# PREDICTING FUNCTIONAL DECLINE IN COMMUNITY-LIVING OLDER PEOPLE WITH A LOW SOCIOECONOMIC STATUS


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| Date: | July 1th 2016 |
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| Contemplated journal: | The Journal of Gerontology, Series A: Medical Sciences |
| Reference style: | Vancouver |
| Transparent reporting following: | Transparent Reporting of a Multivariable Prediction Model for Individual Prognosis or Diagnosis (TRIPOD): The TRIPOD Statement |
| Word count: | 3791 |
| Word count English abstract: | 292 |
| Word count Dutch abstract: | 299 |

# INTRODUCTION

The worldwide population of older people is accelerating rapidly. In 2015, an estimated 901 million people were aged 60 or older, which is expected to increase with factor 2.3 to approximately 2.1 billion older people in 2050 (1). The majority of older people see successful ageing as the maintenance of independence and they have the desire to continue living at home (2,3). The onset of functional decline is one of the greatest threats to the ability of older people to live independently (4). Functional decline can be defined as the loss of ability to independently carry out activities of daily living (ADL) and/or instrumental activities of daily living (IADL) (5). (I)ADL are activities performed by a person in their everyday routine of a normal day, such as transferring, dressing, housekeeping or preparing meals (6). In 2015, 14.2% and 21.9% of the older people (≥55 years) in the Netherlands experienced at least one disability in respectively ADL or IADL (7). Functional decline is one of the major risk factors of morbidity, mortality, poor quality of life and high healthcare utilisation, leading to high healthcare costs (8,9). It is important to focus on people aged 60 years and older because frailty is reported to appear at relatively young age (i.e. ≥60 years) in a substantial part of the ageing population in The Netherlands (10). In addition, because functional decline is a sequela of ageing, its insidious onset manifestation can be overlooked easily (11,12). Therefore, it is essential to identify the older people at risk for functional decline early on while they are living independently in the community. People with a low socioeconomic status (SES) have a high risk of functional decline (8,13-15).

A frequently used definition describes SES as an individual or group's position within a hierarchical social structure, which can be measured by variables such as education, occupation, income, wealth and place of residence (16,17). SES is a complex and multifactorial concept, of which the measurements vary widely in the literature (16). No consensus has been reached in the literature on how SES can be measured sufficiently, leading to difficulties in providing the exact prevalence of (older) people with a low SES (18). In this study, SES is operationalized in accordance with the Dutch Social and Cultural Planning Office (SCP) Socio-Economic Status Index, in which people's residential postcodes were linked to geospatial data on educational level, employment type and average income to create an overall summary score (19). The SCP recommends dividing the summary scores in tertiles to create three subgroups: low SES (score ≤-0.168), average SES (score between -0.168-0.624) and high SES (score ≥0.624) (19).

Multiple studies are conducted to identify functional decline in community-living older people. In 2015, Beaton et al. examined predictors of early functional decline in community-dwelling older people in a narrative review and found 107 predictors (11). Based on eight individual studies, SES was included as one of the predictors. Low SES has often been studied as a predictor of functional decline in older people (8,11,20,21). However, the literature lacks

knowledge on predictors of functional decline in community-living older people with a low SES. This insight is necessary for the professionals in clinical practice to identify the community-living older people with a low SES at risk for functional decline and to provide tailored healthcare to prevent functional decline. Prevention of functional decline could lead to improvements in quality of life for the older people with a low SES and a reduction of healthcare utilisation and healthcare costs.

# AIM

To determine predictors of 12-month functional decline in community-living older people (≥60 years) with a low socioeconomic status.

# METHOD

**Design and source of data**

A prognostic multicentre study was conducted, using data from The Older Persons and Informal Caregivers Survey Minimum DataSet (TOPICS-MDS). TOPICS-MDS is a uniform, national and public dataset which contains essential data from older people to better understand their experienced health challenges (22). In this dataset, data has been prospectively collected between 2010 and 2014 with a self-reported TOPICS-MDS questionnaire (22). The large, standardised dataset includes data from 44.396 older persons, pooled from 53 different research projects conducted across the Netherlands, causing this study to be multicentre (22). All research projects included in the dataset were funded by the National Care for the Elderly Programme (22).

**Participants**

The study sample focused on the community-living older people with a low SES as included in TOPICS-MDS. In order to be eligible for inclusion in this study, participants had to meet all of the following criteria: 1) participant aged 60 years or older; 2) participant lived independently in the community; 3) participant had a low SES (summary score of ≤-0.168); 4) data was administered at baseline and 12 months after baseline. No exclusion criteria were used.

**Procedure**

Because this is a secondary analysis, no participants underwent any procedures in this study. Before receiving the anonymized data from TOPICS-MDS, a data request form was completed and approved by the working group of TOPICS-MDS. Participants from the studies included in TOPICS-MDS were aware of and gave consent for the use of their anonymized data for other research purposes (23).

**Outcome**

The outcome of this study was a decline in one or more (I)ADL functional limitations after 12 months follow-up (i.e. functional decline). Functional limitations were measured with use of a modified version of the Katz Index of Independence Basic ADL and IADL, with an additional indicator of mobility, as measured by the self-reported TOPICS-MDS questionnaire (22). The basis ADL addressed six functions: dressing, bathing, eating, use of incontinence products, toileting and getting up from a chair (22). The IADL addressed eight functions: use of telephone, grooming, travelling, meal preparation, grocery shopping, household task, financial management and taking medication (22). The Katz Index is one of the most frequently used questionnaires to measure functional limitations in older people and proved to be valid to assess functional performance of Dutch older persons in The Netherlands with a Cronbach's alpha between 0.84 and 0.94 (24). Mobility was measured by asking if assistance was required while walking (22). Including a measure for mobility is common in today's practice (25).

All 15 functional limitations measured at both baseline and 12 months after baseline were scored and sum scores were calculated (range 0-15). The binary outcome of functional decline was determined by calculating the difference between both sum scores, wherein an increase in sum scores after 12 months represented functional decline and a decrease or no change represented no functional decline.

**Predictors**

Relevant predictors (i.e. candidate predictors) were sought through clinical reasoning and reviewing the literature. Three reviews were found which described risk factors, indicators or instruments for functional decline in community-living older people (11,20,21). All relevant candidate predictors described in the reviews were listed and compared with the data points available in TOPICS-MDS. This resulted in 30 candidate predictors on demographics, multimorbidity, health state, quality of life, social functioning and healthcare utilisation. All candidate predictors were measured with a self-reported TOPICS-MDS questionnaire (22).

*Demographics*

Demographic characteristics were obtained for gender, age, marital status (categorized to married/sustainable living together, widow(er)/partner deceased, or divorced/single), primary domicile (alone or with others) and educational level (categorized to primary, secondary or higher education).

*Multimorbidity*

Presence of diabetes, ischemic/haemorrhagic cerebrovascular accident/transient ischaemic attack, heart failure, respiratory problems, incontinence, arthrosis/arthritis, depression, anxiety/panic disorder, dementia, hearing problems and problems with vision in the last 12

months were measured dichotomously as morbidities. The presence of two or more conditions indicated multimorbidity. This method of measuring multimorbidity is widely used (26).

*Health state*

Self-perceived health was determined with one question, using phrasing similar to the self-perceived health questions from the RAND-36. This internationally recognised health-related quality of life survey is validated for use in The Netherlands with a Cronbach's alpha between 0.71-0.92 (27). The answer possibilities ("in general, would you say your health is excellent, very good, good, fair or poor?") were dichotomised to excellent/very good/good and fair/poor.

Within health state, pain was measured using a question derived from the EuroQol Five Dimensional scale (EQ-5D) ("What best describes your health today?"). The answer possibilities were dichotomised to "I have no pain" and "I have moderate/very severe pain". The EQ-5D has good evidence for reliability, validity and responsiveness (28).

*Quality of life*

Quality of life was assessed with use of a modified version of Cantril's Self-Anchoring Striving Scale (SASS), in which participants were asked to rate their present life on a range of 0-10 (29). The SASS has shown to have adequate reliability and validity (30).

*Social functioning*

Social functioning was measured using one question derived from the Rand-36, about how often in the past four weeks the participants' physical health or emotional problems hampered their social activities. The answer possibilities for this question were categorised to all/most of the time, some/little of the time and none of the time.

*Healthcare utilisation*

Healthcare utilisation was obtained by binary questions on hospital admission ("have you been admitted to a hospital?"), out-of-hour general practitioner service visits ("have you visited an out of hour general practitioner service?") and receiving home care ("do you receive home care?") in the past 12 months.

**Sample size**

Sample size was estimated with the sample size calculation for logistic regression by Peduzzi et al, wherein calculations are based on the incidence of functional decline and the minimum of 10 events (i.e. presence of functional decline) per included candidate predictor (31,32). With 30 candidate predictors and an incidence of 14.2% and 21.9% for respectively ADL and IADL, estimated sample size was 2.113. With data from 44.396 older persons in the dataset, sufficient data was expected to be available in the dataset to conduct the analyses.

**Statistical analyses**

*Missing data*

The overall percentage of missing values was 3.8%. On case-level, 1.290 participants (24.1%) had missing values on the outcome functional decline and 1.064 participants (19.8%) had missing values in one or more candidate predictors. All variables (outcome and predictors) had one or more missing values. Missing values were handled with multiple imputation to increase statistical power and reduce bias (33). Missing values for predictors and outcome were imputed 10 times. The results of the analyses conducted in the 10 complete datasets were pooled with Rubin's rule.

*Predictor selection*

Candidate predictors consisted of dichotomous, categorical and continuous data. The categorical predictors (marital status, educational level and social functioning) were coded as dummy variables, allowing easy handling of predictors when clinical prediction models are made (32). Age and quality of life rate were modelled as continuous parameters because dichotomization of continuous predictors has many disadvantages (32,34).

Univariable associations (odds ratio (OR) and 95% confidence interval (CI)) between candidate predictors and functional decline were determined with logistic regression. Correlation coefficients between the candidate predictors were calculated with use of Spearman's rho to assess collinearity among the predictors. When the correlation was very strong (coefficient ≥0.7), the easiest measurable candidate predictor remained in the study to enhance use in clinical practice.

Multivariable logistic regression was performed to determine predictors of functional decline and to develop a prediction model. First, all candidate predictors were entered in the multivariable analysis. A stepwise backward selection was used to determine the strongest predictors in the model. This provides the opportunity to reduce the model's size and to improve the use in clinical practice (32). For the level of significance, Akaike Information Criterion (AIC) with a p-value of 0.157 was used as stopping rule for the exclusion of predictors in the backward model. AIC is recommended in simplifying prediction models (35). It includes a penalty against large models, hence attempting to reduce overfitting (36). Ultimately, the final model was created using the enter method, in which the significant predictors (p-value <0.157) from the stepwise backward selection were included.

*Model performance*

Performance of the model was evaluated by determination of the discrimination, calibration and accuracy of the model. To indicate the discriminative ability of the model (i.e. the discrimination between those with the outcome from those without), the area under the receiver operating characteristic (ROC) curve with a 95% CI was calculated (C-statistic), in which higher

values indicate better discrimination (32). The calibration (i.e. the agreement between observed outcomes and predictions) was measured with the Hosmer-Lemeshow goodness of fit test, in which the ability of the model to fit the dataset was tested (32). A p-value <0.05 indicates a lack of fit of the model to the data. The accuracy of the model was measured with the Brier score, in which squared differences were calculated between actual outcomes and predictions (32). A lower Brier score indicates a better accuracy of the model (32). Analyses were performed in IBM SPSS Statistics (SPSS) version 21 (for multiple imputation, correlation, univariable analysis, multivariable analysis and C-statistic) and the R Foundation for Statistical Computing version 3.2.3, using package “rms” (for Brier score) and “ResourceSelection” (for Hosmer-Lemeshow test).

**Ethical issues**

According to the committee on research involving human subjects region Arnhem-Nijmegen, studies using TOPICS-MDS fall outside the remit of the Medical Research Involving Human Subjects Act (WMO) and are therefore exempt from ethical approval (22). This study was conducted in accordance with The European Code of Conduct for Academic Practice, March 2011 and the Declaration of Helsinki, seventh version, October 2013.

# RESULTS

**Participants**

Based on the inclusion criteria which were filled in on the data request form (aged ≥60 years, community-living, measurement at baseline and 12 months after baseline), data of 27.177 participants was removed by the working group of TOPICS-MDS (Figure 1). After receiving the data of the remaining 17.219 participants, irrelevant variables were removed and multiple imputation was conducted. Subsequently, data was removed of 11.190 participants who did not meet the inclusion criteria as well (aged ≥60 years, community-living, low SES), resulting in inclusion of 5.718 participants.

The mean age of the participants was 78.8 years (standard deviation 6.7, range 60-102.3), and 3.357 participants (58.7%) were female. Functional decline was present in 1.904 participants (33.3%) and 3.940 participants (68.9%) experienced multimorbidity. Table 1 presents the characteristics of the participants, stratified by the presence or absence of functional decline. Participants who did not experience functional decline were somewhat younger, more often male, married, experienced fewer morbidities, had fewer hampering social activities due to physical health or emotional problems and had a higher educational level compared with participants who experienced functional decline.

*Insert Table 1.*

*Insert Figure 1.*

**Model development**

Marital status and primary domicile were highly correlated, with Spearman's rho of 0.849. Choosing the easiest measurable predictor, marital status was excluded for further analyses. Table 1 presents the univariable prognostic relations for all candidate predictors with the outcome, with dementia being the most significant with an OR of 3.92 (95% CI 2.92-5.26).

After the stepwise backward selection process, the final multivariable analysis showed that age, educational level, arthrosis/arthritis, dementia, hearing problems, multimorbidity, quality of life rate, reasonable/poor health, some/little hampering social activities and receiving home care were significantly associated (p-value <0.157) with 12-month functional decline in the study sample (Table 2). The predictors with the strongest independent relation with 12-month functional decline were the presence of dementia (OR 3.20, 95% CI 2.36-4.35) and multimorbidity (OR 1.31, 95% CI 1.10-1.56). The weakest predictors within the model were secondary education (OR 0.85, 95% CI 0.71-1.03) and hearing problems (OR 0.88, 95% CI 0.76-1.02). With negative beta coefficients, the protective predictors within the model were higher educational level, higher quality of life rate, arthrosis/arthritis and hearing problems.

*Insert Table 2.*

**Model performance**

Figure 2 shows the ROC curve, accompanied with a C-statistic of 0.69 (95% CI 0.67-0.70). In conducting the Hosmer-Lemeshow test, the pooled number of groups was set to 264 to fit the large sample, based on the equation provided by Paul et al (37). The Hosmer-Lemeshow test revealed no significant lack of fit with a p-value of 0.33. The Brier score for accuracy was 0.20.

*Insert Figure 2.*

# DISCUSSION

A multivariable prediction model for functional decline among community-living older people with a low SES has been presented in this study. Older people with dementia, multimorbidity, a reasonable/poor health, experiencing some/little hampering social activities and receiving home care were most likely to experience 12-month functional decline. The model can predict functional decline reasonably, with a fairly accurate discrimination (C-statistic 0.69, 95% CI 0.67-0.70), calibration (Hosmer-Lemeshow p-value 0.33) and accuracy of the model (Brier score 0.20).

The findings of this study are mostly in line with the results of other studies regarding the prediction of functional decline in community-living older people, based on the results of the reviews by Stuck et al. (1999) and Beaton et al. (2015) (11,21). The systematic review by Stuck et al. examined risk factors for functional status decline in community-living older people, based on 78 longitudinal studies (21). The review by Beaton et al. examined predictors of early functional decline in community-dwelling older people (aged ≥65 years), based on 146 peer-reviewed journal articles, expert opinion articles or primary research studies (11). Both reviews included multiple studies with different design characteristics, sample characteristics and methodological aspects, making it comparable with the results of our study. The presence of multimorbidity, dementia (cognitive impairment), poor self-reported health and older age have been reported by both reviews as a strong predictor of functional decline, which is in line with our results. In addition, our findings support the conclusion of both reviews that having a low level of social activities is a predictor of functional decline (11,21). However, in our study a low level of social activities was measured differently, as hampering social activities due to physical health or emotional problems. The protective effect of a higher education and quality of life rate proved significant in our study, which is in line with both reviews (11,21). Receiving home care has been found to be a predictor of functional decline (11), which is in line with the results of our study. The negative coefficients and therefore protective effect of hearing problems and arthrosis/arthritis as found in our study, could not be found in the literature, wherein the opposite is stated for hearing problems (11,21) and arthrosis/arthritis (21). The coefficients for hearing problems and arthrosis/arthritis reversed from positive in the univariable analysis to negative in the multivariable analysis. This counter-intuitive finding could be explained by the correlation between hearing problems and arthrosis/arthritis with the other variables. Though, this has been studied, and with Spearman's rho's of <0.7, no extreme correlation could be found.

In addition, a systematic review by O'Caoimh et al. (2015) revealed seven risk-prediction instruments for functional decline in community-dwelling older adults (20). These instruments included inter alia older age, cognition disorder, multimorbidity, hearing problems, self-rated health, quality of life and healthcare usage (including home care) as predictors, which is in line with our study. Hampering social activities, educational level and arthrosis/arthritis were not identified as predictors in the risk-prediction instruments.

The predictors of the final model found in our study were mostly in line with the literature. Therefore, it is arguable if predictors of functional decline in community-living older people differ significantly from the predictors of those with a low SES, and if a specific prediction model is needed for this subgroup.

**Strengths and limitations**

The relatively large amount of missing data can be explained due to the fact that TOPICS-MDS includes data from different research projects with various study protocols. This causes differences in sampling framework, baseline measurements, follow-up measurements and inclusion criteria between the research projects, leading to missing data when the different research projects are combined. To deal with missing data, multiple imputation was conducted, which was the best method available to minimize bias (38). The validity and usability of the model is strengthened by choosing candidate predictors based on clinical reasoning, reviewing the literature and practicality of use in clinical practice. Another strength is the use of a large dataset. By using data from TOPICS-MDS, unpublished data has been included and no participants were involved unnecessarily, making it an efficient and cost-effective study (22). Because this study is multicentre, it provides a broader generalizability and external validity than individual research studies (22).

To appreciate the findings of this study, some limitations need to be addressed. First, heterogeneity between the different research projects within TOPICS-MDS may result in differential measurement error, which could lead to biased regression coefficients (39,40). Second, because this study is a secondary analysis, no supplementary data could be measured. Therefore not all important candidate predictors which are expected to be relevant according to the literature (e.g. falls, use of medication, weight loss) could be included in the development of the model. Third, minimal four decimals are needed in the summary score of the SCP socio-economic status index in order to observe a difference. However, the summary scores as they were included in the dataset had only one decimal. Therefore, the cut-off score for low SES was set to -0.2 instead of -0.168. This could lead to an insufficient distinction of those with a low SES in this study.

**Implications for clinical practice and future research**

This study contributes to the existing knowledge that low SES has been associated with functional decline in community-living older people, and predictors of functional decline in these people have been provided. To our knowledge, this is the first study to determine predictors of functional decline in community-living older people with a low SES. Insight in the predictors could help professionals in clinical practice towards identifying older people with a low SES at risk for functional decline. This could help professionals in providing tailored healthcare in preventing functional decline to meet the desire of the older people to maintain independence, leading to improvements in their quality of life. Prevention of functional decline could also contribute to a decrease of healthcare utilisation and healthcare costs, which is essential to deal with the ageing of the worldwide population.

Further research is needed to examine if the predictors of functional decline in community-living older people with a low SES differ from those with an average or high SES.

In addition, further research is necessary on how functional decline can be ameliorated and how substantial improvements can be achieved, specific for the community-living older people with a low SES. At last, more research is needed to create well-defined SES measurements that are as comparable across populations and studies as possible (18).

# CONCLUSION

In this study, we determined predictors of 12-month functional decline in community-living older people with a low SES. Older people with the presence of dementia, multimorbidity, experiencing a reasonable/poor health, some/little hampering social activities and receiving home care were most likely to experience functional decline. Presented model could help professionals in clinical practice towards identifying the community-living older people with a low SES at risk for functional decline. Further research is needed to examine how functional decline can be ameliorated and how substantial improvements by tailored interventions can be achieved within this subgroup.

# REFERENCE LIST


(1) United Nations, Department of Economic and Social Affairs, Population Division (2015). World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. 2015(ESA/P/WP.241).

(2) Beswick A, Gooberman-Hill R, Smith A, Wylde V, Ebrahim S. Maintaining independence in older people. Reviews in Clinical Gerontology 2010;20(02):128-153.

(3) Gabriel Z, Bowling A. Quality of life from the perspectives of older people. Ageing and Society 2004;24(05):675-691.

(4) Reynolds SL, Silverstein M. Observing the onset of disability in older adults. Soc Sci Med 2003;57(10):1875-1889.

(5) Covinsky KE, Justice AC, Rosenthal GE, Palmer RM, Landefeld CS. Measuring prognosis and case mix in hospitalized elders. Journal of General Internal Medicine 1997;12(4):203-208.

(6) Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. J Am Geriatr Soc 1983;31(12):721-727.

(7) Statline. Health and health care use. 2016; Available at: http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=83005NED&D1=47,50&D2=3-13,16&D3=a&D4=l&VW=T. Accessed June 22, 2016.

(8) Chen B, Covinsky KE, Cenzer IS, Adler N, Williams BA. Subjective social status and functional decline in older adults. Journal of general internal medicine 2012;27(6):693-699.

(9) Hebert R. Functional decline in old age. CMAJ 1997 Oct 15;157(8):1037-1045.

(10) Bleijenberg N, Drubbel I, Ten Dam VH, Numans ME, Schuurmans MJ, de Wit NJ. Proactive and integrated primary care for frail older people: design and methodological challenges of the Utrecht primary care PROactive frailty intervention trial (U-PROFIT). BMC Geriatr 2012 Apr 25;12:16-2318-12-16.

(11) Beaton K, McEvoy C, Grimmer K. Identifying indicators of early functional decline in community-dwelling older people: A review. Geriatrics & gerontology international 2015;15(2):133-140.

(12) Grimmer K, Beaton K, Hendry K. Identifying functional decline: a methodological challenge. Patient Relat Outcome Meas 2013 Aug 22;4:37-48.

(13) Isaacs SL, Schroeder SA. Class—the ignored determinant of the nation's health. N Engl J Med 2004;351(11):1137-1142.

(14) Hoeymans N, Melse J, Schoemaker C. Gezondheid en determinanten. Deelrapport van de VTV 210 Van gezond naar beter. : Rijksinstituut voor Volksgezondheid en Milieu RIVM; 2010.

(15) Dury S, De Roeck E, Duppen D, Fret B, Hoeyberghs L, Lambotte D, et al. Identifying frailty risk profiles of home-dwelling older people: focus on sociodemographic and socioeconomic characteristics. Aging & mental health 2016:1-9.
(16) Calixto O, Anaya J. Socioeconomic status. The relationship with health and autoimmune diseases. Autoimmunity reviews 2014;13(6):641-654.
(17) Adler NE, Rehkopf DH. US disparities in health: descriptions, causes, and mechanisms. Annu Rev Public Health 2008;29:235-252.
(18) Braveman P, Cubbin C, Egerter S, Chideya S, Marchi K, Metzler M, et al. Socioeconomic status in health research: one size does not fit all. JAMA 2005;294(22):2879-88.
(19) Knol F. Statusontwikkeling van wijken in Nederland 1998-2010. 2012.
(20) O'Caoimh R, Cornally N, Weathers E, O'Sullivan R, Fitzgerald C, Orfila F, et al. Risk prediction in the community: A systematic review of case-finding instruments that predict adverse healthcare outcomes in community-dwelling older adults. Maturitas 2015.
(21) Stuck AE, Walthert JM, Nikolaus T, Büla CJ, Hohmann C, Beck JC. Risk factors for functional status decline in community-living elderly people: a systematic literature review. Soc Sci Med 1999;48(4):445-469.
(22) Lutomski JE, Baars MA, Schalk BW, Boter H, Buurman BM, den Elzen WP, et al. The development of the Older Persons and Informal Caregivers Survey Minimum DataSet (TOPICS-MDS): a large-scale data sharing initiative. PloS one 2013;8(12):e81673.
(23) van den Brink D, Lutomski JE, Qin L, den Elzen WP, Kempen GI, Krabbe PF, et al. TOPICS-MDS: Veelzijdige bron voor wetenschappelijke en maatschappelijke kennisgeneratie ten behoeve van de ouderenzorg. Tijdschr Gerontol Geriatr 2015;46(2):78-91.
(24) Reijneveld SA, Spijker J, Dijkshoorn H. Katz'ADL index assessed functional performance of Turkish, Moroccan, and Dutch elderly. J Clin Epidemiol 2007;60(4):382-388.
(25) Palmer M, Harley D. Models and measurement in disability: an international review. Health Policy Plan 2012 Aug;27(5):357-364.
(26) Marengoni A, Angleman S, Melis R, Mangialasche F, Karp A, Garmen A, et al. Aging with multimorbidity: a systematic review of the literature. Ageing research reviews 2011;10(4):430-439.
(27) Van der Zee K, Sanderman R. RAND-36. Groningen: Northern Centre for Health Care Research, University of Groningen, the Netherlands 1993;28.
(28) Haywood K, Garratt A, Fitzpatrick R. Quality of life in older people: a structured review of generic self-assessed health instruments. Quality of life Research 2005;14(7):1651-1668.
(29) Kilpatrick FP, Cantril H. Self-anchoring scaling: A measure of individuals' unique reality worlds. J Individ Psychol 1960;16(2):158.
(30) Beckie TM, Hayduk LA. Using perceived health to test the construct-related validity of global quality of life. Soc Indicators Res 2004;65(3):279-298.

(31) Peduzzi P, Concato J, Feinstein AR, Holford TR. Importance of events per independent variable in proportional hazards regression analysis II. Accuracy and precision of regression estimates. J Clin Epidemiol 1995;48(12):1503-1510.

(32) Steyerberg EW. Clinical prediction models: a practical approach to development, validation, and updating. : Springer Science & Business Media; 2008.

(33) Sterne JA, White IR, Carlin JB, Spratt M, Royston P, Kenward MG, et al. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. BMJ 2009 Jun 29;338:b2393.

(34) Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: a bad idea. Stat Med 2006;25(1):127-141.

(35) Ambler G, Brady AR, Royston P. Simplifying a prognostic model: a simulation study based on clinical data. Stat Med 2002;21(24):3803-3822.

(36) Sauerbrei W. The use of resampling methods to simplify regression models in medical statistics. Journal of the Royal Statistical Society: Series C (Applied Statistics) 1999;48(3):313-329.

(37) Paul P, Pennell ML, Lemeshow S. Standardizing the power of the Hosmer–Lemeshow goodness of fit test in large data sets. Stat Med 2013;32(1):67-80.

(38) Janssen KJ, Donders ART, Harrell FE, Vergouwe Y, Chen Q, Grobbee DE, et al. Missing covariate data in medical research: to impute is better than to ignore. J Clin Epidemiol 2010;63(7):721-727.

(39) Lutomski J, van Exel N, Kempen G, van Charante EM, den Elzen W, Jansen A, et al. Validation of the care-related quality of life instrument in different study settings: findings from the older persons and informal caregivers survey minimum DataSet (TOPICS-MDS). Quality of Life Research 2015;24(5):1281-1293.

(40) Imai K, Yamamoto T. Causal inference with differential measurement error: Nonparametric identification and sensitivity analysis. Am J Polit Sci 2010;54(2):543-560.

# TABLES AND FIGURES

**Table 1**

*Baseline characteristics of the study sample and univariable associations between candidate predictors and 12-month functional decline.*

| | **No functional decline*†** N=3.814 n (%) | **Functional decline*‡** N=1.904 n (%) | **Odds ratio (95% CI)*** |
|---|---|---|---|
| *Demographics* | | | |
| Age, mean (SD)[§] | 77.8 (6.5) | 80.9 (6.6) | 1.07 (1.06-1.08) |
| Female | 2169 (56.9) | 1188 (62.4) | 1.26 (1.10-1.44) |
| Marital status | . | . | . |
| Married/sustainable living together | 2117 (55.5) | 907 (47.6) | 1 (-) |
| Widow(er)/partner deceased | 1239 (32.5) | 776 (40.8) | 1.46 (1.25-1.71) |
| Divorced/single | 458 (12.0) | 221 (11.6) | 1.13 (0.90-1.41) |
| Primary domicile: independent, alone | 1671 (43.8) | 955 (50.1) | 1.29 (1.11-1.50) |
| Educational level[‖] | . | . | . |
| Primary education | 949 (24.9) | 608 (31.9) | 1 (-) |
| Secondary education | 1848 (48.5) | 890 (46.7) | 0.75 (0.64-0.89) |
| Higher education | 1017 (26.7) | 407 (21.4) | 0.62 (0.51-0.76) |
| *Multimorbidity* | | | |
| Diabetes | 779 (20.4) | 419 (22.0) | 1.10 (0.94-1.29) |
| Ischemic/haemorrhagic CVA/TIA[{] | 292 (7.7) | 181 (9.5) | 1.27 (1.00-1.60) |
| Heart failure | 691 (18.1) | 435 (22.9) | 1.34 (1.15-1.56) |
| Respiratory problems[#] | 657 (17.2) | 347 (18.2) | 1.07 (0.92-1.26) |
| Incontinence | 796 (20.9) | 508 (26.7) | 1.38 (1.16-1.64) |
| Arthrosis/arthritis | 1550 (40.6) | 799 (42.0) | 1.06 (0.93-1.20) |
| Depression | 274 (7.2) | 213 (11.2) | 1.63 (1.32-2.01) |
| Anxiety/panic disorder | 202 (5.3) | 142 (7.4) | 1.44 (1.07-1.93) |
| Dementia | 116 (3.0) | 208 (10.9) | 3.92 (2.92-5.26) |
| Hearing problems | 1430 (37.5) | 809 (42.5) | 1.23 (1.08-1.41) |
| Problems with vision | 1245 (32.6) | 736 (38.6) | 1.30 (1.14-1.48) |
| Multimorbidity | 2473 (64.8) | 1467 (77.0) | 1.82 (1.58-2.09) |

| | | | |
|---|---|---|---|
| *Health status* | | | |
| Pain | 2101 (55.1) | 1159 (60.9) | 1.27 (1.09-1.48) |
| Self-perceived health: reasonable/poor | 1386 (36.4) | 934 (49.0) | 1.69 (1.47-1.94) |
| *Quality of life* | | | |
| Self-perceived quality of life**, mean (SD)§ | 7.5 (1.2) | 7.2 (1.2) | 0.80 (0.76-0.85) |
| *Social functioning* | | | |
| Hampering social activities†† | . | . | . |
| None of the time | 2041 (53.6) | 804 (42.2) | 1 (-) |
| Some/little of the time | 1307 (34.3) | 788 (41.4) | 1.53 (1.33-1.76) |
| All/most of the time | 465 (12.2) | 313 (16.4) | 1.71 (1.38-2.12) |
| *Healthcare utilisation*‡‡ | | | |
| Hospital admission | 856 (22.4) | 462 (24.3) | 1.11 (0.95-1.29) |
| Out-of-hour general practitioner visits | 741 (19.4) | 447 (23.5) | 1.27 (1.10-1.48) |
| Receiving home care | 1105 (29.0) | 842 (44.2) | 1.95 (1.67-2.27) |

*Note.* * All statistics are pooled from the ten imputed datasets. † No 12-month functional decline, defined as a constant or decrease in summary score after 12 months. ‡ 12-month functional decline defined as an increase in summary score after 12 months. § SD: standard deviation. || Primary education: less than 6 years of primary school, 6 years of primary school or special needs education, primary school with uncompleted further education; Secondary education: vocational school/practical training, secondary professional education; Higher education: pre-university education, university/higher professional education. { CVA: cerebrovascular Accident; TIA: Transient Ischaemic Attack. # Respiratory problems: Asthma, chronic bronchitis, lung emphysema or Chronic Obstructive Pulmonary Disease (COPD). **Quality of life rates between 0-10. †† Hampering social activities in the past 4 weeks due to physical health or emotional problems ‡‡ Healthcare utilisation in the past 12 months.

**Table 2**

*Multivariable logistic regression model for the presence of 12-month functional decline*

| | B*† | Odds ratio (95% CI)* | P value* |
|---|---|---|---|
| Intercept | -4.887 | | |
| Age‡ | 0.061 | 1.06 (1.05-1.08) | <0.000 |
| Education§ | | | |
| Primary education | 0 (ref) | 1 (-) | - |
| Secondary education | -0.159 | 0.85 (0.71-1.03) | 0.097 |
| Higher education | -0.327 | 0.72 (0.58-0.90) | 0.006 |
| Arthrosis/arthritis | -0.230 | 0.80 (0.69-0.91) | 0.001 |
| Dementia | 1.164 | 3.20 (2.36-4.35) | <0.000 |
| Hearing problems | -0.129 | 0.88 (0.76-1.02) | 0.089 |
| Multimorbidity | 0.270 | 1.31 (1.10-1.56) | 0.003 |
| Self-perceived health: reasonable or poor | 0.247 | 1.28 (1.07-1.54) | 0.008 |
| Self-perceived quality of life‖ | -0.119 | 0.89 (0.83-0.95) | 0.001 |
| Hampering social activities: Some/little of the time{ | 0.174 | 1.19 (1.04-1.37) | 0.014 |
| Receiving home care# | 0.192 | 1.21 (1.02-1.44) | 0.031 |

*Note.* * All statistics are pooled from the ten imputed datasets. † B: Beta coefficient. ‡ Per year increase in age. § Primary education: less than 6 years of primary school, 6 years of primary school or special needs education, primary school with uncompleted further education; Secondary education: vocational school/practical training, secondary professional education; Higher education: pre-university education, university or higher professional education. || Quality of life rates between 0-10. { Hampering social activities in the past 4 weeks due to physical health or emotional problems. # Receiving home care in the past 12 months.

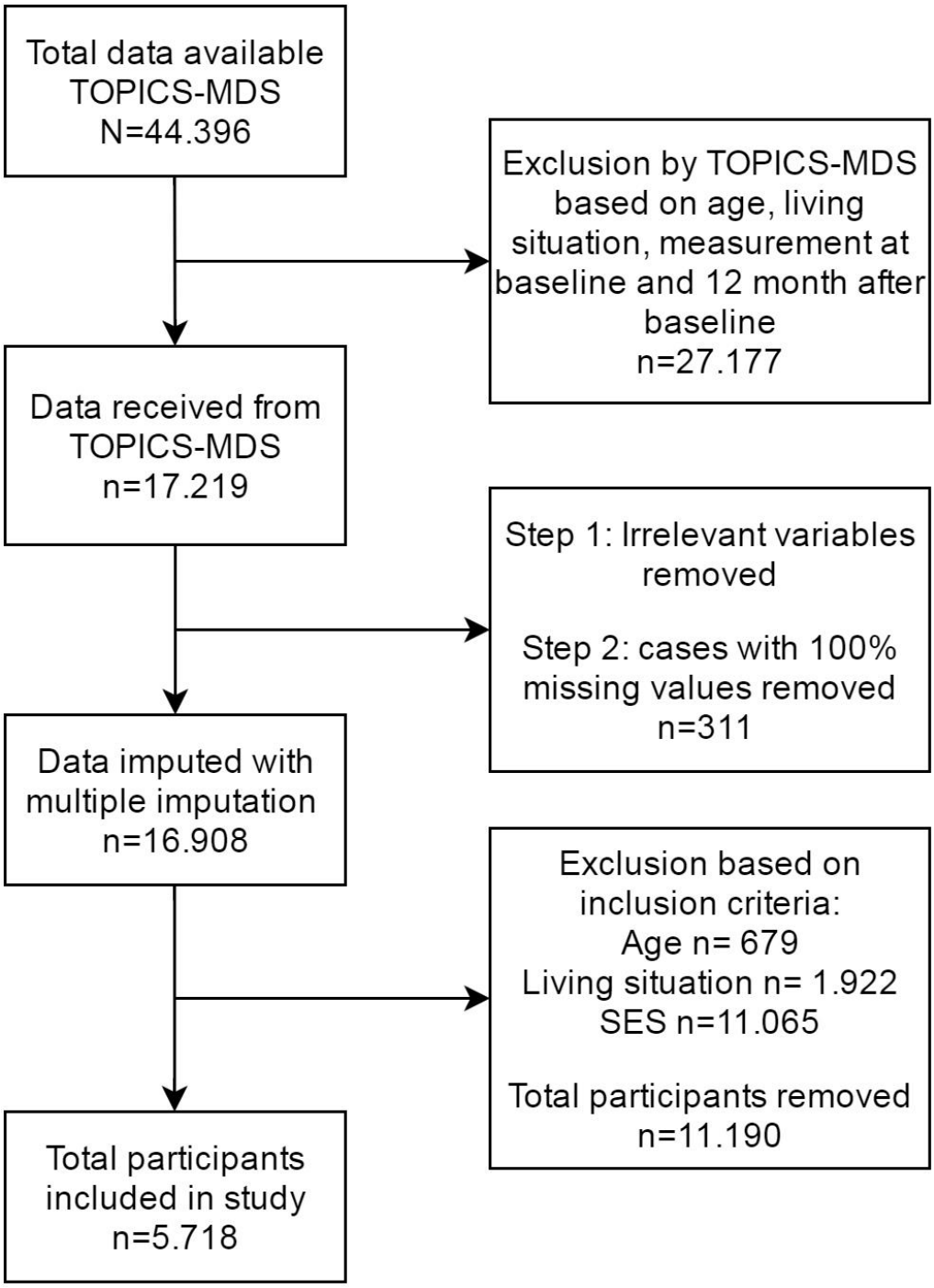


*Figure 1*: Flowchart of inclusion of participants

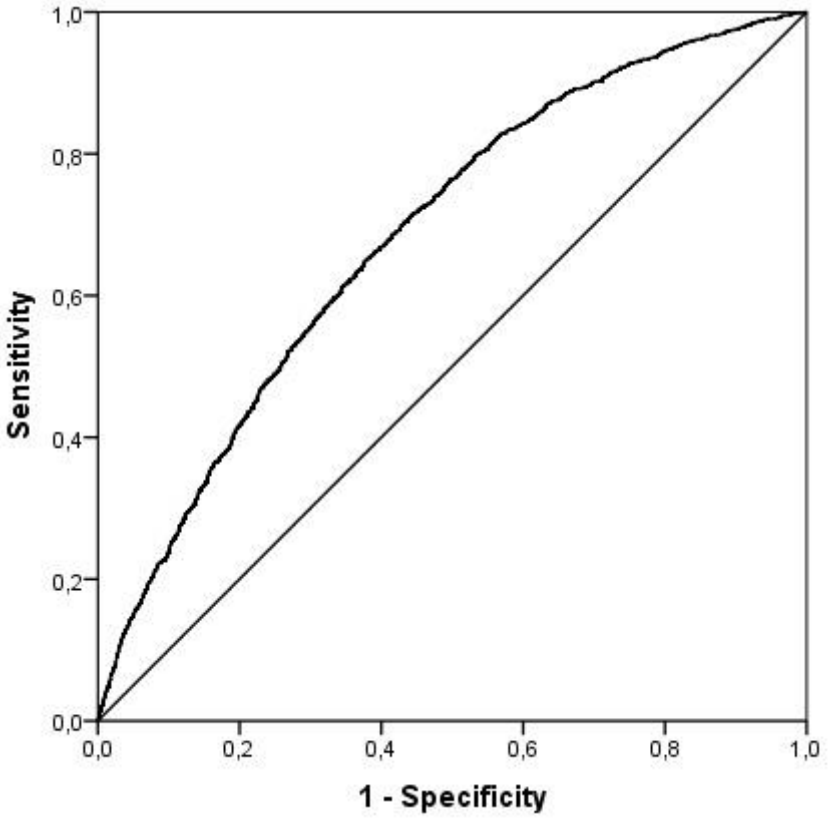


*Figure 2:* Receiver operating characteristic (ROC) curve, with an area under the ROC curve of 0.69 (95% CI: 0.67-0.70)