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Healthy Ageing:

The effect of accumulated lifestyle factors on physical capabilities of elderly in Sweden

Bachelor thesis

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28-01-2022

Abstract
Population ageing is a challenge for all Western countries, especially for countries with a strong social welfare state like Sweden. Improving physical health at older ages both alleviates the burden of an ageing population and is of great interest for individuals and their families. Therefore, the objective of this thesis is to gain more insight into the lifestyle risk factors influencing physical health at older ages from a life course epidemiological perspective. The accompanied central research question is: 'What is the relationship between accumulated lifestyle factors and physical health in later life in Sweden?' The central research question is answered using statistical analyses on the Survey of Health, Ageing and Retirement in Europe (SHARE) dataset looking at the effects of accumulated lifestyle factors upon large muscle function, mobility and fine motor skills. The analyses also look into the effects of the separate lifestyle factors (smoking behaviour, alcohol use, physical activity, body mass index and fruit- and vegetable consumption) as well as gender differences in the effects of accumulated lifestyle factors. Several ordinal logistic regressions and binary logistic regressions were conducted and the effects are controlled for gender, educational levels, number of chronic diseases and age. The resulting odds ratios indicate the accumulated healthy lifestyle factors to have a profound positive effect on all 3 health outcomes. The strongest effect was found to be on mobility with an odds ratio of 1,578 (C.I. coefficient .356-.555) followed by fine motor skills with 1,461 and large muscle function with 1,427 (C.I. coefficient 2.119-3.052). Therefore, it is advisable for governments to direct policies at enhancing healthy lifestyle behaviours to improve physical health at older ages.

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1: Introduction

The Swedish population is ageing just like other Western countries. From 1970 to 2020 the share of the population of Sweden being 65+ and 80+ years old has respectively risen from 13.8% to 20.1% and from 2.4% to 5.3% (Statista, 2021). Simultaneously, the life expectancy at birth in Sweden has increased from 74.5 years in 1970 to 82.8 years in 2019 (Ourworldindata, 2019). Due to population ageing more individuals are reaching vulnerable ages and governments are forced to prioritise their task of ensuring physical and mental health at older ages. Remaining healthy throughout life is also of great interest for the wellbeing of individuals and their families as it will provide people with the opportunity to have control over their own life. Besides governments having the moral duty to ensure public health, healthy ageing would also mean less government expenditures on health and social care services for the older segment of the population. These government expenditures are of particular interest for a country like Sweden with a typical Nordic social welfare state providing its population with universal healthcare and economic security (Jørgensen et al. 2019). An additional challenge is the demographic change, i.e. fewer younger people are filling up the labour market to ensure the generational system of pension and health care insurances. Despite the universal increases in life expectancy, there is no strong evidence suggesting an improvement in older age health over the past generations (Calder et al. 2018).

Healthy ageing is often studied using a life course epidemiological approach: "the study of long term effects on later health or disease risk of physical or social exposures during gestation, childhood, adolescence, young adulthood and later adult life" (Kuh et al. 2003, p.778). Life course epidemiology includes research on the influence of behavioural processes like lifestyle factors on the development of disease risk (Kuh et al. 2003). Some of the lifestyle factors most discussed for their effects on physical health are physical activity, smoking, alcohol use, being overweight (Liao et al. 2011), and nutrition (Calder et al. 2018). Although the direction of the effect on physical health is clear for most lifestyle factors, studies find various effects of physical activity on healthy ageing, ranging from positive to negative effects (Sabia et al. 2012). Previous research considering the effect of lifestyle factors on healthy ageing is predominantly concerned with the effects on separate health outcomes like mortality, cognitive- and physical functioning and the absence of chronic diseases (Sabia et al. 2012). Despite its well-known importance, the combined effect of multiple lifestyle factors on biological ageing still remains rather unknown (Cooper et al. 2016). Larsson, Kaluza and Wolk (2017) did however find in Sweden a positive relationship with the combination of non-smoking, physical activity, limited alcohol consumption and a healthy diet and increases in longevity. Still, more research is needed to map the effects of lifestyle on healthy ageing, including functionality and morbidity (Sabia et al. 2012). Also, more research is needed to investigate the differences in health between men and women, including the biological processes underlying it (Kuh & Hardy, 2002). For the study of healthy physical ageing, research could gain from using objective measures of physical capability (instead of relying on self-reports) for improving accuracy, validity and reproducibility (Kuh et al. 2014). Additional research on the effect of accumulated lifestyle factors on physical health at older ages could contribute to the progress of the life course epidemiological approach.

The objective of this research is to examine the effect of accumulated lifestyle factors on later life physical health of a Swedish elderly cohort aged 50 and older. For the analyses this study uses data from the Survey of Health, Ageing and Retirement in Europe (SHARE) dataset. Physical health in this study is defined at the personal level looking at (absence of) disability, the inability to perform a task. To measure physical health, three objective measures of physical capabilities are used: physical mobility, large muscle function and fine motor skills. The health outcomes were measured using BMI,

smoking behaviour, alcohol use, physical activity and intake of fruits and vegetables are used as lifestyle factors. With the lifestyle factors, physical health and the study population demarcated, the research surrounds the following main research question:
‘What is the relationship between accumulated lifestyle factors and physical health in later life in Sweden?’
The main research question will be answered using the following sub-questions:

- How do separate lifestyle factors influence mobility, large muscle function and fine motor skills in later life?
- How does the accumulation of unhealthy lifestyle factors affect mobility, large muscle function and fine motor skills in later life of the Swedish population over 50 years old?
- How does the effect of the accumulation of unhealthy lifestyle factors on mobility, large muscle function and fine motor skills differ by gender?

The next chapter consists of the theoretical framework and the conceptual model of this research. Afterwards, follow the methodology, results and a discussion of the results. The paper ends with a conclusion and policy recommendations.

2: Theoretical framework

2.1 Previous research

The World Health Organisation (WHO) puts forward a life course approach to healthy ageing which entails researching how health develops at each life stage and how to influence a healthy ageing process throughout life (Kuh, 2019). The life course epidemiological approach of Kuh (2019) extends the concept of a life course approach by considering both physical and mental capacities. The postponement of decline of the physical and mental capacities is widely associated with maintaining a healthy lifestyle throughout the life course (Kuh, 2019). Before going into the effects of accumulated lifestyle factors on physical capacities, first the effects of separate lifestyle factors on physical capacities will be considered.

Strand et al. (2010) studied the cumulative effect of smoking on physical performance, measured by standing balance, chair rise speed and hand grip strength. Their findings showed a negative relationship between smoking intensity and duration on the one hand and overall lower physical performance on the other hand. Especially standing balance and chair rising speed were affected by one's smoking history. Smoking is also related to later loss of bone mineral (osteoporosis) and decreasing muscle and lung function (Calder et al. 2018). Adding to this, former and current smoking are strongly related to muscle strength decline (Stenholm et al. 2011). Overall, it is likely for smokers to enter old age with a lower physiological reserve (Strand et al. 2010).

As a lifestyle factor, alcohol consumption is found to have a negative effect on activities of daily living (ADL) depending on the frequency and intensity of the alcohol use (Liao et al. 2011). The greatest chances at healthy ageing are found amongst people with a moderate alcohol consumption, as compared to heavy alcohol use or total abstinence (Sabia et al. 2012).

Just as smoking, also a lack of physical activity throughout life is separately associated with loss of bone mineral in later life (Calder et al. 2018). Next to this, remaining physically active reduces the risk for disabilities in later adult life (Liao et al. 2011). According to Kuh (2019) physical activity is an important factor for maintaining physical capabilities. According to Kuh and Hardy (2002) physical activity drops on an earlier stage for women than for men, which causes more losses in bone- and muscle strength for women.

Often mentioned as part of the main lifestyle factors affecting healthy ageing is nutrition. Concerning the mental capacities, nutrition can play an important role in preserving cognitive health of older adults via higher intakes of fish, fruits and vegetables (Calder et al. 2018). Physical capacities can be affected by nutrition, e.g. intakes of calcium and vitamin D can slow down the rate of osteoporosis (Calder et al. 2018).

Closely related to physical activity, nutrition is Body Mass Index (BMI), i.e. bodyweight in kilograms divided by the squared body length in metres. BMI is used to filter bodyweight from the effects of body length. Liao et al (2011) found that people with overweight or obesity at the first moment of measurement resulted in having a greater handgrip strength decline afterwards. Also, an extended period of obesity is likely to result in an advanced muscle strength decline (Liao et al. 2011).

Next to research in the field of separate lifestyle factors, there is an increasing interest in the effect of accumulated lifestyle factors on healthy ageing (Sabia et al. 2012). Sabia et al. (2012) theirselves find a positive relationship between good cognitive, physical, respiratory and cardiovascular functioning and the combination of not smoking, moderate alcohol use, physical activity and a healthy diet. Additionally, Larsson, Kaluza and Wolk (2017) found the combination of non-smoking, physical activity, limited alcohol consumption and a healthy diet to have a positive effect on living longer with 4.1 years for men and 4.9 for women.

2.2 Theoretical background

Life course epidemiology aims to study the effect of cumulative damage to one's health reserve as the number of damage exposures, its duration and the intensity increase (Kuh et al. 2003). The accumulation of damage may occur as a result of behavioural exposures, like lifestyle factors. Figure 1 illustrates the various possible patterns of health reserve development and decline over the life course, i.d. the biological and behavioural pathways from gestation until later adult life (Kuh et al. 2014). The figure shows how the accumulation of damage breaks down the intrinsic capacity of an organ or system to function, i.e. the health reserve (Kuh, 2019). The rate and patterns of intrinsic capacity decline varies between individuals (Kuh et al. 2014) and is influenced by the accumulation of risk factors as well as separate risk factors (Kuh et al. 2003). For individuals with a high health reserve at the onset of decline, a perfectly healthy lifestyle is expected to result in a gradual decline in health reserve (see Fig. 1, trajectory A) as accumulated unhealthy lifestyle factors are expected to result in an accelerated decline (see Fig. 1, trajectory C). Specific periods with lasting and lifelong effects on the intrinsic capacity of organs or systems are called critical periods (Ben-Shlomo & Kuh, 2002). In this research the focus will lie on the declines in health reserve during adulthood as affected by lifestyle factors (see Fig. 1, Adult risk factors). Declines in health reserves can differ by gender, these differences partially be explained by biological and socio-economic differences per gender (Hsu, 2005). Such biological differences include women having smaller skeletons and experiencing a loss of oestrogen effects at menopause (Kuh & Hardy, 2002)

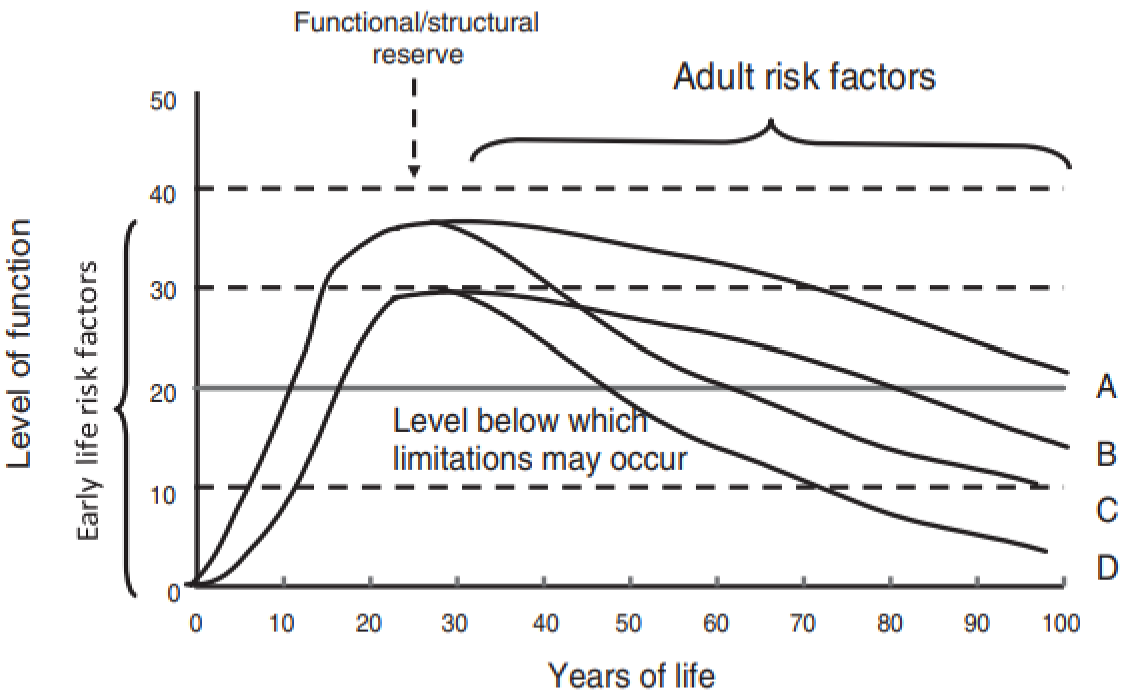

Figure 1: Life course trajectories of ageing. The model shows trajectories with optimal and sub-optimal health reserve development with average and accelerated decline options. (Kuh et al. 2014)

The ability to self-manage is a threshold of physical health and therefore of healthy ageing. Age-related declines in physical capabilities to function are especially reported from mid-life onwards (Cooper et al. 2016), eventually the health reserve drops below a certain level where the accumulation of damage can lead to morbidity (Calder et al. 2018) (see Fig. 1, Level below which limitations may occur).

2.3 Conceptual model

From the literature review in the previous part of this chapter we can conclude smoking behaviour, alcohol use, physical activity, nutrition, BMI and gender affect physical capacities. The effects on physical capacities are found for separate lifestyle factors as well as for accumulated lifestyle factors. So, lifestyle influences the rate and pattern of health reserve declines, eventually leading to problems with physical capabilities.

Therefore, with figure 2, this study proposes the following conceptual model as a tool to better analyse the effects of both the separate and accumulated lifestyle factors on physical capabilities during adulthood. The lines in the model drawn represent the effects of lifestyle factors on physical capabilities, whether the effects are positive or negative depend on the actual lifestyle behaviour. In Addition to the separate effects of the lifestyle factors in the model, the lifestyle factors also add up into the accumulated lifestyle factors with its own effect on physical capabilities over time. The effects of gender on physical capabilities are also included.

Based on the literature review the hypothesis of this study is to find a clear and positive effect of both accumulated and separate healthy lifestyle factors on physical capabilities as well as differences in the size of effect by gender.

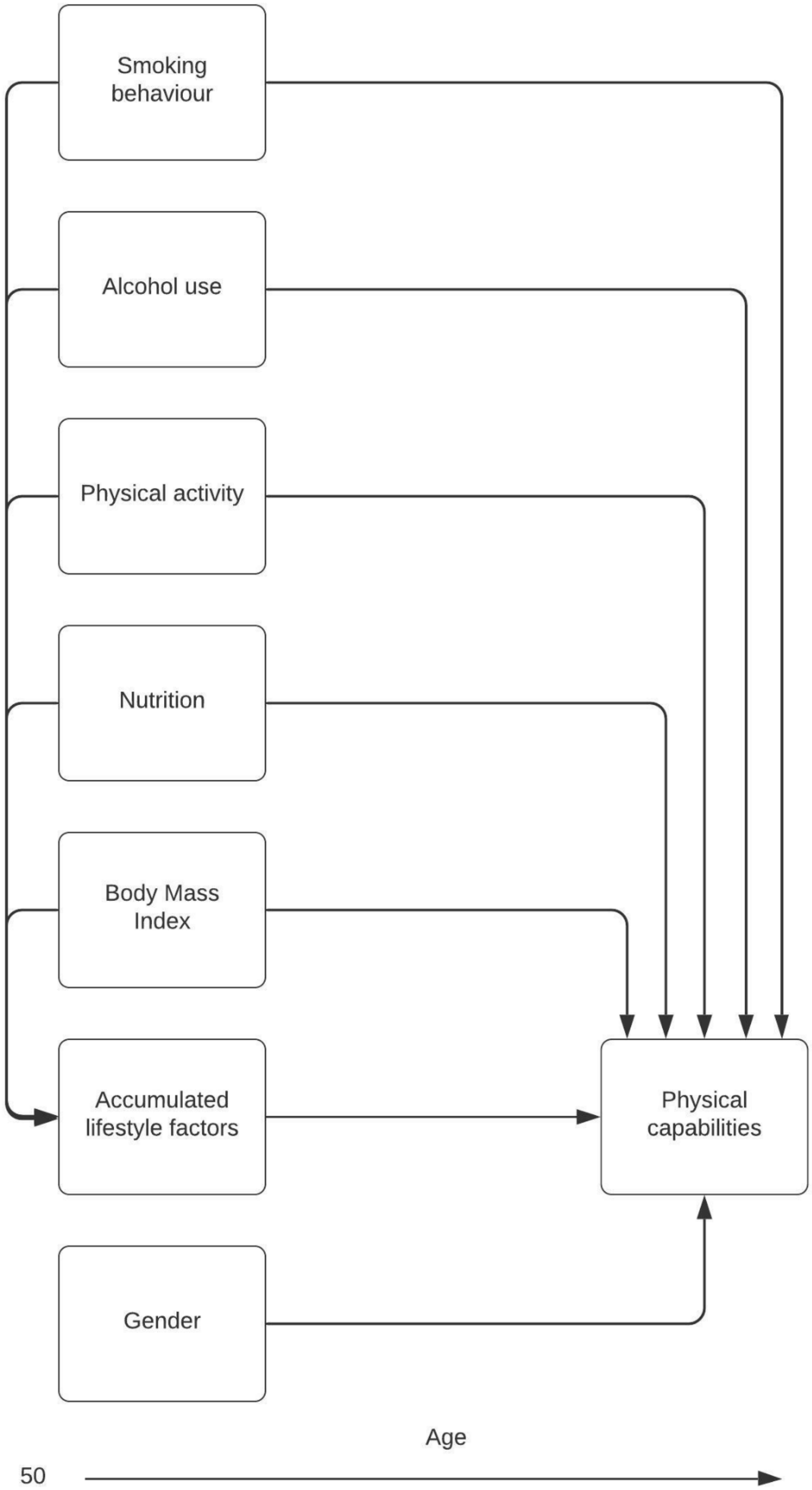

Figure 2: Conceptual model visualising effects of the separate and accumulated lifestyle factors and gender on physical capabilities during adulthood.

3: Methodology

3.1 Data source

For the statistical analysis of the effect of accumulated lifestyle factors on physical capabilities the Survey of Health, Ageing and Retirement in Europe (SHARE) dataset is used. Since 2004 SHARE has collected internationally comparable longitudinal data from people aged 50 years and older from 28 countries across Europe. The SHARE dataset is aimed at being "a research infrastructure for studying the effects of health, social, economic and environmental policies over the life-course of European citizens and beyond" (Share-project.org, 2021). SHARE has since 2004 collected data about the population of Sweden. For the statistical analysis of the effect of lifestyle factors on the physical capabilities in Sweden the data from the 5th wave of data collection (2013) in Sweden was chosen to be used. The 5th wave was chosen for having the highest number of participants as compared to other waves of data collection.

3.2 Study population

The study population of this research was formed by taking the 5th wave of data collection of SHARE and thereafter filtering the dataset for respondents with Sweden as the country identifier and who are aged 50 years or older. The resulting study population consists of 4514 respondents of which 2111 men and 2403 women. Below, figure 3 outlines the age structure of men and women separately.

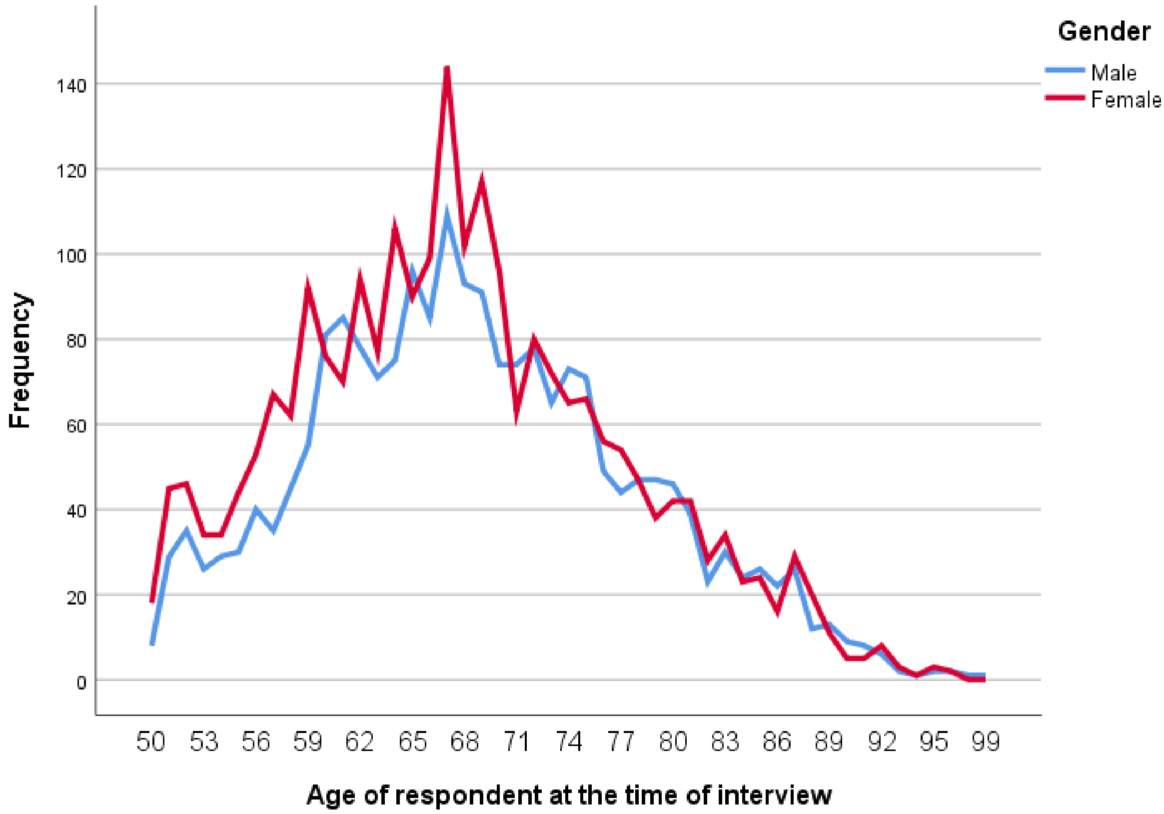

Figure 3: Line chart displaying the age of Swedish respondents at the time of the interview per gender using SHARE data from the 5th wave which took place in 2013.

3.3 Outcome assessment

This research assesses physical health via physical capabilities. Physical capabilities are used as a parameter for functionality, one's ability to self-manage.

Kuh et al. (2014) propose 4 accurately described and objective assessment criteria to measure physical capabilities: locomotor function, strength, balance and dexterity. These criteria are meant to capture the full spectrum of function. For the analyses in this research three different ratio variables are computed to function as dependent variables. The dependent variables capture information about all 4 proposed criteria because they are built up out of multiple already existing variables indicating whether or not respondents have difficulties with performing physical tasks.

The first dependent variable is the mobility index and is computed by counting whether or not respondents have difficulties with walking 100 metres, walking across a room, climbing one flight of stairs and climbing several flights of stairs. The index score starts at a 4 and with every difficulty counted the index decreases with a point, this results in a 0 to 4 range. A higher mobility index corresponds with a higher mobility. Of the aforementioned assessment criteria, the mobility index mainly measures the locomotor function but also touches upon strength and balance.

The same concept is used for the second dependent variable: the large muscle index. The large muscle index is computed by counting whether or not respondents have difficulties with sitting for two hours, getting up from a chair, pulling or pushing large objects and stooping, kneeling or crouching. The resulting variable has a 0 to 4 range where a 4 indicates having no difficulties and a 0 indicates a respondent having difficulties for all counted taks. The large muscle index mainly assesses the strength of the respondent but also includes balance and locomotor function.

Lastly, dexterity is assessed with the fine motor skills index. The variable is computed by counting 3 variables measuring fine motor skills. The fine motor skills index counts whether or not respondents have difficulties with picking up a small coin, eating and cutting up food, and getting dressed. The fine motor skills index has a 0 to 3 range with a higher index corresponding with better fine motor skills.

Table 1 shows the descriptive measures of central tendency of the computed health outcomes.

Variable	n	Mean	Standard deviation	Minimum	Maximum
Mobility index	4506	.31	.769	0	4
Large muscle index	4507	.57	.925	0	4
Fine motor skills index	4506	.11	.390	0	3

Table 1: Frequency table showing frequencies and measures of central tendency for the mobility index, large muscle index and fine motor skills index using SHARE data from the 5th wave of data collection which took place in 2013.

3.4 Exposure

Respondents’ lifestyles will be assessed based on the accumulation of BMI, smoking behaviour, alcohol use, physical activity and nutrition. For every lifestyle factor a cut point for having an unhealthy lifestyle is set. The number of healthy lifestyle factors will be counted for every respondent, this results in an ‘healthy lifestyle index’. The healthy lifestyle index is the main independent variable for the analyses and comes in the form of a discrete variable with a 0 to 5 range. An index score of 5 means a perfectly healthy lifestyle and as the score decreases the number of unhealthy lifestyle behaviours accumulate.

Before setting the cut-off points and computing the healthy lifestyle index, the variables were checked for possible correlations to avoid a model which has significantly fluctuating results and which would be less applicable to other samples. The correlations are tested using the nonparametric Spearman's Rho test because the dataset consists of mainly ordinal variables describing respondents' lifestyle. The nominal smoking behaviour variable is left out of the Spearman's Rho test as it does not meet the requirements of a Spearman's Rho test. The null hypothesis for the test states that there is no linear relationship between the variables in the population, the results are presented in table 1. The variables are suitable for the analyses with correlation coefficients way below 0,800.

		Vigorous activities	Alcohol use	BMI categories	Fruits and vegetables
Vigorous activities	Correlation Coefficient	1,000	0,136	0,053	0,045
	Sig. (2-tailed)		0,000*	0,000*	0,003*
	N	4508	4508	4508	4508
Alcohol use	Correlation Coefficient	0,136	1,000	0,058	0,002
	Sig. (2-tailed)	0,000*		0,000*	0,868
	N	4508	4508	4508	4508
BMI categories	Correlation Coefficient	0,053	0,058	1,000	0,062
	Sig. (2-tailed)	0,000*	0,000*		0,000*
	N	4508	4508	4508	4508
Fruits and vegetables	Correlation Coefficient	0,045	0,002	0,062	1,000
	Sig. (2-tailed)	0,003*	0,868	0,000*	
	N	4508	4508	4508	4514

Table 2: Pairwise correlation matrix for the ordinal measures vigorous activities, alcohol use, BMI categories and fruits and vegetables showing the results using a Spearman's Rho test. Significant results are indicated with a * with a significance level set at 0.05.

For the healthy lifestyle index an unhealthy BMI was defined as having overweight (BMI of 25-29.9) or being obese (BMI of 30 or higher). Smoking behaviour is assessed looking at current smoking behaviour only. Smoking history was left out of consideration because including it would mean a loss of many cases due to missing data. Respondents indicated whether or not they currently smoke. Currently smoking counts as an unhealthy lifestyle factor. Unhealthy alcohol use was defined as consuming alcohol for at least 5 days a week. Physical activity was assessed by looking at the frequency of doing vigorous activities, as a parameter for total physical activity. Respondents indicated how often they play sports, do heavy housework or do a job that involves physical labour. The cut point of having too little physical activity was set at doing vigorous activities less than once a week. The healthy lifestyle index is completed with nutrition. Respondents scored an unhealthy diet if they do not eat fruits and vegetables every day. The consumption of fruits and vegetables is used as a parameter for overall nutrition patterns.

Before computing the 'healthy lifestyle index' variable all separate lifestyle factors were recoded into dummy variables with a 0 for a healthy lifestyle and a 1 for an unhealthy lifestyle. Figure 4 displays the distribution of the healthy lifestyle index scores for the 3233 valid cases with differences by gender visible.

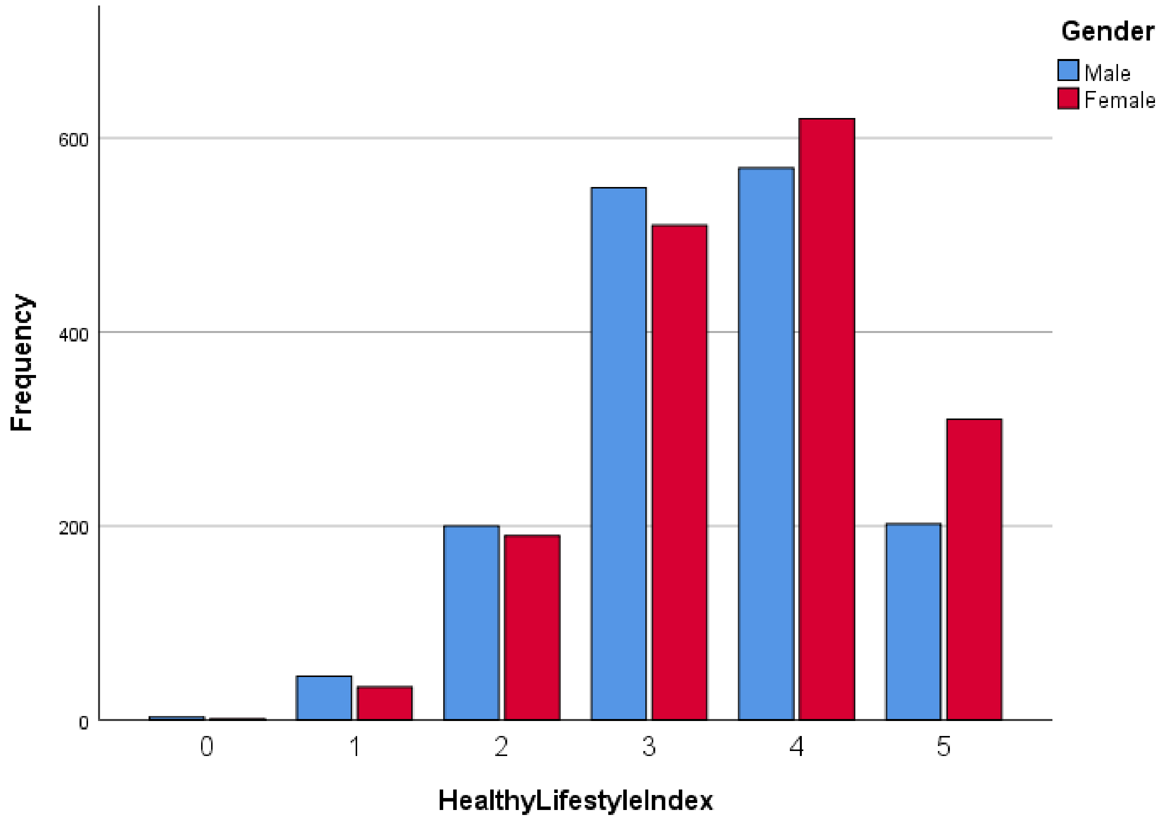

Figure 4: Clustered bar chart displaying the distribution of the healthy lifestyle index scores by gender.

3.5 Control variables

The socio-demographic control variables in the analyses comprise age, gender, number of chronic diseases and educational level. For educational level the ISCED-97 coding of education was used. These control variables account for demographic differences and thereby rule out the effects of demographic differences on the health outcomes. Marital status was excluded as a control variable to prevent losing a large number of cases due to missing data for the marital status variable.

3.5 Statistical analyses

The statistical analysis starts with a descriptive analysis of respondents' behaviour per lifestyle factor.

In order to meet the requirements of a suitable regression analysis the discrete dependent variables of mobility index, large muscle index and fine motor skills index are treated as ordinal variables. For the analyses of the relationship between accumulated lifestyle factors and physical capabilities an ordinal logistic regression is the preferred statistical test as it models the cumulative probabilities rather than probabilities of individual outcomes. The cumulative probabilities help to answer the research question by analysing the relationship between the health outcomes and accumulated lifestyle factors. The ordinal logistic regression is performed separately for the mobility index, large muscle index and fine motor skills index as dependent variables and with the healthy lifestyle index and the control variables (age, gender, number of chronic diseases and level of education) as dependent variables.

As the ordinal logistic regression automatically takes the last category of ordinal and nominal variables as the reference category, first the dependent variables and the healthy lifestyle index are all coded with higher values as outcomes indicate better health. Due to this way of coding the reference categories in the analysis contain sufficient cases for a useful analysis. Secondly, to reduce the number of empty cells and meet the requirements of the ordinal logistic regression, the discrete age variable is computed into an ordinal variable with age groups with a 5-year interval. The age groups start with 50-54 and run until 85-89, the last group contains every respondent aged at least 90. Also, to reduce the number of empty cells, for the healthy lifestyle index value 1 contains both respondents with 4 and respondents with 5 unhealthy lifestyle factors as the latter group contains only 4 cases. Concerning the control variables, the same is done for the ISCED levels 5 and 6 as the latter level of education contains just 12 cases and respondents with 6 or more chronic diseases are combined in one group. After these measures there were no longer unexpected singularities encountered in the Fisher information matrix and the number of empty cells was limited.

After the above outlined data treatment, the requirements are met for an ordinal logistic regression with the mobility index and with the large muscle index as dependent variable with the healthy lifestyle index as independent variable. For the fine motor skills index the requirements of an ordinal logistic regression are not met due to a violation of the assumption of proportional odds. The assumption of proportional odds is the key underlying assumption of an ordinal logistic regression, it assumes equal effects of the explanatory variables across thresholds of the outcome variable.

For the analysis of the relationship between dexterity and cumulative healthy lifestyle factors the fine motor skills index variable is dichotomized. The index is computed into a binary variable containing information whether or not a respondent has any difficulties with either picking up a small coin, eating and cutting up food, or getting dressed. With the binary fine motor skills variable as the dependent variable a binary logistic regression is performed with the healthy lifestyle index as independent variable and age groups, ISCED levels, number of chronic diseases and gender as control variables. The data meets the requirements of this test as it contains independent cases, a binary dependent variable and a linear relationship between the logit of that variable on the one hand and the independent variables on the other hand.

Next to the analysis of the effect of accumulated lifestyle factors on physical capabilities, the separate effects of lifestyle factors on physical capabilities are analysed to gain more insight on the mechanisms underlying the effect of the cumulative lifestyle factors. For the large muscle index an ordinal regression is run with the index as the dependent variable and as independent variables the binary variables on healthy BMI, smoking behaviour, alcohol use, physical activity and nutrition with gender, ISCED levels, number of chronic diseases and age groups as control variables. A likewise analysis was not possible for the mobility index as the assumption of proportional odds was violated with the lifestyle factors included as binary variables. The relationship between dexterity and separate lifestyle factors is tested using a binary logistic regression with the binary fine motor skills variable as the dependent variable and the binary variables on healthy BMI, smoking behaviour, alcohol use, physical activity and nutrition as independent variables controlled for the effects of gender, ISCED levels, number of chronic diseases and age groups.

Lastly the differences in the effect of accumulated lifestyle factors on physical capabilities between men and women are analysed. For this analysis the same dependent and independent variables as for the other analyses of the effect of cumulative lifestyle factors are used but now the tests are run separately for men or women. The differences in the effects across gender were only analysable for the large muscle index as the dependent variable as the data met the requirements for the ordinal logistic regression. For the mobility index as dependent variable, the comparison was not possible due to a violated assumption of proportional odds when selecting only men for the ordinal logistic regression. Differences in the effects on fine motor skills are analysed using a binary logistic regression.

4: Results

In this chapter the results of the statistical analyses are presented. After the descriptive results, the results mainly include the effect of the accumulated lifestyle factors (healthy lifestyle index) on the three parameters of physical capabilities: large muscle index, mobility index and fine motor skills. Additionally, the differences in the effects of accumulated lifestyle factors by gender and the effects of separate lifestyle factors on the large muscle index, mobility index and fine motor skills are described. All results and conclusions drawn from it are taken with a set point of 95% confidence. Emphasising the length of this chapter the results include compressed regression tables with full regression tables placed in the appendix.

4.1 Descriptive results

Table 3 displays the distribution of healthy and unhealthy behaviour for each of the independent variables concerning lifestyle factors.

Variable	Healthy lifestyle % (n)	Unhealthy lifestyle % (n)	Total % (n)
BMI	44.9% (1989)	55.1% (2436)	100% (4425)
Smoking	83.1% (2737)	16.9% (556)	100% (3293)
Alcohol use	91.4% (4116)	8.6% (388)	100% (4504)
Physical activity	58.7% (2644)	41.3% (1861)	100% (4505)
Nutrition	76.9% (3472)	23.1% (1042)	100% (4514)

Table 3: Frequency table showing the percentage of respondents having a healthy or unhealthy BMI, smoking, alcohol use, physical activity and nutrition. The parentheses contain the frequencies.

4.2 Large Muscle Index

4.2.1 Large Muscle Index with accumulated lifestyle factors

Table 4 shows a compressed regression table of the ordinal logistic regression with large muscle index as dependent variable and healthy lifestyle index (HLI) as independent variable. The complete regression model can be found in the appendix as table 11.

The parameter estimates (see table 4) are the core of the ordinal logistic regression results as they give information about the relationship between the large muscle index and the explanatory variable being the healthy lifestyle index. As the coefficient comes in the form of a binary logit the exponent of it is taken to calculate the odds ratio. The coefficient of the healthy lifestyle index is 0,356 which leads to an odds ratio of 1,427. The p-value of 0,000 for the coefficient indicates a statistically significant result. The odds ratio of 1,427 means that with every increase in the number of healthy lifestyle factors (with 0 and 1 combined) the odds of having a healthier large muscle index score can be multiplied with 1,427.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	**.356**	**.040**	**79.376**	**1**	**.000***	**2.119**	**3.052**

Threshold 0	.150	.394	.145	1	.704	-.622	.922
Threshold 1	1.399	.384	13.263	1	.000*	.646	2.151
Threshold 2	2.547	.386	43.636	1	.000*	1.792	3.303
Threshold 3	3.845	.390	97.194	1	.000*	3.081	4.610
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	601.596	21	.000*		3135	.893	.199

Table 4: Compressed regression table of an ordinal logistic regression with large muscle index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.2.2 Large Muscle Index with separate lifestyle factors

Table 5 shows a compressed regression table of the ordinal logistic regression with large muscle index as dependent variable and the separate lifestyle factors as independent variables. The complete regression model can be found in the appendix as table 12.

The parameter estimates (see table 5) indicate the effect of BMI, smoking and physical activity on the large muscle index to be significant with p-values of 0,000. Alcohol use and nutrition test insignificant with p-values of respectively 0,813 and 0,103. The coefficient of physical activity is 0,732 with an odds ratio of 2,079. The coefficient of BMI is 0,288 with an odds ratio of 1,334. The coefficient of smoking is 0,272 with an odds ratio of 1,313. The odds ratios being above 1 indicate a positive effect of healthy lifestyle factors as the test takes the unhealthy lifestyle behaviours as the reference categories. The odds ratios mean an increase in the odds of having a healthier large muscle index score by 107,9% when having healthy physical activity levels, by 33,4% for having a healthy BMI and by 31,3% for not smoking.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
Physical activity 1	**.732**	**.080**	**82.734**	**1**	**.000***	**.574**	**.889**
Alcohol use 1	**-.032**	**.136**	**.056**	**1**	**.813**	**-.299**	**.235**
Smoking 1	**.272**	**.104**	**6.806**	**1**	**.009***	**.068**	**.235**
BMI 1	**.288**	**.081**	**12.682**	**1**	**.000***	**.130**	**.447**
Nutrition 1	**.150**	**.092**	**2.663**	**1**	**.103**	**-.030**	**.330**
Threshold 0	-.434	.407	1.138	1	.286	-1.232	.364
Threshold 1	.819	.397	4.250	1	.039*	.040	1.598

Threshold 2	1.989	.398	24.643	1	.000*	1.197	2.759
Threshold 3	3.288	.402	66.842	1	.000*	2.500	4.076
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	4889.014	25	.000*		3135	.989	.210

Table 5: Compressed regression table for an ordinal logistic regression with large muscle index as dependent variable and physical activity, alcohol use, smoking, BMI and nutrition independent variables (unhealthy behaviours as reference category). The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.2.3 Large Muscle Index with accumulated lifestyle factors per gender

Table 6 shows a compressed regression table of ordinal logistic regressions for females and males separately. The complete regression models can be found in the appendix as tables 13 (females) and 14 (males).

Looking at the parameter estimates (see table 6), the healthy lifestyle index coefficient of 0,225 for men can be turned into an odds ratio of 1,252 with a p-value of 0,000 (significant). For women the coefficient of the healthy lifestyle factor is 0.458 and the accompanied odds ratio is 1,581 with a p-value of 0,000 (significant). So, for men every increase in the number of healthy lifestyle factors (with 0 and 1 combined) result in an increase of 25,2% in the odds of having a healthier large muscle index score and for women the increase would be 58,1%.

Females							
Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	**.458**	**.053**	**73.587**	**1**	**.000***	**.353**	**.563**
Threshold 0	-.016	.536	.001	1	.976	-1.067	1.034
Threshold 1	1.093	.526	4.316	1	.038*	.062	2.124
Threshold 2	2.247	.527	18.161	1	.000*	1.214	3.281
Threshold 3	3.544	.533	44.265	1	.000*	2.500	4.588
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	2290.529	20	.000*		1616	.791	.183
Males							
Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound

HLI	**.225**	**.061**	**.499**	**1**	**.000***	**.105**	**.345**
Threshold 0	-.420	.597	.495	1	.482	-1.590	.750
Threshold 1	1.121	.567	3.905	1	.048*	.009	2.233
Threshold 2	2.277	.570	15.965	1	.000*	1.160	3.394
Threshold 3	3.600	.577	38.904	1	.000*	2.469	4.731
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	304.599	20	.000*		1519	.740	.216

Table 6: Compressed regression table of separate ordinal logistic regressions for females and males with large muscle index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.3 Mobility Index

4.3.1 Mobility Index with accumulated lifestyle factors

Table 7 shows the results of an ordinal logistic regression with the mobility index as the dependent variable and the healthy lifestyle index (HLI) as the independent variable. The complete regression model can be found in the appendix as table 15.

The parameter estimates (see table 7) of the ordinal logistic regression supplies information about the relationship between the mobility index and the healthy lifestyle index. The coefficient of the healthy lifestyle index is 0,456. The exponent of the coefficient is taken to calculate the odds ratio, being 1,578. The p-value of the coefficient is 0,000 and therefore significant. The results mean that with every increase in the number of healthy lifestyle factors (with 0 and 1 combined) the odds of having a healthier mobility index score can be increased by a factor of 1,578.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper Bound
HLI	**.456**	**.051**	**79.961**	**1**	**.000***	**.356**	**.555**
Threshold 0	.391	.430	.823	1	.364	-.453	1.234
Threshold 1	1.709	.416	16.861	1	.000*	.893	2.525
Threshold 2	2.443	.417	34.409	1	.000*	1.627	3.260
Threshold 3	3.840	.422	82.611	1	.000*	.356	.555
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2

Final	740.140	21	.000*		3135	.940	.276

Table 7: Compressed regression table of an ordinal logistic regression with mobility index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.4 Fine Motor Skills

4.4.1 Fine Motor Skills with accumulated lifestyle factors

Below, table 8 shows a compressed regression table of the binary logistic regression with fine motor skills as the dependent variable and healthy lifestyle index (HLI) as the independent variable. The complete regression model can be found in the appendix as table 16.

The healthy lifestyle index has a significant effect on the fine motor skills with an odds ratio of 1,461 (see table 8). This means that with every increase in the number of healthy lifestyle factors (with 0 and 1 combined) the odds of having no difficulties with fine motor skills increase with 46,1%.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	**.379**	**.070**	**29.458**	**1**	**.000***	**1.461**
Constant	-1.290	.522	6.113	1	.013*	.275
Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	237.709	.000*	3135	.164		

Table 8: Compressed regression table of a binary logistic regression with fine motor skills as dependent variable and healthy lifestyle index (HLI) as independent variable. The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.4.2 Fine Motor Skills with separate lifestyle factors

Table 9 shows a compressed regression model for the binary logistic regression with fine motor skills as dependent variable and separate lifestyle factors as dependent variables. The complete regression model can be found in the appendix as table 17.

Looking at the parameter estimates (see table 9), only the coefficient of physical activity is significant with a p-value of 0,000. The effects of the other lifestyle factors are insignificant with p-values of 0,150 (BMI), 0,557 (smoking), 0,993 (alcohol use) and 0,251 (nutrition). The odds ratio for physical activity is 0,370. So, having an unhealthy physical activity level results in a 63,0% increase in the odds of having any difficulties with fine motor skills.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
Physical activity	**-.994**	**.151**	**43.629**	**1**	**.000***	**.370**

Alcohol use	**-.002**	**.236**	**.000**	**1**	**.993**	**.998**
Smoking	**-.111**	**.189**	**.344**	**1**	**.557**	**.895**
BMI	**-.209**	**.145**	**2.072**	**1**	**.150**	**.812**
Nutrition	**-.178**	**.156**	**1.316**	**1**	**.251**	**.837**
Constant	.873	.501	3.039	1	.081	2.394
Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	261.056	.000*	3135	.180		

Table 9: Compressed regression table of a binary logistic regression with fine motor skills as dependent variable and physical activity, alcohol use, smoking, BMI and nutrition as independent variables (unhealthy behaviours coded as 1 and healthy as 0). The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

4.4.3 Fine Motor Skills with accumulated lifestyle factors per gender

The compressed regression tables of separate binary logistic regressions for females and males are shown in table 8 with fine motor skills as dependent variable and healthy lifestyle index (HLI) as independent variable. The complete regression model can be found in the appendix.

Considering the parameter estimates (see table 8), the odds ratio for the healthy lifestyle index is 0.520. However, the coefficient for the healthy lifestyle index is insignificant for men with a p-value of 0,237. So, there is a significant effect of the accumulation of healthy lifestyle factors on fine motor skills for women and there is no significant effect measured for men. For women, every increase in the number of healthy lifestyle factors (with 0 and 1 combined) result in a 48,0% decrease in the odds of having any difficulties with fine motor skills.

Females						
Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	**-.654**	**.102**	**41.358**	**1**	**.000***	**.520**
Constant	1.804	.736	6.004	1	0.14*	6.074
Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	146.391	.000*	1616	.197		
Males						
Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	**-.118**	**.100**	**1.395**	**1**	**.237**	**.889**
Constant	1.015	.753	1.817	1	.178	2.759
Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	116.897	.000*	1519	.165		

Table 10: Compressed regression table of separate binary logistic regressions for females and males with fine motor skills as dependent variable and healthy lifestyle index (HLI) as independent variable. The control variables comprise ISCED levels, number of chronic diseases, age groups and gender. Significant results are indicated with a * with a significance level set at 0.05.

5: Discussion

This thesis reflects the investigation of the relationship between accumulated lifestyle factors and physical health in later life in Sweden. The physical health status is indicated from the physical capabilities which were measured looking at large muscle function, mobility and fine motor skills. Healthy lifestyles in this study are indexed on the basis of an accumulation of smoking behaviour, alcohol use, physical activity, BMI and nutrition. The central research question of the research is 'What is the relationship between accumulated lifestyle factors and physical health in later life in Sweden?' Using data about Swedish inhabitants aged 50 years or older from the SHARE dataset, significant effects of the healthy lifestyle index were found separately on large muscle function, mobility and fine motor skills. The analyses were controlled for the effects of gender, education, chronic diseases and age. Having a healthy lifestyle is found to have the most profound effect on mobility, followed by fine motor skills and large muscle function. For the effects on large muscle function and fine motor skills the strongest underlying lifestyle factor seems to be physical capabilities. Gender differences in the effects of a healthy lifestyle were found in the form of a stronger measured effect for females concerning large muscle function and fine motor skills.

The results confirm a positive relationship between accumulated healthy lifestyle factors and physical capabilities, which are in line with previous academic contributions. So did Sabia et al. (2012) find a similar but less strong effect of healthy behaviours on successful ageing, the odds of ageing successful was measured to increase by 33% per additional healthy lifestyle factor (being smoking, alcohol use, physical activity and nutrition). Also Liao et al. (2011) and Cooper et al (2016) found positive effects of accumulated lifestyle factors on physical capabilities.

Amongst the separate factors underlying the healthy lifestyle index the strongest effects were measured for physical activity. This confirms theories of Kuh (2019) and Liao et al. (2011) underlining the importance of maintaining physically active in order to conserve physical capabilities. In this current study the relationship between the health outcomes and physical activity could be the consequence of measuring both at the same time, as someone with less physical capabilities is less likely to play sports or do vigorous activities. Especially someone having difficulties with picking up a small coin, cutting up food and/or getting dressed can be expected not to do vigorous activities on a weekly basis. Therefore it is not surprising that the strongest relationship was found between physical activity and fine motor skills.

For the separate lifestyle factor of current smoking behaviour the only significant relationship was found with the large muscle index as the health outcome. As the large muscle index includes chair rise speed and standing balance, the results are in line with findings of Calder et al. (2018) which indicated smoking to have the highest effect on chair rise speed and standing balance. Also do the results confirm findings of Stenholm et al. (2011) showing current and former smoking behaviour is strongly related to decreases in muscle strength.

Looking at the gender differences, the results indicate a stronger effect of healthy lifestyle factor on large muscle functions and fine motor skills for females as opposed to males. These findings are in line with research of Kuh and Hardy (2002) stating that women are more vulnerable to muscle strength decline.

The main strength of the research is the objective assessment criteria for large muscle function, mobility and fine motor skills that accurately describe the full spectrum of physical capabilities. This gives a more detailed insight into the way accumulated lifestyle factors affect various parts of physical capabilities. However, for this thesis lifestyle factors are assumed to not heavily change over a short period of time. Future research therefore should be aimed at analysing longitudinal data in order to better capture the effects of the duration and intensity of having a healthy lifestyle. Another shortcoming of this research is using parameters to measure physical activity and nutrition. The frequency of vigorous activities gives an incomplete view of physical activity and frequency of consumption of fruits and vegetables gives an incomplete view of the nutrition pattern. Future research should aim at providing a more complete description of the physical activity and nutrition pattern of its study population.

6: Conclusion

This thesis reflects the investigation of the relationship between accumulated lifestyle factors and physical health in later life in Sweden. For the analyses this research uses a computed healthy lifestyle index which is a variable counting the accumulation of healthy smoking behaviour, alcohol use, physical activity, BMI and nutrition. Using data about Swedish inhabitants aged 50 years or older from the SHARE dataset, significant effects of the healthy lifestyle index were found separately on large muscle function, mobility and fine motor skills. The analyses were controlled for the effects of gender, educational level, number of chronic diseases and age groups. Having a healthy lifestyle is found to have the most profound effect on mobility, followed by fine motor skills and large muscle function. For the effects on large muscle function and fine motor skills the strongest underlying lifestyle factor seems to be physical capabilities. Gender differences in the effects of a healthy lifestyle were found in the form of a stronger measured effect for females concerning large muscle function and fine motor skills. Thus, to answer the main research question, it can be concluded that accumulated healthy lifestyle factors have explicit positive effects on the complete spectrum of physical capabilities. Physical capabilities indicate a person's level of functioning, which is needed to reach the threshold of physical health: the ability to self-manage.

The policy recommendations flowing from the conclusions are to make policies to reduce smoking prevalence, to moderate alcohol use and to stimulate healthy nutrition, a healthy bodyweight and most of all physical activity. Successful policies stimulating healthy lifestyles are of great interest on the individual and family level as it can be expected to have a positive effect on physical health amongst older adults in the population. For the specific case of Sweden, being a typical Nordic welfare state, an increased physical health amongst its older adults presents an opportunity to alleviate the burden of an increasing old-age dependency ratio.

7: References

Ben-Shlomo, Y. & Kuh, D. (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, 31, 285-293.

Calder, P. C., Carding, R., Christopher, G., Kuh, D., Langley-Evans, S. C., & McNulty, H. (2018). A holistic approach to healthy ageing: how can people live longer, healthier lives? *Journal of Human Nutrition and Dietetics*, 31, 439-450.

Cooper, R., Muniz-Terrera, G. & Kuh, D. (2016). Associations of behavioural risk factors and health status with changes in physical capability over 10 years of follow-up: the MRC National Survey of Health and Development. *BMJ Open*, 6(4)

Hsu, H. (2005). Gender Disparity of Successful Aging in Taiwan. *Women & Health*, 42(1), 1-21.

Jørgensen, T.S.H., Fors, S., Nilsson, C.J., Enroth, L., Aaltonen, M., Sundberg, L., Brønnum-Hansen, H., Strand, B.H., Chang, M. & Jylhä, M. (2019). Ageing populations in the Nordic countries: Mortality and longevity from 1990 to 2014. *Scandinavian Journal of Public Health*, 47, 611-617.

Kuh, D. (2019). A Life Course Approach to Healthy Ageing. In: J.P. Michel (Red.), Prevention of Chronic Diseases and Age-Related Disability (pp. 1-9). Springer, Cham.

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J. & Power, C. (2003). Life course epidemiology. *Journal of Epidemiology & Community Health*, 57, 778-783.

Kuh, D. & Hardy, R. (2002). A life course approach to women's health: linking the past, present, and future. In: D. Kuh & R. Hardy, A life course approach to women's health (pp. 1-22).

Kuh, D., Karunananthan, S., Bergman, H. & Cooper, R. (2014). A life-course approach to healthy ageing: maintaining physical capability. *Proceedings of the Nutrition Society*, 73, 237-248.

Larsson, S.C., Kaluza, J. & Wolk, A. (2017). Combined impact of healthy lifestyle factors on lifespan: two prospective cohorts. *Journal of Internal Medicine*, 282, 209-219.

Liao, W., Li, C., Lin, Y., Wang, C., Chen, J., Yen, C., Lin, H. & Lee, M. (2011). Healthy Behaviors and Onset of Functional Disability in Older Adults: Results of a National Longitudinal Study. *Journal of the American Geriatrics Society*, 59, 200-2006.

Our World in Data (2019). *Life expectancy*. Retrieved on November 10, 2021 from https://ourworldindata.org/life-expectancy

Sabia, S., Singh-Manoux, A., Hagger-Johnson, G., Cambois, E., Brunner, E.J. & Kivimaki, M. (2012). Influence of individual and combined healthy behaviours on successful aging. *Canadian Medical Association Journal*, 184(18), 1985-1992.

Statista (2021). *Share of elderly population in Sweden in selected years from 1970 to 2020, by age group*. Retrieved on November 10, 2021 from https://www.statista.com/statistics/525637/sweden-elderly-share-of-the-total-population-by-age-group/

Stenholm, S., Tiainen, K., Rantanen, T., Sainio, P., Heliövaara, M., Impivaara, O. & Koskinen, S. (2012). Long-Term Determinants of Muscle Strength Decline: Prospective Evidence from the 22-Year Mini-Finland Follow-Up Survey. *Journal of the American Geriatrics Society*, 60, 77-85.

Strand, B.H., Mishra, G., Kuh, D., Guralnik, J.M. & Patel, K.V. (2011). Smoking History and Physical Performance in Midlife: Results From the British 1946 Birth Cohort. *Journal of Gerontology: Medical Sciences*, 66A(1), 142-149.

8: Appendix

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	.356	.040	79.376	1	.000	2.119	3.052
ISCED 0	-.400	.506	.625	1	.429	-1.393	.529
ISCED 1	-.310	.113	7.482	1	.006	-.533	-.088
ISCED 2	-.304	.124	6.037	1	.014	-.546	-.061
ISCED 3	-.168	.110	2.315	1	.128	-.384	.048
ISCED 4	-.270	.149	3.270	1	.071	-.563	.023
ISCED 5	0			0			
C.D. 0	2.586	.238	111.133	1	.000	2.119	3.052
C.D. 1	1.813	.222	66.861	1	.000	1.379	2.248
C.D. 2	1.385	.221	39.156	1	.000	.951	1.818
C.D. 3	1.050	.227	21.286	1	.000	.604	1.023
C.D. 4	.554	.239	5.364	1	.021	.085	1.023
C.D. 5	.454	.278	2.666	1	.102	-.091	.999
C.D. 6	0			0			
Age G. 1	1.921	.355	29.343	1	.000	1.226	2.612
Age G. 2	1.855	.316	34.347	1	.000	1.235	2.475
Age G. 3	1.539	.301	26.219	1	.000	.950	2.128
Age G. 4	1.538	.295	27.119	1	.000	.959	2.116
Age G. 5	1.703	.298	32.579	1	.000	1.118	2.288
Age G. 6	1.452	.302	23.109	1	.000	.860	2.043
Age G. 7	1.368	.314	18.989	1	.000	.753	1.983
Age G 8	.857	.324	7.014	1	.008	.223	1.491
Age G. 9	0			0			
Female 0	.627	.078	64.076	1	.000	.474	.781
Female 1	0			0			
Threshold	.150	.394	.145	1	.704	-.622	.922

0							
Threshold 1	1.399	.384	13.263	1	.000*	.646	2.151
Threshold 2	2.547	.386	43.636	1	.000*	1.792	3.303
Threshold 3	3.845	.390	97.194	1	.000*	3.081	4.610
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	601.596	21	.000*		3135	.893	.199

Table 11: Regression table for an ordinal logistic regression with large muscle index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender (females as reference category). Significant results are indicated with a * with a significance level set at 0.05.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
Physical activity 1	.732	.080	82.734	1	.000*	.574	.889
Physical activity 0	0			0			
Alcohol use 1	-.032	.136	.056	1	.813	-.299	.235
Alcohol use 0	0			0			
Smoking 1	.272	.104	6.806	1	.009*	.068	.235
Smoking 0	0			0			
BMI 1	.288	.081	12.682	1	.000*	.130	.447
BMI 0	0			0			
Nutrition 1	.150	.092	2.663	1	.103	-.030	.330
Nutrition 0	0			0			
ISCED 0	-.481	.509	.898	1	.343	-1.476	.514
ISCED 1	-.273	.117	5.477	1	.019*	-.502	-.044
ISCED 2	-.313	.125	6.274	1	.012*	-.558	-.068
ISCED 3	-.155	.112	1.933	1	.164	-.374	.064
ISCED 4	-.286	.150	3.626	1	.057	-.580	.008
ISCED 5	0			0			
C.D. 0	2.524	.239	111.733	1	.000*	2.056	2.993
C.D. 1	1.763	.222	62.906	1	.000*	1.327	2.199
C.D. 2	1.345	.222	36.818	1	.000*	.910	1.779
C.D. 3	1.037	.228	20.737	1	.000*	.591	1.484
C.D. 4	.527	.240	4.832	1	.028*	.057	.997
C.D. 5	.464	.279	2.776	1	.096	-.082	1.010
C.D. 6	0			0			

Age G. 1	1.762	.362	23.635	1	.000*	1.052	2.473
Age G. 2	1.748	.324	29.038	1	.000*	1.112	2.384
Age G. 3	1.422	.307	21.469	1	.000*	.821	2.024
Age G. 4	1.411	.300	22.070	1	.000*	.823	2.000
Age G. 5	1.605	.302	28.162	1	.000*	1.012	2.198
Age G. 6	1.374	.305	20.325	1	.000*	.777	1.971
Age G. 7	1.334	.316	17.809	1	.000*	.714	1.953
Age G. 8	.889	.325	7.487	1	.006*	.252	1.527
Age G. 9	0			0			
Female 0	.547	.080	46.211	1	.000*	.389	.705
Female 1	0			0			
Threshold 0	-.434	.407	1.138	1	.286	-1.232	.364
Threshold 1	.819	.397	4.250	1	.039*	.040	1.598
Threshold 2	1.989	.398	24.643	1	.000*	1.197	2.759
Threshold 3	3.288	.402	66.842	1	.000*	2.500	4.076
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	4889.014	25	.000*		3135	.989	.210

Table 12: Regression table for an ordinal logistic regression with large muscle index as dependent variable and physical activity, alcohol use, smoking, BMI and nutrition independent variables (unhealthy behaviours as reference category). The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender (females as reference category). Significant results are indicated with a * with a significance level set at 0.05.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	.458	.053	73.587	1	.000*	.353	.563
ISCED 0	-.357	.700	.261	1	.610	-1.729	1.014
ISCED 1	-.082	.158	.271	1	.603	-.391	.227
ISCED 2	-.144	.163	.782	1	.377	-.464	.175
ISCED 3	-.104	.141	.538	1	.463	-.380	.173
ISCED 4	-.316	.194	2.638	1	.104	-.697	.065
ISCED 5	0			0			
C.D. 0	2.107	.304	48.094	1	.000*	1.512	2.703
C.D. 1	1.515	.287	27.876	1	.000*	.953	2.077
C.D. 2	1.118	.286	15.331	1	.000*	.559	1.678
C.D. 3	.769	.291	6.978	1	.008*	.199	1.340
C.D. 4	.400	.317	1.589	1	.207	-.222	1.022
C.D. 5	.143	.365	.153	1	.696	-.572	.857
C.D. 6	0			0			
Age G. 1	1.482	.490	9.150	1	.002*	.522	2.443
Age G. 2	1.322	.449	8.661	1	.003*	.442	2.202
Age G. 3	.983	.435	5.112	1	.024*	.131	1.836
Age G. 4	1.154	.430	7.203	1	.007*	.311	1.996
Age G. 5	1.367	.435	9.848	1	.002*	.513	2.220
Age G. 6	.982	.439	5.002	1	.025*	.121	1.843
Age G. 7	.744	.452	2.714	1	.099	-.141	1.629
Age G. 8	.415	.467	.790	1	.374	-.500	1.329
Age G. 9	0			0			
Threshold 0	-.016	.536	.001	1	.976	-1.067	1.034
Threshold	1.093	.526	4.316	1	.038*	.062	2.124

1							
Threshold 2	2.247	.527	18.161	1	.000*	1.214	3.281
Threshold 3	3.544	.533	44.265	1	.000*	2.500	4.588
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	2290.529	20	.000*		1616	.791	.183

Table 13: Regression table for an ordinal logistic regression (only females selected) with large muscle index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.) and age groups (Age G.). Significant results are indicated with a * with a significance level set at 0.05.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	.225	.061	13.517	1	.000*	.105	.345
ISCED 0	-.530	.750	.499	1	.480	-2.000	.941
ISCED 1	-.569	.169	11.283	1	.001*	-.901	-.237
ISCED 2	-.559	.194	8.287	1	.004*	-.939	-.178
ISCED 3	-.308	.181	2.892	1	.089	-.663	.047
ISCED 4	-.249	.240	1.081	1	.298	-.719	.221
ISCED 5	0			0			
C.D. 0	3.550	.392	81.828	1	.000*	2.781	4.319
C.D. 1	2.383	.352	45.809	1	.000*	1.693	3.073
C.D. 2	1.901	.352	29.251	1	.000*	1.212	2.590
C.D. 3	1.586	.365	18.933	1	.000*	.872	2.301
C.D. 4	.964	.370	6.773	1	.009*	.238	1.690
C.D. 5	.988	.434	5.184	1	.023*	.138	1.838
C.D. 6	0			0			
Age G. 1	2.439	.548	19.787	1	.000*	1.364	3.514
Age G. 2	2.506	.469	28.588	1	.000*	1.587	3.424
Age G. 3	2.079	.422		1	.000*	1.252	2.905
Age G. 4	1.852	.410		1	.000*	1.049	2.655
Age G. 5	1.990	.412	23.306	1	.000*	1.182	2.798
Age G. 6	1.849	.419	19.466	1	.000*	1.027	2.670
Age G. 7	1.948	.443	19.320	1	.000*	1.079	2.816
Age G. 8	1.221	.454	7.217	1	.007*	.330	2.112
Age G. 9	0			0			
Threshold 0	-.420	.597	.495	1	.482	-1.590	.750
Threshold 1	1.121	.567	3.905	1	.048*	.009	2.233
Threshold	2.277	.570	15.965	1	.000*	1.160	3.394

2							
Threshold 3	3.600	.570	38.904	1	.000*	2.469	4.731
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	1770.763	20	.000*		1519	.740	.216

Table 14: Regression table for an ordinal logistic regression (only males selected) with large muscle index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender (females as reference category). Significant results are indicated with a * with a significance level set at 0.05.

Variable	Estimate	Std. error	Wald	df	Sig.	Lower bound	Upper bound
HLI	.456	.051	79.961	1	.000	.356	.555
ISCED 0	.345	.596	.336	1	.562	-.822	1.513
ISCED 1	-.246	.141	3.031	1	.082	-.524	.031
ISCED 2	-.373	.160	5.425	1	.020	-.687	-.059
ISCED 3	-.187	.147	1.637	1	.201	-.475	.100
ISCED 4	-.120	.023	.348	1	.555	-.518	.278
ISCED 5	0			0			
C.D. 0	3.220	.298	116.836	1	.000	2.637	3.804
C.D. 1	1.949	.237	67.399	1	.000	1.483	2.414
C.D. 2	1.544	.235	43.326	1	.000	1.084	2.004
C.D. 3	1.209	.241	25.155	1	.000	.736	1.681
C.D. 4	.656	.252	6.797	1	.009	.163	1.150
C.D. 5	.102	.288	.126	1	.722	-.462	.666
C.D. 6	0			0			
Age G. 1	2.687	.427	39.539	1	.000	1.850	3.525
Age G. 2	2.515	.353	50.832	1	.000	1.824	3.206
Age G. 3	2.399	.324	54.728	1	.000	1.764	3.035
Age G. 4	2.465	.315	61.187	1	.000	1.847	3.082
Age G. 5	2.143	.315	46.319	1	.000	1.526	2.760
Age G. 6	1.574	.314	25.075	1	.000	.958	2.191
Age G. 7	1.093	.323	11.420	1	.001	.459	.961
Age G 8	.312	.331	.887	1	.346	-.337	.961
Age G. 9	0			0			
Female 0	.601	.100	36.292	1	.000	.405	.796
Female 1	0			0			
Threshold 0	.391	.430	.823	1	.364	-.453	1.234

Threshold 1	1.709	.416	16.861	1	.000*	.893	2.525
Threshold 2	2.443	.417	34.409	1	.000*	1.627	3.260
Threshold 3	3.840	.422	82.611	1	.000*	.356	.555
Model	Chi-2	df	Sig.		n	Goodness-of-Fit Sig.	Nagelkerke R-2
Final	740.140	21	.000*		3135	.940	.276

Table 15: Regression table for an ordinal logistic regression with mobility index as dependent variable and healthy lifestyle index as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender (females as reference category). Significant results are indicated with a * with a significance level set at 0.05.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	.379	.070	29.458	1	.000*	1.461
ISCED			5.685	5	.338	
ISCED 1	.052	.819	.004	1	.950	1.053
ISCED 2	-.455	.199	5.246	1	.022*	.634
ISCED 3	-.223	.234	.902	1	.342	.800
ISCED 4	-.291	.209	1.937	1	.164	.748
ISCED 5	-.342	.276	1.542	1	.214	.710
C.D.			91.873	6	.000*	
C.D. 1	2.505	.371	45.612	1	.000*	12.249
C.D. 2	1.752	.298	34.590	1	.000*	5.769
C.D. 3	1.345	.291	21.415	1	.000*	3.836
C.D. 4	.817	.293	7.799	1	.005*	2.265
C.D. 5	.465	.307	2.293	1	.130	1.592
C.D. 6	.298	.357	.695	1	.404	1.347
Age G.			40.916	8	.000*	
Age G. 1	2.016	.591	11.636	1	.001*	7.507
Age G. 2	1.709	.452	14.258	1	.000*	5.521
Age G. 3	1.547	.401	14.920	1	.000*	4.699
Age G. 4	1.477	.383	14.911	1	.000*	4.381
Age G. 5	1.442	.387	13.910	1	.000*	4.231
Age G. 6	1.588	.400	15.771	1	.000*	4.894
Age G. 7	.807	.400	4.072	1	.044*	2.242
Age G. 8	.519	.412	1.590	1	.207	1.681
Male 0 Female 1	.006	.136	.002	1	.962	1.006
Constant	-1.290	.522	6.113	1	.013*	.275

Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	237.709	.000*	3135	.164		

Table 16: Regression table of a binary logistic regression with fine motor skills as dependent variable and healthy lifestyle index (HLI) as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender. Significant results are indicated with a * with a significance level set at 0.05.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
Physical activity	-.994	.151	43.629	1	.000*	.370
Alcohol use	-.002	.236	.000	1	.993	.998
Smoking	-.111	.189	.344	1	.557	.895
BMI	-.209	.145	2.072	1	.150	.812
Nutrition	-.178	.156	1.316	1	.251	.837
ISCED			4.798	5	.441	
ISCED 1	-.110	.821	.018	1	.893	.896
ISCED 2	-.428	.204	4.386	1	.036*	.652
ISCED 3	-.241	.237	1.036	1	.309	.786
ISCED 4	-.274	.212	1.672	1	.196	.760
ISCED 5	-.384	.276	1.934	1	.164	.681
C.D.			80.785	6	.000*	
C.D. 1	2.416	.374	41.807	1	.000*	11.201
C.D. 2	1.688	.300	31.714	1	.000*	5.409
C.D. 3	1.308	.292	20.039	1	.000*	3.699
C.D. 4	.812	.294	7.614	1	.006*	2.253
C.D. 5	.474	.310	2.338	1	.126	1.606
C.D. 6	.332	.359	2.338	1	.355	1.394
Age G.			24.778	8	.002*	
Age G. 1	1.670	.607	7.568	1	.006*	5.310
Age G. 2	1.454	.469	9.618	1	.002*	4.279
Age G. 3	1.295	.414	9.780	1	.002*	3.649
Age G. 4	1.233	.394	9.819	1	.002*	3.433
Age G. 5	1.249	.395	10.002	1	.002*	3.486
Age G. 6	1.448	.405	12.813	1	.000*	4.255
Age G. 7	.734	.404	3.300	1	.069	2.084

Age G. 8	.547	.415	1.741	1	.187	1.728
Male 0 Female 1	.114	.140	.662	1	.416	1.121
Constant	.873	.501	3.039	1	.081	2.394
Model	Chi-2	Sig.	n	Nagelkerke R-2		
Final	261.056	.000*	3135	.180		

Table 17: Regression table of a binary logistic regression with fine motor skills as dependent variable and physical activity, alcohol use, smoking, BMI and nutrition as independent variables (unhealthy behaviours coded as 1 and healthy as 0). The control variables comprise ISCED levels, number of chronic diseases (C.D.), age groups (Age G.) and gender. Significant results are indicated with a * with a significance level set at 0.05.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	-.654	.102	41.358	1	.000*	.520
ISCED			5.589	5	.348	
ISCED 1	-.056	1.206	.002	1	.963	.945
ISCED 2	.463	.277	2.798	1	.094	1.588
ISCED 3	-.246	.346	.506	1	.477	.782
ISCED 4	.120	.284	.178	1	.673	1.127
ISCED 5	.167	.392	.182	1	.670	1.182
C.D.			39.219	6	.000*	
C.D. 1	-2.072	.510	16.493	1	.000*	.126
C.D. 2	-1.392	.416	11.207	1	.001*	.249
C.D. 3	-.958	.400	5.753	1	.016*	.384
C.D. 4	-.440	.394	1.244	1	.265	.644
C.D. 5	-.150	.439	.117	1	.733	.861
C.D. 6	.145	.489	.087	1	.768	1.156
Age G.			19.219	8	.014*	
Age G. 1	-2.442	.913	7.147	1	.008*	.087
Age G. 2	-1.477	.636	5.173	1	.023*	.235
Age G. 3	-1.363	.587	5.387	1	.020*	.256
Age G. 4	-1.244	.563	4.874	1	.027*	.288
Age G. 5	-1.476	.583	6.404	1	.011*	.229
Age G. 6	-1.514	.589	6.606	1	.010*	.220
Age G. 7	-.620	.585	1.125	1	.289	.538
Age G. 8	-.542	.605	.802	1	.370	.582
Constant	1.804	.736	6.004	1	.014*	6.074
Model	Chi-2	Sig.	n	Nagelkerke R-2		

Final	146.391	.000*	1616	.197		

Table 18: Regression table of a binary logistic regression with fine motor skills (only females selected) as dependent variable and healthy lifestyle index (HLI) as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.) and age groups (Age G.). Significant results are indicated with a * with a significance level set at 0.05.

Variable	B	Std. error	Wald	df	Sig.	Exp(B)
HLI	-.118	.100	1.395	1	.237	.889
ISCED			4.866	5	.432	
ISCED 1	-.057	1.160	.002	1	.961	.945
ISCED 2	.490	.294	2.774	1	.096	1.633
ISCED 3	.660	.333	3.940	1	.047*	1.935
ISCED 4	.481	.316	2.321	1	.128	1.618
ISCED 5	.572	.396	2.079	1	.149	1.771
C.D.			58.757	6	.000*	
C.D. 1	-3.149	.551	32.653	1	.000*	.043
C.D. 2	2.250	.442	25.966	1	.000*	.105
C.D. 3	-1.851	.436	17.996	1	.000*	.157
C.D. 4	-1.371	.452	9.210	1	.002*	.254
C.D. 5	-.853	.450	3.602	1	.058	.426
C.D. 6	-.744	.538	1.910	1	.167	.475
Age G.			25.344	8	.001*	
Age G. 1	-1.811	.787	5.296	1	.021*	.163
Age G. 2	-2.239	.683	10.733	1	.001*	.107
Age G. 3	-1.845	.559	10.890	1	.001*	.158
Age G. 4	-1.831	.534	11.749	1	.001*	.160
Age G. 5	-1.549	.527	8.644	1	.003*	.213
Age G. 6	-1.783	.554	10.350	1	.001*	.168
Age G. 7	-1.084	.560	3.745	1	.053	.338
Age G. 8	-.655	.575	1.298	1	.254	.519
Constant	1.015	.753	1.817	1	.178	2.759
Model	Chi-2	Sig.	n	Nagelkerke R-2		

Final	116.897	.000*	1519	.165		

Table 19: Regression table of a binary logistic regression (only males selected) with fine motor skills as dependent variable and healthy lifestyle index (HLI) as independent variable. The control variables comprise ISCED levels, number of chronic diseases (C.D.) and age groups (Age G.). Significant results are indicated with a * with a significance level set at 0.05.