How active are Swedish 50-64 year olds?

- A quantitative study investigating physical activity and sedentary behaviour in 50-64 year old men and women from Gothenburg.

Line Røddik Hansen
Hur aktiva är svenska 50-64 åringar?

- En kvantitativ studie som undersöker fysisk aktivitet och stillasittande beteende hos 50-64 åriga män och kvinnor i Göteborg.

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Examensarbeta avancerad nivå 2:2015
Masterprogrammet: 2013-2015
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Abstract

Aim
The main aim of this thesis is to examine the physical activity patterns (PA), including sedentary behaviour (SB), in Swedish middle-aged men and women (50-64 years) by using an objective measurement method (accelerometer) and to analyse differences in gender, age-groups and education level (EL). The thesis also analyses the proportion of the present population that is fulfilling the national recommendations of physical activity (MVPA).

Method
The study cohort consisted of 948 participants (51% women, median age 57.5 years) from the SCAPIS pilot study. The participants wore an accelerometer for seven days collecting data concerning PA patterns and SB. The following tests for analysing the data were used: Mann Whitney U test, 2-sample z-test, Wilcoxon matched pair test, and General linear modelling (mixed model ANOVA).

Results
The main findings showed that the study population spent a median of 60.5% in sedentary (SED), 35.2% in light intensity physical activity (LIPA) and 3.9% in moderate-to-vigorous intensity physical activity (MVPA). On average, 8 hours and 40 min were spent sitting during the day with more than three hours in prolonged bouts (>20 min). Men and the high EL group spent more time in SED, less time in LIPA and more time in MVPA compared with women and the low EL group. The study population was sitting more and had less time in LIPA during weekdays compared to weekends. The same pattern was seen for the high EL group, who compared to low EL group was sitting more and having more time in LIPA during weekdays, but spent more time in MVPA during weekends. The oldest age-group spent less time in MVPA and total movement (cpm), compared to the younger age-groups. Only 7.1% of the study population was fulfilling the national PA recommendation of 30 min MVPA to be done in bouts of 10 min on most of the days of the week.

Conclusions
The study showed that only a small part of the population was fulfilling the current PA recommendations, and that the middle-aged population had a high daily sitting time. A big challenge for the future will be how to change these habits. The focus of replacing the SED with more LIPA during the day will be important and the study showed that the biggest challenge could be during weekdays.
Sammanfattning

Syfte
Syftet var att undersöka det fysiska aktivitetsmönstret, inklusive det stillasittande beteendet, hos svenska medelålders män och kvinnor (50-64 år) registrerat via objektiv mätmetod (accelerometri) och analysera eventuella skillnader i rörelsemönstret mellan könen, åldersgrupper och utbildningsnivåer. Dessutom analyserades hur stor andel av studiepopulationen som uppfyllde de nationella fysiska aktivitetsrekomendationerna.

Metod
Studien bestod av 948 deltagare (51% kvinnor, medelålder 57.5 år) från SCAPIS pilotstudie. Deltagarna bar under sju dagar en accelerometer för att samla in information om det fysiska aktivitetsmönstret och det stillasittande beteendet. Följande tests gjordes för analys av datan: Mann Whitney U test, 2-sample z-test, Wilcoxon matched pair test och General Linear Modelling (flervägs ANOVA).

Resultat
Huvudresultaten visade att studiedeltagarna spenderade 60.5% av tiden i stillasittande (SED), 35.2% i lågintensiv aktivitet (LIPA) och 3.9% i medel till högintensiv aktivitet (MVPA). I genomsnitt var deltagarna stillasittande 8 timmar och 40 minuter under dagen, varav ungefär 3 timmar av dessa var i längre, sammanhängande perioder (minst 20 minuter åt gången). Män och deltagare med hög utbildningsnivå tillbringade mer tid i SED, mindre tid i LIPA och mer tid i MVPA jämfört med kvinnorna och gruppen med låg utbildningsnivå. Hela studiepopulationen spenderade större andel av dagen sittande och hade mindre tid i LIPA under vardagar jämfört med helger. Liknande mönster fanns i gruppen högutbildade, vilka jämfört med lågt utbildade satt mer och hade mindre tid i LIPA under vardagar, men däremot tillbringade mer tid i MVPA under helgerna. Den äldsta åldersgruppen tillbringade mindre tid i MVPA och total rörelse jämfört med de yngre åldersgrupperna. Enbart 7.1% av studiepopulationen uppfyllde nuvarande nationella aktivitetsrekommander om MVPA i perioder av minst 10 min under de flesta av veckans dagar.

Slutsats
Studien visade att endast en liten del av studiepopulationen uppfyllde de nuvarande nationella rekommendationerna och att en stor del av dagen spenderades sittande. En stor utmaning för framtiden kommer att vara hur dessa vanor kan förändras. Fokus på att ersätta SED med mer LIPA under dagen kommer att vara viktig.
# Table of contents

List of abbreviations .................................................................................................................. 1  

1 Introduction ........................................................................................................................................................................ 2
  1.1 Background ........................................................................................................................................................................... 2
    1.1.1 Physical Activity .............................................................................................................................................................. 2
  1.1.2 Sedentary Behaviour ......................................................................................................................................................... 3
    1.1.3 Recommendations ........................................................................................................................................................... 4
  1.2 Measurements of Physical Activity and Sedentary Behaviour ............................................................ 4
  1.3 Levels of Physical Activity and Sedentary Behaviour .................................................................... 6
    1.3.1 Time in Moderate-to-Vigorous Intensity Physical Activity and Fulfilment of PA Recommendations .......................................................................................................................................................................................... 8
  1.4 More Research is Needed ......................................................................................................................... 9

2 Hypothesis ........................................................................................................................................................................ 10

3. Project Aims ................................................................................................................................................................... 10

4. Materials and Methods ................................................................................................................................. 11
  4.1 Ethics ......................................................................................................................................................................................... 12
  4.2 Methodological Choice ....................................................................................................................................................... 12
  4.3 Study Population and Selection .............................................................................................................................. 13
  4.4 Study Procedure ............................................................................................................................................................... 14
  4.4.1 Measurement and Data Processing .................................................. 15
    4.4.1.1 Measurement and Data Processing of the Accelerometer .... 15
  4.4.2 Other Measurements ...................................................................................................................................................... 17
  4.5 Data Analysis and Presentation ......................................................................................................................... 18
  4.6 Validity and Reliability .................................................................................................................................................... 20

5. Results ......................................................................................................................................................................... 21
  5.1 Study Population ............................................................................................................................................................... 21
  5.2 Physical Activity Patterns .............................................................................................................................................. 22
  5.3 Characteristics of the Sedentary Behaviour .............................................................................................. 23
  5.4 Moderate-to-Vigorous Intensity Physical Activity .............................................................................. 24
  5.5 Physical Activity Pattern Weekdays Compared to Weekends .................................................................... 25
  5.6 Fulfilling of Recommendations ....................................................................................................................... 26

6. Discussion ................................................................................................................................................................. 28
  6.1 The Movement Pattern and Sedentary Behaviour .............................................................................. 29
    6.1.1 Study Population .......................................................................................................................................................... 29
  6.1.2 Gender ................................................................................................................................................................................. 30
  6.1.3 Age-groups ....................................................................................................................................................................... 31
  6.1.4 Education Level ............................................................................................................................................................. 31
  6.1.5 Discussion of the Movement Pattern .............................................................................................................. 33
  6.2 Fulfilment of Physical Activity Recommendations ............................................................................... 33
  6.4 Future Research ......................................................................................................................................................... 36
Acknowledgements

Bibliography

Appendix 1 – Literature search

Figures:

Figure 1 – An example of the distribution of SB, LIPA and MVPA during a day measured by the objective accelerometer and its potential effect on the health (Dunstan D. W. et al. 2012a).

Figure 2 - Distribution of time (hour/day) spent in SED, LIPA and MVPA in quartiles of SED time - US NHANES (Dunstan D. W. et al. 2012a)

Figure 3 - Sampling procedure of the project

Figure 4 – An example of an Actigraph registration under one day during the current study.

Figure 5. Daily PA pattern for 50-64 year-olds in Gothenburg

Figure 6 - Comparing men and women fulfilling MVPA recommendations

Tables:

Table 1. Characteristics of the study population with regard to gender

Table 2. Characteristics of the study population with regard to gender and compared to Swedish population data (2012)

Table 3. Daily movement pattern (% of wear time in different intensity categories) and daily mean of average cpm among all study participants and in subgroups

Table 4. Characteristics of sedentary behaviour among all study participants and in subgroups

Table 5. Time in MVPA

Table 6. Movement pattern for high and low EL in different times during the week (weekdays compared with weekends)

Table 7. Fulfilments of different defined MVPA recommendations among all study participants and in subgroups
### List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>BMI</td>
<td>Body mass index</td>
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<tr>
<td>CHD</td>
<td>Coronary heart disease</td>
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<tr>
<td>cpm</td>
<td>Counts per minute</td>
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<td>CVD</td>
<td>Cardiovascular disease</td>
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<td>EE</td>
<td>Energy expenditure</td>
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<td>EL</td>
<td>Education level</td>
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<td>GLM</td>
<td>General linear modelling</td>
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<td>METS</td>
<td>Metabolic equivalent task score</td>
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<td>min</td>
<td>Minutes</td>
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<td>MVPA</td>
<td>Moderate-to-vigorous intensity physical activity</td>
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<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
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<td>LIPA</td>
<td>Light intensity physical activity</td>
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<td>PA</td>
<td>Physical activity</td>
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<td>SB</td>
<td>Sedentary behaviour</td>
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<td>SED</td>
<td>Sedentary</td>
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<tr>
<td>SCAPIS</td>
<td>Swedish CardioPulmonary bioImage Study</td>
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<td>VGR</td>
<td>Västra Götaland region</td>
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<td>WHO</td>
<td>World Health Organization</td>
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1 Introduction

1.1 Background

Although there has been a decline in mortalities related to cardiovascular disease (CVD) over the last 25 years for both men and women, CVD is still the most common cause of death for both men (37.5%) and women (38.5%) (Causes of death, 2012). Physical activity (PA) is important for primary and secondary prevention of CVD in both genders, as well as for other chronic diseases such as non-insulin-dependent diabetes, dyslipidemia and obesity (Lee, Shiroma, Lobelo, Puska, Blair & Katzmarzyk 2012; Pedersen & Saltin 2006). Physical inactivity has been identified as the fourth leading risk factor for global mortality (6.0%) (World Health Organisation, 2010). There is strong evidence suggesting that continued and regular PA in different intensities during the day reduces CVD prevalence, mortality and benefits persons with a high risk of stroke and coronary heart disease (CHD) (Dunstan, Salmon, Owen, Armstrong, Zimmet, Welborn, Cameron, Dwyer, Jolley & Shaw 2005; Healy, Winjndaele, Dunstan, Shaw, Salmon & Zimmet 2008a; Lee et al. 2012; Pedersen & Saltin 2006; Vuori 2010; Wannamethee & Shaper 2001).

1.1.1 Physical Activity

PA is defined as any bodily movement produced by skeletal muscles that results in energy expenditure (EE) (Caspersen, Powell & Christenson 1985; Corbin, Pangrazi & Franks 2000; Shephard 1995). PA is thus not only exercise, but a constant part of our daily life. EE is often expressed in kilojoules (kJ) for the amount of energy that an activity requires. The total EE done is related to the daily PA. The EE requirement of an activity is related to the intensity, duration and frequency of the activity, but also other factors such as muscle mass, gender and age have an importance for the total EE.

PA is divided in two categories; daily life (occupational, transport, leisure time, household tasks etc.) and exercise. Exercise however is a subset of PA that is planned, structured, and repetitive. Exercise has been defined as PA in leisure time performed with the intention of developing physical fitness (Ibid). To be able to study the PA pattern during the day the intensities of PA has to be clarified. PA is separated in three intensities: light, moderate and vigorous and the intensities (the EE) can be expressed in the metabolic equivalent task score (METS; 1 METS=3.5 ml/kg/min). Light intensity physical activity (LIPA) involves EE at the
level of 1.6-2.9 METS and includes activities such as cooking food, sitting and writing, washing dishes and walking slowly. Moderate (3-6 METS) and vigorous (>6 METS) PA has normally been combined and classified as practice or exercise (Moderate-to-vigorous intensity physical activity (MVPA)), involving EE at a level on >3 METS. (Ainsworth, Caspersen, Matthews, Måsse Baranowski & Zhu 2012; Dunstan, Howard, Healy & Owen 2012a; Haskell, Lee, Pate, Powell, Blair, Franklin, Macera, Heath, Thompson & Bauman 2007; Pate, O’Neill & Lobelo 2008).

1.1.2 Sedentary Behaviour
Sedentary behaviour (SB) is defined as activities that do not increase EE substantially above resting level and corresponds to an EE level of 1-1.5 METS (Haskell et al. 2007; Pate et al. 2008; Sedentary Behaviour Research Network, 2012). SB includes activities such as sleeping, lying in the bed, sitting, watching television etc. Prolonged sitting has been recognized to independently (regardless of MVPA) increase the risk for non-insulin dependent diabetes, CVD and all-cause mortality (Dunstan et al. 2005; Rezende, Rodrigues, Rey-López, Matsudo & Luiz 2014; Wilmot, Edwardson, Achana, Davies, Gorely, Gray & Kunti 2012). People who spend more time sedentary (SED) have been shown to have greater risk of having the metabolic syndrome (an increase of 73%) (Edwardson, Gorely, Davies, Gray, Khunti, Emma Yatesa & Biddle 2012). For each hour of daily sitting there was a 2% increase of all-causes mortality, but the biggest and significant increase appears when adults sit more than seven hours per day (Chau et al. 2013). Studies have shown that people with a daily TV-time of seven or more hours compared with people with the same amount of MVPA who spends less than an hour in front of the television, the first group had a 50% greater risk of death from all-cause mortality and twice the risk for CVD mortality. (Dunstan et al 2005a; Dunstan et al 2012a; Healy et al. 2008a).

Reducing total SED time has shown to be important for CVD health, but also breaking up the SED time more often has shown beneficial effects (Healy, Dunstan, Salmon, Cerin, Shaw, Zimmet & Owen 2008b; 2011). In longitudinal studies, the importance of avoiding prolonged sitting and spending more time in LIPA has shown to be beneficial for preventing CVD. Through questionnaire-based studies it was shown that individuals who claimed to spend more time in LIPA had a lower risk for developing CVD. (Dunstan, Kingwell, Larsen, Healy,
1.1.3 Recommendations

The first recommendations to promote and maintain health for all healthy adults in the age range of 18 to 65 years appeared in 1995 and were later revised and updated due to new research (Pate, Pratt, Blair, Haskell, Macera Bouchard, Buchner, Ettinger, Heath & King 1995). The recommendations are based on results from subjective population-based studies (questionnaires), where the answers regarding movement patterns during the day have been combined with rates of mortality, illnesses etc. The latest guidelines, both in Sweden and internationally, recommend at least 150 minutes (min) of total MVPA per week in bouts each lasting 10 or more min preferable on most days of the week, or at least 75 min of vigorous intensity PA per week (Haskell 2007; The Swedish National Board of Health and Welfare, 2011; World Health Organization, 2010). The modifications adding the possibility of doing the MVPA in bouts of 10 min or more is supposed to make it easier for the Swedes to meet the daily recommendation. Together with the previously mentioned research regarding being seated, a recommendation to avoid prolonged sitting and adding small breaks from SED has been implemented in the Swedish national guidelines (The Swedish National Board of Health and Welfare, 2011; World Health Organization, 2010).

1.2 Measurements of Physical Activity and Sedentary Behaviour

PA is a complex behaviour and is mainly covered by four components: type of activity, frequency, duration and intensity. SB is also covered by four components: type, frequency, duration and, unlike PA, the fourth component is to measure the number of interruptions in SED time. For measuring PA and SB both subjective and objective measurements have been used. Subjective methods are questionnaires, recalls and diaries. Objective methods include accelerometers, heart rate monitors, GPS and pedometers. (Troiano, Pettee, Welk, Owen & Sternfeld 2012). Troiano et al. (2012) describe the importance of choosing the right method and to carefully consider which method suits the research question best.

Since the 1950’s, when research about PA and health started, subjective measurements such as self-report, questionnaires, recalls and diaries have been used the most, and the
recommendations about PA and SB have been made based on results from such studies. Self-report is often described as both cheaper and easier (to be used in bigger samples) compared to objective methods. Later on, self-reported methods have been questioned as it has been shown that the subjects often overestimate PA and underestimate time in SED. Investigating the validity using self-report, the self-report has often been compared with logs and accelerometers. Healy, Clark, Winkler, Gardiner, Brown & Matthews (2011a) did comparative studies researching the validity of the International Physical Activity Questionnaire (IPAQ) self-report, which is used worldwide. Most of these studies showed a low-to-moderate correlation for reporting SED time, with an underestimation of SED time. The studies also showed in average a validity coefficient at $r=0.40$. A coefficient of $r=1$ is a perfect coefficient and $r=0$ is the worst possible, therefore $r=0.40$ is in the lower half. This yields an explained variance of $r^2=0.16$, which means that only 16% of the “real” SED time can be measured by the IPAQ. For measuring PA some reliability studies have shown a low reliability for self-report questionnaires (Shephard 2003). Some of the reasons for low reliability were described as seasonal and/or temporal variations in PA, but other difficulties were caused by the short term memory with variations of 50% or more in questionnaire responses. The highest reliability was found while using more simple questionnaires (ibid). In addition, other reliability studies for SED time have shown a moderate-to-high correlation for measuring SB while using self-reported measurements methods (Healy et al. 2011a). Healy et al. (2011a) compared different reliability studies for SED times, with the range at $r=0.30-0.90$. The best reliability was achieved when the participant had to describe “concrete” actions as in e.g. TV-time, working sitting time etc., while it was more difficult describing SED time during spare time and everyday living.

Objective measurements, such as accelerometers have been used more and more frequently (Grimm, Swartz, Hart, Miller & Strath 2012; Troiano et al. 2012). The accelerometer is a small and lightweight device. The participant is wearing the device over the hip and the accelerometer records the subjects’ accelerations while moving. This can be translated into the intensity, duration and frequency of the subjects PA and SB. The accelerometer gives more valid and reliable data on actual PA, sitting time and breaks in SED, compared to self-reported data (Chen & Bassett 2005). When measuring PA, the accelerometer has also been better at differentiating the intensities of PA; specifically the accelerometer has shown itself better at measuring LIPA, an area that has received more focus recently (Chen & Bassett
The validity studies showed accelerometers to have a high validity while measuring SB compared with other objective measuring methods (the Intelligent Device for Energy (IDEEA) and the active PAL activity monitor) with an average at r=0.68 (Healy et al. 2011a). Big differences between using the accelerometer compared to self-reporting have been reported when measuring time in MVPA. Tucker, Welk and Beyler (2011) showed in U.S. adults that a mean of 56.9 min. per day was reportedly spent in MVPA using self-report, while only 9.1 min were recorded with the accelerometer. The same big difference was seen investigating the rate of fulfilment of the national PA recommendations; 63.9 % fulfilled the recommendations according self-report, but only 8.2 % when using the accelerometer data (Ibid). A study of older adults (over 50 years old) showed that there was only 40-46 % compliance between the two measurement methods if you compare the IPAQ-Short Form and the accelerometer when measuring the population fulfilling PA recommendations (Grimm 2012).

1.3 Levels of Physical Activity and Sedentary Behaviour

A previous report has described the distribution of daily SED and PA as follows (see figure 1): SED 55-60%, LIPA 35-40% and MVPA 5% of wear time (Dunstan et al. 2012a).

Figure 1 – An example of the distribution of SB, LIPA and MVPA during a day measured by the objective accelerometer and its potential effect on the health (Dunstan et al. 2012a).
A study by Hagströmer, Troiano, Sjöström and Berrigan (2009) using the accelerometer to measure PA patterns, showed a similar distribution in Swedish adults (40-75 years). The men spent on average 58.0% of wear time in SED, 38.0% in LIPA and 3.5% in MVPA, while the women spent 57.0% in SED, 40.5% in LIPA and 3.5% in MVPA. The national statistical survey from the Public Health Agency showed that 14.0% of men and women in the Västra Götaland Region (VGR) reported to be SED in their spare time, with no difference between men and women (Public Health Agency, 2009-2012). One study conducted on approximately 50,000 men and women from 20 different countries showed, using questions from the IPAQ, that the self-reported daily median sitting time was 300 min (Bauman, Ainswoth, Sallis, Hagströmer, Craig, Bull Pratt, Venugopal, Chau & Sjöström 2011). The same study showed that young adults (aged 18-39 years) had significantly higher sitting time than middle-aged and older adults (age ≥ 40 years) (Ibid). Other studies, using the accelerometer to measure SED time, have shown longer daily sitting time compared to the earlier mentioned studies (which used questionnaires) with a median of 540 to 600 min per day (55-60 % of wear time) (Hagströmer, Oja & Sjöström 2007; Healy et al 2008a; Tudor-Locke, Brashear, Johnson & Katzmarzyk 2010). Also a study in the United States (US), National Health and Nutrition Examination Survey (NHANES), showed by using the accelerometer on 6329 participants, that 54.9% of the day was spent SED, with a significant higher time in SED (60.0%) for older adults (≥60 years) compared to the younger study participants (<60 years) (Matthews, Chen, Freedson, Buchowski, Beech & Pate 2008). Hagströmer, Kwak, Oja & Sjöström (2014) made a longitudinal study observing the PA before and after a six year period. This study showed that over this period the total study population had a significant increase in SED (26 min/day (Ibid). The Eurobarometer 64.3 study (Bennie, Chau, Ploeg, Stamatakis, Do & Bauman 2013) showed that adults with lower education level (EL) (18 years or less years in school) were less likely to be in the high-sit/low-active group compared with adults with higher EL (19 or more years in school).

In a review by Dunstan et al. (2012a) it is described how new changes (technology, social and environmental) have resulted in a higher proportion of SB. The higher proportion of SB has shown to take over LIPA in daily life. The review has shown a clear connection between SB and LIPA while MVPA is only a little part of the daily PA pattern. This is shown in figure 2, which shows the distribution of time (hours/day) spent in SED, LIPA and MVPA in four different quartiles of SED time. Figure 2 shows that when time in SED increases, it is mainly associated with a corresponding decrease of time in LIPA, while time in MVPA is only
slightly different between the quartiles of SED time. The NHANES study showed an almost perfect inverse connection (-0.98) of time spent in LIPA and SED, which means that time in LIPA is mainly substituted by time spent in SED. (Dunstan et al. 2012a).

![Figure 2 - Distribution of time (hours/day) spent in SED, LIPA and MVPA in quartiles of SED time - US NHANES (Dunstan et al. 2012a)](image)

### 1.3.1 Time in Moderate-to-Vigorous Intensity Physical Activity and Fulfilment of PA Recommendations

The national Public Health Agency presented data from a national statistical survey about public health, showing that 65% of the men and women in Sweden are reaching the recommendations of 30 min MVPA every day. The same investigation showed more specifically that 67% women and 64% of the men from the VGR were meeting those recommendations (Public Health Agency, 2009-2012).

Hagströmer et al. (2007) made a population study on 1114 Swedish adults (men and women, 45±15 year) measuring their PA patterns while using the accelerometer as the measurement method. The study showed that adults spent a median of 31 min per day in MVPA, with men having a median of 33 min per day and women 29 min per day in MVPA. Looking at the results from the middle-aged adults (age 45-65 years) in that study, they only had a median of 21 min per day in MVPA (Ibid). Analyzing the fulfilment of the PA recommendations of 30 min of MVPA per day, 52% of the adults were meeting this recommendation (men 57% and
women 48%). At the same time, only 1% fulfilled the more modified and specific recommendation of 30 min of MVPA per day from three or more bouts of at least 10 min (Hagströmer et al. 2007). Another study by Orsini, Bellocco, Bottai, Hagströmer, Sjöström, Pagano and Wolk (2008) using the accelerometer for measuring PA patterns, though with a smaller sample group in Sweden (133 participants) of women between 56-75 years, showed that on average the women spent 103 min/day in MVPA and 44% of them were meeting the recommendation for PA (30 min per day in MVPA in one bout or several bouts lasting at least 8-10 min five days or more per week).

The same study showed that older obese women had less time in MVPA compared to younger obese women (Ibid). These results were similar to a study using accelerometers that compared men and women from Sweden and the United States. The latter study showed that older people and people with a high body mass index (BMI) had lower PA, compared to younger people and people with a low BMI (Hagströmer et al. 2010). Hagströmer et al. (2014) undertook a longitudinal study observing the PA changes before and after a six year period. This study showed that men and participants aged ≥60 years had a significant decrease in average intensity PA, while women had an increase in time in MVPA (Ibid).

1.4 More Research is Needed

Previous studies describing the PA pattern of the Swedish population have mainly used subjective methods such as questionnaires. Until now, only the population-based study by Hagströmer et al. (2007) has used accelerometers to measure PA and SED time for middle-aged and older men and women in Sweden.

We know that methods using self-report often overestimate PA level and underestimate SED, while objective methods such as accelerometers have shown a higher reliability and validity. Therefore, studies using objective measurements to investigate PA patterns in the Swedish population are needed.

Moreover, more recent studies have highlighted the importance of describing all components of the daily PA pattern: SED, LIPA and MVPA. The main focus of the PA recommendations has been on MVPA, but later studies have shown that SED are often replacing LIPA and that this development may have an important affect on health and disease risk. Therefore, more
research is needed to focus on not only the beneficial well-known effects of MVPA and also on LIPA. Further research is also needed to divide SB from LIPA, as well as to promote awareness of the health benefits by breaking up SED. Through more research it is possible to get an overview on the PA patterns, and maybe through this new knowledge reconsider the recommendations to include LIPA and breaks from SED more clearly. This knowledge will also make it easier to find new ways to help the population adopt a healthier lifestyle. Therefore, it is important to do more studies using objective measurements methods such as the accelerometer to investigate all components of the PA pattern of the Swedish population.

2 Hypothesis

It is to be expected that the results in this study as well as other studies using objective measurements will probably show different results compared to studies using subjective measurements. The results will probably be similar to Hagströmer et al. (2007) study, where it was shown that only a small part of the population fulfilled the more specific recommendation of 30 min of daily MVPA, which all are in bouts of 10 min or more. It is therefore hypothesized that there will be shown a high SED time for the participants.

3. Project Aims

The main aim of the report is to examine the PA patterns, including SB (SED time and number of breaks in SED time) in Swedish middle-aged men and women (50-64 years) in Gothenburg by using objective measurements method (accelerometer). Secondarily this report will analyse differences in gender, age and EL for these variables. A third aim is to analyse the proportion of the present population that is fulfilling the national recommendations of MVPA.

To evolve the overall project aim in smaller steps, the following research questions were specified:

- What do the daily movement pattern\(^1\) and the sedentary behaviour\(^2\) look like in a...

\(^1\) Proportion of wear time in SED, proportion of wear time in LIPA, proportion of wear time in MVPA and mean count per min (cpm).

\(^2\) Number of breaks in SED time, numbers of and time in prolonged SED bouts and average time in prolonged SED bouts (min).
population of middle-aged (50-64 years) men and women from Gothenburg?

- Are there differences in the movement patterns\(^3\) and sedentary behaviour\(^4\) between genders (men and women), age-groups (50-54, 55-59 and 60-64) and EL (university degree or not)?
- What proportion of the study population (in total and stratified for gender, age-groups and EL) meet the Swedish national PA recommendations?

4. Materials and Methods

This project is within the sports science area, and has its focus on PA and health. The study is a part of the Swedish CArdioPulmonary biolImage Study (SCAPIS), which is today one of the biggest science projects in Sweden regarding heart, vessels and lungs. SCAPIS is a study that was conducted at the Sahlgrenska University Hospital in Gothenburg. The data analysis is derived from the result of 1067 people who participated in the pilot study of the SCAPIS, men and women aged 50 to 64 years, randomly selected from both high and low socioeconomic status areas in Gothenburg. The participants underwent, during a two-day period, both physical and medical examinations. Blood samples were drawn (to examine cholesterol, blood sugar and kidney function), height, weight, waist and hip were measured, lung functions were tested, blood pressure was measured, ultrasonography (carotid arteries, liver), and ECG and radiography (CT) (heart, blood vessels and lungs) was made. The participants also performed a sub-maximal cycle test to estimate their cardiorespiratory fitness. The participants wore an accelerometer for seven days to objectively register the daily PA pattern and did also answer a questionnaire about lifestyle and living conditions. In this current study, it will be the results from wearing the accelerometer that will be analyzed as a means to describe the movement pattern and sedentary behaviour, and furthermore for analysing the fulfilsments of the PA recommendations for the total study population and the sub-groups (gender, age-groups and EL). The answers about lifestyle and living conditions will be used for the characteristics of the study population and for testing if the study population can be considered representative of the Swedish population.

\(^3\) Proportion of wear time in SED, number of breaks in SED time, numbers of and time in prolonged SED bouts, proportion of wear time in LIPA, proportion of wear time in MVPA and mean count per min (cpm).

\(^4\) Number of breaks in SED time, numbers of and time in prolonged SED bouts and average time in prolonged SED bouts (min).
4.1 Ethics

The study examines the participants’ physical health through different medical and physical tests, questionnaires and by wearing an accelerometer. Such information needs to be viewed as sensitive. The SCAPIS study was approved by the Umeå ethical board (Dnr 2010-228-31M). All participants provided informed consent and were asked if they wanted to participate. They were then informed that it was voluntarily and they were free to discontinue the participation whenever they wanted. The study investigated the PA pattern through the data collected from the accelerometer the participants were wearing. The participants were informed that all data was confidential and evaluated in an anonymous way. All data from each individual was given a participant number and the data was analysed through groups (medians) and therefore no individual results were exposed. Through this the thoughts of the study was not to show “how bad” they are, or telling people that they are not “good enough”. It was hoped that the study could be of help for the future, and that the outcome could provide us with important information for future recommendations for PA to be beneficial to general health. The participants were wearing an accelerometer during all wake hours for a week, and this did not present the participant with any risks.

4.2 Methodological Choice

The approach of this study is positivistic, because the principles and methods are selected from the natural sciences, and human behaviour is studied as objectively as possible. In the study, human behaviour is observed through measuring facts and analysing these. The measurement method makes statistical analyses possible and allows creation of results with no influences of the researcher. This thesis focus is to show results from a population-based health study while using an accelerometer. The data collected by the accelerometer is quantitative, thus the method of this study is also quantitative. The study is deductive. Through earlier research, ideas and hypotheses of how the PA behaviour is for the Swedish population, this study will investigate the PA behaviour and describe and analyse the result of the collected data. (Gratton & Jones 2010, p. 23ff). The study is an epidemiology study and is also called population-based. Epidemiology is the study of the patterns, causes, and effects of health and disease conditions in defined populations. Epidemiology is seen as the core science of public health. (Rothman 2002, p. 1). This kind of populations-based study is an observational study design and specifically a cross-sectional survey design. With these kinds
of study designs it is possible to work with large sample sizes (hundreds to thousands) trying to describe the prevalence of a health-related outcome, at the population level, from representative samples. In this study the aim is to estimate characteristics of PA behaviours in a population (e.g. group medians, prevalence estimates at a specific time). Here, a sample from an overall population (Swedish men and women in the age of 50-64 in Gothenburg) is chosen, and relationships are analysed for different subgroups of gender, age-groups and EL.

4.3 Study Population and Selection

The study population in the SCAPIS pilot study was randomly selected from the people’s register through inclusion criteria. The inclusion criteria were living in the Gothenburg area, being 50 to 64 years old, and were stratified by socioeconomic area. All the randomly selected persons got an invitation letter to participate in the study. A total of 2243 persons were invited and 1111 said yes to participate in the SCAPIS pilot study, where 1067 agreed to wear an accelerometer. Therefore, a total of 1067 participants (50% women) agreed to participate in the SCAPIS study during 2012 and wear an accelerometer for seven days. Under the study a total of eight accelerometers were either lost by the participants or lost in the mail transport, and 111 accelerometers provided invalid data. See a more detailed description of dropout and participant rates in figure 3 and a failure analyses in table 1 (in the result part). The study finally included 948 (51% women) participants.
The aim of the random selection of the participants was to get a cohort of men and women that was representative of the source population of Gothenburg in the same age group.

### 4.4 Study Procedure

All participants who volunteered to participate got an accelerometer device (ActiGraph GT3X and GTX3+) before leaving the testing centre after the two test days. Before they left participants were instructed on how to wear the accelerometer over their right hip. They were told to wear the accelerometer during all waking hours, except during water bath activities, for at least seven consecutive days. The participant got a prepared pre-paid envelope to send back the accelerometer after the seven days.
4.4 Measurements and Data Processing

4.4.1 Measurement and Data Processing of the Accelerometer

The accelerometer used in this study was a GTX3 and GT3X+, ActiGraph LCC, Pensacola, FL, USA. The accelerometer is a small (3.8 x 3.7 x 1.8 cm), lightweight (27 g) electronic device that measures body movement in terms of acceleration. Compared to a pedometer, which is measuring the number of steps, the accelerometer is also capable of measuring the intensity of these steps. The most commonly used accelerometer in science is the ActiGraph. The accelerometer is often worn on the hip in a belt. Because the accelerometer is without a display the participant does not get any direct feedback. This is positive for this study because the aim is to measure PA, and not to motivate people to exercise. The ActiGraph GT3X+ is capable of measuring the acceleration in three orthogonal planes (anteroposterior, mediolateral, and vertical), but only the vertical axis was used for this study to be able to compare with previously published data (such as Hagströmer et al.), which used an older version of ActiGraph capturing only this one axis. Acceleration is the change in speed in regards to time. The accelerometer is able to measure the intensity, duration, frequencies and the distribution of the activity at a specific time. The raw accelerations are automatically measured by the Actigraph software (Actilife) and converted to digital signals (30 Hz), filtered, full wave rectified and integrated to yield “counts”. The activity will be presented as counts per min (cpm). The higher cpm the accelerometer is measuring, the more intense activity the person is doing. Through the measured movement signals (counts) it will be possible using regressions models to translate these into EE.

The data is recorded by an internal memory and then downloaded to a computer. Figure 4 shows an example of a graphic and specific feedback from a day of registering with an Actigraph accelerometer during the current study. Here it is possible to see the time spent in the different activity levels (SED, LIPA, MVPA) during the day measured by the accelerometer. The vertical axis represents the registered activity in counts and the horizontal axis shows the time of the day.
Figure 4 – An example of an Actigraph registration under one day during the study.

The accelerometer used in the study was initialized as described by the manufacturer (Shallimar 1995) and the sample rate of 30 Hz was used. A minimum of four days (including one weekend day) with a minimum registration time of 600 min per day were required for the data to be included in the data analyses. Wear time validation was made in order to identify wear time and non-wear time. Wear time was defined by subtracting non-wear time from 24 h and non-wear time was defined as at least 60 consecutive min with no movement (0 cpm) with an allowance of maximum 2 min of counts between 0-100 cpm. The majority of the participants had valid data for at least seven days (67%), 19% for six days, 9% for five days and 5% for four days.

The components of the daily movement patterns that were analysed were:

- Percentage of wear time in SED (<100 cpm)
- Percentage of wear time in LIPA (100-2019 cpm)
- Percentage of wear time in MVPA (≥2020 cpm)
- Total amount of PA (mean cpm/day)
- Numbers of SED breaks (a transition from <100 cpm to >100 cpm in minimum 1 min)
- Numbers of prolonged SED bouts (≥20 min of <100 cpm)
- Average time in prolonged SED bouts (min)
(Healy et al. 2008b; Matthews et al. 2008; Troiano, Berrigan, Dodd, Måsse, Tilert & McDowell 2008).

However, due to the variations in wear time between the participants, the daily movement pattern was presented as percentage of wear time spent in different intensity-specific categories. To analyze where the participants were doing the PA in different intensities, the week was divided into weekdays and weekends to be able to compare the movement pattern during the week.

The proportion of the study population fulfilling different defined MVPA recommendations was analysed. The current Swedish national guidelines recommend at least 150 min per week of total MVPA in bouts of 10 min or more preferably on most days of the week (The Swedish National Board of Health and Welfare. 2011). To investigate the fulfilment of “preferably most days of the week”, 5 of 7 days with 30 min MVPA was required. Therefore the analysis of fulfilment of the PA recommendations was divided into the four following:

1) Accumulating at least 150 min per week of total MVPA.
2) Accumulating at least 150 min per week of total MVPA, of which all are in bouts of 10 min or more.
3) Accumulating 30 min per day on at least 5 of 7 days of the week.
4) Accumulating 30 min per day on at least 5 of 7 days of the week, of which all are in bouts of 10 min or more.

The data was uploaded onto a computer and analysed in the program ActiLife v.6.10.1. Raw data was obtained from the accelerometer and transformed into 60-sec epochs before being entered into the analyses.

4.4.2 Other Measurements

During the two testing days, measurements of weight (kg), height (m) and circumference of the waist (cm) were assessed. BMI was computed as weight (kg) divided by square height (m²). All the participants answered a questionnaire; the questions asked were concerning age, EL, smoking habits etc. Age was categorized into three levels (50 to 54, 55 to 59, 60 to 64).

\(^5\) (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
EL was categorized in high or low (university degree or not). Smoking habit was described as being a regular smoker or not. To compare the study population with the general Swedish population, the same questions for self-reported PA and SB as the one by the Public Health Agency of Sweden used to screen the entire population was used. SB was categorized into highly SED leisure time or not, and PA habits into accumulating at least 30 min of daily MVPA or not.

### 4.5 Data Analysis and Presentation

Statistics is often used for the interpretation of systematic assumptions, where it is necessary to separate what is less likely to occur. The method is to work with theoretical and analytical statistics, and uses descriptive statistics in order to present and put together collected data. While working with statistics it is normal to start by using descriptive statistics to get an overview over the collected material. The data can be shown in figures and tables and it is common to calculate the average and observe differences between groups. While working with scientific statistics, tests where analysing correlation is important because it makes it possible to investigate how variables correlate with each other. After connecting descriptive statistics, analytic statistics are used to assess the data. Through the analytical statistics we can assess if the result is true for the population. In analytical statistics, it is possible to make different kind of tests, depending on which kind of selection and which kind of result the researcher is interested in. (Befring 1994, p. 98ff).

For the statistical analysis, the SPSS (Statistical Package for the Social Sciences for Windows, 14.0, 2006, SPSS Inc., Chicago IL) program was used. The data was checked for normality using the Shapiro-Wilk test. Most of the data variables were skewed, and hence the descriptive data is presented as proportions or median and 25th-75th percentile (Q1-Q3). Following tests were made for analysing the result:

- For comparing the gender differences with characteristics of the study population (age, weight, height, waist, BMI, high EL, BMI≥25, regular/daily smoker) a Mann Whitney U test was used for the non-parametric data.

- For comparing the proportional differences between the study population (high EL, BMI≥25, regular/daily smoker, highly SED during leisure, 30 min per day of PA (MVPA)) and the Swedish national data EL, BMI and smoking from Statistics
Sweden and self-reported SED and PA behaviour from the Swedish National Institute for Public Health), a 2-sample z-test was used.

- General linear modelling (GLM, Mixed model ANOVA) was used to compare the estimated marginal means (means adjusted for by the covariates age, gender, EL (when not evaluated) and wear time in the model) for percentage of time spent in SED, LIPA and MVPA, mean cpm, total wear time, and the variables in the SED pattern analysis between the sub-groups (gender, age and EL). All skewed dependent variables were transformed to get normally distributed data before the GLM analysis.

- For analysing differences in the movement pattern during the week for the total study population and sub-groups (gender, age and EL), Wilcoxon matched pair test was used to compare the median proportion of SED/LIPA/MVPA/total cpm between weekdays and weekend days.

- The current Swedish national guidelines recommend at least 150 min per week of MVPA in bouts of 10 min or more preferably on most days of the weeks. Hence, these recommendations require regular accumulation of MVPA during the week as well as MVPA min accumulated in prolonged bouts. To catch this complexity, we evaluated the percentage of the study population meeting the criterion of 150 min of MVPA per week with a variation in the requirement of regularity and/or accumulation in prolonged bouts, according to the following criteria; 1) Accumulating at least 150 min per week of total MVPA, 2) Accumulating at least 150 min per week of total MVPA, of which all are in bouts of 10 min or more, 3) Accumulating 30 min per day on at least 5 of 7 days of the week 6, 4) Accumulating 30 min per day on at least 5 of 7 days of the week 2, of which all are in bouts of 10 min or more.

- For potential differences between gender, age-groups, and EL for fulfilment of the PA recommendation, a 2-sample z-test was used.

The significance level for all of the above was an analysed data set at P<0.05. For multiple testing between age-groups adjustments was made by using significance level p<0.00125 for proportional comparison, and Bonferroni confidence interval adjustment in GLM. The results are presented in figures and tables made in Excel.

6 (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
4.6 Validity and Reliability

This study used accelerometers to collect the data. While using the accelerometer as measurement method, it is important to be aware of some issues/limitations. Limitations using the accelerometer are for example, that the type of activity that the participant is performing is unknown. It is not possible for the accelerometer to differentiate between sitting and standing position, or if the participants are not wearing the monitor. However, wear time validation minimize the problem of identification when not worn. Previous studies have shown that there will be behaviour changes in the movement of the participants the first two or three days, which will make them more active. This has been called the Hawthorne effect and that is one of the reasons why the participants in this study, were asked to wear the accelerometer for seven consecutive days. There can also be some technical limitations in the accuracy and precision depending on when the participants are wearing the equipment. The accelerometer has shown to underestimate biking, and is less valid in high intensities for example running in the speed range of 6-12 mph. In general the accelerometer has shown to have both a better validity and reliability than self-reported data. The accelerometer has also shown to accurately measure SED and the numbers of breaks in SED. It costs more money and time to use the accelerometer than sending out questionnaires, and that makes it more difficult with large populations. It is also important to be aware, that using objective measurement is still a newer methodology for measuring PA, thus the results will probably be different from earlier studies, which have used subjective measurement methods (e.g. questionnaires). It is possible, that there will be some additional limitations that we are not yet are aware of. Using the accelerometer also makes it possible to measure PA patterns at the specific moment, instead of earlier studies using questionnaires. As mentioned earlier, the higher reliability and validity of the accelerometer compared to self-report is one of the main reasons for choosing to work with the accelerometer as the measurement method in this study (Chen & Bassett 2005; Troiano et al. 2012).
5. Results

5.1 Study Population

The characteristics of the study population, with regard to gender, are presented in table 1. The median age of men was 58 (54-62) years and the median BMI 27.1 (25.1-29.3). The women had a median age of 57 (54-61) years and a median BMI of 26.0 (23.4-29.0), which was significantly lower than the BMI for men. A significantly higher proportion of the women (41%) had a high EL compared to the men (35%). There were no differences regarding age and smoking habits between men and women. For weight, height, waist and BMI there were significant differences shown between men and women.

Table 1. Characteristics of the study population, with regard to gender.

<table>
<thead>
<tr>
<th></th>
<th>Study population</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men (n=462)</td>
<td>Women (n=486)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>57.7 (53.8-62.0)</td>
<td>57.5 (53.7-61.4)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>86.6 (79.5-95.0)</td>
<td>70.4 (63.7-80.0)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>178 (173-183)</td>
<td>165 (160-169)</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>99 (94-105)</td>
<td>89 (81-98)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.1 (25.1-29.3)</td>
<td>26 (23.4-29)</td>
</tr>
<tr>
<td>High EL (university degree)</td>
<td>35%</td>
<td>41%</td>
</tr>
<tr>
<td>BMI ≥25</td>
<td>77%</td>
<td>60%</td>
</tr>
<tr>
<td>Regular/Daily smoker</td>
<td>13%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Data presented as Median (Q1-Q3)

* Significant gender difference (independent Mann-Whitney U test for the non-parametric data)

In table 2, the characteristics of the study population are compared to Swedish population data for the age-group 45-64 years for 2012 (Statistics Sweden; Swedish National Institute for Public Health). No differences were revealed comparing the study population with the Swedish population data with regard to EL, self-reported highly SED during leisure and 30 min of daily PA-recommendation. A larger proportion of women in the Swedish population were regular/daily smokers (19%) compared to the study population (11%). Regarding men, no differences were seen for those variables. Beyond that, men and women in the study population had a significantly higher BMI compared to the Swedish population data.
Table 2. Characteristics of the study population with regard to gender and compared to Swedish population data (2012)

<table>
<thead>
<tr>
<th>Study population</th>
<th>Study population</th>
<th>Swedish population data*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>High EL (university degree)</td>
<td>35%</td>
<td>41%</td>
</tr>
<tr>
<td>BMI ≥25</td>
<td>77%</td>
<td>60%</td>
</tr>
<tr>
<td>Regular/Daily smoker</td>
<td>13%</td>
<td>11%</td>
</tr>
<tr>
<td>Highly SED during leisure</td>
<td>16%</td>
<td>15%</td>
</tr>
<tr>
<td>30 min per dag of PA</td>
<td>65%</td>
<td>61%</td>
</tr>
</tbody>
</table>

Data presented as Median (Q1-Q3)

* Swedish population data for the age-group 45-64 years for year 2012. Data for EL, BMI and smoking are from Statistics Sweden (www.scb.se). Data for the self-reported SED and PA behaviour are from the Swedish National Institute for Public Health (http://fhi.se).

# Weight and height were measured in the present study population, but self-reported in the Swedish population data.

a Significant gender difference (independent Mann-Whitney U test for the non-parametric data).

b Significant proportion difference between study population and Swedish population data.

5.2 Physical Activity Patterns

The daily PA pattern is divided into three intensities: SED, LIPA and MVPA. 50-64 year old people in Gothenburg spent 60.5% of the daily wear time in SED, 35.2% in LIPA and 3.9% in MVPA (see figure 5), with a median daily wear time of 14.3 hours (no significant differences between the subgroups included in the analysis were found). Data describing the participants’ PA pattern is located in table 3.

![Daily physical activity pattern](image)

Figure 5. Daily PA pattern for 50-64 year-olds in Gothenburg
Table 3. Daily movement pattern (% of wear time in different intensity categories) and daily mean of average cpm among all study participants and by subgroup.

<table>
<thead>
<tr>
<th></th>
<th>SED (%)</th>
<th>LIPA (%)</th>
<th>MVPA (%)</th>
<th>Mean cpm/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>60.5 (54.5-66.4)</td>
<td>35.2 (29.9-41.1)</td>
<td>3.9 (2.4-5.6)</td>
<td>335.6 (263.7-422.9)</td>
</tr>
<tr>
<td>Women</td>
<td>58.4 (53.2-64.8)</td>
<td>37.2 (31.5-42.2)</td>
<td>3.6 (2.2-5.2)</td>
<td>336.8 (265.8-414.2)</td>
</tr>
<tr>
<td>Men</td>
<td>62.0 (56.2-67.8)$^a$</td>
<td>33.5 (28.0-38.5)$^a$</td>
<td>4.1 (2.5-5.8)$^a$</td>
<td>333.0 (262.5-433.3)</td>
</tr>
</tbody>
</table>

Age (y)

<table>
<thead>
<tr>
<th></th>
<th>SED (%)</th>
<th>LIPA (%)</th>
<th>MVPA (%)</th>
<th>Mean cpm/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-54</td>
<td>60.9 (54.2-65.9)</td>
<td>35.1 (30.6-41.3)</td>
<td>3.9 (2.5-5.7)</td>
<td>344.6 (279.8-426.9)</td>
</tr>
<tr>
<td>55-59</td>
<td>59.2 (53.5-66.3)</td>
<td>36.1 (29.8-41.8)</td>
<td>4.2 (2.8-6.0)</td>
<td>456.4 (278.3-438.4)</td>
</tr>
<tr>
<td>60-64</td>
<td>61.4 (56.0-67.0)</td>
<td>34.6 (29.4-39.8)</td>
<td>3.3 (1.8-5.2)$^{b,c}$</td>
<td>311.8 (224.5-398.5)$^{b,c}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>SED (%)</th>
<th>LIPA (%)</th>
<th>MVPA (%)</th>
<th>Mean cpm/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low EL</td>
<td>59.8 (53.4-66.2)</td>
<td>36.3 (30.5-42.1)</td>
<td>3.7 (2.1-5.6)</td>
<td>330.9 (259.1-423.7)</td>
</tr>
<tr>
<td>High EL</td>
<td>61.3 (55.8-66.5)$^{d}$</td>
<td>34.1 (29.2-38.9)$^{d}$</td>
<td>4.1 (2.8-5.6)$^{d}$</td>
<td>339.2 (277.8-421.2)</td>
</tr>
</tbody>
</table>

All data presented as Median (Q1-Q3) and adjusted for gender, age-groups, EL and wear time (when not evaluated).

$^a$ Significant gender difference, p<0.05.
$^b$ Significant age-group difference vs. 50-54 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).
$^c$ Significant age-group difference vs. 55-59 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).
$^d$ Significant EL difference, p<0.05

The men spent significantly more time in SED (62.0%) compared to the women (58.4%). In contrast to that, the women spent significantly more time in LIPA (37.2%) than the men (33.5%), whereas men were spending significantly more time in MVPA (4.1 % vs. 3.6 %). There was subsequently no difference in the total movement (mean cpm/day). Regarding the three age-groups, no differences could be found for percent of wear time spent in SED and in LIPA. However, the 60-64 year olds spent significantly less time (3.3%) in MVPA compared to the groups aged 50-54 years (3.9%) and 55-59 years (4.2%). Subsequently, the oldest group also had a significantly lower total movement during the day (mean cpm/day). Participants in the high EL group spent significantly more time in SED (61.3%) than participants from the low EL group (59.8%). The low EL group had significantly more time in LIPA (36.3%) compared with the high EL group (34.1%), but instead the high EL group spent more time in MVPA (4.1%) compared with the low EL group (3.7%). In summary there was no difference in total movement (cpm/day) between the EL groups.

### 5.3 Characteristics of the Sedentary Behaviour

The characteristics of the SB include the numbers of prolonged SED bouts (≥ 20 min of cpm <100), time in prolonged SED bouts and numbers of SED breaks (interruption in SED time (minimum 1 min)). They are presented in table 4.
Table 4. Characteristics of SB among all study participants and in subgroups.

<table>
<thead>
<tr>
<th></th>
<th>Daily average number of SED bouts*</th>
<th>Daily average time in SED bouts (min)</th>
<th>Daily average number of SED breaks#</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>5.8 (4.3-7.6)</td>
<td>188.8 (136.3-252.6)</td>
<td>85.8 (76.6-95.7)</td>
</tr>
<tr>
<td>Women</td>
<td>5.3 (4.1-7.1)</td>
<td>170.1 (127.3-235.3)</td>
<td>88.5 (78.9-97.8)</td>
</tr>
<tr>
<td>Men</td>
<td>6.4 (4.7-8.0)#</td>
<td>209.8 (146.2-267.8)</td>
<td>83.5 (74.6-93.4)#</td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-54</td>
<td>5.8 (4.3-7.3)</td>
<td>189.0 (131.5-242.2)</td>
<td>86.5 (77.1-95.8)</td>
</tr>
<tr>
<td>55-59</td>
<td>5.7 (4.4-7.6)</td>
<td>183.4 (136.7-254.4)</td>
<td>86.8 (76.6-96.1)</td>
</tr>
<tr>
<td>60-64</td>
<td>6.0 (4.4-7.7)</td>
<td>194.0 (139.4-264.2)</td>
<td>84.5 (75.9-95.1)</td>
</tr>
<tr>
<td>Low EL</td>
<td>5.6 (4.2-7.5)</td>
<td>179.2 (127.7-246-8)</td>
<td>86.1 (76.8-96.8)</td>
</tr>
<tr>
<td>High EL</td>
<td>6.1 (4.7-7.6)#</td>
<td>204.1 (150.1-259.1)</td>
<td>85.3 (76.3-93.7)#</td>
</tr>
</tbody>
</table>

All data presented as Median (Q1-Q3) and adjusted for gender, age-groups, EL and wear time (when not evaluated).

* A SED bout is defined as ≥ 20 min of cpm <100.
# A SED break is considered interruption in SED time (minimum 1 min).
Significant gender difference, p<0.05.
Significant EL difference, p<0.05.

The total study population had 5.8 SED bouts per day, spent on average 188.8 min in those SED bouts and broke up their SED 85.7 times. Men had more prolonged bouts, spent more time in prolonged SED bouts and had less breaks during the day compared to women. However, there was no difference between the age groups. Although it is possible to see that the oldest age group had a higher number of prolonged SED bouts, higher time in SED bouts and lesser breaks, there was no significant difference. The participant with high EL were sitting more than the participants with a lower EL and had both significantly more numbers of SED bouts, higher time in SED bouts and less breaks from SED.

5.4 Moderate-to-Vigorous Intensity Physical Activity

The study population spent a median of 32.8 min per day in MVPA, with an average of only 9.5 min in bouts of 10 min or more (table 5). Men (35.4 min) spent significantly more time in MVPA than the women (30.9 min), but when it had to be in bouts of 10 min or more, no gender difference was seen. As mentioned earlier, there were also significant differences between the different age-groups, where the oldest group (60-64 years) spent less time in MVPA compared with the younger groups (50-54 and 55-59 years). The same difference was seen within bouts of 10 min or more between the oldest group (60-64 years) and the middle age-group (55-59 years). The high EL group was, as mentioned earlier, spending significantly more time in MVPA compared with the low EL groups and this significant difference was
also seen within bouts of 10 min or more. A detailed description of time being spent in MVPA is presented in table 5.

Table 5. Time in MVPA for all study participants and in subgroups.

<table>
<thead>
<tr>
<th></th>
<th>Daily average MVPA (min)</th>
<th>Daily average MVPA in bouts ≥ 10 min (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>32.8 (19.9-48.3)</td>
<td>9.5 (2.6-21.4)</td>
</tr>
<tr>
<td>Women</td>
<td>30.9 (19.3-45.6)</td>
<td>9.4 (2.6-20.4)</td>
</tr>
<tr>
<td>Men</td>
<td>35.4 (21.4-49.5)</td>
<td>9.6 (2.7-22.1)</td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-54</td>
<td>32.8 (21.4-48.4)</td>
<td>9.3 (2.6-20.7)</td>
</tr>
<tr>
<td>55-59</td>
<td>36.0 (23.6-51.1)</td>
<td>11.4 (3.4-24.0)</td>
</tr>
<tr>
<td>60-64</td>
<td>28.3 (16.1-45.5)</td>
<td>8.2 (1.9-18.0)</td>
</tr>
<tr>
<td>Low EL</td>
<td>31.1 (18.6-48.0)</td>
<td>8.0 (1.6-19.3)</td>
</tr>
<tr>
<td>High EL</td>
<td>35.3 (23.9-49.0)</td>
<td>12.8 (5.6-23.4)</td>
</tr>
</tbody>
</table>

Data presented as median (Q1 - Q3). Analyses comparing subgroups for daily average MVPA and daily average MVPA in bouts ≥ 10 min are adjusted for (when not evaluated) gender, age-groups, EL and wear time (when not evaluated).

a Significant gender difference, p<0.05.
b Significant age-group difference vs. 50-54 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).
c Significant age-group difference vs. 55-59 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).
d Significant EL difference, p<0.05

5.5 Physical Activity Pattern Weekdays Compared to Weekends

Analysing the movement pattern during weekdays compared to weekends showed that the total study population spend more time in SED during weekdays compared to weekends, and less time in LIPA during weekdays compared to weekends. No differences were seen for the time in MVPA and for the total movement (mean cpm/day). Analysing differences in the movement pattern between weekdays and weekends for the high EL group compared with low EL group, showed a different trend. Participants in the high EL group was sitting more during the weekdays compared to weekends. They were having less time in LIPA and MVPA on weekdays compared to weekends. A different trend was shown for the group with low EL, who were sitting to a similar extent during weekdays and weekends, and reported the same time in LIPA, but were spending more time in MVPA during weekdays compared to weekends. For an overview of these results see table 6.
Table 6. Movement pattern for high and low EL in different times during the week (weekdays compared with weekends).

<table>
<thead>
<tr>
<th></th>
<th>High EL (total)</th>
<th>High EL (weekdays)</th>
<th>High EL (weekends)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SED (%)</td>
<td>61.3 (55.8-66.5)</td>
<td>62.6 (56.8-68.7)</td>
<td>57.3 (49.8-63.5)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>LIPA (%)</td>
<td>34.1 (29.2-38.9)</td>
<td>32.9 (27.4-38.3)</td>
<td>37.5 (31.8-44.2)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>MVPA (%)</td>
<td>4.1 (2.8-5.6)</td>
<td>3.8 (2.7-5.7)</td>
<td>4.2 (2.0-7.0)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Mean cpm</td>
<td>339 (278-421)</td>
<td>329 (263-414)</td>
<td>370 (265-493)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Data presented as Median (Q1-Q3)

<sup>a</sup> Significance difference p<0.05 between weekdays and weekends.

5.6 Fulfilling of Recommendations

In table 7, the fulfilments of different defined PA recommendations are presented. The least demanding recommendation with 150 min/week in MVPA is fulfilled by 72.5% of the men and women in the study, but with the addition of MVPA to be accumulated in bouts of ≥10 min, only 25.1% are fulfilling these. If the MVPA had to be spread out on most of the days per week<sup>7</sup>, 35.3% are fulfilling these recommendations, and for the recommendation with requirement of both accumulated in prolonged bouts of ≥ 10 min on most of the days per week (as in line with current Swedish PA recommendations) only 7.1% of the study population fulfilled this recommendation.

<sup>7</sup> (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
Table 7. Fulfilment of different defined MVPA recommendations among all study participants and in subgroups.

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>150 min/week</th>
<th>150 min/week in bouts of ≥10 min</th>
<th>30 min/day on most days of the week*</th>
<th>30 min/day in bouts of ≥10 min on most days of the week*</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>72.5%</td>
<td>25.1%</td>
<td>35.3%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Women</td>
<td>70.0%</td>
<td>23.7%</td>
<td>30.7%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Men</td>
<td>75.1%</td>
<td>26.6%</td>
<td>40.3%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Age (y)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-54</td>
<td>75.7%</td>
<td>24.6%</td>
<td>34.1%</td>
<td>5.2%</td>
</tr>
<tr>
<td>55-59</td>
<td>78.3%</td>
<td>29.2%</td>
<td>41.8%</td>
<td>8.1%</td>
</tr>
<tr>
<td>60-64</td>
<td>63.7%</td>
<td>21.5%</td>
<td>30.2%</td>
<td>7.4%</td>
</tr>
<tr>
<td>Low EL</td>
<td>67.5%</td>
<td>22.4%</td>
<td>34.6%</td>
<td>6.7%</td>
</tr>
<tr>
<td>High EL</td>
<td>80.8%</td>
<td>29.7%</td>
<td>36.7%</td>
<td>7.8%</td>
</tr>
</tbody>
</table>

Data presented as percentages.

* Significant gender difference, p<0.05.

a Significant age-group difference vs. 50-54 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).

b Significant age-group difference vs. 55-59 y, p<0.05 (after Bonferroni confidence interval adjustment for multiple testing).

c Significant EL difference, p<0.05.

* 5/7 days, or 4/6 days, or 4/5 days, or 3/4 days.

Men spent significantly more time in MVPA, but this difference is only seen when it is without the criteria in bouts of ≥10 min or more (see figure 6). Comparing the differences in fulfilling the recommendations the result looks like the one presented previously, that participants of 60-64 years are having less time in MVPA, but the difference here is minor, when it is within bouts of 10 min or more. For the recommendation of 30 min per day on most days of the week the middle age-group had significantly more participants fulfilling the recommendation (41.8%), compared with both the oldest group of 60-64 years (30.2%), and the youngest age-group of 50-54 years (34.1%). For the high EL group a significantly higher proportion was fulfilling the recommendation, but only without the specification that it had to be divided on most of the days per week.

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8 (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)

9 (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
6. Discussion

The main aim of this study was to investigate the PA patterns, including SB, in middle-aged men and women (50-64 years) randomly selected from the Gothenburg area. Analyses with regard to gender, age and EL were performed. Analyses of the proportion of the population that fulfilled the PA recommendations were also performed. The study was made through a quantitative methodology using accelerometer.

The main findings of this study were as expected in the hypothesis that the study population spent more time in SED and less time in PA just as seen in earlier studies (using subjective measurements methods). The study population had a median of 60.5% in SED of daily wear time, 35.2% in LIPA and 3.9% in MVPA. In relation to the average wear time (14.3 h), the study participants spend on average 8 hours and 40 min sitting during the day, with more than three hours in prolonged bouts (> 20 min). More time was spent in SED, and less time in LIPA during weekdays compared to weekends. Men spent more time in SED and less time in LIPA compared with the women. Men spent more time in MVPA, but when a requirement of accumulation in bouts of 10 min or more was set, no difference was seen. The 60-64 year old participants spent significantly less time in MVPA and had lower total movement (cpm) compared with the younger age-groups. The high EL group was spending more time in SED.
and less time in LIPA compared with the participants from the low EL group, but more time in MVPA. The high EL group was sitting more and spent less time in LIPA during the weekdays compared with weekends, where they spent more time in MVPA. The low EL did spend around the same amount of time in SED and in LIPA during weekdays compared to weekends, but more time in MVPA during weekdays. The least demanding recommendation of 150 min/week of total MVPA was fulfilled by 72.5% of the study population, but with the requirement of accumulation of MVPA in bouts of ≥10 min on most of the days per week, only 7.1% of the study population fulfilled this recommendation. This study showed, as expected in the hypothesis, results that were similar to accelerometer studies such as Hagströmer et al. (2007). However, it is important to note that this study reveal an unexpected result, with 7.1% of the population fulfilling the recommendation compared to Hagströmer et al’s (2007) 1.0%. This could be due to the definitions of the recommendation and inclusion demand, or it could be because of the different study populations (age).

6.1 The Movement Pattern and Sedentary Behaviour

6.1.1 Study Population

The results of this report has shown that the men and women in the present study population had a daily PA pattern, which was distributed with a median of 60.5% in SED, 35.2% in LIPA and 3.9% in MVPA. Compared to earlier studies by Dunstan et al. (2012) and Hagströmer et al. (2010) this study did not show big differences, but a little more time in SED, a little less time in LIPA, and a slightly increased quantity of time in MVPA. The results showed that participants spent on average 32.8 min in MVPA during the day. When the time in bouts of 10 min or more were accounted for, the average was only 9.5 min instead of the aforementioned 32.8 min. These outcomes are similar to Hagströmer et al. (2007), which reported 31 min/day in a similar accelerometer study. Another accelerometer study measuring MVPA in women between 56-76 years by Orsini et al. (2008) showed a significant higher average with 103 min/day in MVPA. It is however important to consider that the cut-point definition of MVPA in the Orsini study was lower (≥760 cpm/min) compared to this study and most other studies where MVPA is defined as ≥2019 cpm/min. The median wear time spent in SED was 60.5% in the present study population. In relation to the average wear

10 (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
time, the SED time for the study population was around 520 min/day. Compared to studies using self-reporting (Bauman et al. 2011), with a mean time of 300 min/day, the result of the study is as expected much higher almost the double. This result is similar to Hagströmers et al. 2007; Healy et al. (2008a) and Tudor-Locke et al. (2010) studies using the accelerometer, which showed SED with a median of 540 to 600 min/day.

When analysing the PA pattern and the SB, it is interesting to see when the participants are doing the PA and when they are in SED, because this could help us get an understanding of where the challenges are, and where it could be possible to make changes. For the total study population the analysis showed that they were sitting more during weekdays, compared to weekends. This difference could be due to the participants sitting more at work compared to in their spare time, and spent more time in LIPA at the weekends. The analysis also shows that there was no difference in time spent on MVPA when comparing weekdays and weekends. If the wish is to make people more active, the above shows us that an important area is getting people to spend more time in LIPA, and less time in SED, during weekdays. The findings make it understandable that SED jobs and SED working conditions are one of the big challenges of getting a more physically active lifestyle, and to get people being more active and do less sitting. The results show that the extra focuses on the small changes as breaking up SED (more standing instead of sitting etc.) are of big importance.

6.1.2 Gender

This study has shown, just like Hagström et al. (2010), that men had more time in SED and less time in LIPA compared to women. Instead, men in this study spent more time in MVPA compared to women so the total quantity of cpm/day was almost comparable between men and women. This could imply that women are more likely to be active in their daily life, while men are more likely to do activity in higher intensities, but spend more time sitting down. Comparing men and women in this study, men did spend more time in MVPA than women. Other studies (Hagströmer et al. 2007; 2010) have shown similar gender differences. It is interesting to see that this difference is no longer seen when the time of MVPA had to be accumulated in bouts of 10 min or more. It implies that men are not doing more exercise in higher intensities as biking, running etc., but instead could be doing more activity in higher intensities in their normal daily living. It could be that the women’s normal day activities are in lighter intensities compared to the mens’.
The result showed that women were sitting less than men. This gender differences was not seen in the national Public Health Agency statistic survey (Public Health Agency, 2009-2012), which relied on self-report. However, considering Hagströmer et al. (2010) who also used accelerometers, a small but not significantly difference was seen with men having more time in SED compared to women. The trend with men spending more time in SED was also observed in the further analyses of the SB, which showed that men had significantly prolonged SED bouts, more time in prolonged SED and less breaks from SED.

### 6.1.3 Age-groups

The study showed that the oldest group (60-64 years) spent less time in MVPA and therefore had a lower total mean cpm/day. This is comparable with Orsini et al. 2008 who showed that older adults were less active in MVPA than younger adults. Hagströmer et al. (2010) also showed that the older the persons, the less PA they perform. This probably reflects the physiological part of aging, which makes it more difficult to obtain MVPA, enhancing the importance of performing LIPA in daily life.

In this study there was no significant differences between the age-groups and time in SED, while previous studies have shown that older adults had more time in SED (Matthews et al. 2008). However, in the present study it is possible to see the trend that the oldest groups have more time in SED (61.4% vs. 59.2% and 60.9%). A reflection could be that this difference might have been significant with an even older group (for example 65-70 years), but this is only a hypothesis.

### 6.1.4 Education Level

Considering the EL groups, there were some differences between the low and high EL groups. The low EL group was sitting less and had more time in LIPA compared to the high EL group. This could be an effect of the individuals with high EL having jobs with less activity, for example working in an office with a lot of sitting, and therefore they are spending more time in SED, while the group with a lower EL could have more active jobs. These results relate to the analyses of the data from the Eurobarometer (Bennie et al. 2013), which showed that adults with more education were more likely to be in a high-sit/less-active group
compared to adults with a lower EL. At the same time the result showed no difference between these two groups in the total quantity of total PA (mean cpm/day), as participants in the high EL level group spent more time in MVPA. A reason for this could be that this activity takes place when the higher EL group is outside working hours and could be some kind of training in their spare time. By contrast, the low EL group might have occupations, which require less sitting and more movement, but do not engage in as much exercise in their spare time compared to the high EL group. This could easily be a social class question about the possibilities for the low EL group to perform exercise such as going to the gym etc., possibly due to the low EL group having less money or maybe less spare time. Exercise as a social class question is already a topic that has been discussed.

As mentioned earlier, there were also some differences between the low and high EL group regarding time in SED. Here the trend also continued in the SED analysis with the high EL group having more numbers of SED bouts, higher time in SED bouts and less breaks from SED. As mentioned earlier this could probably be depending on the type of work they do. Analysing the SB with SED bouts and breaks is a new research area, and there are not many results to compare this study results with. However, Healy et al. (2011b) has investigated SB and found similar results as the present study. Healy et al. (2011b) showed that the analysed population (US adults) had on average 92.5 breaks in the SED time during the day, which is similar to this study’s average with 85.8 breaks per day. Even more important is this research area about SB, because Healy et al. (2008b) has shown that breaking up SED time, independent from total SED time, time in MVPA and the mean intensity of the breaks, is health beneficial.

While investigating the PA pattern during the day between the EL groups, it was interesting to see that participants in the high EL group were sitting more, had less time in LIPA and MVPA during the weekdays compared to weekends, while the low EL group was more active (MVPA) during the weekdays compared to the weekends. This could indicate that participants in the low EL group are more active while doing their job, but then less active in their spare time. The high EL group does, as mentioned earlier, probably have more “office sitting jobs”, but they are instead better at doing planned training, such as going to the gym in their spare time. Describing the differences, it is important to be aware of both the health benefits and the complications for both groups. The high EL group spending more time in MVPA is getting the well-known health benefits of MVPA, while the increased time spent in
SED and less time in LIPA might induce health risks. Therefore, to be able to give the right recommendations, it is important to know where the obstacles are. According to the results, it will for the high EL be important to find a way to do less sitting and spend more time in LIPA during working time, while it for the low EL might be more important to find a way to spend more time in MVPA outside working time.

6.1.5 Discussion of the Movement Pattern

New technological changes have resulted in a high proportion of daily SED time in the population. This increase was also shown in this study with the total study population spending 60.5% in SED and 35.2% in LIPA. Dunstan et al. 2012a showed how LIPA in daily life was replaced by SED, while MVPA only represents a small part of the total movement pattern during the day. A lot of studies have shown that more time in SED increases the risk of having metabolic syndrome, higher risk for diseases as non-insulin dependent diabetes, CVD and increase of all-cause mortality (Chau et al. 2013; Dunstan et al. 2005; Dunstan et al. 2012a; Edwardson et al. 2012; Healy et al. 2008a & Wilmot et al. 2012). Not only reducing SED has shown to reduce the risks, but also breaking up the SED more often has shown health beneficial effects (Dunstan et al. 2012b; Healy et al. 2008b; 2011). Small changes in the daily life, with reduced SED and increased LIPA and breaking up SED more, can make big health beneficial changes. To change routines and lifestyles in the daily life routine are not easy and big changes as starting to train for example running etc. three times a week, is difficult for a lot of people. It is extra important to focus on the small changes that may make a difference. It could be to take the stairs instead of the elevator, an active transport to work (biking, walking, etc.), or go for a half an hour walk in the evening. Also small changes at work such as standing by the desk instead of sitting or taking breaks from the regular sitting (go take a cup of coffee, say hello to the person sitting next door etc.). This advice is not new, so the big question should be, how do we reach the population and how do we really get them to make these changes?

6.2 Fulfilment of Physical Activity Recommendations

The least demanding recommendation with 150 min/week of total MVPA were in this study fulfilled by 72.5% of the participants, but with the specification of MVPA in bouts of $\geq$10
min, only 25.1% fulfilled it. If the MVPA had to be 30 min per day on most days per week\textsuperscript{11}, 35.3% fulfilled the recommendation. If the requirement was set to accumulation in bouts of ≥10 min and on most of the days of the week (according to current Swedish PA recommendations), only 7.1% fulfilled this recommendation. The 35.3% fulfilling 30 min MVPA on the most days per week\textsuperscript{12} is a significant lower proportion than reported in The national Public Health Agency’s statistic survey, which showed that of 65.0% of the study population fulfilled the recommendation (Public Health Agency, 2009-2011). The specification of the MVPA being distributed on most days of the week makes a big difference in how many participants are fulfilling the recommendation, 72.5% vs. 35.3%. Similarly, only counting the time in MVPA in bouts of 10 min or more makes a big difference in fulfilling the recommendation (72.5% vs. 25.1% and 35.3% vs. 7.1%). The same difference was seen in the study by Hagströmer et al. (2007) where the proportion of participants fulfilling recommendations fell from 52.0% to 1.0% when complying with the defined specifications. These results shows that defining the recommendation of MVPA to be in bouts of 10 min or more, makes it a lot more difficult for the population to meet this specific recommendation.

The gender differences, also mentioned earlier, were also seen here. Higher proportions of the men did, in this and in most other studies (Hagströmer et al. 2007), fulfil the recommendations. But this difference was no longer seen with the requirement of accumulation in bouts of 10 min or more. Some speculations about this result could be that the men are more likely to be in higher PA intensities in normal daily living while the women are more in LIPA during normal daily activities, but both groups are doing the same amount of exercise. Comparing the differences in fulfilling the recommendations between age-groups, the result is similar before where men and women after 60 years spent less time in MVPA, but the difference here is also smaller, when bouts of ≥10 min is required. A significant difference in fulfilment of the recommendation between the high EL group and the low EL without the specification of 30 min most days of the week\textsuperscript{13}. This could indicate that it is because the high EL group are more likely to do more exercise in their spare time and therefore the PA is less divided during the week.

\textsuperscript{11} (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
\textsuperscript{12} (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
\textsuperscript{13} (5/7 days, or 4/6 days, or 4/5 days, or 3/4 days)
6.3 Methodological Considerations

The limitations of the accelerometer have been presented earlier in this thesis (see method part – measurements and data processing). Non-awareness of which type of activity the participants are engaged in could give some inaccuracies in the result. When the accelerometer shows that the participants are sitting it might be that the participants in fact are not wearing the accelerometer or standing. If that were the fact it would make the participant be more in SED than in reality. To try to eliminate these errors, there are some adjustments and inclusion rules for the result from the accelerometer and wear time validation (see method part – measurements and data processing). Non-awareness of type of activity (running, biking, walking etc.) is not as important in this study, because it deals with a general overview of the PA and SB and not the exact knowledge of which kind of activity the participants are doing. The limitations of accurately registering both biking and running at high intensities can also have an effect, resulting in making the participant less active than in reality, thus it will be the time in MVPA that will be lower than the exact result. As described earlier there is only a small difference seen for the MVPA in the PA pattern, where the relation between time in LIPA and SED is more affected. It is important to be aware of common changes in PA behaviour the first two-three days (the Hawthorne effect, see method part – validity and reliability) when the participants start to wear the accelerometer. In an attempt to try to remove these errors the inclusion rules (see the method part - measurements and data processing) with a minimum of four days have been added. However, with these limitations, the accelerometer has still been found to have good validity, and better than earlier used subjective measurement methods.

The random selection of the 50-64 years old men and women provides a good representation of the whole population in this age-group. The gender differences for weight, height, waist and BMI are natural biological differences between men and women. Because this is the pilot study with participants from Gothenburg, it is not possible to make the result representative for the whole Swedish population, but only for the population from the Gothenburg area. However, the comparison with the Swedish population data (see result part – study population) that showed good agreement between the study population and the Swedish population of the same age, makes it possible to see the study population as representative of men and women in the Swedish population for the corresponding age-group. The significant differences in the BMI between men and women of the study population and the Swedish
population data, could be explained through the difference in the collection of these data, because while it was measured in the current study, it was self-reported in the Swedish population data.

6.4 Future Research

The big differences in results, measuring PA patterns and fulfilments of recommendations using the accelerometer (objective method) compared to subjective methods, gives us an understanding of the limited basic knowledge of the actual movement pattern of the Swedish population. Therefore, this study implies that more studies using objective measurement methods are needed to get a better overview of the populations PA and SB. This knowledge will make it easier to clarify possible obstacles to make the population healthier and reduce the risk of CVD and mortality. However, this study only gives a picture of the behaviour for Swedish men and women in the age of 50-64 years from Gothenburg, and hence more studies are needed to get an overview of the whole Swedish population. The future planned large SCAPIS study is one of these needed studies and will give this overview, as approximately 30000 men and women from different places of Sweden will be included.

Current mentioned recommendations of PA are based on previous research using subjective measurement methods. With more studies using objective measurement methods, future guidelines might be adjusted. Specifying in the recommendation that MVPA should be in bouts of only 10 min or more might help people to fulfil the recommendations, because 10 min should be easier to overcome than 30 min. But this study has shown that instead, a much lower proportion of the study population fulfilled the recommendations, and it shows that only a small proportion of them are doing MVPA bouts of 10 min or more. A big question for future research will therefore be how to get more people to fulfil the recommendations. This could be researched through intervention studies, to try to get an understanding of how to make lifestyle changes in the population and how to get the population to understand the importance of PA and reduction of SED time. Also the gender, ages and EL group differences in PA and SB in the study are important, because there can be different obstacles and various places changes will need to be made.

The focus on describing all three components of the daily PA pattern (SED, LIPA, MVPA) is an area that needs more research in the future. The trend of replacing LIPA with more SED
time is a major problem for the future health. Research is needed to increase awareness of how big the problem is, both regarding how the populations’ PA and SED patterns are, and to get an even better knowledge of how big of an effect it has on health. It is also important to start considering how to stop this development, and how to change these lifestyle habits. A big question will be how to get the population to replace the SB with more time in LIPA, but also to get the population to fulfil the MVPA recommendations.

7. Conclusion

The study has some major findings:

Only a small part of the present study population was fulfilling the current PA recommendations, and the participants had a high daily sitting time. This shows that a great challenge in the future will be to find methods to increase the PA level for the population in the age-group of 50 to 64 year olds. It will be important to recognize the differences between gender, age-groups and EL, if we are going to be able to find the right places to motivate lifestyle changes. The biggest challenge will be how to change the population’s habits.

Investigating all three components (SED, LIPA and MVPA) has shown to have a high relevance for studying the PA pattern and will be important for future research. A greater focus on replacing the SED with more LIPA during the day will be important. This study shows that one of the biggest challenges for this could be during working time.

The accelerometer results showed higher SED time and less PA, compared to earlier studies that used subjective measurement methods such as questionnaires. This highlights the importance of using objective measurement methods (such as accelerometers) moving forward, instead of (or together with) subjective methods. Objective studies will give us a more precise understanding of the population activity patterns. It will also provide a better view on the most inactive hours during the week and during each weekday. Thus we will get a picture of where the biggest challenges are and where to direct our focus when making changes.
Thoughts that have emerged during this study are that middle-aged adults spent much time in SED and that this is probably replacing time being spent in LIPA. Therefore a huge challenge exists. We need to figure out how to stop and change these lifestyle habits. The biggest challenge is the lifestyle during weekdays, specifically during work time, since more and more people have SED jobs. This area needs more research and a bigger focus. Therefore this thesis will end with a quote from Dunstan as a reminder to everybody:

“Stand up, sit less, move more, move often” (Dunstan et al. 2012a).

Acknowledgements

The Swedish Heart and Lung Foundation, the Knut and Alice Wallenberg Foundation, the Swedish Research Council and VINNOVA support SCAPIS. The SCAPIS pilot study also received funding from the Sahlgrenska Academy at Gothenburg University and strategic grants from ALF/LUA in Western Sweden. I am grateful to all the participants in this study and a big thanks to all test personnel at the SCAPIS test centre in Gothenburg.

Finally, I am really thankful for the great help and support I received from my supervisor Elin Ekblom-Bak throughout the whole project.
Bibliography


Appendix 1 – Literature search

Project aims:
The main aim is to examine the PA patterns, including SB (SED time and number of breaks in SED time) in Swedish middle-aged men and women (50-64 years) by using objective measurements method (accelerometer). Moreover, to analyse differences in age, gender and EL for these variables. A second aim was to analyse the proportion of the present population that is fulfilling the national recommendations of MVPA.

What search word have you used?

| Physical activity AND accelerometer; sedentary AND accelerometer; physical activity AND diseases AND prevention; cardiorespiratory fitness AND all-cause mortality; socioeconomic AND physical activity AND Sweden; sedentary behaviour AND definitions; physical activities AND definitions; Validity AND accelerometer |

Where have you search?

PubMed, Sportdiscus.

Searching yielding relevant results

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| Physical activity AND accelerometer |
| Sedentary AND accelerometer |

Comments

Most of the literature was found by related articles on PubMed and Sportdiscus. A lot of the articles was mentioned by my supervisor and then found through PudMed and Sportdiscus without searching.