Lifestyle and future need for social care

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Contents

ABSTRACT 3
INTRODUCTION 4
Data and methods 6
Data 6
Dependent variable 7
Independent variables 8
Empirical strategy 11
Results 12
Descriptive statistics 12
Empirical results 18
Discussion and conclusions 22
REFERENCES 23

Abstract

Early-age lifestyle may be an important predictor of demand for social care later in life. Using a longitudinal dataset, in this paper we analyse the effects of previous lifestyle choices on the need for social care. Physical exercise, smoking, alcohol consumption and body mass index are measured in 1986, and a proxy for the need for social care, ADL score, is measured in 2006 for individuals aged 70 or above. Results are estimated by a flexible finite mixture model that splits the population into two groups depending on need. Findings suggest that smoking behaviour and obesity are significantly and positively associated with future need for social care, whereas doing exercise has a negative influence. However, we do not find any significant and consistent result for different levels of alcohol consumption. The results differ by gender. The findings have important policy implications for countries with an ageing population.

Keywords: social care, lifestyle, ageing, count data models, finite mixture model

Introduction

The number and proportion of old-aged persons in the population are increasing in most Western countries due to increased life expectancy and high birth rates in the post-war period. Older people often have chronic and long-term health problems that require both health care and social care (Martin et al., 2011). It is not obvious that increased life expectancy increases the demand for health care but it is quite likely that health problems demanding some level of social care develop with aging (Zweifel et al., 1999; de Meijer et al., 2009). The potential need for social care may depend on previous lifestyle choices.

Social care is delivered by public or private institutions, termed formal care, and informally by family members. Changes in family structures may affect the supply of informal care. The capacity of the traditional pool of informal caregivers (typically elderly wives, daughters and daughters-in-law) is declining relative to the increased demand for long-term care. Moreover, changes in demographics, the economic situation and social factors may have large effects on informal caregiver availability (Miller and Weissert, 2000). Aging is associated with an increased risk of chronic diseases (cardio-vascular diseases, cancer, etc.), functional disability and cognitive impairment. Thus, a rise in the need for social care services is to be expected in years to come, which may be a burden for the public purse. A question is the degree to which individuals' lifestyles in previous years may affect their need for these services. If associations can be detected, it may support policies intended to affect lifestyle, such as smoking and drinking behaviour and physical activity. Therefore, it is of interest to consider whether lifestyle choices are expected to affect future public or private social care expenditures.

It is reasonable to assume that healthy lifestyle choices at an early age have a positive impact on health and the need for social care at older stages in life. Theoretically, a lifestyle choice may be considered an investment, as analysed in the classical Grossman model (Grossman, 1972). When investment decisions on lifestyle are made early in life, the rate at which people discount the future is important (Balia and Jones, 2008). Socio-economic variables such as education will also have a direct effect on investment, and indirectly by signalling how future returns are evaluated.

Fries (1980) hypothesized that the need for medical services and social care may be reduced if the onset of chronic diseases and disability can be postponed. Thus, with the objective of reducing or postponing health problems, measures to modify or change unhealthy lifestyle factors at an early age have received substantial attention in current research. Smoking, physical activity, alcohol consumption, and obesity are among modifiable lifestyle factors that are related to serious health conditions such as myocardial infarction and cancer; however, they may also have consequences for the ability to do more daily life activities at later stages in life. Evidence suggests that improvement in these factors can prevent the functional limitations that are strongly associated with advanced age, and can thus lead to a healthier, more active and more independent way of aging (Strawbridge et al., 1996; Lantz et al., 2001). This study is

designed to assess the relationship between early-age lifestyle choices and the need for social care at older age. For this purpose, we use a rich Norwegian panel dataset.

Few empirical studies have investigated the effects of lifestyles on the need for social care of elderly people. However, a considerable number of empirical studies have investigated the association between lifestyles, socio-economic status, self-reported health, morbidities and mortality. Based on U.S. panel data, Lantz et al. (2001) investigate socio-economic disparities in health when taking into account risky health behaviour. Using Danish data, Borg and Kristensen (2000) find that smokers and obese individuals have a higher probability of belonging to the lower social classes, and that the proportion of individuals with poor self-rated health increases with decreasing social class. Balia and Jones (2008) have used British panel data to investigate the determinants of premature mortality, and the contribution of lifestyle choices to socio-economic inequality in morbidity and mortality; however, they find that lifestyles have a small effect on health and they do not mediate the relationship between socio-economic factors and health.

Using the SENECA panel data, Haveman-Nies et al. (2003) try to identify the dietary and lifestyle factors that contribute to healthy ageing. The study investigated people at 70–75 years of age in Belgium, France, Denmark, Italy, the Netherlands, Portugal, Spain, Switzerland and Poland. The population was followed for 10 years. Results show that unhealthy lifestyle habits, such as smoking, having a low-quality diet and being physically inactive, are highly related to an increased mortality risk. The net effect of a healthy lifestyle at older age is positively related to a reduced mortality risk and to a delay in the deterioration in health status. A review by Knoops et al. (2004) assesses differences in dietary and lifestyle factors among elderly Europeans, and identifies factors that contribute to healthy aging, with results similar to Haveman-Nies et al. (2003). A five-year follow-up programme with populations aged 65 and older examines effects of smoking on mortality and morbidities (LaCroix et al., 1991. Rates of total mortality among current smokers are twice those of non-smokers. With relative risk adjusted for age, the findings support the conclusion that smoking cessation should continue to improve prospects for longer life expectancy and decreased morbidity for the elderly.

Charles and Sevak (2005) examine the effect of alcohol consumption on the mortality of elderly women in the U.S. For older women with coronary risk factors, light-to-moderate alcohol consumption is associated with a reduction in total mortality. For heavier alcohol intake, mortality is increased. Similarly, Thun et al. (1997) find that overall death risk is reduced among men and women reporting one drink daily. Mortality from cardio-vascular and other diseases increases with heavier drinking. Alcohol consumption is associated with a small reduction in the overall risk of death in middle age (35–69), whereas smoking approximately doubles this risk. Using the first wave of the NESARC dataset, for U.S. individuals older than 65 years, Balsa et al. (2008) examine the association between different levels of alcohol intake and several indicators of health status and health care utilization. Results show that alcohol use among women is positively associated with better health status, improved cardio-vascular health and reduced rates of hospitalization. There was no significant association for older men.

Studies investigating the effects of physical exercise on health are more limited. From medical research, results indicate that lack of physical activity is highly associated with mobility impairment (Nelson et al., 2007) and with a decreased risk for a variety of chronic and cardio-vascular diseases, depression, obesity and premature death (Caspersen et al., 1985). Takeshima et al. (2002) look at the effect of water-based exercise on health among older women. Their results indicate that water-based exercise elicits significant improvements in cardio-respiratory fitness, muscular strength, body fat and cholesterol in older adult women. Using longitudinal data, Stewart et al. (1994) examine whether levels of physical activity among American adults with various chronic diseases are associated with long-term functioning activities and well-being. They find that higher levels of exercise are uniquely associated with better (psychological) well-being and functioning. Holmerova et al. (2010) conduct an experimental study to examine the effect of the Exercise Dance for Seniors (EXDASE) programme on lower-body functioning among older individuals from residential care facilities in the Czech Republic. The findings indicate that relatively simple dance-based exercises can support lower-body functioning in previously sedentary, frail, older adults. Substantial epidemiological evidence indicates that obesity is highly associated with mortality and morbidities among elderly people but to our knowledge, no studies have investigated the effect of obesity on the need for social care for the elderly. Adams et al. (2006) examine the effect of obesity on mortality among 50–71 year-olds. They find that obesity is strongly associated with the risk of death for both men and women, in all racial and ethnic groups in the U.S. Similar results are obtained by Grabowski et al. (2006) for American nursing home residents. Using the European SHARE data, Andreyeva et al. (2006) find that men and women with higher body mass index (BMI) have significantly higher risks for all chronic health conditions except heart disease. For women, depression is linked to obesity. Persons with severe obesity problems have particularly pronounced risks of impaired health and chronic health conditions. The effects of obesity on health do not vary significantly across countries.

There is considerable research documenting the association between lifestyles and health-related problems and mortality, but little attention is paid to the effects of lifestyle factors on the need for social care among the elderly. Using a rich longitudinal dataset, this study aims to fill this knowledge gap by investigating whether differences of early-life lifestyle choices have a direct and significant influence on the need for social care at old age. We examine the relationship between individuals' lifestyle choices in 1986, and their need for social care 20 years later.

Data and methods

Data

Data are drawn from the Nord-Trøndelag Health Study (HUNT), one of the largest health studies ever performed. The HUNT data collection was conducted in three waves, HUNT1 in 1984–1986, HUNT2 in 1995–1997 and HUNT3 in 2006–2008. All residents of Nord-Trøndelag county in Norway aged 20 and older were invited to participate in the study. The participation rate in HUNT1 was 88.1 % (74,599 persons).

The participation rates in HUNT2 and HUNT3 were somewhat lower, at 70 % and 56 %, respectively. As our prime objective is to investigate how lifestyle influences future need for social care, we use data from HUNT1 (lifestyle factors and health status) and HUNT3 (need for social care).

Respondents aged 70 or older in HUNT3, who participated in HUNT1, are included in the sample, giving a total of 4,826 individuals.

Dependent variable

As a proxy for need for social care, we use information about Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs). ADLs refer to an individual's ability to perform basic functional activities such as dressing, bathing and eating. IADLs are located at a higher level of functioning as these tasks require both mental and physical capacity (e.g., housework or shopping). IADLs typically diminish earlier than ADLs. In HUNT3, all respondents aged 70 or more were asked whether or not they could do different daily tasks without the help of others (see Table 1).

Table 1: *Activities of daily living (ADLs)*

Can you do the following daily tasks without the help of others?	
ADLWalk	Walk around indoors on the same floor
ADLToil	Go to the toilet
ADLWash	Wash yourself
ADLBath	Take a bath or shower
ADLDres	Dress and undress yourself
ADLBed	Go to bed and get up
ADLEat	Feed yourself
ADLCook	Prepare warm meals
ADLDish	Do light housework (e.g., wash dishes)
ADLClean	Do heavier housework (e.g., wash floors)
ADLLaun	Wash clothes
ADLShop	Do the shopping
ADLPay	Pay bills
ADLTab	Take medication
ADLGoOut	Go out
ADLGoBus	Take the bus

We have coded the variables so that 1 represents «No» and 0 represents «Yes». The dependent variable, the ADL score, is the sum of 16 ADL variables. Thus, an individual scoring 0 on the ADL score will be in no need of help, while an individual scoring 16 will have a substantial need for assistance.

Independent variables

In HUNT1, respondents were asked four questions on lifestyle concerning smoking, alcohol consumption, exercise and their BMI (see Table 2). We control for smoking by a dummy variable that takes the value 1 if the individual is a daily smoker, and 0 otherwise. The level of physical activity among respondents in HUNT1 was measured by the following question: «how often do you exercise?» We categorize the respondents' replies into five groups: never exercise (Exercise_0), less than once a week (Exercise_1), once a week (Exercise_2), 2 or 3 times a week (Exercise_3), and nearly every day (Exercise_4). Alcohol consumption is measured by dummy variables indicating how often the respondents had been drinking during the previous 14 days: never drink alcohol (Alcohol_00), not been drinking alcohol (Alcohol_0), 1 to 4 times (Alcohol_1), and 5 times or more (Alcohol_2). BMI may be a result of genetic as well as lifestyle choices. It is important to include BMI as an explanatory variable since it is in itself expected to be a predictor of future need for social care. We categorize individuals into four groups: BMI < 18.5 (underweight); $18.5 \leq$ BMI < 25 (normal weight); $25 \leq$ BMI < 30 (overweight); and BMI ≥ 30 (obese).

We include several health-related variables, observed in 1984–86. Self-assessed health (SAH) is considered a good indicator of health status. Respondents are asked to rank their self-assessed health, with four response options: very good, good, not very good, and poor. We subsume them into three categories: 1) poor and not very good health; 2) good health; and 3) very good health. High blood pressure is a dummy variable that takes the value 1 if the respondent claims to take or has taken medication for high blood pressure, and 0 otherwise. Psychological impairment or mental health problems may affect the need for social care. Respondents were asked whether they suffer from any long-term illness or injury of a physical or psychological nature that impairs their functioning in their everyday life. If yes, they were asked to describe whether the impairment due to mental health problems was mild, moderate or severe; here, these are defined as no impairment (Psych_imp0), mild impairment (Psych_imp1), moderate or severe impairment (Psych_imp2), with no problem as the reference category. Finally, we include information about physical impairment. Respondents are divided into three categories based on their physical impairment: no impairment (Mot_imp0); mild impairment (Mot_imp1); and moderate or severe impairment (Mot_imp2). Several other health-related variables have been tested in the empirical analyses (diabetes, high blood pressure, angina pectoris, etc.). Because they had no significant effect on the ADL score, they were not included in the final empirical models.

The need for social care may differ by gender. We use a dummy variable with 1 for male, 0 for female. It is likely that the need for care differs between those who are close to 70 years old, and those who are considerably older; therefore, we control for respondent's age in 2006. The education level is an important socio-economic variable,

and it also indicates the level of human capital accumulation. Moreover, education may have both positive and negative influence on different lifestyle factors. The educational level is categorized into four groups: primary school education or less (Education_1); lower secondary school (Education_2); upper secondary school (Education_3); and university/college education, (Education_4).

Table 2: *Definitions of variables*

Male	Male = 1, female = 0
Age	Age in 2006
Education (in 1996): What is your educational background? Only specify the highest level achieved.	
Education_1	Primary education or less
Education_2	Lower secondary education
Education_3	Upper secondary education
Education_4	University/college education
Lifestyle in 1986	
Exercise: How often do you exercise?	
Exercise_0	Never
Exercise_1	Less than once a week.
Exercise_2	Once a week.
Exercise_3	Two or three times a week
Exercise_4	Nearly every day
Smoking: Do you currently smoke daily?	
Daily smoker	Yes = 1, No = 0
Alcohol: How often did you drink alcohol (beer, wine or spirits) during the LAST 14 DAYS?	
Alcohol_00	Never drink alcohol
Alcohol_0	Not been drinking alcohol during the last 14 days
Alcohol_1	1–4 times
Alcohol_2	5 times or more
Body mass index: based on measured height and weight at time of interview	
Underweight	BMI < 18.5
Normal weight	18.5 ≤ BMI < 25
Overweight	25 ≤ BMI < 30
Obese	BMI ≥ 30
Health status in 1986	
High blood pressure	Do you take or have you taken medication for high blood pressure? Yes = 1, No= 0
Do you suffer from any long-term illness or injury of a physical or psychological nature that impairs	

your functioning in your everyday life? If Yes, would you describe your impairment due to mental health problems as mild, moderate or severe?	
Psych_imp0	No impairment
Psych_imp1	Mild impairment
Psych_imp2	Moderate or severe impairment
Do you suffer from any long-term illness or injury of a physical or psychological nature that impairs your functioning in your everyday life? If YES, would you describe your motor impairment as mild, moderate or severe?	
Mot_imp0	No impairment
Mot_imp1	Mild impairment
Mot_imp2	Moderate or severe impairment
Self-assessed health: How is your health at the moment?	
Poor health	Poor & not very good
Good health	Good health
Very good health	Very good health

Empirical strategy

When the dependent variable takes only non-negative integer values, count data regression models are considered more appropriate than standard linear regression (Greene, 2003). Here the dependent variable, ADL score, is a non-negative integer variable. It varies from 0 to 16, with a mean of 0.623 and standard deviation of 1.642. The data contain a large proportion of zeros (75.6 %), and they also display some degree of overdispersion. A common solution to these problems is to use the zero-inflated negative binomial model or the hurdle negative binomial model.

However, an additional problem in our analysis is that we do not have information on ADLs in HUNT1 (1984–86). Some individuals who have problems performing daily life activities in HUNT3 (2006–08) might have had similar problems in HUNT1. In such cases, it appears in our data as if these individuals have experienced an increased need for social care. Because the same problems could influence lifestyle factors in HUNT1 (e.g., the level of physical activity or the probability of being overweight), this might potentially lead to biased estimates of the factors influencing ADLs. Although we control for several important health factors, there might also be other unobservable health problems that are correlated with the independent variables and the need for social care. To take account of the high frequency of zero observations and unobserved heterogeneity (frailty), we use a finite mixture model.

One of the advantages of the finite mixture model is that it is possible to distinguish between two (or more) disaggregated subgroups. We assume that our data are drawn from two subpopulations (components): component 1 with a low average ADL score on the dependent variable (low need for social care); and component 2 with a high average ADL score (high need for social care). Thereby, we allow for the observed

factors such as lifestyle to have different effects for different groups of individuals and we assume that individuals having problems performing ADLs in HUNT1 will have a high probability of becoming a member of component 2. Furthermore, the approach is semi-parametric, so that it does not require any distributional assumptions for the mixing variable (Deb and Trivedi, 1997). The finite mixture models are implemented using the Stata package fmm. Different probability distributions (e.g., normal, Poisson or negative binomial) can be chosen for the mixture component densities. Because of the large number of zero observations in our data, we assume that the negative binomial distribution (Negbin 2) provides the best fit for our data.

Results

Descriptive statistics

As mentioned, the dependent variable (ADL score) is constructed as the sum of the 16 ADLs, and the ADL score is considered as a proxy for need of social care. In Table 3, we present the detailed descriptive statistics for the dependent variable. More than 99 % of individuals walk around indoors on the same floor, are able to go to the toilet, dress and undress, go to bed and get up, and eat without the help of others. In contrast, more than 16 % need help to do heavier housework or cleaning. Similarly, around 9 % report that they are unable to wash clothes (ADLLaun) or take a bus (ADLGoBus) without the help of others. Moreover, 95 % are able to prepare warm meals, do shopping and pay bills, and 97–98 % of the individuals are able to wash themselves, take a bath, do light housework (wash dishes), take medications, and go out without any kind of help.

Table 3: Descriptive statistics of activities of daily living (ADLs)

	Able to do ADLs	
	Number of observations	Per cent of observations
ADLWalk	4,788	99.21 %
ADLToil	4,792	99.30 %
ADLWash	4,768	98.80 %
ADLBath	4,702	97.43 %
ADLDres	4,778	99.01 %
ADLBed	4,786	99.17 %
ADLEat	4,807	99.61 %
ADLCook	4,621	95.75 %
ADLDish	4,719	97.78 %
ADLClean	4,020	83.30 %
ADLLaun	4,393	91.03 %
ADLShop	4,602	95.36 %
ADLPay	4,595	95.21 %
ADLTab	4,747	98.36 %
ADLGoOut	4,708	97.55 %
ADLGoBus	4,382	90.80 %

Figure 1 shows the distribution of the dependent variable. We note that the majority of individuals in our sample (75.6 %) have a score equal to zero, i.e., they are able to perform all 16 ADLs. Further, 20.7 % of the sample are not able to perform between one and five ADLs, while only 3.7 % of the sample cannot perform five or more ADLs.

Figure 1: *The distribution of the dependent variable (ADL score)*

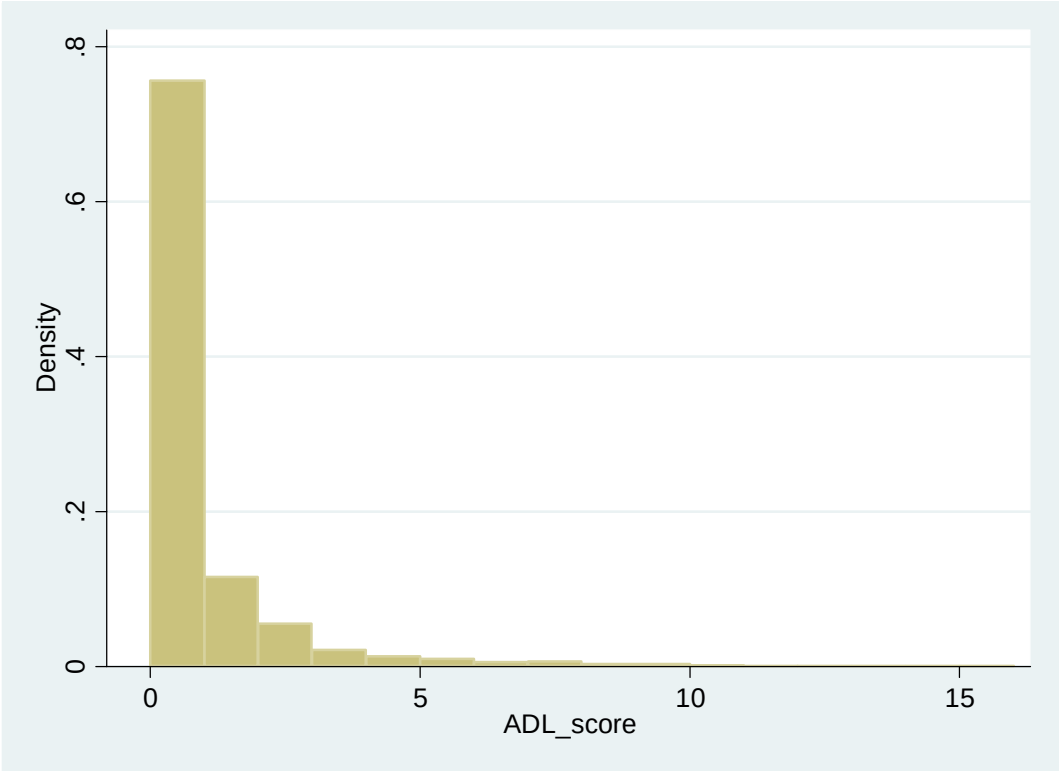

Table 4 presents descriptive statistics for the total sample (column 1) and for males and females separately (columns 2 and 3). Columns 4 and 5 include response shares for those with an ADL score at 0 and larger than 0, respectively. As seen from Table 4, the average ADL score is 0.62; it is higher for males at 0.73 than for females at 0.53. The average age of the sample individuals is about 77 years for both males and females. The sample consists of 44 % males and 56 % females. About 40 % of the individuals belong to the lowest educational group (primary school or less), and 24 % belong to Education_2 (lower secondary school). Upper secondary education was completed by about 27 % of the sample, and university education by 9 %.

In 1984–86, 24 % of the respondents reported that they were daily smokers, 28 % males and 20 % females. About 29 % stated that they do exercise once a week (Exercise_2). When it comes to more frequent exercises, there was some gender difference, and the highest frequencies were reported by females (Exercise_3 and Exercise_4). Non-drinkers were more frequent among women (Alcohol_0) but medium consumption (Alcohol_1) was higher for males at 47 % compared with 24 % for females. The same holds for high levels of alcohol intake, where 9.5 % of males and 3.7 % of females reported drinking alcohol five times or more during the previous 14 days.

Many empirical studies support the evidence that females are more likely to be obese than males. We find the same pattern in our data, with frequencies of obesity at 6 % and 12 % for males and females, respectively. On the other hand, males were more likely to be overweight, 52 % compared with 40 % for females.

Our sample includes respondents aged 70 or above in 2006. It is not very surprising that the number of respondents reporting physiological impairments was relatively low 20 years previously; around 9 % of the sample reported mild to severe impairments. Relatively few also reported suffering from psychological impairment; in total 4.6 % had mild to severe impairment, somewhat higher for females than males. The proportion of respondents reporting having high blood pressure was somewhat higher, 8.5 % for males and 12.9 % for females. Males reported that, in general, they had better self-assessed health, with 79 % males and 74 % females reporting good and very good health.

When considering responses contingent on the ADL score, columns 4 and 5 of Table 4, an expected pattern emerges. Those who reported some problems reported on average 2.6 (between 2 and 3 «no» answers), they tended to be older, and the score was higher for women. Respondents with an ADL score above 0 did less exercise, they were slightly more likely to smoke, and they had a higher probability of being overweight or obese. However, concerning alcohol consumption, there was a slightly higher proportion of non-drinkers among individuals with a positive ADL score, and a higher proportion of moderate consumers among those with a zero ADL score. Socio-economic background as measured by education, and health indicators, show that those with some problems (ADL > 0) had on average lower education and poorer health, both self-assessed health and reported physical and mental impairments.

Table 4: *Descriptive statistics for the total sample and males and females separately*[a]

	All respondents	Males	Females	ADL score = 0	ADL score > 0
ADL score	0.623 (1.642)	0. 735 (1.814)	0.534 (1.485)	0	2.558 (2.474)
Male	0.444 (0.496)	1	0	0.427 (0.495)	0.496 (0.500)
Age	76.954 (5.082)	76.672 (4.864)	77.180 (5.162)	76.150 (4.591)	79.451 (5.526)
Education_1	0.405 (0.490)	0.359 (0.479)	0.441 (0.497)	0.379 (0.485)	0.483 (0.499)
Education_2	0.235 (0.423)	0.182 (0.385)	0.277 (0.448)	0.246 (0.430)	0.201 (.400)
Education_3	0.266 (0.441)	0.331 (0.470)	0.213 (0.409)	0.270 (0.444)	0.251 (0.433)
Education_4	0.095 (0.293)	0.128 (0.334)	0.068 (0.252)	0.104 (0.306)	0.065 0.247)
Exercise_0	0.087 (0.284)	0.096 (0.294)	0.083 (0.276)	0.078 (0.268)	0.122 (0.326)
Exercise_1	0.253 (0.434)	0.275 (0.446)	0.235 (0.423)	0.247 (0.431)	0.271 (0.444)
Exercise_2	0.291 (0.454)	0.291 (0.454)	0.291 (.454)	0.301 (0.459)	0.259 (0.437)
Exercise_3	0.249 (0.432)	0.239 (0.426)	0.257 (0.437)	0.257 (0.437)	0.224 (0.416)
Exercise_4	0.119 (0.323)	0.099 (0.299)	0.134 (0.340)	0.236 (0.321)	0.125 (0.330)
Daily smoker	0.240 (0.427)	0.284 (0.451)	0.205 (0.403)	0.236 (0.425)	0.254 (0.435)
Alcohol_00	0.115 (0.319)	0.061 (0.239)	0.158 (0.365)	0.108 (0.310)	0.139 (0.345)

Alcohol_0	0.479 (0.499)	0.372 (0.483)	0.564 (0.496)	0.479 (0.499)	0.478 (0.499)
Alcohol_1	0.344 (0.475)	0.472 (0.499)	0.241 (0.428)	0.351 (0.478)	0.321 (0.467)
Alcohol_2	0.062 (0.241)	0.095 (0.292)	0.037 (0.187)	0.062 (0.242)	0.062 (0.241)
Underweight	0.004 (0.060)	0.003 (0.052)	0.004 (0.066)	0.003 (0.054)	0.006 (0.076)
Normal weight	0.453 (0.497)	0.420 (0.493)	0.480 (0.499)	0.481 (0.499)	0.365 (0.481)
Overweight	0.449 (0.497)	0.518 (0.499)	0.395 (0.488)	0.437 (0.496)	0.488 (0.500)
Obese	0.094 (0.291)	0.060 (0.237)	0.121 (0.326)	0.079 (0.269)	0.141 (0.348)
High blood pressure	0.110 (0.312)	0.085 (0.280)	0.130 (0.335)	0.093 (0.291)	0.160 (0.367)
Psych_imp0	0.954 (0.148)	0.963 (0.189)	0.947 (0.223)	0.965 (0.183)	0.919 (0.272)
Psych_imp1	0.023 (0.151)	0.017 (0.128)	0.027 (0.162)	0.020 (0.140)	0.030 (0.170)
Psych_imp2	0.023 (0.089)	0.021 (0.141)	0.026 (0.158)	0.015 (0.119)	0.051 (0.220)
Mot_imp0	0.913 (0.282)	0.915 (0.278)	0.911 (0.285)	0.927 (0.259)	0.868 (0.338)
Mot_imp1	0.048 (0.213)	0.048 (0.213)	0.048 (0.213)	0.044 (0.205)	0.058 (0.233)
Mot_imp2	0.040 (0.194)	0.037 (0.189)	0.041 (0.199)	0.028 (0.166)	0.074 (0.261)
Poor health	0.243 (0.428)	0.211 (0.408)	0.269 (0.443)	0.212 (0.409)	0.338 (0.473)

Good health	0.655 (0.475)	0.676 (0.468)	0.637 (0.480)	0.675 (0.468)	0.592 (0.491)
Very good health	0.102 (0.303)	0.113 (0.316)	0.094 (0.291)	0.113 (0.316)	0.071 (0.256)
Number of respondents	4826	2142	2684	3650	1176

[a] The means (and standard deviations in parentheses) are given in the body of the table.

Empirical results

Table 5 presents the results from the finite mixture model for the total sample (columns 1 and 2) and stratified according to gender (columns 3–6). Results are reported for the two components of the mixture model, which represent a group with a relatively low need for social care (component 1) and a group with a higher need (component 2). We immediately observe that the mixture estimates suggest that most observations belong to the former component, 93.4 % of a total of 4,826. The low number of observations obviously makes results for component 2 less reliable, especially when we stratify the sample according to gender. We interpret a positive significant effect of a variable on the ADL score to represent an increased probability of the need for social care. The reported estimates are marginal effects.

Table 5: *Results of finite mixture model (Negbin 2), marginal effects with robust standard errors in parentheses*

	Total sample		Females		Males	
	Comp 1	Comp 2	Comp 1	Comp 2	Comp 1	Comp 2
Male	0.1866*** (0.0423)	1.9838*** (0.5348)	–	–	–	–
Age	0.0619*** (0.0055)	0.1317*** (0.0502)	0.0697*** (0.0080)	0.1355 (0.0945)	0.0633*** (0.0089)	0.0682 (0.0711)
Education_2	–0.0489 (0.0460)	–1.0336* (0.6171)	–0.0446 (0.0585)	–0.4204 (0.9602)	–0.0518 (0.0856)	–0.9497 (0.9593)
Education_3	–0.0460 (0.0441)	–1.5061** (0.6385)	–0.0339 (0.0634)	–0.8366 (1.1726)	–0.0208 (0.0692)	–1.7016* (0.9525)
Education_4	–0.1600** (0.0727)	0.1969 (0.9575)	–0.2332* (0.1236)	1.2636 (1.3867)	–0.1571 (0.1042)	0.0536 (1.2128)
Lifestyle factors in 1984–86:						
Exercise_1	–0.0678 (0.0612)	–0.5156 (0.8496)	–0.0672 (0.0924)	–0.0900 (1.3737)	–0.1050 (0.0940)	–0.1520 (1.2641)
Exercise_2	–0.1686*** (0.0644)	–1.6362** (0.8267)	–0.1419 (0.0937)	–1.1120 (1.2214)	–0.2558*** (0.0940)	–0.8066 (1.2632)
Exercise_3	–0.1954*** (0.0659)	–0.4805 (0.8025)	–0.0826 (0.0929)	1.0709 (1.3782)	–0.3204*** (0.1093)	0.0538 (1.2631)
Exercise_4	–0.2500*** (0.0765)	–0.2226 (0.8943)	–0.1933* (0.1045)	0.1953 (1.3163)	–0.2702*** (0.1260)	1.4295 (1.4565)
Daily smoker	0.1552*** (0.0435)	0.4558 (0.5479)	0.1573** (0.0653)	0.8357 (0.9642)	0.1759*** (0.0705)	0.6765 (0.7900)
Alcohol_0	–0.0756 (0.0515)	–1.3449* (0.7539)	–0.1127* (0.0602)	–1.3622 (1.0610)	0.1286 (0.1303)	–0.1591 (1.4481)
Alcohol_1	–0.0643 (0.0585)	–1.4166* (0.8394)	–0.2566*** (0.0813)	–1.6745 (1.2394)	0.2083 (0.1331)	–0.2649 (1.4070)
Alcohol_2	–0.0274 (0.0835)	–1.9267 (1.2644)	–0.0086 (0.1260)	–0.6121 (2.0664)	0.0971 (0.1569)	–1.5215 (1.7477)

Underweight	0.5166** (0.2183)	–2.5299 (5.8374)	0.4804 (0.3152)	–3.1722 (6.9892)	0.5465* (0.3401)	–8.1990 (10.9592)
Overweight	0.1349*** (0.0398)	–0.0836 (0.4662)	0.0620 (0.0541)	–0.6446 (0.7978)	0.2086*** (0.0689)	0.2348 (0.6496)
Obese	0.3502*** (0.0623)	0.3469 (0.7817)	0.2518*** (0.0756)	0.2828 (1.4939)	0.5576*** (0.1290)	–0.8169 (1.4999)
Health status in 1984–6:						
Psych_imp1	0.3387*** (0.0805)	–67.9233 (6377.504)	0.2519** (0.1054)	–152.9813 (5.32e+07)	0.3830** (0.1560)	–3.0659 (4.3878)
Psych_imp2	0.4209*** (0.0836)	–5.9984* (3.2023)	0.4936*** (0.1122)	–10.7373** (4.6883)	0.3484** (0.1565)	–8.4412 (7.0233)
High blood pressure	0.1061* (0.0504)	0.4006 (0.7923)	0.1777*** (0.0625)	2.2271** (1.0160)	0.0057 (0.0909)	–2.8920* (1.5830)
Mot_imp1	0.0744 (0.0739)	0.4857 (1.0564)	0.1997** (0.0834)	6.2058* (2.8990)	0.3858*** (0.1128)	–64.5446 (2716.739)
Mot_imp2	0.2489*** (0.0706)	–0.8059 (1.1118)	0.2591*** (0.0984)	0.1342 (1.4315)	0.3416*** (0.1209)	–2.7735 (2.0824)
Good health	–0.1361*** (0.0427)	–1.4867** (0.5758)	–0.2498*** (0.0602)	–1.4940* (0.9183)	–0.0295 (0.0704)	–2.1954** (0.9273)
Very good health	–0.2598*** (0.0853)	–0.8436 (0.8871)	–0.3414*** (0.1167)	–6.8843*** (2.7187)	–0.1189 (0.1322)	–1.2804 (1.1904)
π	0.934		0.964		0.912	
Log-likelihood	–4326.383		–2130.605		–2158.693	
Observations	4826		2684		2142	

Notes: π is the probability that an observation is in component 1.

***, **, * indicate significance at the 1 %, 5 % and 10 % levels, respectively.

We present results for the total sample and stratified according to gender when relevant. *Males* have a higher need for social care than females, and the need increases with *age*. This holds for both components. For the socio-economic variable *education*, the lowest education group with only primary schooling is the reference category. Higher education is associated with less need for care but it is significant for component 1 only for those with the highest educational level and for component 2 only for those with lower

secondary or upper secondary education. The results are quite similar when dividing the sample according to gender; however, because of larger standard errors, they are not always statistically significant.

We now look at the lifestyle variables. These are measured in 1984–86, whereas the need for social care is measured 20 years later. Being a *smoker* has a significantly positive effect on the need for care among individuals belonging to component 1, whereas smoking has no significant effect for those in component 2. This result is similar for both genders. When comparing a daily smoker with a non-smoker, the former has 0.16 higher ADL score.

Deviation from *normal weight* significantly increases the ADL score and the need for care for individuals in component 1. Being underweight relative to normal weight is associated with significantly increased need for social care. An overweight person has 0.13 higher ADL score compared with a person of normal weight, and an obese person has 0.35 higher score. Given that the average ADL score is 0.62 (see Table 4), this appears to be quite a large effect. However, deviations from normal weight seem to have less effect among those with the highest need. There is some gender difference, in the sense that overweight seems to have a larger impact on future need for social care more among males than females.

The estimated marginal effects for three *exercise* variables (except Exercise_1) are negative and statistically significant in component 1, implying that early-life exercise is positively associated with the need for care of elderly people. The association is very clear and strong for those with moderate need, while it is weaker for respondents in component 2. If we stratify the sample according to gender, the results indicate that exercise may have a larger effect on ADLs for males than for females.

As was also indicated by the descriptive statistics, the estimated coefficients for *alcohol consumption* are generally not significantly different from zero. However, for individuals within component 2, low or moderate alcohol consumption reduces their need for care. If we split the sample, we find some interesting gender differences. For individuals in component 1, our results indicate that compared to males females with low or moderate alcohol consumption have less need for social care.

As lifestyle choices are obviously related to individual health, it is of great importance to control for health status. We find expected effects of health for individuals within component 1, but for those in component 2, there seems to be a negative association between good health and the need for social care. However, the estimated effects and standard errors are very large, probably due to the small number of observations belonging to component 2; therefore, we focus on the component 1 results. Here, we find that the effects for *mental health impairment* are positive and highly significant. Compared with no mental health impairment, individuals with mild and moderate/severe problems have 0.34 and 0.42 higher ADL score, respectively. Individuals who suffer from *high blood pressure* also have a higher ADL score, both in total and spilt according to gender. Those with moderate or severe *physical impairment* have a higher need for care, and this effect seems to be stronger for males than for females. The coefficients for *self-assessed health* are also as expected when we look at the total sample. Compared to those with poor health, those with good and very good

health have lower need for care. However, the effect of self-assessed health is only significant for females.

Discussion and conclusions

The prime objective of this research is to investigate associations between lifestyle choices at a younger age and the need for social care at a later stage in life. Our data permit a 20-year lag between reports of lifestyle and observations of need for care. The latter is measured by an ADL score, with the number of problems in performing daily life activities as the basis for constituting the index. The dependent variable is discrete, which calls for a count data model. We tested several models and found that a finite mixture model with two components produces the most reliable results. We find a strong statistically significant impact of lifestyle choices on the need for social care among the elderly. This effect is only found for individuals with a relatively low need for social care (component 1), indicating that lifestyle primarily protects against less severe health problems. However, one possible reason for this finding might be the high drop-out rates for those with the most severe health problems.

We conclude that better lifestyle choices have a positive impact on the need for social care at old age (above 70 years). This finding has important policy consequences; producing arguments that precautionary measures and interventions to encourage preferred behaviour may lead to reducing the demand for resources to care for the elderly. For example, a person who is a daily smoker is expected to have a higher need for assistance later in life. A similar outcome is expected for an obese or overweight person. Those who do regular exercise have, on the other hand, a lower probability of demanding social care. Previous research is somewhat inconclusive on the long-term effects of alcohol consumption but some evidence exists (e.g. Thun et al., 1997; Balsa et al., 2008) that moderate alcohol consumption can have positive health effects related to cardio-vascular diseases, stroke and dementia. Our results provide some support for these results, particularly for women.

We control for socio-economic status and health. These variables are observed for the period 1984–86, 20 years before the need for care is measured. Additional control for health and relevant individual heterogeneity, of particular importance because we do not observe an ADL score in the first wave (HUNT1), is obtained by the finite mixture approach, allowing individuals to group themselves according to relevant characteristics that are unobservable by the researcher.

Quite expectedly, the oldest within the group aged 70 or above report the highest need for social care. It may be considered more surprising that males have a higher need for care. Women have a longer life expectancy than men, and it is thereby expected that on average older women would report more problems. However, we do control for age and other observed and unobserved characteristics, so the effect may rather reflect that when health deteriorates, males suffer from problems that make daily life activities more difficult to perform.

The negative effect of education on need for social care corresponds to results from the standard Grossman model. People with higher levels of education may be expected to be more knowledgeable about health issues and, in particular, how lifestyle choices

affect future health. Fuchs (1982) suggests that the individual rate of time preference has an important role in individual health decisions. When the discount rate is low, people tend to invest more in both education and behaviours that enhance health (Balia and Jones, 2008).

To our knowledge, this is the first longitudinal study showing that lifestyle factors are significantly associated with the future need for social care. We have access to quite unique data that give reliable information on lifetime development of health. However, the setting produces some challenges when it comes to interpreting the results. First, lifestyle choices are probably influenced by the health status of individuals. Even if we control for several important health factors in the analyses, we cannot argue that the estimates are causal effects. Second, an important problem in surveying older people is the high drop-out rates over time. We followed people for 20 years; at the time of the last observation, they are 70 years or older. Because those with more severe problems may have a higher probability of dying or may be too sick to participate in the last wave, the sample may be over-represented by individuals with good health. As a result, our analysis probably under-estimates the effects of lifestyle factors for individuals with the greatest need for social care.

Third, a potential limitation, often discussed in connection with studies of this type, is that variables are based on self-reporting. This could result in «common method variance» (Spector, 1987), which may lead to a positive bias so that we overestimate the real associations. Some may have a tendency for over-reporting positive and under-reporting negative lifestyle factors. On the other hand, such measurement errors might go either way, and there is no strong reason to believe that individuals with problems of performing daily life activities at some stage in life would be more inclined than others to have systematically reported falsely 20 years earlier. Some variables may be assumed to be quite precisely measured, such as BMI, which is based on objective information on height and weight.

Finally, although we included relevant control variables that are available, it should be noted that we do not have information of actual demand for social care; information on this is not available in the data. However, we do consider reports on problems of performing daily activities to be very good indicators of the need for social care. These problems are exactly the kinds of problems that are considered when deciding to offer a person social care.

One aim of this study is to contribute to the literature on the demand for social care services that are often the responsibility of the public sector and thus have fiscal consequences. We have been able to include several variables that reflect lifestyle choices of likely relevance for the future need for social care. Finally, we have access to datasets that by international standards have high participation rates, both for HUNT1 and HUNT3.

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