 are the results from the Andersen-test relative to ethnicity, SES and sex. CRF varies significantly within all measured groups. On average the W group ran 85.1 meters (95% CI: 65.4, 104.9) further than the NW group ($p < 0.001$). The HS group ran 99.8 meters (95% CI: 83.3, 116.2) more than LS ($p < 0.001$). Finally, boys ran 74.8 meters (95% CI: 58.2, 91.5) more compared to girls. ($p < 0.001$).

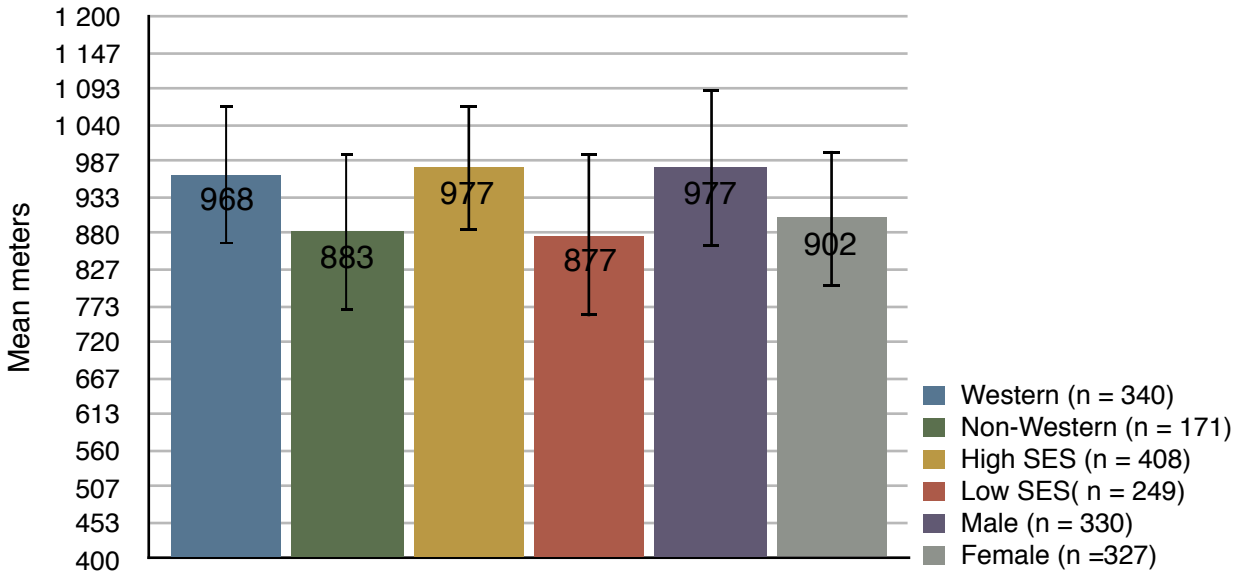

Figure 3.0 Overview of meters ran on the Andersen test relative to the different groups

Values are presented as mean (± SD)

4.4 Physical activity levels socioeconomic status and ethnicity.

Figure 4.0 displays the accelerometer data relative to the three different groups, measured as CPM. The largest gap is seen between boys and girls, with boys averaging 92.2 CPM (95% CI: 59.0, 125,5) more compared to girls ($p < 0.001$). The HS registered 47.7 CPM (95% CI: 11.2, 84.2) more than the LS group on average ($p = 0.011$), whereas the W group on average registered 48.8 CPM (95% CI: 9.2, 88,4) more compared to the NW ($p = 0.016$).

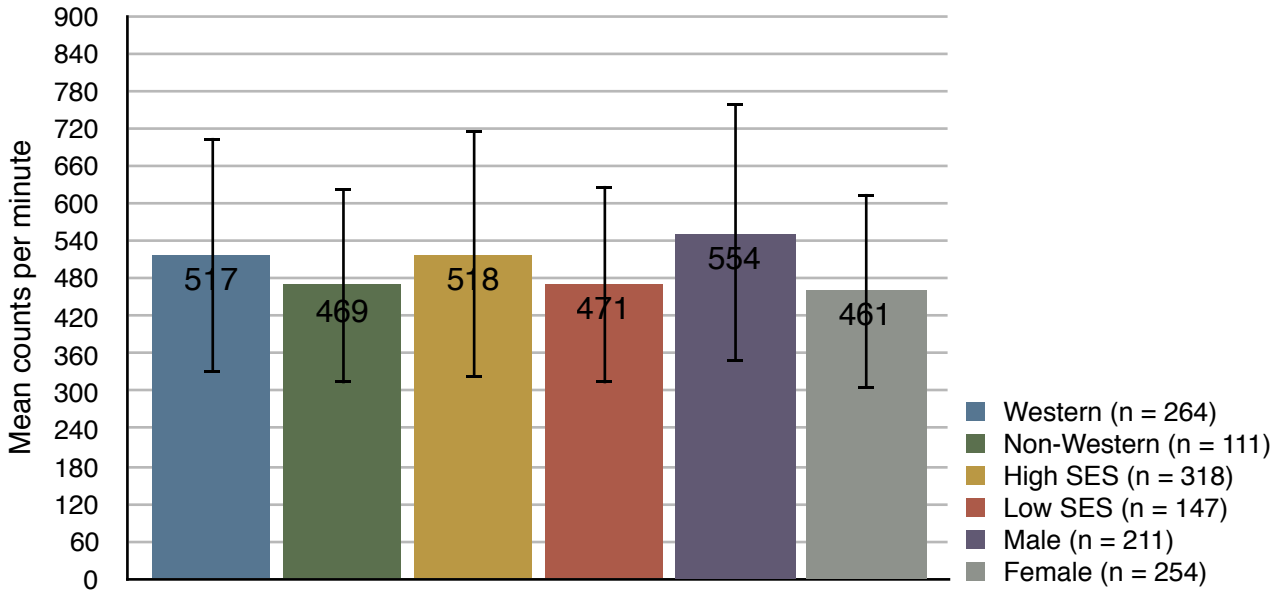

Figure 4.0 Overview of counts per minute relative to the different groups.

Values are presented as mean (± SD)

4.7 Multiple regression.

Ethnicity, SES and gender, together accounts for 6.6% of the variance in CPM, and 27,3% of the variance the results on the Andersen-test. Portrayed in table 7.0 the results from the multiple regression analysis. When all the independent variables are controlled for each other, i.e. ethnicity, SES and gender, significant differences in physical activity levels measured from the accelerometer is only apparent within gender ($p = 0.000$), and not SES ($p = 0.510$) and ethnicity ($p = 0.194$)

Cardiorespiratory fitness however is significantly associated by all three independent variables ($p \leq 0.001$). Living in areas of high socioeconomic status positively affects CRF. Adolescents of HS were running 70,3 meters more on average compared to those of LS. Non-westerners have poorer CRF compared to westerners, averaging on 38 meters less compared to westerners

Table 7.0 portrays the differences within all groups relative to the Andersen-test and accelerometer data from multiple regression analysis.
Values are mean and 95% confidence interval

	CRF - Andersen-test (meter)		**PAL - Accelerometer data (CPM)**	
	Unstandardized coefficients B (95% CI)	p-value	Unstandardized coefficients B (95% CI)	p-value
Ethnicity (NW - W)	38.0 (14.7 - 61.3)	0,001	32,4 (16.5 - 81.2)	0,194
SES LS - HS	70,3 (47.9 - 92.7)	0,000	15,7 (31.2 - 62.7)	0,510
Gender F - M	68,5 (51.6 - 85.5)	0,000	85.0 (49.6 - 120.5)	0,000

Sig, Significant; NS, not significant; SES, Socioeconomic status; CPM, counts per minute; NW, non-western; W, western; LS, low socioeconomic status; HS, high socioeconomic status; F, female; M, male

5.0 Discussion

5.1 Summary of the results

Amongst adolescents in Oslo and surrounding areas, significant differences in both CRF and PAL were identified within both socioeconomic status and ethnicity when measured with the Andersen-test and accelerometers (p-value < 0.05). Boys ran on average 7.66% longer than girls, W ran 8,8% further than NW and those of HS ran 10,2 % more compared to those of LS. Furthermore, boys were 16.66% more active compared to girls. W 9,43% more active than NW, and those of HS were 9,2% more active compared to those of LS.

However results from the multiple regression analysis shows that when SES, ethnicity and sex are controlled for each other, significant differences is only detected in CRF. Significant differences in PAL were only identified within gender.

5.2 Discussion of methodology

5.2.1 Study design

As study-designs relate heavily on the nature of the research question, the first important step is to decide on what kind of information you need. The purpose of this paper was to investigate if SES and ethnicity has any associations with CRF and PAL in 9th grader in Oslo. The benefits of the cross-sectional design is that it opens for comparisons of many variables at the same time. As in this paper, 9th graders, SES and ethnicity in relation to CRF and PAL, with little or no additional cost. The study method is defined by the feature that it can compare different populations and multiple variables at a single point in time. However there are some limitations to this design as well. It does not provide definite information about cause-and-effect relationships.

5.2.2 Selection

The studied population of this study was a large selection of 9th grader from 7 different schools in Oslo, and surrounding municipalities. Even though there is no exact consensus on needed participation rates, somewhere in between 60-75 % should be considered adequate (Halvorsen, 2008).

A total of 707 participants partook in this study. Four schools were categorized as HS (n = 444) category, and three schools as LS (n = 263). 76.8% of the participants answered on ethnicity (n = 543). The participation rate was significantly higher on the Andersen-test, compared to the waring the accelerometer. Overall 94,1 and 92,9% partook on the Andersen-test within ethnicity and SES respectively. Sufficient participation rates was also observed for the measurements of PAL, with 69.1% for ethnicity and 65,8% for SES. This should be considered sufficient for generalization, as it is well above 60 %, set a a minimum requirement by Halvorsen 2008.

5.2.3 Questionnaire and ethnicity

In order to categorize ethnicity, participants in this study where asked if their parents were born in Norway. If not from Norway, the followup question asked where were their parents were born. However we have noe data on the grandparents of the participants, and therefor no data on how long they have lived in Norway. A total of 66 counties were represented in this study. All countries were manually categorized as either western or non-western. 76.8% (n = 543) of the subjects answered regarding ethnicity, which should be considered sufficient. 66,5% of those who answered was categorized as westerners, and 33,5% as non-westerners. Non-westerners includes; Eastern Europe outside the EU, Asia, Africa and Latin-America.

The vast majority of non-westerners were addressed to schools in LS areas. This is most likely due to the fact that areas which have the highest immigrant densities are also the ones with lower SES. (SSB 2015 & NOVA 8/15)

When developing and using questionnaires, the content must be understandable for the targeted population. Ethnic minority groups could have trouble understanding the questionnaires, leading to misinterpretation and a raised number of non-responders. Furthermore, when operating with broad categories such as western and non-western, we must be careful when generalizing. Immigrants come from continents all across the world. It is important to mention the huge verity within such broad terms of immigrants. The Oslo Immigrant Health Profile (OIHP) show that there are a considerable diversity within western immigrants, as well as non-western when in comes to health. Therefore we should not see immigrants as a homogenous group. (Kumar et al 2008)

5.2.4 Socioeconomic status

SES is a theoretical construct including individual, family, district or societal access to resources. Normally it is conceptualized as a combination of economic, social and work status, measured by income, education and occupation (Psaki et al 2014).

SES is in this paper measured on the basis of mean and median income, education, and life expectancy. All the participants were addressed to their respective schools and it´s surrounding district. Several epidemiological studies look at SES and it affect on PA. However there is a wide spread on the measurements used. There is no standardized approach when comparing SES across multiple sites in epidemiological studies, which give cause for concern when it comes to comparisons (Psaki et al 2014) Current income, allows access to material goods and services that could influence health. However it is age dependent, more unstable measure compared to education or occupation and have higher non-response rate compared to other measurements (Shavers 2007). Furthermore, income is in this paper is based on the average income of specific districts within the city of Oslo, and not the actual individuals.. This could be considered as a weakness, as it is possible to obtain income for the actual studied population, which in turn wold bring forth more accurate numbers and interpretations.

Education is easy and practical to measure, it excludes few members considering populations, education is also quite stable after early adulthood and it is one of the socioeconomic measures most likely to capture aspects of lifestyle and behavior, as higher education is often predicative of better jobs, housing, neighborhoods and income (ibid). Limitations including only education includes; Lack of knowledge of cognitive, material, social and psychological resources gained through education over the life course makes it difficult to understand the educational link to health and to effectively design appropriate interventions, economic returns may differ significantly across racial/ethnic and gender groups, and it has different social meanings and consequences in different periods and cultures (ibid). Again, that fact that the numbers concerning education, are not from the actual studied population, but rather averages from the district of the schools could raise concerns, as it affects the validity.

Oslo is a city with substantial differences amongst the different districts. In this paper SES is based on three factors; income, education and life expectancy, which is considered as strong measurements (Crimmins et al. 2004). However, the fact that the methodology concerning participants SES in in this paper is based on averages on group level, assumed area of residence, and not individual data could be considered a weakness.

5.2.5 Measurement of physical fitness and physical activity levels

The objective assessment of CRF and PAL, i.e Andersen-test and accelerometer , in 9th grader is one of the strengths of this study. Both methods are validated for measuring PA and CRF. (Eklund et al, Andersen et.al 2008 & Aadland et.al 2014).

The Andersen-test is i suitable substitute for more accurate criterion measures such as maximal (peak) oxygen consumption measured to voluntary exhaustion on treadmills ore bicycles, which even tough more accurate - is time consuming expensive and not suitable for large samples of adolescents. One of the setbacks assessing CRF from the Andersen-test is that for most adolescents, the test-protocol is new. A significant increase in meters ran is seen from test one to test two, however no further increase were detected in the third run. This could be due to the fact that for adolescents who have never tired an intermitted running test before, might find in difficult to distribute their capacity accordingly, and therefore, either start to hard, or ending the test without reading full exhaustion. Therefore, it could be advisable to perform two test, at least when converting results into vo2max. In this study however, meter ran was the determinant of CRF. The test protocol was accurately explained, and the subjects also tried it during warm up.

Participation rates on the Andersen-test was more than sufficient. Above 90% within all groups of SES, ethnicity and gender partook on the testing, with valid results. This ensures a representative selection, and generalizability in the results. Even though the Andersen-test is a good way for assessing CRF in young adolescents, the participants are still asked to give it their best. They are encouraged to take it all out. Difficulties regarding language could cause confusion as to how correctly perform the test. Instructions are given through out the test, and the participants should understand it all, if the test is to be carried out correctly. Furthermore, the test will «favor» those who know how to run. For those not used to running, the test could be considered more difficult. Finally, the term take it all out is not as easy for everyone to understand, those with more knowledge towards running and training are more likely to end up near total exhaustion.

Accelerometer are the preferred tool for assessing physical activity patterns in large-scale studies. As explained earlier, the accelerometer has some limits regarding upper body movement, it can not distinguish wether a subject is carrying any extra weight, thus increasing the workload and intensity (Lee & Shiroma 2014). The most commonly used criteria for the accelerometer is to wear it eight hours per day, for at least three days (Toftager et al 2013), although this is not standardized. Eight hours a day for at least two days were used for the UngKan2, in Norway. (Kolle et al 2012). Due to the prioritization of number of subjects, all those who wore the accelerometer one or more days, for at least eight hours were included. This could be considered as a weakness in this study. Although, no more than eight percent of the participants wore the accelerometer for only one day.

Participation rates for the accelerometer was, as mentioned, significantly lower that on the Andersen-test. Even though the overall participation rate was 69,06 % for ethnicity and 65 % for SES, there were some subgroups standing out. Especially LS with as little as 55.89% participation. However, the especially low participation rate for the LS group was due to technical problems with the accelerometer, and therefor totally random.

Furthermore, significantly lower levels of participation was also observed for boys and NW, with 59,94% and 60.99% respectively. This causes for concern. Lower participation rates such as those observed here, do not have the same statistical strength nor generalizability.

5.3 Discussion of results

5.3.1 Physical fitness, physical activity levels & and socioeconomic status

No significant differences was found within SES and PAL when all other factors were accounted for, i.e. ethnicity and gender. This might be due to the low participation rate of those in LS, 55,89%, compared to 71,66 in the HS group. Those of lower SES could be associated with lower self-esteem and motivation (NOVA 8/15). This would again mean that those who actually partook in the accelerometer measurements, providing valid data, represent a fictive and improved version of what the group should look like. On the other side, the low participation rate in the LS group was random. But again, such low rates of participation should be interpreted with caution.

However, it could be, that in this particular studie SES is not a very strong indicator of PAL, or that the methods used for assessing SES ar inaccurate. Several studies carried out with accelerometers have concluded with this (Kolle et al 2012, Riddoch et al 2007). Keeping in mind the differences in age, and methods for measuring SES.

Physical fitness however, was significantly affected by SES. The results indicate that subjects from areas of high SES have improved CRF compared to those form low SES areas. This matches the results seen in other studies (Stalsberg & Pedersen 2010, Brodersen et al. 2006, Andersen & Bakken 2015 and HUBRO 2002).

5.3.2 Physical fitness, Physical activity levels & ethnicity.

No association between PAL and ethnicity were found when controlled for SES and gender. There are similarities in the participation rate within ethnicity when compared to SES. The NW group had low participation in regards to accelerometer measures, 60.99%, whereas the almost 75% partook in the W group. Even though the participation could be considered sufficient in regards to just reaching recommended levels (Halvorsen 2008). Several studies have reported lower levels of physical activity on minority groups, (Kolle et al 2012, Brodersen et al. 2006, Andersen & Bakken).

The NW group who participated in the accelerometer measurements is relatively small (n = 111), compared to W (n = 264), underlining the importance that they should be interpreted with caution. Furthermore, the relatively low participation rates, strengthen this assumption. With the knowledge of minority groups and their association to lower PAL, in addition to huge variations within, it could be plausible that the subjects committing to the accelerometer measurements, are those more active (Kumar et al 2008). It is curious that the LS and NS groups are the ones with much lower participation rates

Associations between ethnicity and CRF was observed, even after controlling for SES and gender. The NW immigrants in Oslo are less physically fit, compared to westerners. These results are similar to other studies carried out in Oslo (Kolle et.al, Kumar et al 2008 and Andersen & Bakken 2015)

6.0 Further studies

Further studies should look into the huge varieties within groups categorized as Non-Western. As mentioned, this groups are not homogeneous, and the differences within would be interesting to investigate further. In addition to this, earlier studies shows that is is especially girls who are affected by SES and ethnicity. Finally, the participants ending up in the LS category in this paper comes are addressed to areas with significantly higher immigrant density, meaning the two groups could be to similar. How are Non-Western immigrants doing, in relation to PAL and CRF in areas of high socioeconomic status? And how are are «Westerners» in areas of low socioeconomic status.

7.0 Conclusion

This study shows that both socioeconomic differences, and ethnicity affects physical fitness in the young population from Oslo and surrounding municipalities. Adolescents from areas with low SES have poorer physical fitness, compared to those from high SES areas. Furthermore, Norwegians and western immigrants are more physically fit, compared to non-western immigrants.

No associations were found for ethnicity or SES in relation to physical activity levels.

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