**SUPPLEMENT**

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3. **Supplement: Methods**
	1. **Sampling**

Multi-stage stratified sampling design with household as the sampling unit was used to obtain a nationally representative data on individuals aged 50 years and older in the Czech Republic [1]. In the first stage, 12,466 districts of the Czech Republic (Czech Statistical Office, 2009) were divided into 21 strata by using combinations of regional code and size of municipality and factor analysis was performed. Then electoral districts were selected based on their factor scores by systematic sampling with a fixed step. In the second stage, households/addresses were selected within each district by simple random sampling. Field screening for age-eligibility was performed in the third stage. The household addresses were obtained from a database of the Ministry of the Interior of the Czech Republic. The oldest member of the household (=>50 years) and their partner, irrespective of age, were eligible for the interview. Only community-dwelling individuals were recruited at baseline. However, if they moved to an institution, follow-up interviews were conducted there.

* 1. **Fieldwork**

CAPI was performed by professional interviewers who were trained in the following way: First, two head trainers responsible for the Czech Republic attended a centralized SHARE training that was held before every pilot phase, pretest and the main data collection. Afterwards, they taught the field interviewers at national trainings to ensure cross-country standardization. The content of the trainings concerned methodological issues (e.g. sample eligibility, response rates, interviewer techniques, etc.), SHARE softwares and physical measurements.

At the trainings, mock interviews were performed, including administration of cognitive tests. If possible, the same interviewers were kept for the study participants because interviewer stability is associated with respondents’ continued cooperation [2]. The median number of interviews per one interviewer in the Czech Republic was 16. In order to verify that an interview has taken place and was done properly, a back-check was performed in at least 20% of all interviewed households.

* 1. **Cognitive measures**

Verbal fluency score was derived from an animal fluency test [3]. The participants were asked to name as many different animals as they could think of within one minute. The verbal fluency score was the sum of acceptable animals. Immediate and delayed recall were extracted from an adapted 10-word delay recall test [4]. The format of the test used in SHARE is based on the Telephone Interview of Cognitive Status-Modified (TICS-M) [5]. Immediate recall score (range 0-10) was the number of recalled words after the interviewer read a list of 10 words from their computer screen. At the end of the cognitive testing session, the participants were asked again to recall any of the words from the list, which captured delayed recall score (range 0-10). Temporal orientation was adapted from Mini Mental State Examination [6]. The participants were asked ‘what is the month’, ‘the day of the month’, ‘year’ and ‘day of the week’ (range of points 0-4).

* 1. **Cognitive impairment**

Cognitive impairment is operationalized using an algorithm. Previous studies, some with validation of the endpoint, used similar operationalization [7-9]. Such a definition is relative and can indicate a spectrum of neurocognitive disorders clinically presenting as mild cognitive impairment and dementia. The scores in this study sample appear similar to those of a nationally representative Czech older population. For example, the verbal fluency scores were fairly similar to 2012 National Normative Study of Cognitive Determinants of Healthy Aging (NANOK) [10]. In our study sample, the median number of animals was 20 and interquartile range (IQR) 10, while in NANOK the median was 20 and IQR 9 [11]. Cohort 2 has a higher education than cohort 1, but the scores of cognitive tests are not adjusted for education from the beginning, as we use adjustment for education in the multivariable analysis.

Cognitive impairment 1 was the most extreme scenario, as we classified all individuals with any missing data on cognition as having cognitive impairment. Cognitive impairment 2 used two proxy variables to define cognitive impairment in individuals with incomplete data. The proxy variables were: 1) self-report of the diagnosis of dementia, senility or Alzheimer´s disease established by a doctor; 2) report (by respondent or proxy) of difficulty in at least one of 3 instrumental activities of daily living (IADL) [12] - telephone use, taking medication and managing finances, which were previously correlated with cognitive impairment independently of age, sex and education [13]. After use of proxy variables, if any respondents with missing data remained and had impaired performance in at least one other cognitive measure, we classified them as having cognitive impairment. All others were considered free of cognitive impairment.

For cognitive impairment 3, we executed complete case analysis by excluding individuals with any missing data on cognition. We alternatively defined cognitive impairment 4 by constructing a scale from the four cognitive measures so that each cognitive measure gave 0-4 points to the summary scale. The measure of temporal orientation (range 0-4) was used as it is, while we used quintiles when assigning points for the remaining three cognitive measure, as previously conducted by Doblhammer [8], by giving 0 points for the 1st quintile, 1 point for the 2nd quintile, 2 points for the 3rd quintile, 3 points for the 4th quintile and 4 points for the 5th quintile. The final scale reached then 0-16 points. We chose a cut-off of 6 points so that individuals reaching the 20% of the lowest distribution of the scale (0-6 points) were classified with cognitive impairment.

This is a rationale based on a study by Langa et al [7] who constructed a cognitive scale in the Health and Retirement Study, where individuals reaching the scores of the 20%of the lowest distribution were classified as having dementia. The cut-point was validated against the prevalence of dementia in the Aging, Demographics and Memory Study (ADAMS), a sub-study of the Health and Retirement Study concerning Alzheimer´s disease and dementia that used a 3-4 hour in-home neuropsychological and clinical assessment as well as expert clinician adjudication [14, 15]. Participants with any missing data on cognitive measures were classified as having cognitive impairment.

* 1. **Covariates**

*Sociodemographic characteristics*

* Age (in years)
* Gender (men vs. women)
* Birth cohort was used as a categorical variable (1=1911-1929; 2=1930-1934; 3=1935-1939; 4=1940-1945; 5=1946-1950)
* Education (years)
* Family status (1=living with a spouse: married and living with spouse / registered partnership vs. 0=alone: married and not living with spouse / never married / divorced / widowed)
* Employment (1=currently working: employed / self-employed vs. 0=not working: retired / unemployed / permanently sick / homemaker / other)
* Household net worth: sum of household net financial assets and household real assets. Household net financial assets are calculated as the difference between household gross financial assets (sum of bank accounts, bond, stock and mutual funds and savings for long-term investments) and financial liabilities. Household real assets are calculated as follows: Value of main residence\*percentage of house owned/100 + value of own business\*share of own business/100 + value of cars + value of other real estate – mortgage on main residence). This variable is used as a binary variable: highest decile of net worth vs. other.

*Cardiovascular health*

* Stroke
* Heart attack
* High blood pressure or hypertension
* High blood cholesterol
* High blood sugar or diabetes mellitus

All above is derived from a question “Has a doctor ever told you that you have *the specific disease?”*

* Drugs for high blood pressure
* Drugs for cholesterol
* Drugs for diabetes mellitus
* Drugs for coronary heart disease

All above is derived from a question “Do you take *drugs against the specific disease*?”

*Overall health*

* Depressive symptoms were assessed by EURO-D scale [16], which consists of 12 items (depressed mood, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness). Further, respondents were asked whether they take drugs for anxiety or depression. Individuals that scored 4 and more points on the EURO-D scale or reported taking this medication were classified as having depression.
* Excessive alcohol consumption was calculated based on several self-reported questions as follows: In wave 2, participants who reported drinking alcohol almost every day or every day during the past 3 months and further reported drinking 3 or more drinks per day were classified as having excessive alcohol consumption. In wave 6, participants who drank at least 1 alcoholic beverage during the past week and reported 3 or more drinks per day were defined as having excessive alcohol consumption.
* Obesity was defined as body mass index (BMI) higher than 30. BMI was calculated from self-reported weight and height.
* Physical inactivity: considered if the participants reported that they never do vigorous nor moderate physical activity.
	1. **Sampling weights**

The weights were derived based on the procedure by Deville and Särndal [17] and used in order to reduce the potential selection bias generated by participants´ non-response at baseline and sample attrition. The weights depend on the underlying sampling design and an individual specific set of calibration variables [37]. They were calculated at the national level for 8 age-groups, gender and region and are scaled to reproduce the size of the target population, which was derived according to the regional demographic statistics given by Eurostat.

* 1. **Sensitivity analyses**

To test the robustness of our findings, we conducted the following sensitivity analyses: We kept the individuals with missing data on covariates in the sample and estimated the prevalence of cognitive impairment in this larger sample. In the larger sample including also individuals with missing data on covariates, the frequency of cognitive impairment 1 was 1.2 time lower in cohort 2 relative to cohort 1 (12% vs. 10%,).We also analysed a change in impairment for individual cognitive domains. Including individuals from cohort 1, who survived until wave 6 and were included in cohort 2, could bias our estimates, thus we excluded them and repeated the analyses. These 318 individuals scored higher in all cognitive measures compared to other participants in cohort 1. The prevalence of cognitive impairment 1 in this sub-sample of 318 individuals was 3% in wave 2 and 10% in wave 6. From those who did not have cognitive impairment 1 in wave 2, almost 10% developed it in wave 6.

* 1. **Ethical considerations**

SHARE has been repeatedly reviewed and approved by the Ethics Committee of the University of Mannheim. All participants signed written consent and have been informed about the storage and use of the data and their right to withdraw the consent. All data were pseudo-anonymized. The present analysis was approved by the Ethics Committee of the National Institute of Mental Health, Czech Republic.

* 1. **Funding of SHARE**

This paper uses data from SHARE Waves 2 and 6, see elsewhere for details [18] (DOIs: [10.6103/SHARE.w2.600](http://dx.doi.org/10.6103/SHARE.w2.600), [10.6103/SHARE.w6.600](http://dx.doi.org/10.6103/SHARE.w6.600)). The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812) and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01\_AG09740-13S2, P01\_AG005842, P01\_AG08291, P30\_AG12815, R21\_AG025169, Y1-AG-4553-01, IAG\_BSR06-11, OGHA\_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see [www.share-project.org](http://www.share-project.org/)).

**Supplemental Table S1** Characteristics of participants (not weighted, not standardized)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Cohort 1(n=1,071) | Cohort 2(n=2,980) | p value |
| **Sociodemographic characteristics** |  |  |  |
|  Age, median (IQR)  | 72 (10) | 72 (10) | 0.85 |
|  Female gender, n (%) | 607 (57) | 1 727 (58) | 0.47 |
|  Years of education, mean ± SD | 11 ± 3 | 12 ± 3 | ˂0.001 |
|  Living with a spouse, n (%) | 591 (55) | 1 786 (60) | 0.01 |
|  Currently working, n (%) | 12 (1) | 36 (1) | 0.82 |
|  Highest decile of household net worth, n (%) | 65 (6) | 404 (14) | ˂0.001 |
| **Cardiovascular health, n (%)** |  |  |  |
|  Stroke | 80 (8) | 154 (5) | 0.01 |
|  Myocardial infarction | 269 (25) | 465 (16) | ˂0.001 |
|  High blood pressure | 555 (52) | 1 712 (57) | 0.001 |
|  High blood cholesterol | 210 (20) | 828 (28) | ˂0.001 |
|  High blood sugar | 217 (20) | 719 (24) | 0.01 |
|  Drugs for high blood pressure | 586 (55) | 1 883 (63) | ˂0.001 |
|  Drugs for cholesterol | 211 (20) | 1 017 (34) | ˂0.001 |
|  Drugs for diabetes mellitus | 174 (16) | 642 (22) | ˂0.001 |
|  Drugs for coronary heart disease | 101 (9) | 363 (12) | 0.02 |
| **Overall health, n (%)** |  |  |  |
|  Depression | 318 (30) | 762 (26) | 0.01 |
|  Excessive alcohol consumption | 24 (2) | 102 (3) | 0.06 |
|  Obesity | 246 (23) | 938 (32) | ˂0.001 |
|  Physical inactivity | 258 (24) | 384 (13) | ˂0.001 |
| **Cognitive functions, n (%)** |  |  |  |
|  Verbal fluency, mean ± SD | 16 ± 7 | 22 ± 8 | ˂0.001 |
|  Immediate recall, mean ± SD | 4 ± 2 | 5 ± 2 | ˂0.001 |
|  Delayed recall, median (IQR)  | 3 (3) | 4 (2) | ˂0.001 |
|  Full orientation, n (%)  | 817 (76) | 2 480 (83) | ˂0.001 |
|  Cognitive impairment 1 | 125 (12) | 246 (8) | 0.001 |
|  Cognitive impairment 2 | 125 (12) | 183 (6) | ˂0.001 |
|  Cognitive impairment 3 | 109 (10) | 120 (4) | ˂0.001 |
|  Cognitive impairment 4 | 362 (34) | 471 (16) | ˂0.001 |

IQR, interquartile range; SD, standard deviation

**Supplemental Table S2** Associations of participants´ characteristics with cognitive impairment

|  |  |
| --- | --- |
|  | OR (95 % CI) |
| **Sociodemographic characteristics** |  |
|  Age | 1.13 (1.07; 1.19)\*\* |
|  Female gender | 0.74 (0.56; 0.96)\* |
|  Education: 13 years of more | 0.52 (0.39; 0.70)\*\* |
|  Living with a spouse | 1.14 (0.88; 1.49) |
|  Currently working | 2.19 (0.65; 7.39) |
|  Highest decile of household net worth | 0.69 (0.43; 1.12) |
| **Cardiovascular health** |  |
|  Stroke | 1.87 (1.26; 2.77)\* |
|  Myocardial infarction | 0.89 (0.65; 1.21) |
|  High blood pressure | 0.83 (0.56; 1.21) |
|  High blood cholesterol | 1.81 (1.24; 2.64)\* |
|  High blood sugar | 0.71 (0.42; 1.20) |
|  Drugs for high blood pressure | 1.03 (0.70; 1.51) |
|  Drugs for cholesterol | 0.50 (0.34; 0.72)\*\* |
|  Drugs for diabetes mellitus | 1.66 (0.97; 2.85) |
|  Drugs for coronary heart disease | 1.82 (1.28; 2.58)\* |
| **Overall health** |  |
|  Depression | 1.54 (1.20; 1.97)\* |
|  Excessive alcohol consumption | 2.80 (1.57; 4.99)\* |
|  Obesity | 1.04 (0.79; 1.36) |
|  Physical inactivity | 4.46 (3.46; 5.74)\*\* |

OR, odds ratio; CI, confidence interval

\*p<0.05; \*\*p<0.001

Results are odds ratios with 95% confidence intervals for the associations of participants´ characteristics with cognitive impairment 1, derived from logistic regression. All characteristics were entered into the model simultaneously. The model was also adjusted for wave and birth cohort (not presented in tables). The model was not weighted with sampling weights.

**Supplemental Table S3** Proportion of differences in prevalence of cognitive impairment between cohort 1 (2006/2007) and cohort 2 (2015) attributable to examined predictors

|  |  |
| --- | --- |
|  | % explained |
| **Sociodemographic characteristics** |  |
|  Age | -0.46 |
|  Female gender | 1.37 |
|  Years of education | 23.17\* |
|  Living with a spouse | -2.81 |
|  Currently working | -0.19 |
|  Household net worth | 14.96 |
| **Cardiovascular health** |  |
|  Stroke | 5.68\* |
|  Myocardial infarction | -3.33 |
|  High blood pressure | 5.86 |
|  High blood cholesterol | -19.9\* |
|  High blood sugar | 5.43 |
|  Drugs for high blood pressure | -0.48 |
|  Drugs for cholesterol | 29.5\* |
|  Drugs for diabetes mellitus | -10.09 |
|  Drugs for coronary heart disease | -3.28 |
| **Overall health** |  |
|  Depression | 3.61 |
|  Excessive alcohol consumption | -3.57\* |
|  Obesity | 2.37 |
|  Physical inactivity | 59.08\*\* |

\*p<0.05; \*\*p<0.001

The percentages reported correspond to proportion of cognitive impairment 1 prevalence differences between cohort 1 and cohort 2 that are attributable to shifts in distribution of the characteristics of the cohorts. *Note*: Differences in characteristics explained the majority of the differences between the cohorts (88%) and we do not report percentage associated with differences in group cohort comparison due to lack of meaningful interpretation. Differences in effect (difference in coefficients) corresponded to 12% and none of the estimates indicated that the predictors played a differential role across cohorts. The method assumes that the associations are causal, which cannot be concluded from our study.

**Supplemental Table S4** Association of cohort 2 (relative to cohort 1) with specific cognitive measures

|  |  |
| --- | --- |
|  | OR (95% CI) |
|  | Not weighted | Weighted |
| Impairment in verbal fluency |
| Model 1 | 0.22 (0.12; 0.39)\*\* | 0.21 (0.21; 0.22)\*\* |
| Model 2 | 0.25 (0.14; 0.45)\*\* | 0.22 (0.21; 0.22)\*\* |
| Model 3 | 0.27 (0.15; 0.52)\*\* | 0.23 (0.22; 0.23)\*\* |
| Impairment in immediate recall |
| Model 1 | 0.46 (0.26; 0.80)\* | 0.45 (0.44; 0.46)\*\* |
| Model 2 | 0.44 (0.26; 0.75)\* | 0.47 (0.46; 0.48)\*\* |
| Model 3 | 0.46 (0.26; 0.80)\* | 0.48 (0.48; 0.49)\*\* |
| Impairment in delayed recall |
| Model 1 | 0.46 (0.29; 0.72)\* | 0.52 (0.51; 0.53)\*\* |
| Model 2 | 0.55 (0.34; 0.87)\* | 0.56 (0.55; 0.57)\*\* |
| Model 3 | 0.59 (0.37; 0.96)\* | 0.61 (0.60; 0.62)\*\* |
| Impairment in temporal orientation |
| Model 1 | 0.26 (0.14; 0.48)\*\* | 0.29 (0.28; 0.29)\*\* |
| Model 2 | 0.29 (0.15; 0.55)\*\* | 0.30 (0.29; 0.31)\*\* |
| Model 3 | 0.35 (0.17; 0.68)\* | 0.33 (0.33; 0.34)\*\* |

*\*p<0.05; \*\*p<0.001; OR, odds ratio; CI, confidence interval*

*Model 1: age, gender, birth cohort*

*Model 2: age, gender, birth cohort, education*

*Model 3: age, gender, birth cohort, education, living with a spouse, net worth, currently working, stroke, myocardial infarction, high blood pressure or hypertension, high blood cholesterol, high blood sugar or diabetes mellitus, drugs for high blood pressure, drugs for cholesterol, drugs for diabetes mellitus, drugs for coronary heart disease, depression, alcohol, obesity, physical inactivity*

**Supplemental Table S5** Sensitivity analysis: multivariable analysis after exclusion of 318 survivors from cohort **2**

|  |  |
| --- | --- |
|  | OR (95% CI) |
|  | Not weighted | Weighted |
| Cognitive impairment 1 |
| Model 1 | 0.61 (0.37; 1.01) | 0.71 (0.70; 0.72)\*\* |
| Model 2 | 0.70 (0.42; 1.15) | 0.73 (0.72; 0.74)\*\* |
| Model 3 | 0.74 (0.43; 1.27) | 0.71 (0.69; 0.72)\*\* |
| Cognitive impairment 2 |
| Model 1 | 0.42 (0.25; 0.71)\*\* | 0.49 (0.48; 0.50)\*\* |
| Model 2 | 0.48 (0.28; 0.81)\* | 0.50 (0.49; 0.51)\*\* |
| Model 3 | 0.48 (0.27; 0.85)\* | 0.46 (0.46; 0.47)\*\* |
| Cognitive impairment 3 |
| Model 1 | 0.33 (0.18; 0.58)\*\* | 0.35 (0.34; 0.35)\*\* |
| Model 2 | 0.38 (0.21; 0.68)\* | 0.36 (0.35; 0.37)\*\* |
| Model 3 | 0.41 (0.22; 0.75)\* | 0.35 (0.34; 0.35)\*\* |
| Cognitive impairment 4 |
| Model 1 | 0.29 (0.19; 0.44)\*\* | 0.44 (0.43; 0.44)\*\* |
| Model 2 | 0.33 (0.22; 0.51)\*\* | 0.46 (0.45; 0.46)\*\* |
| Model 3 | 0.34 (0.22; 0.54)\*\* | 0.44 (0.43; 0.45)\*\* |

*\*p<0.05; \*\*p<0.001; OR, odds ratio; CI, confidence interval*

*Model 1: age, gender, birth cohort*

*Model 2: age, gender, birth cohort, education*

*Model 3: age, gender, birth cohort, education, living with a spouse, net worth, currently working, stroke, myocardial infarction, high blood pressure or hypertension, high blood cholesterol, high blood sugar or diabetes mellitus, drugs for high blood pressure, drugs for cholesterol, drugs for diabetes mellitus, drugs for coronary heart disease, depression, alcohol, obesity, physical inactivity*

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