SUPPLEMENTARY MATERIAL

Härkänen T, Sainio P, Stenholm S, Lundqvist A, Valkeinen H, Aromaa A and Koskinen S:
Projecting long-term trends in mobility limitations: impact of excess weight, smoking and physical inactivity.

Contents

Introduction

Theoretical background

The theoretical approach of this study is based on the International Classification of Functioning, Disability and Health (ICF) by WHO (WHO, 2001). In the broad and multidimensional ICF-model, an individual's functioning is formed and modified by complex interactions of the health condition, environmental and personal factors. The model provides an opportunity to describe specific aspects of the process leading to disability. Many health-related, personal and environmental factors (e.g. assistive devices, accessible housing and public transportation, social environment and social support) have been found to influence mobility (e.g. Yeom et al.[1]). In our study, we concentrate on certain personal factors (age, sex, education, behavioral factors) as risk factors on activity limitations (mobility limitations), with a focus of assessing the role of three modifiable behavioral risk factors (smoking, physical inactivity and obesity) in the future development of mobility limitations. These three modifiable risk factors have earlier been shown to be particularly important risk factors of mobility limitations.[1-4]

Methods

Variables measured in 2000 and 2011

Sample sizes and participants in the surveys

The methodology reports of the Health 2000 [5] and 2011 [6] Surveys present detailed information on the samples and participation rates. The web addresses of these reports are http://urn.fi/URN:NBN:fi-fe201204193320 and http://urn.fi/URN:ISBN:978-952-302-669-8, respectively. Selected tables and figures describing the sample and participation are presented in the Appendix of this Supplement.

Number of participants in the analysis dataset

We included in our study sample all individuals, who were 19 years old or older and had participated at least in one part of the Health 2000 Survey or in the new sample of young adults in the Health 2011 Survey. There were 8468 individuals in this subset in the Health 2000 Survey, who had at least one observed value in the BMI, smoking or physical inactivity variables. In the Health 2011 Survey the corresponding figure was 6358.

Missing data

Nonparticipants of the Health 2011 survey appeared to have more difficulties in walking, be more frequently smokers, be less physically active at the baseline Health 2000 Survey and have higher BMI (Table S1). This suggests that walking difficulties are more prevalent among nonparticipants in the Health 2011 Survey. More information on the nonparticipation in 2011 can be found in the methodology report [6] and in the article comparing different methods to correct the effect of nonparticipation.[7]

Supplementary Table S1. Crude, unweighted means and prevalences of the outcome and the three risk factors in the Health 2000 Survey by age group in 2000 and participation status in 2011.

Health 2011 Survey	Health 2000 Survey					
Nonparticipant	Age group	n	Walking difficulties (%)	BMI (mean)	Smoking (%)	Physical inactivity (%)
No	19-29	1007		23.6	25.1	26.0
Yes		462		24.3	35.4	28.3
No	30-40	1381	0.3	25.3	25.0	25.1
Yes		327	0.9	26.0	36.5	35.0
No	41-51	1491	0.8	26.6	26.1	24.3
Yes		328	1.5	27.1	42.5	32.1
No	52-62	1194	2.4	27.6	17.6	20.3
Yes		198	3.6	28.6	38.1	25.7
No	63-73	572	3.9	28.1	6.7	22.2
Yes		194	8.9	27.8	12.0	20.1
No	74-84	132	9.2	28.0	1.5	33.1
Yes		126	23.2	28.3	2.4	42.6
No	85-	6	50.0	24.8	16.7	50
Yes		15	35.7	26.9	0.0	61.5

BMI and smoking were asked or measured in many stages of the surveys, thus the number of missing data was smaller in these variables (Table S2). Physical inactivity was not asked the new sample of young adults in 2011, thus the number of missing values was largest. The outcome, walking difficulties was not asked among the young adults, thus the number of missing values was large.

Supplementary Table S2. Number of missing values in the outcome and main risk factors.

Year	Walking difficulties	BMI	Physical inactivity	Smoking
2000	1402	200	732	51
2011	2604	1723	3653	1787

Data collection

Health 2000 and 2011 surveys were large nationally representative health examination surveys. The data collection of adults 30 years and older comprised assessments of many aspects of health, e.g. anthropometry, ECG, laboratory tests, physical performance, cognition, as well as face-to-face health interview and several questionnaires.[5, 6] Five field teams with 15–17 health care professionals in each collected the data around Finland, after receiving a 2–3 week training and written instructions. The quality of the data was continuously monitored during the field work. For those not attending the health examination site a supplementary examination was conducted at home or institution. Finally, a telephone interview was conducted or a questionnaire sent for those not reached by other means. The data on young adults 18–29 years was collected mainly through interview and questionnaires, with only a small sample of young adults having a health examination in 2011. The tables in the end of the Supplement, drawn from the methodology reports of the surveys, show participation in different stages of the data collection.

Outcomes and predictors

The instruments used to measure the outcome, predictors and auxiliary variables used in the imputation models are described in Table S3. Only self-reported information on weight and height was available in the age group 18–29 years for all participants in 2000. In 2011, 80.4 % of the observed BMI values were based on self-reported weight or height. In the age group 30+, 18.3 % and 20.7 % of the observed BMI values were based on self-reported height or weight in 2000 and 2011, respectively. Self-reported BMI has been found to underestimate the more precise, measured BMI by 0.3 to 1.2 kg/m^2.[8] This could result in overestimating the BMI change between the two youngest age groups 19-29 and 30-40 years, but not in the older age groups. As all or most of the BMI values in the age group 19-29 years were self-reported in both surveys 2000 and 2011, respectively, these overestimates should cancel out without creating bias in the projections in the older age groups.

Supplementary Table S3. The description of the variables used in the study.

Analysis variables	**Instrument**	**Transformation**	**References**
Walking difficulties	Self-reported question: Are you able to walk about half a kilometer without resting? 1) no difficulties, 2) with minor difficulties, 3) with major difficulties, 4) not at all	Dichotomy: 1–2 vs 3–4	[9, 10]

Smoking	<u>Self-reported question</u>: Do you smoke nowadays? 1) daily 2) occasionally 3) not at all	Dichotomy: 1 vs 2–3	11, 12
Physical inactivity	<u>Self-reported question</u>: How much do you exercise and strain yourself physically in your leisure time? 1) In my leisure time I read, watch TV and do other activities in which [9] and which do not strain me physically; 2) In my leisure time I walk, cycle and move in other ways at least four hours per week; 3) In my leisure time I exercise at least three hours per week; 4) In my leisure time I practice regularly several times per week for competition	In the modelling, a three-category variable was used (options 3 and 4 were merged due to the small number of observations). In the tables and figures physical inactivity was dichotomized (1 vs. 2–4)	13-15
BMI	<u>Measurement</u>: Height was measured using a standard protocol using a stadiometer. Weight was measured as a part of bioimpedance body composition analysis or, if that was not possible, with digital floor scale. <u>Self-reported question</u>: How tall are you? (cm); How much do you weigh at present? (kg)	BMI was calculated as weight (in kilos) / height^2	16
Age	Register: Population Register Centre, continuous (years)	No transformation, individually linked with the survey data.	
Sex	Register: Population Register Centre (male or female)	No transformation, individually linked with the survey data.	
Mortality	Register: Registry of causes of death, Statistics Finland (the day of the death)	No transformation, individually linked with the survey data.	
Auxiliary variables[1)]			
Running difficulties	<u>Self-reported question</u>: Are you able to run a longer distance (about half a kilometre)? 1) no difficulties, 2) with minor difficulties, 3) with major difficulties, 4) not at all	No transformation.	9, 10
Frequency of	<u>Self-reported question</u>: How often do you	No transformation	15

leisure time physical activity (LTPA)	exercise in your leisure time for at least half an hour so that you are at least slightly out of breath and sweating? 1) daily 2) 4-6 times a week 3) 2-3 times a week 4) once a week 5) 2-3 times a month 6) few times a year or even more rarely		
Education	Register: Register of Completed Education and Degrees, Statistics Finland	Transformed from six levels to three: 1) low (max. 9 years), intermediate (10–12 years) and high (13 or more years. Individually linked with the survey data.	17

[1)] Auxiliary variables in the imputation models

Information on walking difficulties and on the strenuousness of physical activity was not asked from the young adults aged 18–29, and therefore we applied multiple imputation (MI) [18]. The imputation models included age (as continuous) and sex. In addition to the risk factors of interest (smoking, physical inactivity, and BMI), we included three auxiliary variables for all age groups in the imputation models, namely frequency of leisure time physical activity, difficulties in running 500 meters and education.

Running difficulties is an important predictor in the imputation model for walking difficulties, because if a person can run, it is very unlikely that he/she has walking difficulties (Table S4). Note that in the age groups 30-40 and 41-51 years if an individual replied that he/she is able to run with or without difficulties, then he/she had no difficulties or only minor difficulties in walking. If he/she was not able to run at all, then about 10% of them had major difficulties in walking or was not able to walk at all. This information was then applied to impute the missing walking information for the youngest age group 19-29 years, in which only 27 individuals reported major difficulties or incapacity in running, thus the multiply imputed prevalence in this age group was only 0.8%.

Supplementary Table S4: Walking difficulties versus running difficulties in the Health 2000 Survey in the three youngest age groups.

	Crude observations, frequency	Multiply imputed prevalence (%)

Age group	Running difficulties	Walking difficulties				
		n	mild*	major *	mild*	major*
19-29	no difficulties	1096			99.6	0.4
	with minor difficulties	244			99.2	0.8
	with major difficulties	66			98.6	1.4
	not at all	27			89.8	10.2
	all	1477			99.2	0.8
30-40	no difficulties	1272	1272	0	99.7	0.3
	with minor difficulties	254	254	0	99.3	0.7
	with major difficulties	58	58	0	98.7	1.3
	not at all	69	60	8	88.3	11.7
	all	1737	1690	8	99.0	1.0
41-51	no difficulties	1112	1112	0	99.6	0.4
	with minor difficulties	368	368	0	99.2	0.8
	with major difficulties	98	98	0	98.7	1.3
	not at all	222	200	22	89.3	10.7
	all	1902	1845	23	98.5	1.5

* Walking dichotomized into 'mild' (with no difficulties or with minor difficulties) and 'major' (with major difficulties or not at all) difficulties.

We decided not to include number of cigarettes per day in our projection model, as it was not significantly associated with the incidence of walking difficulties between 2000 and 2011 based on the estimates of a multiple logistic regression model (Table S5).

Supplementary Table S5. Odds ratio estimates for the incidence of walking difficulties between 2000 and 2011.

Predictor in 2000	OR	Confidence interval (95%)
Age	1.13	(1.11, 1.14)
Gender		
male	1.00	
female	1.33	(0.97, 1.80)
Smoking		
occasionally or not at all	1.00	
daily	2.08	(1.06, 4.07)
BMI	1.14	(1.11, 1.17)
Physical inactivity		
exercise at least three hours per week	1.00	
walk, cycle and move in other ways at least four hours per week	1.08	(0.69, 1.69)

I do not move much	1.80	(1.11, 2.93)
Number of cigarettes per day	1.02	(0.98, 1.05)

Statistical methods

Selection bias

In the Health 2000 Survey the participation rates were high, but it has been shown that risk of death is higher among nonparticipants, thus it is likely that the available methods such as the poststratification weights based on the missing at random (MAR) assumption can completely remove the selection bias due to effects of nonparticipation.

In the Health 2011 Survey the nonparticipation increased considerably compared to the baseline survey. We have assumed that the changes in the risk factor or outcome values between 2000 and 2011 are similar among those who participated in both waves and among those who participated only in 2000 (whose risk factor and outcome values were missing in 2011). Under this assumption it is possible to impute the missing values in 2011 using the observed values in 2000 with good accuracy (Table 1 and Figure 1).

Poststratification weights

The oversampling of people aged 80 years or older, and nonparticipation in the Health 2000 Survey [5, 19] was handled using poststratification weights, which were calibrated [20] with respect to

- Design weight based on adjusted inclusion probability
- Health centre district indicator
- University hospital district indicator
- Age (10 year categories for persons aged 30 or over, 3 categories for the age range 18–29 years)
- Gender
- Native language (2 categories)

Multiple imputation: Classification and regression trees (CART) and MICE

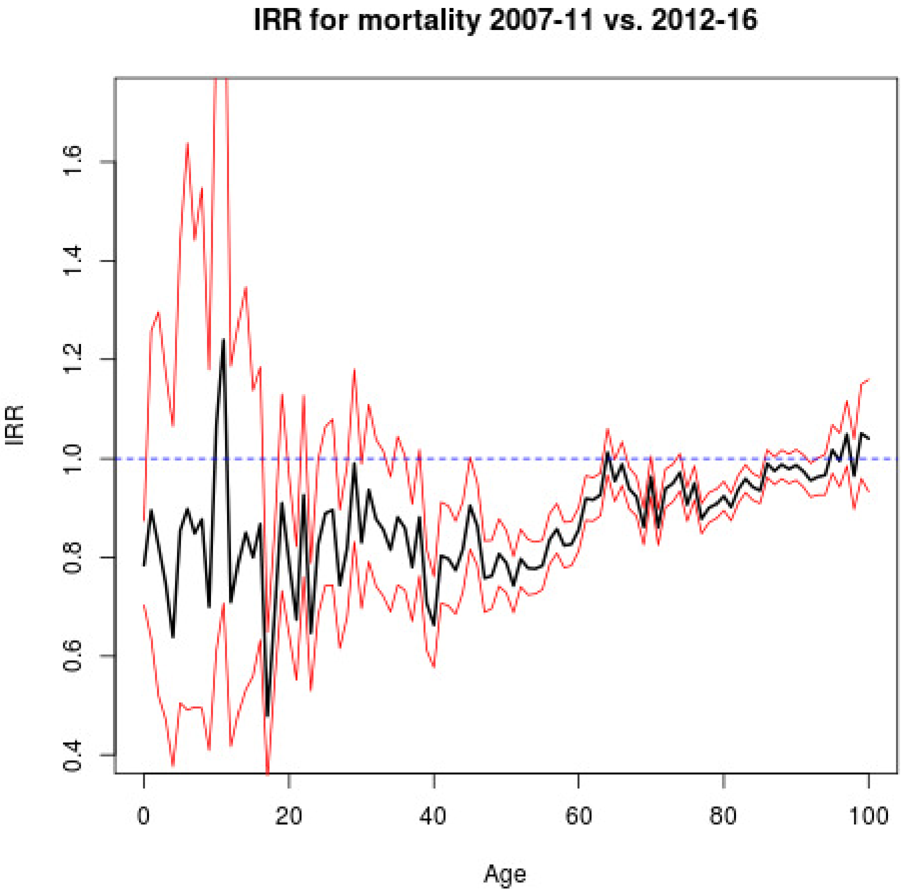
We applied multiple imputation [21] based on MICE [22] and CART [23] methods on the 36 bootstrap samples. The imputed values approximate the Bayesian posterior predictive distribution $p(y^{miss}|y^{obs}) = \int p(y^{miss}|\theta)p(\theta|y^{obs})d\theta$, where y^{miss} and y^{obs} correspond to the missing and observed data, respectively, and θ to the model parameters. The posterior distribution of the parameters is $p(\theta|y^{obs})$. These are proper imputation methods, that is, the uncertainty in the parameter estimates are accounted for [24, 25].

One of the benefits of tree-based methods such as the CART [26] is that nonlinearities (e.g. a possible U-shape in the association of BMI and risk of disability) are accounted for in the analysis automatically. Also possible interactions of the predictors are accounted for.

Transitions of the multistate model [27] between the three states (mobile, disabled or death) during the 11-year interval are handled using the CART model.[26] The missing outcome values (missing data in 2011 or in the prediction time points 2022, 2033 and 2044) are multiply imputed based on the associations of the observed data in 2000 and 2011. The imputation model accounts for the transition probabilities, which depend on the initial state.

Mortality changes in the Finnish population 2007-11 versus 2012-16

We found that the decreasing trend in mortality seems to be continuing (Figure S1) based on the population and mortality statistics of Statistics Finland. Especially (approximately) between ages 40 and 80 mortality has significantly decreased (the incidence rate ratio IRR was below 1). The result was based on a Poisson regression model containing the main effect of categorical 1-year age and the interaction of age and year interval (2007-11 vs. 2012-16), and the R statistical software[28]. The Wald test for the interaction terms was highly significant ($p<0.00001$).



Supplementary Figure S1. Incidence rate ratios (IRR) in mortality in the Finnish population. The black curve represents the point estimate and the red curves the 95% confidence intervals of the IRR with reference category as 2007-11.

Projections

The changing educational composition was accounted for by assuming that among individuals aged 30 and above the level of education remained the same, but that those aged under 30 had a possibility to move to a higher education group according to the transition probabilities observed during the period 2000–2011 (data not shown).

The combination of the bootstrap method and multiple imputation [21] were based on MICE [22] and CART [23] methods. Therefore the averages, standard deviations, quantiles and other statistics calculated from the projected (i.e. multiply imputed) individual risk factor and outcome values y^{2022}, y^{2033} and y^{2044} for 2022, 2033 and 2044 correspond to the statistics of the predictive population distribution, and these projections are generated sequentially using the Bayesian predictive distributions:[29]

1. $p(y^{2022}|y^{2000,2011}) = \int p(y^{2022}|\theta, y^{2011})p(\theta|y^{2000,2011})d\theta$
2. $p(y^{2033}|y^{2000,2011}) = \iint p(y^{2033}|\theta, y^{2022})p(y^{2022}|\theta, y^{2011})p(\theta|y^{2000,2011})dy^{2022}d\theta$
3. $p(y^{2044}|y^{2000,2011}) =$
   $\iiint p(y^{2044}|\theta, y^{2033})p(y^{2033}|\theta, y^{2022})p(y^{2022}|\theta, y^{2011})p(\theta|y^{2000,2011})\mathrm{d}y^{2033}dy^{2022}d\theta.$

Note that these projections can be generated using the multiple imputation, because the missing or projected values are generated using the posterior predictive distributions, which is the recommended method to create projections as it incorporates both prediction and parameter uncertainties in the predicted values, based on the observed data y^{2000} and y^{2011}.[30]

Technically, our algorithm proceeded as follows (see also Table S6):

1. Convert the survey data set into the wide format: data matrix with one row per individual, containing both the baseline variables recorded in 2000 and follow-up variables in 2011. Call these two groups of columns as C_1 and C_2, respectively, and the rows of this data matrix by A_1.
2. Generate bootstrap samples from the survey data matrix.
3. Impute the missing values in this data matrix: One imputation for each bootstrap sample.
4. Add rows to the data matrix: One row for each individual alive in 2011. Call these new rows of the data matrix as A_2. Copy the 2011 variable values of these alive individuals (cells (A_1, C_2)) to the corresponding 2000 variables in the new rows (cells (A_2, C_1)).
5. Impute the missing values in the new rows using all rows A_1 and A_2, in which the columns of the 2011 variables (cells (A_2, C_2)) correspond to the projected values for the year 2022.
6. Repeat steps 4 and 5 to produce projections for years 2033 and 2044 (columns C_2 of rows A_3 and A_4), respectively.

Note that in the step 5 we utilize the associations of all 2000 and 2011 variables, which are obtained using the rows A_1 in the imputation, to produce projections for 2022 (cells (A_2, C_2)) using the 2011 risk factor and outcome values (cells (A_2, C_1)). The structure of the data matrix is illustrated in Table S6.

Supplementary Table S6. Structure of the data matrix, and the notation for the Health 2000 (H2000) and Health 2011 (H2011) Surveys, and the projections for 2022, 2033 and 2044.

	Columns		
Rows	C_1	C_2	Individuals

	the H2000 variables	the H2011 variables	
A_1	observed data in 2000	observed data in 2011	H2000 and H2011 participants
A_2	observed data in 2011	projections for 2022	participants who survived until 2011
A_3	projections for 2022	projections for 2033	participants who survived until 2022
A_4	projections for 2033	projections for 2044	participants who survived until 2033

However, as our procedure was time consuming and the number of imputations was relatively small, instead of reporting the 2.5% and 97.5% quantiles of the predictive distributions, we reported the posterior expectation (approximated by the mean of the imputations) plus minus 1.96 times the corresponding standard deviation as the limits of the 95% credible (or prediction) interval due to numerical instability.

The MI algorithm produced not only projected values for the walking disability outcome, but also to mortality and risk factors. As a side product, we also obtained projections for population sizes and age distributions in the future assuming the null or the other scenarios, and for risk factor prevalences.

As our data represented the population at the baseline, and we accounted for mortality, the individuals, who were either in the state mobile or disabled (i.e. not dead), represent the (future) population in 2022, 2033 and 2044. Therefore all projected statistics can be calculated directly from the projected data values of the living individuals. In other words, there is no need to calculate weighted averages of age-specific projections.

Data sets, which are based on shorter measurement intervals than the 11-year interval of this study and represent the whole adult population, are rare not only in Finland but also in other countries. Modelling of the transitions within the 11-year interval is not necessary because we are only interested in the projections in 2022, 2033 and 2044 – not between these years. The marginal transition probabilities, which can be estimated from the data, are sufficient to provide these projections. It is not important if there has been only one transition during the 11 year period or, for example, 21 transitions. A more detailed transition model would be needed if we wanted to project, for example, (individual) expected life years without mobility limitations, but here we wanted to project cross-sectional population sizes and prevalence at the three time points in the future. The important point is that we assume that the transition probabilities are the same after 2011 as between 2000 and 2011, but the parameter uncertainty is accounted for by the application of the bootstrap method. In that case also the marginal transition probabilities are the same in the future.

Results

Projections separately for men and women

The observed difference between genders appeared to be large in 2000 and 2011, but our projections suggest that this difference will tend to disappear in the future (Table S7). The projected decline in the gender difference results largely from the growing similarity of the age structure of the female and male population aged 52+.[31]

Supplementary Table S7. Projected prevalences and number of individuals with walking difficulties in the age group 52 years and older.

		Males		Females	
Scenario	year	n (in 1000's)	Prevalence (%)	n (in 1000's)	Prevalence (%)
Observed	2000	81 (70, 92)	11.5 (9.9, 13.1)	150 (135, 165)	16.7 (15.1, 18.2)
Observed	2011	68 (58, 77)	7.6 (6.5, 8.7)	126 (112, 141)	11.9 (10.6, 13.3)
Null	2022	113 (92, 134)	10.2 (8.4, 12.0)	152 (126, 177)	12.8 (10.8, 14.9)
Smoking		114 (94, 133)	10.1 (8.4, 11.9)	152 (126, 177)	12.7 (10.7, 14.7)
Couch		109 (88, 131)	9.8 (7.8, 11.8)	145 (118, 173)	12.2 (10.0, 14.4)
BMI		95 (77, 112)	8.5 (7.0, 10.1)	125 (98, 152)	10.6 (8.4, 12.7)
All		89 (68, 110)	7.9 (6.0, 9.9)	122 (93, 150)	10.1 (7.8, 12.5)
AllMax		74 (51, 96)	6.5 (4.6, 8.5)	97 (64, 131)	8.1 (5.4, 10.8)
Null	2033	169 (138, 199)	14.1 (11.6, 16.5)	187 (148, 225)	15.3 (12.3, 18.2)
Smoking		168 (139, 197)	13.8 (11.4, 16.2)	189 (159, 218)	15.2 (13.0, 17.4)
Couch		157 (123, 191)	13.0 (10.2, 15.7)	177 (138, 215)	14.3 (11.3, 17.3)
BMI		132 (99, 164)	11.0 (8.3, 13.7)	150 (115, 186)	12.3 (9.5, 15.1)
All		127 (91, 163)	10.3 (7.4, 13.2)	145 (111, 179)	11.5 (8.9, 14.2)
AllMax		114 (77, 150)	9.1 (6.2, 12.0)	128 (86, 169)	10.1 (6.9, 13.3)
Null	2044	198 (154, 241)	16.3 (12.9, 19.6)	205 (157, 252)	16.6 (13.0, 20.2)
Smoking		201 (162, 240)	16.1 (13.1, 19.1)	203 (160, 247)	16.1 (12.9, 19.3)
Couch		183 (142, 225)	14.9 (11.7, 18.1)	193 (143, 243)	15.5 (11.8, 19.2)
BMI		156 (118, 194)	12.8 (9.7, 15.8)	164 (121, 208)	13.3 (10.0, 16.7)
All		153 (107, 198)	12.1 (8.4, 15.8)	160 (115, 205)	12.5 (9.1, 15.9)
AllMax		140 (93, 188)	10.9 (7.3, 14.6)	147 (91, 204)	11.4 (7.2, 15.7)

Accuracy of the projections

The accuracy of the projections was relatively good in 2022, but was increased as the standard deviation of the predictive distribution increase later on (Table S8). The accuracy was assessed using the Monte Carlo errors (MCE) of the point projections.[32] A larger number of bootstrap samples would have improved the accuracy, but the memory constraints did not allow more than 36 bootstrap samples.

Supplementary Table S8. Projections based on the Null scenario ('Mean'), the standard deviation ('SD') of the predictive distribution and the Monte Carlo errors ('MCE') of the projections of the null scenario by age group.

		Persons with severe mobility limitation, n in 1000's			Prevalence of severe mobility limitation, %-unit			Population size, n in 1000's		
Year	Age group	Mean	SD	MCE	Mean	SD	MCE	Mean	SD	MCE
2022	52-62	25	5.6	0.93	3.2	0.73	0.12	771	5.6	0.93
2033		23	5.8	0.96	3.3	0.84	0.14	691	6.4	1.07
2044		25	7.2	1.21	3.6	1.02	0.17	714	7.9	1.31
2022	63-73	53	9.6	1.60	6.8	1.21	0.20	780	10.1	1.69
2033		50	8.4	1.41	6.8	1.17	0.19	726	11.0	1.83
2044		45	8.1	1.35	6.9	1.26	0.21	654	12.6	2.11
2022	74-84	110	12.4	2.06	20.1	2.23	0.37	546	11.5	1.91
2033		150	18.9	3.14	22.5	2.70	0.45	667	15.7	2.61
2044		148	18.3	3.05	23.2	2.84	0.47	639	18.0	3.01
2022	85-	77	11.0	1.83	39.5	5.75	0.96	195	8.5	1.41
2033		132	18.8	3.13	39.7	5.11	0.85	334	15.4	2.57
2044		183	28.8	4.79	41.7	5.70	0.95	439	23.2	3.87
2022	All	265	19.9	3.31	11.6	0.84	0.14	2293	18.6	3.10
2033		355	32.4	5.40	14.7	1.25	0.21	2418	33.8	5.63
2044		402	41.8	6.97	16.4	1.62	0.27	2447	47.3	7.89

Estimated contrasts between the scenarios

The scenarios, which involved modification of the BMI, differed from the null scenario (Table S9).

Supplementary Table S9. Differences between the null scenario and the other scenarios by age group (contrasts and their 95% credible intervals), in the projected a) number persons with severe walking limitations, b) prevalence of severe walking limitations, and c) the population size.

Scenario	**Age**	**Year**	**Persons with severe mobility limitation, n in 1000's**	**Prevalence of severe mobility limitation, %-unit**	**Population size n in 1000's**
Smoking50% [1)]	52-62	2022	-2.7 (-12.3, 7.0)	-0.4 (-1.6, 0.9)	5.8 (-4.1, 15.7)
		2033	-0.7 (-13.3, 11.9)	-0.1 (-2.0, 1.7)	8.3 (-7.9, 24.5)
		2044	-3.8 (-13.7, 6.2)	-0.6 (-2.0, 0.9)	6.9 (-5.7, 19.5)
	63-73	2022	-0.5 (-15.0, 14.1)	-0.1 (-2.0, 1.7)	6.7 (-10.8, 24.2)
		2033	-3.2 (-19.6, 13.2)	-0.6 (-2.8, 1.7)	15.2 (1.6, 28.8)
		2044	-1.7 (-24.0, 20.6)	-0.4 (-3.8, 3.0)	16.1 (-5.8, 38.1)
	74-84	2022	-0.9 (-18.2, 16.3)	-0.4 (-3.4, 2.6)	6.5 (-15.0, 28.0)

		2033	-0.3 (-27.5, 26.8)	-0.4 (-4.0, 3.2)	10.2 (-25.3, 45.7)
		2044	-2.3 (-25.5, 20.8)	-1.0 (-4.7, 2.7)	19.0 (-9.2, 47.2)
	85-	2022	4.6 (-14.5, 23.7)	1.3 (-7.0, 9.7)	4.9 (-15.4, 25.3)
		2033	5.9 (-17.3, 29.0)	0.5 (-6.0, 7.0)	11.3 (-17.8, 40.4)
		2044	9.6 (-25.8, 45.0)	0.5 (-7.5, 8.6)	17.5 (-22.1, 57.1)
	All	2022	0.5 (-28.9, 29.9)	-0.1 (-1.3, 1.1)	23.9 (-12.2, 60.0)
		2033	1.6 (-35.6, 38.9)	-0.2 (-1.6, 1.2)	44.9 (-6.0, 95.8)
		2044	1.8 (-49.4, 52.9)	-0.3 (-2.4, 1.8)	59.6 (-12.0, 131.2)
Physical inactivity50%[1)]	52-62	2022	-1.7 (-12.5, 9.2)	-0.2 (-1.6, 1.2)	2.1 (-7.8, 12.0)
		2033	-0.9 (-13.9, 12.1)	-0.1 (-2.0, 1.8)	2.2 (-13.8, 18.2)
		2044	-1.7 (-12.2, 8.8)	-0.2 (-1.7, 1.2)	1.7 (-11.5, 14.9)
	63-73	2022	-3.7 (-20.7, 13.2)	-0.5 (-2.7, 1.6)	5.1 (-9.7, 19.8)
		2033	-5.0 (-19.3, 9.3)	-0.8 (-2.7, 1.2)	7.5 (-8.5, 23.5)
		2044	-3.1 (-22.0, 15.8)	-0.5 (-3.4, 2.3)	6.5 (-16.6, 29.7)
	74-84	2022	-5.1 (-21.9, 11.7)	-1.1 (-4.2, 2.0)	4.0 (-16.4, 24.5)
		2033	-12.0 (-39.7, 15.6)	-2.0 (-6.1, 2.1)	6.2 (-30.0, 42.3)
		2044	-14.6 (-40.1, 11.0)	-2.5 (-6.6, 1.6)	7.2 (-26.7, 41.1)
	85-	2022	0.3 (-17.0, 17.6)	-0.6 (-8.1, 7.0)	3.2 (-15.8, 22.3)
		2033	-3.9 (-24.8, 17.0)	-1.8 (-7.9, 4.4)	5.8 (-23.8, 35.3)
		2044	-6.6 (-40.3, 27.0)	-2.5 (-9.3, 4.2)	11.3 (-22.8, 45.5)
	All	2022	-10.3 (-43.3, 22.8)	-0.5 (-1.9, 0.9)	14.4 (-18.1, 46.9)
		2033	-21.8 (-61.1, 17.5)	-1.0 (-2.6, 0.6)	21.6 (-41.1, 84.3)
		2044	-26.0 (-78.9, 27.0)	-1.2 (-3.4, 0.9)	26.7 (-45.8, 99.3)
BMI50%[2)]	52-62	2022	-8.7 (-19.2, 1.9)	-1.1 (-2.5, 0.2)	-0.2 (-11.5, 11.0)
		2033	-9.4 (-19.9, 1.1)	-1.4 (-2.9, 0.1)	1.0 (-15.1, 17.2)
		2044	-11.5 (-23.4, 0.3)	-1.6 (-3.3, 0.1)	2.8 (-9.7, 15.3)
	63-73	2022	**-14.3 (-28.6, -0.1)**	**-1.8 (-3.6, -0.1)**	1.2 (-13.4, 15.7)
		2033	**-21.7 (-34.4, -9.0)**	**-3.0 (-4.7, -1.2)**	2.2 (-12.1, 16.4)
		2044	**-18.7 (-35.4, -1.9)**	**-2.9 (-5.4, -0.3)**	3.3 (-22.5, 29.1)
	74-84	2022	**-18.9 (-37.6, -0.2)**	**-3.4 (-6.7, -0.2)**	-1.1 (-22.5, 20.4)
		2033	**-31.1 (-58.2, -4.0)**	**-4.7 (-8.4, -1.0)**	1.1 (-29.1, 31.4)
		2044	**-34.3 (-65.1, -3.5)**	**-5.5 (-9.9, -1.1)**	4.4 (-27.8, 36.7)
	85-	2022	-3.5 (-22.2, 15.3)	-1.2 (-10.7, 8.4)	-2.7 (-23.7, 18.3)
		2033	-11.1 (-34.6, 12.3)	-2.8 (-9.6, 4.0)	-3.8 (-37.3, 29.8)
		2044	-17.2 (-60.5, 26.1)	-3.8 (-12.1, 4.6)	-0.9 (-48.8, 46.9)
	All	2022	**-45.4 (-74.9, -15.9)**	**-2.0 (-3.2, -0.7)**	-2.8 (-34.4, 28.8)
		2033	**-73.3 (-123.7, -23.0)**	**-3.0 (-4.9, -1.1)**	0.6 (-55.7, 56.9)
		2044	**-81.7 (-145.7, -17.8)**	**-3.4 (-5.7, -1.0)**	9.6 (-60.6, 79.7)
All risk factors 50%[1,2)]	52-62	2022	-9.3 (-20.0, 1.4)	-1.2 (-2.6, 0.2)	7.7 (-3.2, 18.6)
		2033	**-11.6 (-22.9, -0.4)**	**-1.7 (-3.3, -0.1)**	9.5 (-7.1, 26.1)
		2044	**-13.6 (-24.4, -2.8)**	**-1.9 (-3.4, -0.4)**	9.5 (-2.2, 21.1)
	63-73	2022	-17.3 (-36.1, 1.4)	-2.3 (-4.6, 0.0)	13.1 (-6.4, 32.6)
		2033	**-24.7 (-39.4, -9.9)**	**-3.5 (-5.5, -1.5)**	**21.6 (4.5, 38.7)**
		2044	**-23.2 (-41.8, -4.7)**	**-3.7 (-6.5, -0.9)**	**23.8 (1.1, 46.5)**
	74-84	2022	**-23.9 (-46.1, -1.6)**	**-4.6 (-8.4, -0.8)**	6.5 (-20.8, 33.8)
		2033	**-36.1 (-57.0, -15.1)**	**-6.0 (-8.8, -3.3)**	25.7 (-2.7, 54.1)

		2044	**-39.0 (-64.7, -13.2)**	**-7.0 (-10.6, -3.3)**	**33.7 (2.8, 64.6)**
	85-	2022	-3.7 (-22.5, 15.1)	-2.3 (-11.6, 6.9)	2.9 (-22.0, 27.8)
		2033	-10.6 (-36.8, 15.7)	-4.6 (-12.8, 3.6)	15.1 (-21.6, 51.7)
		2044	-13.6 (-55.0, 27.9)	-5.7 (-14.6, 3.2)	33.6 (-7.9, 75.1)
	All	2022	**-54.2 (-89.3, -19.2)**	**-2.5 (-3.9, -1.0)**	30.2 (-13.5, 73.9)
		2033	**-82.9 (-125.1, -40.8)**	**-3.7 (-5.3, -2.2)**	**71.9 (16.3, 127.6)**
		2044	**-89.3 (-155.6, -23.1)**	**-4.1 (-6.7, -1.6)**	**100.5 (39.6, 161.4)**
All risk factors 100%[3]	52-62	2022	**-14.4 (-24.8, -4.0)**	**-1.9 (-3.2, -0.5)**	12.3 (-6.7, 31.2)
		2033	**-15.5 (-27.2, -3.8)**	**-2.3 (-3.9, -0.6)**	15.9 (-3.5, 35.4)
		2044	**-17.1 (-32.4, -1.7)**	**-2.4 (-4.6, -0.3)**	13.7 (-1.2, 28.5)
	63-73	2022	**-29.5 (-47.0, -12.0)**	**-3.8 (-6.0, -1.7)**	13.6 (-42.7, 69.8)
		2033	**-31.8 (-46.8, -16.8)**	**-4.5 (-6.5, -2.5)**	27.9 (-16.0, 71.8)
		2044	**-28.8 (-43.6, -14.0)**	**-4.5 (-6.8, -2.3)**	28.4 (-11.4, 68.3)
	74-84	2022	**-36.4 (-64.5, -8.3)**	**-7.0 (-11.5, -2.4)**	13.0 (-45.2, 71.1)
		2033	**-46.1 (-88.3, -4.0)**	**-7.7 (-13.1, -2.4)**	37.1 (-39.3, 113.5)
		2044	**-47.4 (-84.7, -10.0)**	**-8.5 (-13.6, -3.4)**	46.5 (-13.6, 106.6)
	85-	2022	-13.7 (-37.1, 9.8)	-7.1 (-18.0, 3.7)	1.2 (-28.5, 30.8)
		2033	-20.2 (-54.0, 13.5)	-7.5 (-15.8, 0.8)	16.5 (-51.8, 84.8)
		2044	-21.3 (-71.0, 28.4)	-7.4 (-16.1, 1.4)	34.6 (-63.0, 132.3)
	All	2022	**-94.0 (-146.2, -41.7)**	**-4.2 (-6.3, -2.1)**	40.0 (-73.8, 153.8)
		2033	**-113.7 (-183.7, -43.7)**	**-5.1 (-7.6, -2.6)**	97.4 (-65.2, 260.0)
		2044	**-114.5 (-194.2, -34.9)**	**-5.2 (-8.1, -2.4)**	123.3 (-51.5, 298.0)

[1] 50% of individuals in the high-risk category were moved to the low-risk category (nonsmoker or moderate PA) in years 2011, 2022, and 2033; otherwise the risk factors were assumed to change with the same transition probabilities as between 2000 and 2011

[2] all BMI values above 25 were replaced by the average of the BMI value and 25 in years 2011, 2022, and 2033; otherwise the subjects' BMI was assumed to change similarly as between 2000 and 2011

[3] all individuals in the high-risk categories were moved to the low-risk categories (nonsmoker or moderate PA) and all BMI values above 25 to 25 in years 2011, 2022, and 2033; otherwise the risk factors were assumed to change with the same transition probabilities as between 2000 and 2011

bold = the 95% credible interval of the contrast of the scenario and the null scenario did not contain zero

Appendix

The Health 2000 Survey

Table 10.1. Original sample, final sample, participation in different stages of data collection and non-participation.

	Number		%	
Sample	8,028			
deceased before fieldwork		49		
Final sample	7,979		100.0	
Participants in home-visit interview	7,087		88.8	
long interview		6,986		87.6
short interview		101		1.3
Participants in health examination	6,354		79.6	
symptoms interview		6,238		78.2
measurements: measurement point 1		6,351		79.6
measurement point 2		6,339		79.4
laboratory		6,354		79.6
oral examination		6,335		79.4
functional capacity measurements		6,329		79.3
clinical examination		6,326		79.3
mental health interview		6,005		75.3
Participants in home-visit health examination instead of health examination proper [1]	417		5.2	
Questionnaire respondents [2]				
basic questionnaire (questionnaire 1) [2]		6,736		84.4
infection questionnaire (questionnaire 2) [2]		6,734		84.4
complementary questionnaire (questionnaire 3)		6,269		78.6
dietary questionnaire [3]		5,998		75.2
Participants in telephone interview [4] or post-questionnaire	306		3.8	
telephone interview[4]		243		3.0
post-questionnaire		63		0.8
Participants in any stage of data collection[5]	7,415		92.9	
Non-participation	564		7.1	
refused		451		5.4
abroad		30		0.4
not reached		68		1.1
other reasons		15		0.2

[1] A total of 417 home visits were made. Home visit measurements consisted mainly of those taken at measurement point 1 and functional capacity measurements. Blood samples were also taken. The number of symptoms interviews completed (short version) was 393.

[2] Includes abridged (short) versions of questionnaires.

[3] Population weight calculated for 6,005 persons.

[4] Of the 892 persons in the final sample who did not take the home interview, 243 took the telephone interview. In addition, 211 persons who took part in the home-visit interview but who did not attend the health examination, provided responses to four key items inquired in the health examination through the short telephone interview.

[5] Participants in the home-visit interview (7,087) or in the telephone interview and post-questionnaire (306) and 22 persons who only took the health examination or who returned some questionnaire.

Table 10.2. Participation in different stages of data collection by sex and age.

	Final sample	Interview (short or long)		Health examination (at clinic or at home)		Telephone interview or post-questionnaire	
	number	number	%	number	%	number	%
Men							
30–44	1,276	1,075	84.2	1,018	79.8	66	5.2
45–54	973	848	87.2	826	84.9	40	4.1
55–64	618	555	89.8	527	85.3	26	4.2
65–74	432	398	92.1	379	87.7	16	3.7
75–84	236	214	90.7	203	86.0	6	2.5
85–	79	72	91.1	58	73.4	2	2.5
Total	3,614	3,162	87.5	3,011	83.3	156	4.3
Women							
30–44	1 322	1,185	89.6	1,148	86.8	37	2.8
45–54	943	863	91.5	843	89.4	27	2.9
55–64	703	645	91.7	634	90.2	20	2.8
65–74	551	498	90.4	478	86.8	18	3.3
75–84	557	485	87.1	448	80.4	31	5.6
85–	289	249	86.2	209	72.3	17	5.9
Total	4,365	3,925	89.9	3,760	86.1	150	3.4
Both sexes							
30–44	2,598	2,260	87.0	2,166	83.4	103	4.0
45–54	1,916	1,711	89.3	1,669	87.1	67	3.5
55–64	1,321	1,200	90.8	1,161	87.9	46	3.5
65–74	983	896	91.1	857	87.2	34	3.5
75–84	793	699	88.1	651	82.1	37	4.7
85–	368	321	87.2	267	72.6	19	5.2
Total	7,979	7,087	88.8	6,771	84.9	306	3.8

Table 10.4. Sample of young adults aged 18–29, participation in different stages of data collection and non-participation.

	Number	%
Sample	1,894	
deceased before field survey	0	
Final sample	1,894	100.0
Participants in		
interview	1,503	79.4
basic questionnaire	1,282	67.7
dietary questionnaire	789	41.7
post-questionnaire	205	10.8
at least one of the above	1,710	90.3
Non-participation	184	9.7
refused	114	6.2
abroad	12	0.6
not contacted	55	2.9
other reasons	3	0.2

The Health 2011 Survey

Table 1.2.1. Sample sizes in the Health 2011 Survey.

Sample	Age group (yrs)	Men	Women	All
Health 2000				
	41–50	820	875	1,695
	51–60	826	899	1,725
	61–70	712	750	1,462
	71–80	388	513	901
	81–	152	384	536
	All	2,898	3,421	6,319
Health 2000 young adults				
	29–34	484	451	935
	35–40	460	421	881
	All	944	872	1,816
New sample of young adults				
	18–23	580	537	1,117
	24–28	436	441	877
	All	1,016	978	1,994

Figure 3.1.1. Participation in the Health 2011 Survey (Health 2000 sample).

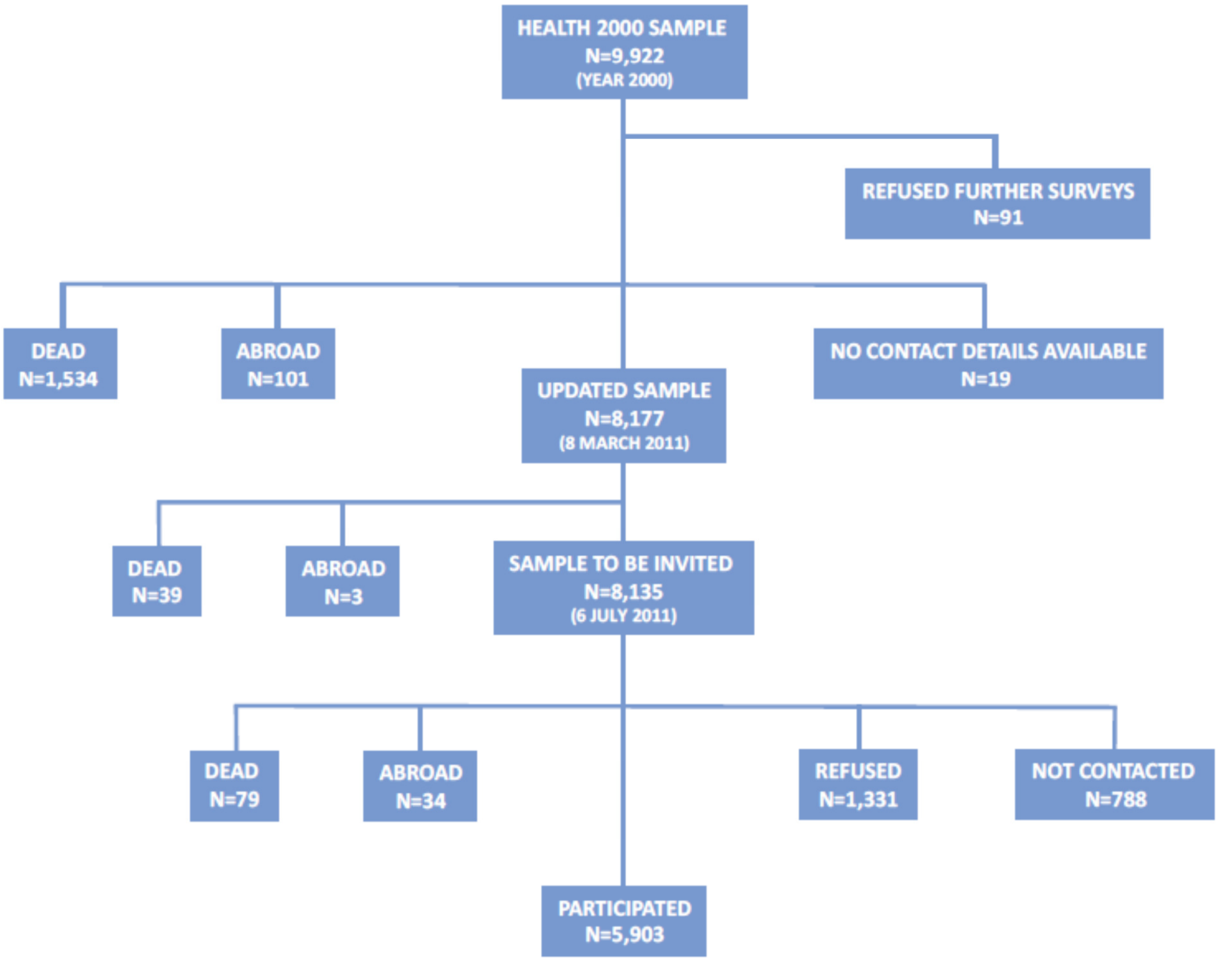


Table 3.1.1. Participation in different stages of data collection by sex and age (Health 2000 sample).

	Final sample	Health examination		Phone interview		Short questionnaire		At least one	
	n	n	%	n	%	n	%	n	%
Men (yrs)									
29–40	934	312	33,4	63	6,7	128	13,7	503	53,9
41–50	816	463	56,7	41	5,0	72	8,8	576	70,6
51–60	816	490	60,0	26	3,2	83	10,2	599	73,4
61–70	698	487	69,8	29	4,2	44	6,3	560	80,2
71–80	377	263	69,8	15	4,0	22	5,8	300	79,6
81–	138	92	66,7	4	2,9	9	6,5	105	76,1
All	3,779	2,107	55,8	178	4,7	358	9,5	2,643	69,9
Women (yrs)									
29–40	866	411	47,5	64	7,4	128	14,8	603	69,6
41–50	873	579	66,3	35	4,0	88	10,1	702	80,4
51–60	898	594	66,1	57	6,3	80	8,9	731	81,4
61–70	744	544	73,1	33	4,4	52	7,0	629	84,5
71–80	500	328	65,6	25	5,0	40	8,0	393	78,6
81–	362	166	45,9	12	3,3	24	6,6	202	55,8
All	4,243	2,622	61,8	226	5,3	412	9,7	3,260	76,8
All (yrs)									
29–40	1,800	723	40,2	127	7,1	256	14,2	1,106	61,4
41–50	1,689	1,042	61,7	76	4,5	160	9,5	1,278	75,7
51–60	1,714	1,084	63,2	83	4,8	163	9,5	1,330	77,6
61–70	1,442	1,031	71,5	62	4,3	96	6,7	1,189	82,5
71–80	877	591	67,4	40	4,6	62	7,1	693	79,0
81–	500	258	51,6	16	3,2	33	6,6	307	61,4
All	8,022	4,729	59,0	404	5,0	770	9,6	5,903	73,6

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Table 3.1.2. Participation in different stages of data collection in the Health 2011 Survey among young adults (new sample, aged 18–28 years).

	Final sample	Health examination		Phone interview		Mailed questionnaire		At least one	
	n	n	%	n	%	n	%	n	%
Health examination	406	121	29.8	24	5.9	69	17.0	214	52.7
Questionnaire	1,575	-		-		623	39.6	623	39.6
Both samples (total)	1,981	121		24		692		837	42.3

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