

Supplementary Methods

S1.1 Goals of the study

We aimed at developing an RPM for late life depression that had the following features:

(i) knowledge-based: predictors were identified from an up-to-date literature, including the broadest possible spectrum of risk factors (i.e. socioeconomic, psychological, biological);

(ii) methodologically robust: we employed multiple methodologies of risk prediction including procedures for cross-validation, calibration and discrimination, as well as sensitivity analyses as recommended by guidelines (Collins et al. 2015). ANNs are widely employed in health-related RPMs and are especially powerful in detecting non-linear relationships (Miotto et al. 2017). Moreover, while recent studies suggest that regression-based RPMs can reach similar performance to that of complex machine learning algorithms (Christodoulou et al. 2019);

(iii) translatable for clinical use: we included predictors that could be ascertained without the need of instrumental procedures, and sought to develop an abridged version to allow rapid screening, i.e. that could be administered within the time of a clinical consultation;

(iv) accessible: the RPM was adapted into a free-to-use web-based instrument. This study follows the TRIPOD tool for transparent reporting of multivariable prediction models (Collins et al. 2015).

The study aimed at providing clinicians with an instrument that might increase the implementation of available preventive strategies for late life depression, such as psychosocial interventions, pharmacotherapy, lifestyle modification and/or management of comorbid medical conditions (Alexopoulos 2001; Almeida 2014; Baldwin 2010; Cuijpers et al. 2015; Karp et al. 2016; Laird et al. 2019)

S1.2 Literature review and selection of predictors for the RPM

We conducted a systematic review to identify predictors of depression among community-dwelling older adults, following a previous systematic review of longitudinal studies (Cole and Dendukuri 2003). Studies were identified with the following criteria: (i) observational, longitudinal design with at least six months of follow-up (we excluded RCTs or other intervention studies, but we considered available meta-analyses); (ii) including subjects aged 55 or older; (iii) recruiting community-dwelling subjects (hospital or primary care settings were excluded); (iv) including a majority of non-depressed subjects at baseline (i.e. studies focused on depression course or relapse were excluded); (v) not recruiting participants with a specific medical condition; (vi) using depression at follow up as the outcome, ascertained with a broad definition (i.e. diagnosed by clinical interview, questionnaire score, with or without cut-off values), while excluding studies that used anxiety or combined anxiety/depression (e.g. HADS scores), quality of life or other constructs as the outcome.

Eligible studies were identified with a search conducted on June the 1st, 2019 in the Pubmed database, using the following string: ("late life" OR "old age" OR "older adults") AND depress* AND ("risk factor" OR "risk factors" OR predict*) AND (longitudinal OR prospective OR cohort), with no past date restriction. The bibliographic search was aided by the revtools R package (Westgate, 2019). We additionally screened the bibliographies of recent meta-analyses and umbrella review on risk factors for late life depression (van Agtmaal et al. 2017; Cole and Dendukuri 2003; Köhler et al. 2018; Valkanova and Ebmeier 2013). Abstract screening was followed by full-text examination and discussion by three independent researchers (Matteo Respino, F.T. and M.B.M.).

We selected 129 potential predictors of late-life depression identified in 227 studies (Figure S1). The selection of predictors for the RPMs the following criteria: (i) Predictors had to be defined according to clear, reproducible operational criteria; (ii) they had to be significantly associated with depression at follow up, using the study-defined alpha level, in at least one study; (iii) the assessment of predictors did not require instrumental, laboratory or excessively lengthy assessments (e.g. we excluded studies examining predictors assessed by blood sample analysis, specialist medical work-up, cognitive assessments, extensive structured interviews). Rather, predictors needed to be amenable to be ascertained using simple questions that can be

asked to an individual during a clinical consultation by lay interviewers, or through a questionnaire; (iv) predictors had to be included in the dataset.

To match specific data available in SHARE we devised additional criteria: (i) the predictor had to be assessed in the SHARE dataset with operational definitions that were as similar as possible to those of primary studies; (ii) less than 33% of missing data. Predictors were grouped according to construct similarities within three broadly-defined categories: Sociodemographic, Mental Health/Psychological, and Physical Health. We sought to find a balance between precision (we expected to find several predictors with different operational definitions or nomenclatures), and the need to synthesize them into a set that could correspond as much as possible to widely available data. The final decision whether to include a predictor in RPM development was solved by discussion among clinical researchers (MR, FT, MBM, SC).

S1.3 Additional information on the SHARE study

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multi-national, longitudinal study dedicated to the study of health, social, economic, and environmental policies on citizens from 28 European countries and Israel in mid- and late-life. SHARE started in 2004 and is still ongoing. Participants were assessed every two years collecting information on socio-demographic and economic factors, lifestyle, physical health and psychological well-being. The inclusion of individuals in their midlife was chosen to explore the transition between work and retirement, which is believed to be critical for social, mental and physical health later in life. In-person interviews are based on computer-assisted personal interviewing. Eligibility criteria are age of 50 or older, regular domicile in a SHARE country, being fluent in the country's language. The SHARE study employed probability-based sampling from national or regional registers of the residential population to ensure representativity of the target population (Bethmann, Bergmann, and Scherpenzeel 2019). This study analyzes data from wave 5 (baseline, collected in 2013) and wave 6 (endpoint, collected in 2015), including participants from: Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, France, Israel, Italy, Luxembourg, Netherlands, Sweden, and Slovenia. All instruments were translated in the language of each participating country. Waves 5 and 6 granted a large sample size while allowing the possibility of further validation in follow up studies from subsequent waves.

In the SHARE study, depressive symptoms are assessed with the EURO-D questionnaire, developed by harmonizing different questionnaires and interviews used in large European surveys (Prince, Reischies, et al. 1999). The EURO-D rates the presence/absence of 12 depressive symptoms; analysis of the scale yielded two main latent factors: affective suffering (depression, tearfulness and wishing to die) and motivation (loss of interest, poor concentration and lack of enjoyment). The EURO-D includes pessimism, sleep problems and tearfulness as independent items, while the DSM groups them with other symptoms. Irritability, an independent item in the EURO-D, is not listed by the DSM as a symptom of major depression in adulthood. A EURO-D cut-off score of 4 or higher is shown to indicate the presence of major depression, following studies demonstrating concordance with interview-based DSM diagnosis of Major Depression established with the Diagnostic Interview Schedule (DIS) (Robins et al. 1981); diagnosis of Major Depression established with the Composite International Diagnostic Interview (CIDI; World Health Organization, 1990) and diagnosis of clinically significant depression established with the GMS-AGECAT (Copeland, Dewey, and Griffiths-Jones 1986). Further details on SHARE methodology is available at

S1.4 Additional details on the Artificial Neural Networks

Two types of ANNs were trained and cross-validated to solve different problems. The first ANN method aimed at the prediction of depression on non-depressed participants at baseline, using L1 regularization. The second ANN method aimed at the prediction of depression on the whole population, using a wrapper method for feature selection. The first was aimed at maximizing the accuracy of the model, while the second method aimed at reaching an optimal trade-off between accuracy and the number of used features. Having a training set with an infinite number of subjects, model performance would be a non-decreasing function of model complexity. However, the bias-variance trade-off emerging from a training set with finite sample size makes model performance reach a peak at intermediate values of model complexity (Shalev-Shwartz and Ben-David 2013).

The ANNs hyperparameters (HPs, Table S 1) were chosen using a 3-fold CV, nested within another 4-fold CV loop for model testing. Samples were stratified by outcome. Multilayer perceptrons with fully connected layers were trained by backpropagation with Nesterov optimization and exponential learning rate

decay. Minibatches of 512 samples were used in training for the first method. Batches including the whole training set were used for the second method. All input units accepted continuous values, all layers except the last included a bias unit with a fixed activation of 1.

The first method used the softplus activation function for the other units, while the second uses the sigmoid activation function. The output layer is composed of just one unit with an activation that represents the estimated probability of the adverse event. Two kinds of HPs are learned. Level 1 HPs are learned using the nested CV, while level 2 HPs are learned on the whole training sets of the outer CV before running the nested CV. Level 2 HPs are chosen in advance using a simpler process than level 1 HPs, leading to faster computation and reduced risk of overfitting, while level 1 HP tuples are explored with a search algorithm.

Numerical features were encoded with two units, if the value is known the first unit is set to 0 and the second contains the numerical value scaled on the interval $[0, 1]$ ^a. If the value is unknown the first feature is set to 1 and the second to 0. Categorical features are represented with one-hot encoding, with a unit for each category, all set to 0 in case the feature is unknown, or only the unit corresponding to the actual category set to 1 and all the others to 0.

Level 2 HPs include the filtering out of features with very low predictive power, and the choice of representation of the single features between numerical and categorical. In order to do this for each feature 2 ANNs with a single input feature and a single hidden layer of 2 units are trained for 100 epochs, with the exception of the features where more than 50 different values are present, in which case the categorical option is not considered. The first ANN takes in input the feature in numerical format, and the second ANN takes it in categorical format. Depending on the ANN with the best R^2 the input format for that specific ANN is chosen and used in the following nested CV. If the best R^2 is lower than 0.0001 the feature is filtered out.

The level 1 HPs to test by nested CV are chosen by a search algorithm. The space for the search is a graph with a vertex for each HP tuple^b. Vertices related to HP tuples that are equal with the exception of a single HP, and with contiguous values on that HP, are considered neighbours. Table S1 reports the list of level 1 HPs and their possible values. If not otherwise specified, the contiguous values are the preceding and the following in the ordered sequence of possible values.

Table S1. List of level-1 hyperparameters (HP) of the neural network

HP name	Possible values	Notes
Epochs	10, 20, 30, 50, 100, 200, 300, 500, 1000, 2000, 3000, 5000, 10000.	
Learning rate	In the first method: 2^k with $k \in \mathbb{N}$ In the second method: 0.0001, 0.0002, 0.0003, 0.0005, 0.001, 0.002, 0.003, 0.005, 0.01, 0.02, 0.03, 0.05, 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 5, 10, 20, 30, 50.	
Learning rate decay	In the first method: 2^k with $k \in \mathbb{N}$ In the second method: 0, 0.0001, 0.0002, 0.0003, 0.0005, 0.001, 0.002, 0.003, 0.005, 0.01, 0.02, 0.03, 0.05, 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 5, 10, 20, 30, 50, 100.	
Momentum term	0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.75, 0.8, 0.85, 0.9, 0.95, 0.98, 0.99, 0.995, 0.997, 0.998, 0.999, 0.9995, 0.9997, 0.9998, 0.9999, 0.99995, 0.99997, 0.99998, 0.99999.	
Multiplier of initial weights	0.0001, 0.0002, 0.0003, 0.0005, 0.001, 0.002, 0.003, 0.005, 0.01, 0.02, 0.03, 0.05, 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 5, 10.	Fixed to 3 in the first method
Architecture	Vertices in graph of architectures.	
L1 regularization	$(1000^{1/100})^k$ with $k \in \mathbb{N}$	Used only in the first method
Feature (an HP for each feature)	Active, not active.	Used only in the second method

^a The scaling is computed only on the training set, so the values of the testing set may possibly fall in a different interval.

^b The graph is implicit, never fully represented in memory.

The possible ANN architectures correspond to the vertices of an (implicit) graph that is never fully built, also because it is infinite. For each vertex the neighbours are the following.

- Architectures with a layer increased by one unit.
- Architectures with a layer with more than 2 units decreased by one unit.
- Architectures with an additional layer of 2 units before the output layer.
- Architectures with the layer before the output layer removed, if it contains 2 units and the number of hidden layers is greater than the minimum number.

The minimum number of hidden layers for this experiment is set to 1. Shallow models are tested with logistic regressions (see below).

The level 1 HP search algorithm starts with an open set of available vertices corresponding to an initial HP tuple, then at each exploration step does the following.

- Chooses from the open set the vertex with the best heuristic. At the first step there is just one available vertex so that is selected.
- Trains and tests ANNs with the nested cross validation, using the HPs related to the chosen vertex, computing the average Brier score. The vertex is added to a closed list to avoid redundant evaluations.
- Creates neighbouring nodes not in closed list, and adds them to the open list, associating a heuristic to them. The heuristics of the neighbours are created if not already present. Otherwise they are updated so that only the best one is kept.

The heuristic is composed by a pair of values: the best Brier score evaluated on the neighbours, and an estimated training cost, as number of ANN weights multiplied by number of epochs. Between two heuristics, the best one has the lower Brier, or the lower cost in case of ties.

When new nodes are created to be added to the open list, all neighbours are created with the exception of the one with a lower number of epochs. The rationale is that training ANNs with less epochs and equal other parameters is most probably a waste of computational resources.

Final ANNs have been trained on the whole dataset. Their resulting characteristics follow.

First ANN method: 123 used features. One hidden layer with 4 softplus units.

Second ANN method: 35 used features. One hidden layer with 3 sigmoid units.

S1.5 Additional details on regression models

The logistic regression models were regularized with a group lasso penalty. The lasso penalty avoids overfitting while selecting a limited number of regression variables, while the group variant of this regularization technique allows variable selection of groups of variables (Meier, Van De Geer, and Bühlmann 2008). Groups were defined as single continuous variables or dummy variables coding for one same categorical variable. Data related to predictors were entered in the model by coding questions that mapped to categorical variables with p levels into $p-1$ dummy variables.

The first logistic model was fitted choosing the regularization parameter λ giving the minimum Brier score (mean squared error), while for the second model, λ was chosen to ensure a number of selected variables less than 35. In both cases, λ was chosen with a 10-fold cross-validation, nested within another 10-fold cross-validation loop for model testing. Folds were determined randomly, balancing cases and controls.

Regression models were fitted with the R package *grplasso* (Meier 2018) using calibrated sample weights. Missing values on continuous variables were imputed by the median. Missing values on categorical variables were treated as an additional level of the variable. We used the calibrated longitudinal weights (waves 5 and 6) for model fitting. These weights are provided within the SHARE dataset to adjust for sampling design, sample nonresponse, and panel attrition (Deville and Särndal 1992; De Luca, Rossetti, and Malter 2015).

S1.6 Additional details on models evaluation

ROC curves and AUC were computed with the R package *WeightedROC* (Hocking 2020). 95% confidence intervals (CI) were obtained with bootstrap with 1000 draws. ROC curves for the learned models

(ANN, logistic and lean logistic models) were obtained averaging for each threshold probability the true and false positive rates obtained on the external cross-validation folds. Similarly, AUC, MSE and their CI of the learned models were obtained as the median of these quantities calculated on external cross-validation folds.

S1.7 Additional details on the comparison with previous RPMs

In order to calculate the DRAT-up risk score (Cattelani et al. 2019), disability was defined as not having any dependence in activities of daily living (ADL) or instrumental activities of daily living (IADL), sleep disturbance was derived from the question of the EURO-D scale about troubles in sleeping, while current depression was defined with a EURO-D score equal to or greater than 4 (Prince, Beekman, et al. 1999; Prince, Reischies, et al. 1999).

In order to compute the Okamoto and Harasawa (Okamoto and Harasawa 2011) risk score, subjective usefulness was derived from the item “I feel that my life has meaning” of the CASP scale for quality of life (Hyde et al. 2003): yes (‘often’ or ‘sometimes’), no (‘rarely’ or ‘never’). Feeling of economic leeway was derived from the CASP item “Shortage of money stops me from doing the things that I want to do”: low (‘often’ or ‘sometimes’), high (‘rarely’ or ‘never’). Low emotional support was estimated as not receiving any help from household members or others. Poor appetite was derived from the EURO-D 8th item. Hearing problems were derived from participant self-assessed hearing state: bad (‘fair’, ‘poor’) and good (‘excellent’, ‘very good’, or ‘good’). Missing values were replaced by prevalence rates reported in (Okamoto and Harasawa 2011). The models in (Xu et al. 2019) could not be reproduced.

Supplementary Results

Figure S1. Flow chart of the study selection procedure for the literature review

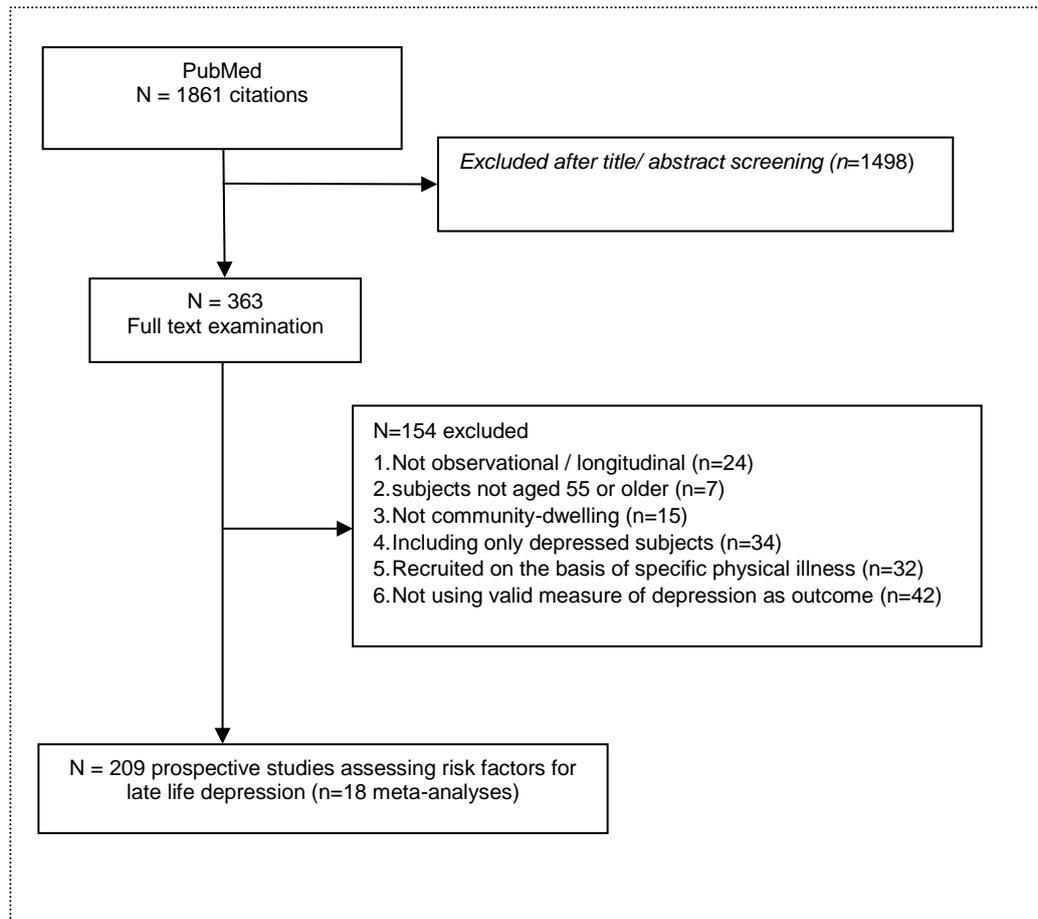


Table S2. Predictors of late life depression

The table reports predictors for late life depression identified using the criteria described in par. 2.1. For each predictor, we report the citation of the primary studies that identified the predictor as significantly associated with depression, as well as meta-analyses examining the association with depression, where available. We indicate the direction of the association between Predictors and depression as detected by studies. Predictors have been grouped according to similar nomenclature, and are presented in three broad categories. If one study examined more than one predictor, it is cited multiple times.

Predictors	results
1. Sociodemographic	
Age	Positive association age/ depression (Burns et al. 2013; Harlow, Goldberg, and Comstock 1991; Kennedy, Kelman, and Thomas 1990; Roberts et al. 2000; Schoevers et al. 2000; Wallace and O'Hara 1992); Negative association (Briggs, Kenny, and Kennelly 2017; Nabeta et al. 2014); Non-linear relationship (Fauth et al. 2012; Lue, Chen, and Wu 2010; Tait et al. 2012)
Gender	Female gender increasing the risk (Anstey et al. 2007, 2009; Beekman et al. 2001; De Beurs et al. 2001; Briggs et al. 2018, 2017; Burns et al. 2013; Cacioppo et al. 2006; Cotten et al. 2014; Duberstein et al. 2008; Fauth et al. 2012; Green et al. 1992; Gureje, Oladeji, and Abiona 2011; Harlow et al. 1991; Kennedy et al. 1990; Lue et al. 2010; Mcevoy et al. 2013; Roberts et al. 2000; Tait et al. 2012; Vink et al. 2009; Wallace and O'Hara 1992) Meta-analysis (Cole and Dendukuri 2003)
Ethnicity	Hispanics individuals have higher risk (Cotten et al. 2014); black individuals have higher risk (Skarupski et al. 2005); non-white ethnicity (Kennedy et al. 1990)
Education	Lower education increases the risk (Anstey et al. 2007, 2009; Beekman et al. 2001; Briggs et al. 2018; Cotten et al. 2014; Forsell 2000; Al Groffen et al. 2013; Harlow et al. 1991; Kamiya et al. 2013; Koster et al. 2006; Roberts et al. 2000; Sachs-Ericsson et al. 2007; Skarupski et al. 2005; Tait et al. 2012; Tani et al. 2016; Wallace and O'Hara 1992); Higher education increases the risk (Nyberg et al. 2018) Meta-analysis of 12 prospective studies found increased risk for low education (Chang-Quan et al. 2010)
Marital status / widowhood / bereavement	married or in a relationship and widowed higher risk than never married (Anstey et al. 2007); divorced or separated have higher risk than married (Anstey et al. 2009); married individuals have lower risk than other categories (Cotten et al. 2014; Ramos and Wilmoth 2003); separated/divorced or widowed have higher risk relative to married (Kamiya et al. 2013; Min, Ailshire, and Eileen 2016; Tait et al. 2012) Meta-analysis on marital status (Yan et al. 2011) Widowhood, especially if recent bereavement, increases the risk (De Beurs et al. 2001; Gertner, Domino, and Dow 2017; Green et al. 1992; Holley and Mast 2007; Mendes de Leon, Kasl, and Jacobs 1994; Schoevers et al. 2000; Sikorski et al. 2014; Turvey, Carney, and Arndt 1999) Meta-analysis on widowhood (Onrust and Cuijpers 2006)
Living conditions	
Country	Significant between-countries differences (Gallagher et al. 2013) (study based on SHARE)
Residence (rural/urban)	Rural higher risk than urban (Gureje et al. 2011), Rural lower risk than urban (Kamiya et al. 2013; St John, Blandford, and Strain 2009)
Living alone	Absence of partner in the household (Sonnenberg et al. 2013); living alone higher risk (Gitlin et al. 2007); eating alone Increases the risk (Tani et al. 2015) Meta-analysis showing that living alone increases the risk (Hu et al. 2012)
Relocation	Relocation associated with higher risk (Schoevers et al. 2000)
Home environment	Accessibility problem in the home environment increase the risk (Wahl et al. 2009)
Perception of neighborhood	"Neighborhood disorder" i.e. perception of physical and social dysfunction within the neighborhood associated with higher risk (Bierman 2009)
Social contacts	
Social network / support	Poor/small social network or frequency of contacts increase the risk (Beekman et al. 2001; Beller and Wagner 2018; Byers et al. 2012; Fauth et al. 2012; Förster et al. 2018; García-Peña et al. 2013; Gureje et al. 2011; Herbolzheimer, Ungar, and Peter 2018; Lee et al. 2017; Ma, Sun, and Tang 2018; Ramos and Wilmoth 2003; Sakurai et al. 2019; Sonnenberg et al. 2013; Stafford et al. 2011; Teo et al. 2015; Wallace and O'Hara 1992); poor social support increases the risk (Harlow et al. 1991; Phifer and Murrell 1986; Roberts et al. 2000; Russell and Cutrona 1991) Meta-analysis (Gariépy, Honkaniemi, and Quesnel-Vallée 2016)

Caregiving /familial relationships	Grandchild caregiving reduces risk; parent caregiving or variation in spousal caregiving increases risk (Liu and Lou 2017) Current and long-term spousal caregiving increases risk (Capistrant, Berkman, and Glymour 2014) Better intergenerational relationships with adult migrant offspring increases the risk (Lu et al. 2018)
Negative social exchanges	Increases the risk (Mavandadi et al. 2007)
Employment/ Economic	
Occupation/employment	Homemaker vs other occupations increases the risk (Al Groffen et al. 2013); retirement increases the risk (Shiba et al. 2017)
Perception or indices of poverty	Not owning house/car, not enough to eat, no occupation increase the risk (Al Groffen et al. 2013); rented home higher risk than owned (Tani et al. 2016); perceived financial stress increases the risk (Lue et al. 2010); perception of inadequate basic needs (Blazer, Sachs-Ericsson, and Hybels 2007); lower perceived social status (Collins and Goldman 2008; Nyberg et al. 2018); financial distress (SHARE study) (Gallagher et al. 2013); low self-rated socioeconomic status increases the risk (S. C. Chang, Pan, et al. 2016; Nyberg et al. 2018)
Low income	Increases the risk (Kamiya et al. 2013; Kennedy et al. 1990; Koster et al. 2006; Lee et al. 2017; Tani et al. 2016)
Childhood socioeconomic indices	worse financial situation in childhood increases the risk (Kamiya et al. 2013; Tani et al. 2016); overcrowding in childhood increases the risk (Cheval et al. 2019) SHARE study (Angelini et al. 2016)
Activities	
Specific activities	Past military service and combat experience reduce the risk (Schaper et al. 2018); history of participation in combat sports reduces the risk (Bäckmand et al. 2009); internet use reduces the risk (Cotten et al. 2014); Using personal computer, participation in community events reduce the risk (Uemura et al. 2018); church attendance more often than weekly reduces the risk (Norton et al. 2008); social activities reduce the risk (Isaac et al. 2009)
2. Mental health - psychological	
Mental health	
Prior depression / depression at baseline	increases the risk (Beekman et al. 2001; Callahan et al. 1998; Forsell 2000; McHorney and Mor 1988; Roberts et al. 1997; Schoevers et al. 2000; Teodorczuk et al. 2007); early onset depression (SHARE study) (Gallagher et al. 2013). Meta-analysis (Cole and Dendukuri 2003)
Psychotropic drug use	Antidepressant use increases the risk (Briggs et al. 2018); hypnotics increase the risk (Harlow et al. 1991)
Anxiety	Increases the risk (Potvin et al. 2013; Schoevers et al. 2000)
Stressful events	
Life events	Increase the risk (Anstey et al. 2009; Brilman and Ormel 2001; Förster et al. 2018; Kivelä, Köngäs-Saviaro, et al. 1996; Moos et al. 2005; Ormel et al. 2001; Phifer and Murrell 1986; Russell and Cutrona 1991); lifetime cumulative adversity (SHARE study) (Shrira 2012)
Perceived stress	Increases the risk (Tsai, Chi, and Wang 2013a)
Parental mental health problems	Increases the risk (Angelini et al. 2016) (SHARE study)
Personality	
Neuroticism	Increases the risk (Bellovin-Weiss 2014; Duberstein et al. 2008; Ormel et al. 2001; Pakkala et al. 2010; Steunenberget al. 2006, 2010; Vink et al. 2009)
Locus of control	Increases the risk (Beekman et al. 2001; García-Peña et al. 2013)
Affective instability	Increases the risk (Eldesouky et al. 2018)
Cognitive	
Cognitive functions	Worse MMSE scores increase the risk (Monin et al. 2018; Turvey et al. 2009); Worse cognitive function (cognitive batteries such as WAIS, MMSE, CVLT and others) increases the risk (Aichele et al. 2018; Mojtabei and Olfson 2004; Perrino et al. 2008; Prince et al. 1998); Worse memory increases the risk (Brailean et al. 2017; Jajodia and Borders 2011); poor executive functions (Dementia Rating Scale-IP) increase the risk (Park, Han, and Kang 2014)
Subjective cognitive impairment	Cognitive complaints increase the risk (Potvin et al. 2013); awareness of the diagnosis of dementia increases the risk (Stites et al. 2017)
Quality of life and other psychological dimensions	
Quality of life (QOL)	Worse QOL increases the risk (Teodorczuk et al. 2007); worse life satisfaction increases the risk (Green et al. 1992; Lue et al. 2010)
Religiosity	Attendance to religious services increases the risk (Min et al. 2016); frequency of prayer among non-religious increases the risk (Braam et al. 2007); changes in religiosity increases the risk (Cohen-Mansfield, Shmotkin, and Hazan 2016); Baseline religiosity reduces the risk (Sun et al. 2012); low spirituality for African Americans increases the risk (Gitlin et al. 2007)

Loneliness	Increases the risk (Beller and Wagner 2018; Cacioppo et al. 2006; Green et al. 1992; Heikkinen and Kauppinen 2004)
Dissatisfaction with relatives	Increases the risk (Ramos and Wilmoth 2003)
“Negative ageing perceptions”	Increases the risk (Freeman et al. 2016; Gum and Ayalon 2018)
Sense of Mastery	Low SOM increases the risk (Assari and Lankarani 2017)
Will to live	Low will to live increases the risk (Carmel et al. 2018)
Hopelessness	High hopelessness increases the risk (Gum and Ayalon 2018)
“negative” cognitive style	Increases the risk (Meyer et al. 2010)
Perceived expectation regarding activation demands	Increases the risk (Pavlova and Silbereisen 2016)
3. Physical health	
Physical illnesses	<i>All increase the risk of depression</i>
Heart diseases	Heart disease (Anstey et al. 2007) Heart failure (Luijendijk et al. 2010) Myocardial infarction (Byers et al. 2012)
Hypertension	(Armstrong et al. 2017; Byers et al. 2012)
Stroke /Vascular disease/Vascular risk factors	Stroke (Anstey et al. 2009) TIA (Hickie et al. 2003) CHD or stroke (Kivimäki et al. 2012); stroke and hypertension (Petersson et al. 2014); heart attack and stroke (Simning, Seplaki, and Conwell 2018); heart disease and stroke (Kim et al. 2006); vascular Predictors (Carmasin et al. 2014; Holley and Mast 2007). Meta-analysis (Valkanova and Ebmeier 2013)
Diabetes	(Anstey et al. 2009; Armstrong et al. 2017; Byers et al. 2012); Meta-analysis (Hasan et al. 2014)
Asthma	(Mcevoy et al. 2013)
Traumatic brain injury	(Osborn et al. 2018)
Physical illnesses/ disease burden/ multimorbidity	Chronic illnesses (Beekman et al. 2001; Fonda and Herzog 2001; Heikkinen and Kauppinen 2004; Turvey et al. 2009); disease burden (Briggs et al. 2017; S. C. Chang, Pan, et al. 2016; Cotten et al. 2014; Geerlings et al. 2000; Hsu and Hsu 2013; Kennedy et al. 1990; Lee et al. 2017; Lys, Belanger, and Phillips 2019; Nyberg et al. 2018; Phifer and Murrell 1986; Prince et al. 1998; Schoevers et al. 2000); polypharmacy (Gale et al. 2011); new/acute physical illnesses (Beekman et al. 1995; Harlow et al. 1991; Kennedy et al. 1990; Livingston et al. 2000) Multimorbidity (Fauth et al. 2012; de la Torre-Luque et al. 2019; St John et al. 2019). Meta-analysis (Huang et al. 2010)
Perceived health	Worse perceived health (Harlow et al. 1991; Kamiya et al. 2013; Kennedy et al. 1990; Kivelä, Kongäs-Saviaro, et al. 1996; Lue et al. 2010; Min et al. 2016; Pavlova and Silbereisen 2016; Potvin et al. 2013; Sachs-Ericsson et al. 2007; Tsai, Chi, and Wang 2013b; Wallace and O’Hara 1992); unrealistic expectations re. physical health (Chipperfield et al. 2019)
Biological indices and parameters	
Cardiovascular risk factors	Higher systolic BP increases the risk of depression (Briggs et al. 2017); antihypertensive use increase the risk of depression (Luijendijk et al. 2008); low blood pressure increasing the risk (Paterniti et al. 2000); hyperlipidemia increases the risk of depression (Armstrong et al. 2017); metabolic syndrome increase the risk of depression (Vogelzangs et al. 2011). Umbrella review (Köhler et al. 2018)
Microvascular dysfunction	Microbleeds and brain infarctions higher risk (Van Sloten et al. 2015); white matter hyperintensities increase the risk of depression (Godin et al. 2008; Grool et al. 2013; Olesen et al. 2010; Rosano et al. 2016; Saavedra Perez et al. 2013; Teodorczuk et al. 2010). Meta-analysis (Van Agtmaal et al. 2017)
Low vitamin d	Increases the risk of depression (Williams et al. 2015)
Glucocorticoid receptor gene (NR3C1) methylation	Increases the risk of depression (Kang et al. 2018)
Biological age	Worse aggregated indicators of inflammatory, metabolic, cardiovascular, lung, liver, and kidney functioning increase the risk of depression (Brown et al. 2018)
Healthcare related	
Healthcare use	Hospitalizations, 5 or more physician visits in the past year increase the risk of depression (Feng et al. 2009); institutionalization increases the risk (Beekman et al. 1995)
Healthcare perceived quality	Low trust in physician increases the risk of depression (Dong, Bergren, and Simon 2017)
Functional limitations / worse physical performance / disability	<i>All increase the risk of depression</i>

Vision/hearing loss	Vision and/or hearing impairment increase the risk (Capella McDonnell 2009, 2011; Cosh et al. 2018; Forsell 2000; Kennedy et al. 1990) Vision impairment increase the risk (Chou 2008) Hearing impairment (de la Torre-Luque et al. 2019; Michikawa 2016) Meta-analysis (Huang et al. 2010)
Eating problems	Eating problems (Cuijpers et al. 2006); worse oral health (non intact teeth) (de Almeida Mello J et al. 2019; Komiyama et al. 2019)
Body Mass Index /Obesity / BMI / waist circumference	Higher BMI increases the risk (Dearborn, Robbins, and Elias 2018) Obesity increase the risk (Byers et al. 2012; Sachs-Ericsson et al. 2007) Meta-analysis in adults (Luppino et al. 2010) Higher waist circumference increases the risk (Vogelzangs et al. 2011; Zaninotto et al. 2010)
Weight loss	Weight loss increases the risk (Briggs et al. 2017); weight loss (Forman-Hoffman et al. 2007)
Poor physical performance	Lower gait speed, handgrip strength increase the risk (Veronese et al. 2017) gait speed (Kyrdalen et al. 2019; Sanders et al. 2012; Turvey et al. 2009) Lower handgrip strength increase the risk (Hamer, Batty, and Kivimaki 2015) Physical impairment increase the risk (Byers et al. 2012; Geerlings et al. 2000; Huang et al. 2017) Walking steps (protective) (Raudsepp and Riso 2017)
Disability / functional limitations	Disablement (handicap) (Prince et al. 1998) Disability (ADL / IADL / self-rated) increase the risk (Anstey et al. 2007; Beekman et al. 1995, 2001; S. C. Chang, Pan, et al. 2016; Chen et al. 2012; Fauth et al. 2012; Forsell 2000; Geerlings et al. 2000; Gertner et al. 2017; Gitlin et al. 2007; Kennedy et al. 1990; Kivelä, Kongäs-Saviaro, et al. 1996; McHorney and Mor 1988; Roberts et al. 2000; Schoevers et al. 2000; Teodorczuk et al. 2007; Wallace and O'Hara 1992; Yang 2006; Zeiss et al. 1996). Meta-analysis (Cole and Dendukuri 2003)
Frailty	increase the risk (Briggs et al. 2017; Collard et al. 2015; Feng et al. 2014)
Physical symptoms	<i>All increase the risk of depression</i>
Shortness of Breath	increase the risk (Blazer and Hybels 2010)
Sleep disturbances	increase the risk (S. C. Chang, Pan, et al. 2016; Cuijpers et al. 2006; Harlow et al. 1991; Hyong et al. 2008; Jackowska and Poole 2017; Kennedy et al. 1990; Lee et al. 2013; Livingston, Blizard, and Mann 1993; Mallon, Broman, and Hetta 2000; Martin et al. 2010; Prince et al. 1998; Roberts et al. 2000) Meta-analysis (Bao et al. 2017)
Tinnitus	increase the risk (Gopinath et al. 2010)
Pain	increase the risk (Arola et al. 2010; S. C. Chang, Pan, et al. 2016; Chou 2007; García-Peña et al. 2013; Geerlings et al. 2002; Gureje et al. 2007; Hawker et al. 2011; Hilderink et al. 2012; Livingston et al. 2000; Mavandadi et al. 2007; Sanders et al. 2015)
Fatigue	increase the risk (Hawker et al. 2011; Moreh, Jacobs, and Stessman 2010)
Habits / lifestyle	
Smoking	Current smoking (Luijendijk et al. 2008) smoking increase the risk (Anstey et al. 2009; Byers et al. 2012; S. C. Chang, Pan, et al. 2016; Green et al. 1992; Tait et al. 2012; Tsai et al. 2013a)
Alcohol use	Increases the risk (Anstey et al. 2007; Bots et al. 2008; S. C. Chang, Pan, et al. 2016; Tait et al. 2012)
Diet	vegTable Ss-fruit reduce the risk (Chan, Chan, and Woo 2014); flavonoids reduce the risk (S. C. Chang, Cassidy, et al. 2016); Nutritional status (Boult et al. 1999)
Physical (in)activity	Physical activity: Physical, but not intellectual or social activities reduce the risk (Chao 2016); exercising reduces the risk (Kritz-Silverstein, Barrett-Connor, and Corbeau 2001; Ku et al. 2012; Tsai et al. 2013a); Habitual physical activity (questionnaire-based) reduces the risk (Pasco et al. 2011); Out-of-Home Physical Activity reduces the risk (Herboldsheimer et al. 2018) Physical inactivity (Bots et al. 2008; Byers et al. 2012; M. Chang et al. 2016; S. C. Chang, Pan, et al. 2016; Chao 2016; Cotten et al. 2014; Hamer et al. 2009; Joshi et al. 2016; Park et al. 2015; Sachs-Ericsson et al. 2007; Tsai et al. 2013a); reducing exercise intensity increases the risk (Lampinen, Heikkinen, and Ruoppila 2000); Meta-analysis (Schuch et al. 2018)

Table S3. Selection of risk factors from the literature into the RPM and operationalization in the SHARE dataset

RF	Notes	SHARE dataset	variables	Label, operationalization in SHARE
1. Sociodemographic				
age		cv-r	age_int	Age of respondent at the time of interview, continuous (range 55-102)
Gender		dn	dn042_	Binary (male, female)
Ethnicity	Proxy: born a citizen of country of interview	dn	dn503_	Binary (y/n)
Education		dn	dn041_	Years of education; continuous (range 0-26)
Marital status / widowhood / bereavement		dn	dn014_	6 categories (Married and living with partner, registered partnership, married not living together, never married, divorced, widowed)
	Only included recent widowhood: partner status: deceased from previous wave (4) data (adapted from ²¹⁰)	cv-r	Deceased (relative to partner id: mergeidp6)	Deceased; Binary (y/n)
Living conditions				
Residence (rural/urban)	Proxy: location of household	iv	iv009_	Which area building located: 5 categories (Big city, big city suburbs, large town, small town, rural area or village)
Living alone		cv-r	Hhsize	Continuous (0-15)
Relocation		dn	dn503	Born a citizen of country of interview (yes/no)
Home environment	Not available in SHARE			-
Perception of neighbourhood	Feeling part of this area (excluded due to missing values)	hh	hh022_	-
Social contacts				
Social network / support	SHARE Social Networks module (sn) not available for wave 5; also unpractical to translate sn variables into brief assessment for clinical use	-	-	-
	Proxy: social support	sp	sp002_	Received help from others; binary (y/n)
	Proxy: given help to others	sp	sp008_	Given help last twelve months y/n; binary
	If I were in trouble, there are people in this area who would help me (excluded due to missing values)	hh	hh025_	
Caregiving /familial relationships	Proxy: number of children	ch	ch001_	Continuous, (0-17)
	Proxy: number of grandchildren	ch	ch021_	Continuous, (0 – 25)
	Proxy: number of siblings	dn	dn034_	ever had any siblings; binary (y/n)
Negative social exchanges	Not available in SHARE			
Employment/ Economic				
Occupation/employment		ep	ep005_	Current job situation; 6 categories (retired, employed or self-employed, unemployed, permanently sick or disabled, homemaker, other)
Perception or indices of poverty		co	co007_	Is household able to make ends meet; 4 categories (with great difficulty, with some difficulty, fairly easily, easily)
		co	co201_	Afford to regularly buy necessary groceries; binary (y/n)
Low income	Excluded – not readily assessed in ambulatory setting	hh	Hh017e	
Childhood socioeconomic indices	Not available in SHARE			
Activities				
Specific activities	Activities in last year	ac	ac035d1	done voluntary or charity work; binary (y/n)
		ac	ac035d4	attended an educational or training course; binary (y/n)
		ac	ac035d5	gone to a sport, social or other kind of club; binary (y/n)
		ac	ac035d6	taken part in activities of a religious organization; binary (y/n)

		ac	ac035d7	taken part in a political or community-related organization; binary (y/n)
		ac	ac035d8	read books, magazines or newspapers; binary (y/n)
		ac	ac035d9	did word or number games; binary (y/n)
		ac	ac035d10	played cards or games such as chess; binary (y/n)
		ac	ac035dno	none of these; binary (y/n)
		it	it003_	Computer skills; 6 categories (Excellent, very good, good, fair, poor, never used a computer)
2. Mental health - psychological				
Prior depression / depression at baseline	Current depression (all individual symptoms)	gv-health	euro1-euro12	12 variables related to the presence of individual depressive symptoms (Depression, Pessimism, Suicidality, Guilt, Sleep, Interest, Irritability, Appetite, Fatigue, Concentration, Enjoyment, Tearfulness); binary (yes/no)
	Early onset of depression	ph	ph009	Age of onset of emotional disorders; continuous (0-87) <50 yr
Psychotropic drug use		ph	ph011d10	Use of anxiety or depression drugs; binary (yes/no)
Anxiety	Not available in SHARE			
Stressful events				
Life events	Excluded due to missing values	Sharelife ac	sl_ac002d1-10	lived in children's home; binary (yes/no), fostered with another family; evacuated/relocated during war; lived in prisoner of war camp; lived in prison; lived in labor camp; lived in concentration camp; inpatient in tb institution; stayed in psychiatric hospital; homeless for 1 month; none of these;
Perceived stress	Not available in SHARE			
Parental mental health problems	Excluded due to missing values	Sharelife hs	sl_hs045d3	Did parents: have mental health problems; binary (yes/no)
Personality				
Neuroticism	Not available in SHARE			
Locus of control	Not available in SHARE			
Affective instability	Not available in SHARE			
Cognitive				
Cognitive functions	Unpractical to translate into brief assessment for clinical use			
Subjective cognitive impairment	Proxy: having been told by doctor about cognitive problems	ph	ph006d16	Doctor told you had: alzheimer's disease, dementia, senility; binary (y/n)
Quality of life and other psychological dimensions				
Quality of life (QOL)			ac012_	How satisfied with life; continuous (0-10)
Religiosity	Proxy: religious activities (see above)			
Loneliness		mh	mh037_	Feels lonely; 3 categories (Often, Some of the time, hardly ever or never)
Dissatisfaction with relatives	Not available in SHARE			
"Negative ageing perceptions"	Not available in SHARE			
Sense of Mastery	Not available in SHARE			
Will to live	Already entered as depressive symptom (death wishes)			
Hopelessness	Proxy: entered as depressive symptom (pessimism)			
"negative" cognitive style	Proxy: variables related to aging perceptions	ac	ac014_	Age prevents from doing things; 4 categories (often, sometimes, rarely, never)
			ac015_	Out of control;
			ac016_	Feel left out of things;
			ac017_	Do the things you want to do;
			ac018_	Family responsibilities prevent;
			ac019_	Shortage of money stops;
			ac020_	Look forward to each day;

			ac021_	Life has meaning;
			ac022_	Look back on life with happiness;
			ac023_	Feel full of energy;
			ac024_	Full of opportunities;
			ac025_	Future looks good;
Perceived expectation re.demands	Not available in SHARE			
3. Physical health				
Physical illnesses				
Heart diseases		PH	ph006d1	Doctor told you had: heart attack; binary (y/n)
			ph072_1	Had a heart attack since last interview
Hypertension	Excluded due to missing values	PH	ph006d2	
Stroke /Vascular disease		PH	ph006d4	Doctor told you had: stroke; binary (y/n)
		PH	ph072_2	Had a stroke/diagnosed with cerebral vascular disease since last interview; binary (y/n)
Diabetes		PH	ph006d5	Doctor told you had: diabetes or high blood sugar; binary (y/n)
Asthma	Proxy: chronic lung diseases	PH	ph006d6	Report diagnosis of chronic lung disease; binary (y/n)
Traumatic brain injury	Not available in SHARE	PH		
Physical illnesses / Chronic disease burden / Multimorbidity	Proxy: other diseases, not previously included	PH	ph006d12	Doctor told you had: Parkinson disease; y/n; binary
	Proxy: other diseases, not previously included	PH	ph006d14	Doctor told you had: hip fracture or femoral fracture; y/n; binary
	Proxy: other diseases, not previously included	PH	ph072_3	Been diagnosed with cancer since last interview
	Proxy: other diseases, not previously included	PH	ph072_4	Suffered a hip fracture since last interview
	Proxy: other diseases, not previously included	PH	ph011d1	Drugs for: high blood cholesterol; y/n; binary
		PH	ph011d11	Drugs for: osteoporosis
		PH	ph011d13	Drugs for: stomach burns
		PH	ph011d14	Drugs for: chronic bronchitis
		PH	ph011d15	Drugs for: suppressing inflammation (only glucocorticoids or steroids)
		PH	ph011d2	Drugs for: high blood pressure
		PH	ph011d3	Drugs for: coronary diseases
		PH	ph011d4	Drugs for: other heart diseases
		PH	ph011d6	Drugs for: diabetes
		PH	ph011d7	Drugs for: joint pain
		PH	ph011d8	Drugs for: other pain
		PH	ph011d9	Drugs for: sleep problems
		PH	ph011dno	Drugs for: none
		PH	ph011dot	Drugs for: other
	Proxy: corticosteroids	ph	ph011d15	Use of corticosteroids; y/n; binary
Perceived health		ph	ph003_	Health in general question 2; excellent, very good, good, fair, poor; categorical (5)
Biological indices and parameters				
Cardiovascular risk factors	Proxy: hypercholesterolemia		ph006d3	Doctor told you had: high blood cholesterol; y/n; binary
Microvascular dysfunction	Not available in SHARE;			
Low vitamin d	Not available in SHARE;			

Glucocorticoid receptor gene (NR3C1) methylation	Not available in SHARE;			
Biological age	Not available in SHARE;			
Healthcare related				
Healthcare use		HC	hc002_	How often seen or talked to medical doctor last 12 months
		HC	hc012_	Stayed overnight in hospital last 12 months y/s; binary
		HC	hc029_	In a nursing home during last 12 months Yes temporarily, yes permanently, no; categorical (3)
		HC	hc114_	Could not see a doctor because of cost y/s; binary
		HC	hc115_	Could not see a doctor because of long waiting times y/s; binary
Healthcare perceived quality		HC	hc125_	Satisfaction with own coverage in basic health insurance/national health system Very satisfied, somewhat satisfied, somewhat dissatisfied, very dissatisfied; categorical (4)
Physical condition				
Vision/hearing loss		ph	ph046_	Hearing; excellent, very good, good, fair, poor; categorical (5)
		Ph	ph043_	Eyesight distance; excellent, very good, good, fair, poor; categorical (5)
		Ph	ph044_	Eyesight reading; excellent, very good, good, fair, poor; categorical (5)
Eating problems		Ph	ph092_	How many natural teeth missing
Body Mass Index /Obesity / BMI / waist circumference		Gv-health	Bmi2	Bmi categories <18.5, 18.5-24.9, 25-29.9,>=30; categorical (categories overweight and obese)
Weight loss		PH	ph065_	Lost weight; y/n; binary
Poor physical performance / Disability	Proxy: ADLs		ph048d1	Difficulties: walking 100 metres
			ph048d2	Difficulties: sitting two hours
			ph048d3	Difficulties: getting up from chair
			ph048d4	Difficulties: climbing several flights of stairs
			ph048d5	Difficulties: climbing one flight of stairs
			ph048d6	Difficulties: stooping, kneeling, crouching
			ph048d7	Difficulties: reaching or extending arms above shoulder
			ph048d8	Difficulties: pulling or pushing large objects
			ph048d9	Difficulties: lifting or carrying weights over 5 kilos
			ph048d10	Difficulties: picking up a small coin from a table
			ph048dno	Difficulties: none of these
Functional limitations	Proxy: IADLs		ph049d1	Difficulties: dressing, including shoes and socks
			ph049d2	Difficulties: walking across a room
			ph049d3	Difficulties: bathing or showering
			ph049d4	Difficulties: eating, cutting up food
			ph049d5	Difficulties: getting in or out of bed
			ph049d6	Difficulties: using the toilet, incl getting up or down
			ph049d7	Difficulties: using a map in a strange place
			ph049d8	Difficulties: preparing a hot meal
			ph049d9	Difficulties: shopping for groceries
			ph049d10	Difficulties: telephone calls
			ph049d11	Difficulties: taking medications
			ph049d12	Difficulties: doing work around the house or garden
			ph049d13	Difficulties: managing money
			ph049dno	(Difficulties: none of these.)
Frailty	Proxy: "bothered by frailty" fear of falling		ph089d1	Bothered by frailty: falling down; y/n; binary
			ph089d2	Bothered by frailty: fear of falling down

			ph089d3	Bothered by frailty: dizziness, faints or blackouts
Physical symptoms				
Shortness of Breath	Not available in SHARE			
Sleep disturbances	Already included as depressive symptom (see above)			
Tinnitus	Not available in SHARE			
Pain		ph	ph084_	Troubled with pain; y/n; binary
Fatigue			ph089d4	Bothered by frailty: fatigue
Habits / lifestyle				
Smoking		br	br002_	Current smoking; y/n; binary
Alcohol use		Br	br023_	How often six or more drinks last 3 months (valore: 5 o 4)
Diet	Not available in SHARE			
physical (in)activity		br	br015_	Sports or activities that are vigorous
			br016_	activities with moderate energy level >1/week, 1/week, 1-3/month, hardly ever or never; categorical (4)
		gV_health	Phactiv	Never vigorous nor moderate physical activity, other. y/n; binary

Figure S2. Flow chart of inclusion and exclusion of subjects from SHARE to arrive at the final dataset used for analyses

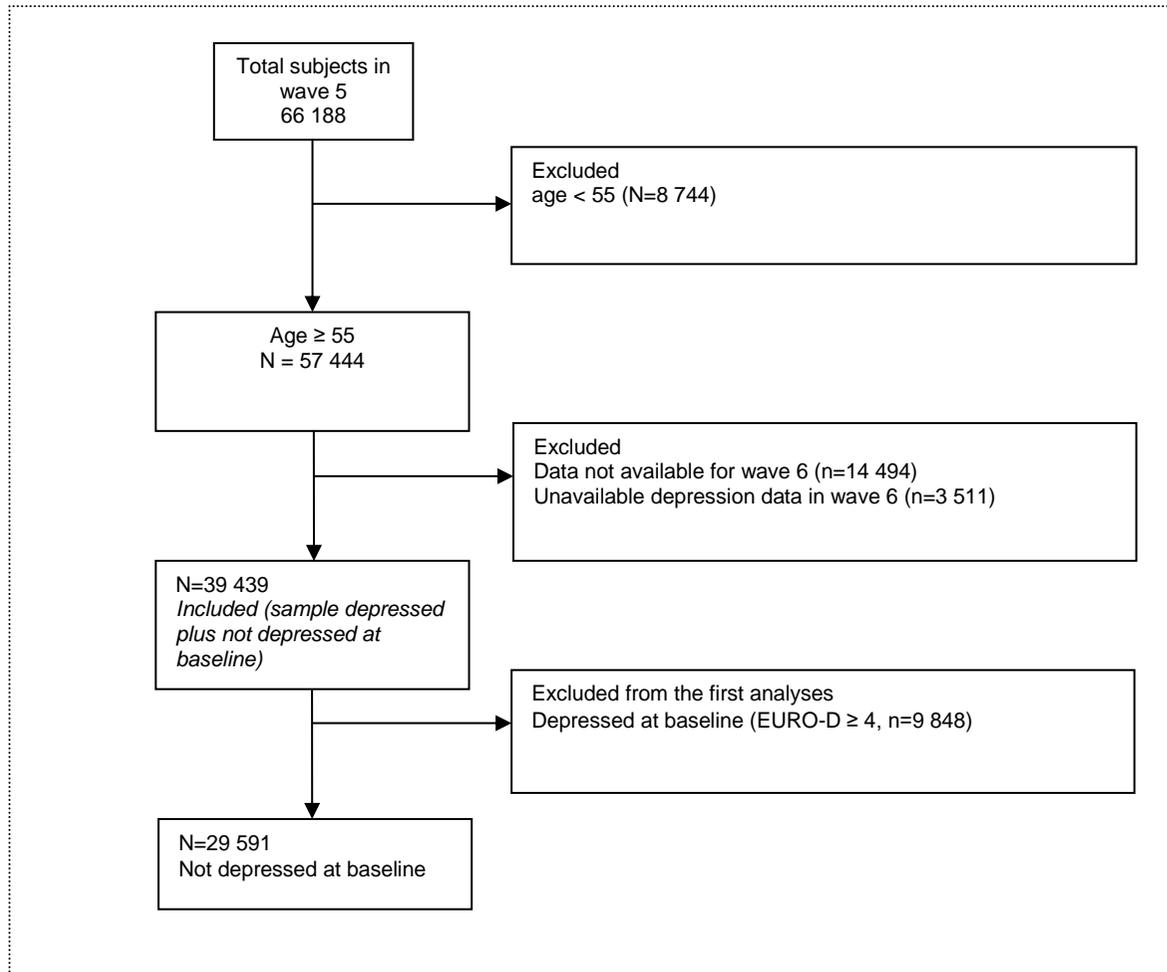


Figure S3. Histogram of EUROD scores at wave 5 in the combined sample

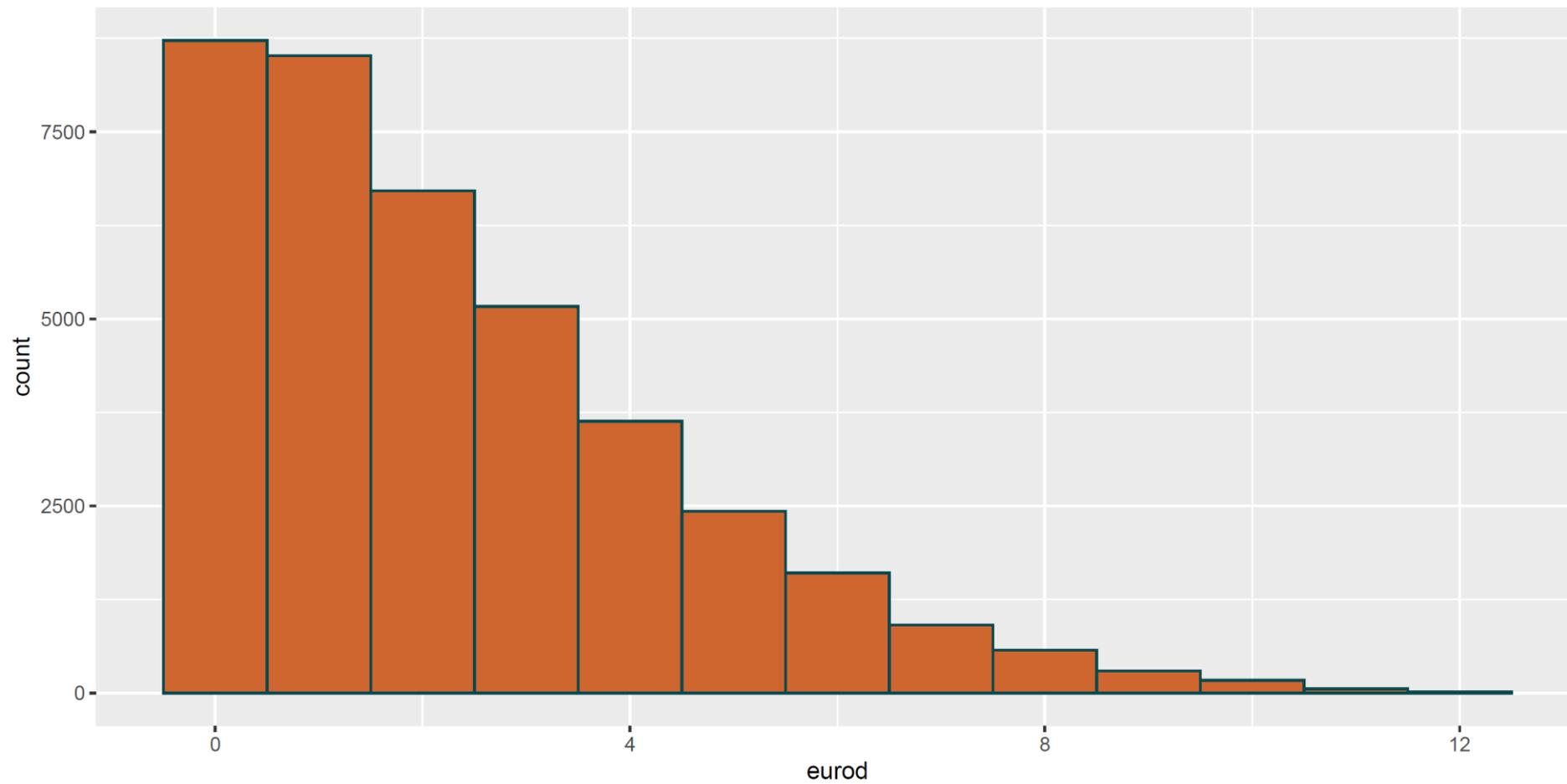


Table S4. Combined sample descriptive statistics

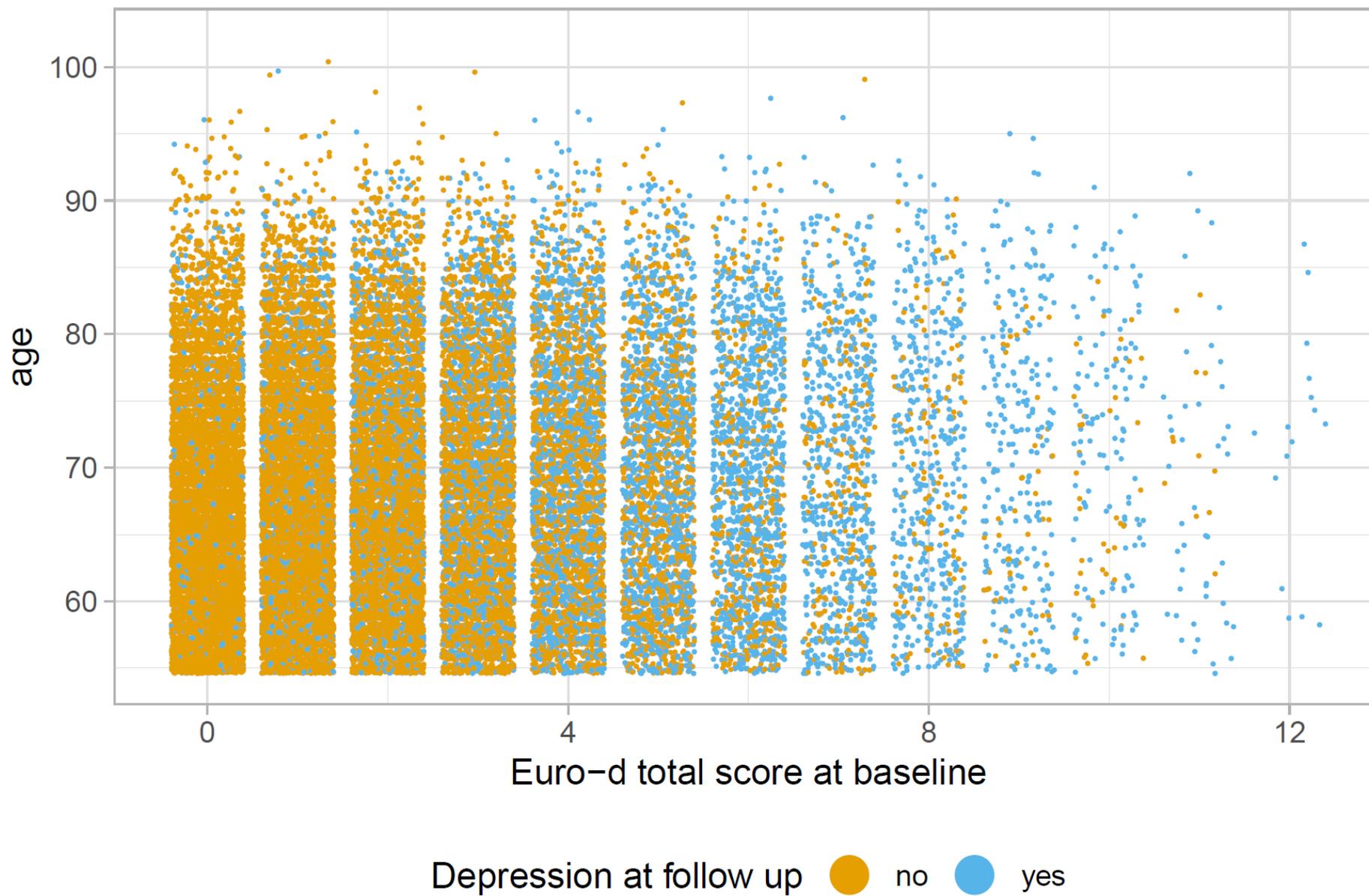
Variable	Variable label	Responses (% or Median plus interquartile range)	NA, %
ac012_	How satisfied with life (0-10)	8 (7-9)	1.2%
ac014_	Age prevents from doing things	Often 14.4%, Sometimes 34.1%, Rarely 23.2%, Never 27.3%,	0.9%
ac015_	Out of control	Often 8.0%, Sometimes 25.9%, Rarely 29.4%, Never 35.2%,	1.5%
ac016_	Feel left out of things	Often 4.6%, Sometimes 15.7%, Rarely 24.3%, Never 54.2%	1.2%
ac017_	Do the things you want to do	Often 50.7%, Sometimes 29.6%, Rarely 12.6%, Never 6.1%	1.1%
ac018_	Family responsibilities prevent	Often 5.9%, Sometimes 20.2%, Rarely 23.1%, Never 49.9%	0.9%
ac019_	Shortage of money stops	Often 17.9%, Sometimes 26.2%, Rarely 21.3%, Never 33.7%	0.9%
ac020_	Look forward to each day	Often 64.4%, Sometimes 21.8%, Rarely 7.5%, Never 5.0%,	1.3%
ac021_	Life has meaning	Often 68.9%, Sometimes 22.0%, Rarely 5.6%, Never 2.0%	1.5%
ac022_	Look back on life with happiness	Often 53.7%, Sometimes 33.8%, Rarely 8.6%, Never 2.6%	1.3%
ac023_	Feel full of energy	Often 41.4%, Sometimes 38.0%, Rarely 15.6%, Never 4.0%	0.9%
ac024_	Full of opportunities	Often 40.0%, Sometimes 36.4%, Rarely 17.2%, Never 4.7%	1.7%
ac025_	Future looks good	Often 37.9%, Sometimes 36.2%, Rarely 17.4%, Never 6.3%	2.1%
ac035d1	Activities: done voluntary or charity work	No 81.6%, Yes 17.5%	1.0%
ac035d10	Activities: played cards or games such as chess	No 68.6%, Yes 30.5%	1.0%
ac035d4	Activities: attended an educational or training course	No 87.1%, Yes 11.9%	1.0%
ac035d5	Activities: gone to a sport, social or other kind of club	No 69.4%, Yes 29.7%	1.0%
ac035d6	Activities: taken part in religious organization	No 28.5%, Yes 2.6%	68.9%
ac035d7	Activities: taken part in a political or community organization	No 92.3%, Yes 6.7%	1.0%
ac035d8	Activities: read books, magazines or newspapers	No 22.1%, Yes 76.9%	1.0%
ac035d9	Activities: did word or number games	No 53.6%, Yes 45.4%	1.0%
ac035dno	Activities: none of these	No 86.5%, Yes 12.5%	1.0%
age_int	Age of respondent at the time of interview	67 (61-74)	0.0%
bmi2	Bmi categories	Below 18.5 - underweight 1.1%, 18.5-24.9 - normal 34.1%, 25-29.9 - overweight 41.0%, 30 and above - obese 21.5%	2.3%
br002_	Smoke at the present time	Yes 16.3%, No 67.7%	16.1%
br015_	Sports or activities that are vigorous	More than once a week 33.8%, Once a week 14.2%, One to three times a month 8.9%, Hardly ever, or never 42.9%	0.1%
br016_	Activities requiring a moderate level of energy	More than once a week 70.1%, Once a week 13.2%, One to three times a month 5.7%, Hardly ever, or never 10.9%	0.1%
br023_	How often six or more drinks last 3 months	Daily or almost every day 1.5%, Five or six days a week 0.4%, Three or four days a week 0.8%, Once or twice a week 2.4%, Once or twice a month 4.8%, Less than once a month 9.8%, Not at all in the last 3 months 48.7%	31.6%
ch001_	Number of children	2 (1-3)	30.0%
ch021_	Number of grandchildren	2 (0-4)	30.4%
co007_	Is household able to make ends meet	With great difficulty 6.1%, With some difficulty 16.8%, Fairly easily 20.0%, Easily 25.4%	31.6%
co201_	Afford to regularly buy necessary groceries	Yes 58.6%, No 7.5%	33.9%
dn014_	Marital status	Married and living together with spouse 23.2%, Registered partnership 0.3%, Married, living separated from spouse 0.4%, Never married 1.4%, Divorced 2.6%, Widowed 5.1%	67.1%
dn034_	Ever had any siblings	Yes 26.0%, No 3.2%	70.8%

dn041_	Years education	12 (8-14)	71.0%
dn042_	Male or female	Male 44.1%, Female 55.9%	0.0%
dn503_	Born a citizen of country of interview	Yes 26.6%, No 1.4%	72.0%
ep005_	Current job situation	Retired 64.1%, Employed or self-employed (including working for family business) 21.5%, Unemployed 2.3%, Permanently sick or disabled 2.7%, Homemaker 7.6%, Other 1.0%	0.7%
euro1	Depression(part of EURO-D)	No 60.9%, Yes 38.5%	0.6%
euro10	Concentration (part of EURO-D)	No 83.6%, Yes 15.6%	0.8%
euro11	Enjoyment (part of EURO-D)	No 88.4%, Yes 10.9%	0.7%
euro12	Tearfulness (part of EURO-D)	No 76.7%, Yes 22.7%	0.6%
euro2	Pessimism (part of EURO-D)	No 83.7%, Yes 15.6%	0.8%
euro3	Suicidality (part of EURO-D)	No 92.8%, Yes 6.5%	0.7%
euro4	Guilt (part of EURO-D)	No 91.4%, Yes 7.8%	0.7%
euro5	Sleep (part of EURO-D)	No 64.5%, Yes 34.9%	0.5%
euro6	Interest (part of EURO-D)	No 91.1%, Yes 8.3%	0.6%
euro7	Irritability (part of EURO-D)	No 71.6%, Yes 27.8%	0.6%
euro8	Appetite (part of EURO-D)	No 92.0%, Yes 7.5%	0.5%
euro9	Fatigue (part of EURO-D)	No 64.2%, Yes 35.2%	0.6%
hc002_	How often seen or talked to medical doctor last 12 months	4 (2-8)	0.9%
hc012_	Stayed over night in hospital last 12 months	Yes 15.1%, No 84.8%	0.1%
hc029_	In a nursing home during last 12 months	Yes, temporarily 0.1%, Yes, permanently 0.0%, No 99.1%	0.7%
hc114_	Could not see a doctor because of cost	Yes 4.4%, No 95.4%	0.1%
hc115_	Could not see a doctor because of long waiting times	Yes 6.8%, No 93.1%	0.1%
hc125_	Satisfaction with own coverage in basic health insurance/national health system	Very satisfied 36.1%, Somewhat satisfied 48.7%, Somewhat dissatisfied 10.5%, Very dissatisfied 3.0%	1.7%
hhsz	Household size	2 (2-2)	0.0%
it003_	Computer skills	Excellent 3.5%, Very good 8.1%, Good 20.0%, Fair 19.8%, Poor 16.9%, I never used a computer 31.5%	0.1%
iv009_	Which area building located	0 45.4%, A big city 21.1%	33.5%
mh037_	How often feels lonely	Often 5.6%, Some of the time 16.8%, Hardly ever or never 76.9%	0.6%
ph003_	Health in general question 2	Excellent 7.5%, Very good 17.5%, Good 37.6%, Fair 28.2%, Poor 9.1%	0.1%
ph006d1	Doctor told you had: heart attack	No 87.9%, Yes 12.0%,	0.2%
ph006d12	Doctor told you had: parkinson disease	No 99.1%, Yes 0.7%,	0.2%
ph006d14	Doctor told you had: hip fracture or femoral fracture	No 98.0%, Yes 1.9%,	0.2%
ph006d16	Doctor told you had: alzheimer's disease, dementia, senility	No 98.9%, Yes 0.9%	0.2%
ph006d3	Doctor told you had: high blood cholesterol	No 74.7%, Yes 25.2%	0.2%
ph006d4	Doctor told you had: stroke	No 96.1%, Yes 3.8%	0.2%
ph006d5	Doctor told you had: diabetes or high blood sugar	No 86.2%, Yes 13.6%	0.2%
ph006d6	Doctor told you had: chronic lung disease	No 93.8%, Yes 6.0%	0.2%
ph009_18	Age affective or emotional disorders	0 0.7%, 1 0.8%	98.5%
ph011d1	Drugs for: high blood cholesterol	No 74.6%, Yes 25.3%	0.1%
ph011d10	Drugs for: anxiety or depression	No 93.7%, Yes 6.2%	0.1%
ph011d11	Drugs for: osteoporosis	No 94.2%, Yes 5.7%	0.1%
ph011d13	Drugs for: stomach burns	No 90.9%, Yes 9.0%	0.1%

ph011d14	Drugs for: chronic bronchitis	No 97.0%, Yes 2.9%	0.1%
ph011d15	Drugs for: suppressing inflammation (only glucocorticoids or steroids)	No 96.6%, Yes 3.2%	0.1%
ph011d2	Drugs for: high blood pressure	No 54.3%, Yes 45.6%	0.1%
ph011d3	Drugs for: coronary diseases	No 90.4%, Yes 9.5%	0.1%
ph011d4	Drugs for: other heart diseases	No 89.4%, Yes 10.5%	0.1%
ph011d6	Drugs for: diabetes	No 87.5%, Yes 12.4%	0.1%
ph011d7	Drugs for: joint pain	No 82.5%, Yes 17.4%	0.1%
ph011d8	Drugs for: other pain	No 87.5%, Yes 12.3%	0.1%
ph011d9	Drugs for: sleep problems	No 91.9%, Yes 8.0%	0.1%
ph011dno	Drugs for: none	No 78.1%, Yes 21.8%	0.1%
ph011dot	Drugs for: other	No 80.7%, Yes 19.2%	0.1%
ph043_	Eyesight distance	Excellent 20.5%, Very good 28.8%, Good 36.2%, Fair 10.6%, Poor 3.7%	0.2%
ph044_	Eyesight reading	Excellent 16.9%, Very good 26.9%, Good 36.0%, Fair 13.5%, Poor 6.5%	0.1%
ph046_	Hearing	Excellent 14.5%, Very good 25.3%, Good 39.8%, Fair 16.8%, Poor 3.5%	0.1%
	ADLs		
ph048d1	Difficulties: walking 100 metres	No 90.2%, Yes 9.7%	0.1%
ph048d2	Difficulties: sitting two hours	No 89.2%, Yes 10.7%	0.1%
ph048d3	Difficulties: getting up from chair	No 80.8%, Yes 19.1%	0.1%
ph048d4	Difficulties: climbing several flights of stairs	No 73.4%, Yes 26.6%	0.1%
ph048d5	Difficulties: climbing one flight of stairs	No 88.3%, Yes 11.7%	0.1%
ph048d6	Difficulties: stooping, kneeling, crouching	No 69.0%, Yes 31.0%	0.1%
ph048d7	Difficulties: reaching or extending arms above shoulder	No 91.0%, Yes 8.9%	0.1%
ph048d8	Difficulties: pulling or pushing large objects	No 86.7%, Yes 13.3%	0.1%
ph048d9	Difficulties: lifting or carrying weights over 5 kilos	No 80.3%, Yes 19.6%	0.1%
ph048d10	Difficulties: picking up a small coin from a table	No 96.0%, Yes 3.9%	0.1%
ph048dno	Difficulties: none of these	No 49.1%, Yes 50.8%	0.1%
ph049d1	Difficulties: dressing, including shoes and socks	No 93.1%, Yes 6.8%	0.1%
ph049d2	Difficulties: walking across a room	No 98.3%, Yes 1.6%	0.1%
ph049d3	Difficulties: bathing or showering	No 95.4%, Yes 4.5%	0.1%
ph049d4	Difficulties: eating, cutting up food	No 98.5%, Yes 1.4%	0.1%
ph049d5	Difficulties: getting in or out of bed	No 96.7%, Yes 3.2%	0.1%
ph049d6	Difficulties: using the toilet, incl getting up or down	No 98.1%, Yes 1.8%	0.1%
ph049d7	Difficulties: using a map in a strange place	No 93.1%, Yes 6.8%	0.1%
ph049d8	Difficulties: preparing a hot meal	No 97.1%, Yes 2.8%	0.1%
ph049d9	Difficulties: shopping for groceries	No 95.0%, Yes 4.9%	0.1%
ph049d10	Difficulties: telephone calls	No 98.8%, Yes 1.2%	0.1%
ph049d11	Difficulties: taking medications	No 98.8%, Yes 1.1%	0.1%
ph049d12	Difficulties: doing work around the house or garden	No 89.7%, Yes 10.2%	0.1%
ph049d13	Difficulties: managing money	No 96.9%, Yes 3.0%	0.1%
ph049dno	Difficulties: none of these	No 18.8%, Yes 81.1%	0.1%
ph065_	Check: lost weight	Yes 20.0%, No 79.8%	0.2%
ph072_1	Had a heart attack since last interview	Yes 1.4%, No 69.3%	29.3%

ph072_2	Had a stroke/ cerebral vascular disease since last interview	Yes 1.0%, No 69.7%,	29.3%
ph072_3	Been diagnosed with cancer since last interview	Yes 1.7%, No 69.0%,	29.3%
ph072_4	Suffered a hip fracture since last interview	Yes 0.5%, No 70.2%,	29.3%
ph084_	Troubled with pain	Yes 43.7%, No 56.3%	0.1%
ph089d1	Bothered by frailty: falling down	No 92.6%, Yes 7.3%	0.1%
ph089d2	Bothered by frailty: fear of falling down	No 87.2%, Yes 12.8%	0.1%
ph089d3	Bothered by frailty: dizziness, faints or blackouts	No 85.4%, Yes 14.6%	0.1%
ph089d4	Bothered by frailty: fatigue	No 79.9%, Yes 20.0%	0.1%
ph092_	How many natural teeth missing	10 (4-23)	23.4%
phactiv	Physical inactivity	Other 89.9%, Never vigorous nor moderate physical activity 10.0%	0.1%
recent_bereavement		False 41.0%, True 0.7%	58.3%
sp002_	Received help from others (outside household)	Yes 14.1%, No 56.0%	29.9%
sp008_	Given help last twelve months	Yes 20.3%, No 49.8%	29.9%
widowed		False 27.8%, True 5.1%	67.1%

Figure S4. Distribution of incident depression according to baseline depression severity and age



Supplementary Results 2: RPMs run on participants without depression at baseline

ANN = Artificial Neural Network
 Lean LR = Lean Logistic Regression
 Full LR = Full Logistic Regression

Table S5. Model performance of the ANN model among participants without depression at baseline

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5.0%	16.9%	96.2%	19.3%	17.8%	96.6%	31.1%
10.0%	44.1%	82.9%	49.0%	22.9%	94.1%	54.2%
15.0%	61.9%	67.3%	67.1%	27.2%	91.9%	67.2%
20.0%	73.6%	53.3%	78.4%	31.1%	90.3%	74.6%
25.0%	82.2%	40.8%	86.3%	35.3%	89.0%	79.4%
30.0%	88.3%	29.4%	91.5%	38.8%	87.7%	81.9%
35.0%	92.7%	20.3%	95.1%	43.1%	86.8%	83.6%
40.0%	95.6%	13.3%	97.2%	47.4%	86.1%	84.3%
45.0%	98.0%	6.8%	98.8%	52.0%	85.4%	84.7%
50.0%	99.4%	2.3%	99.7%	53.4%	84.9%	84.7%
55.0%	99.9%	0.5%	100.0%	64.6%	84.7%	84.7%
60.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
65.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
70.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
75.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
80.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
85.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
90.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%
95.0%	100.0%	0.0%	100.0%	NA	84.6%	84.6%

Table S6. Model performance of the Full Logistic Regression Model among participants without depression at baseline

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5%	10.8%	98.3%	12.5%	17.1%	97.5%	25.8%
10%	41.9%	85.7%	46.9%	22.8%	94.7%	52.9%
15%	61.9%	68.2%	67.5%	27.7%	92.0%	67.6%
20%	74.4%	53.0%	79.5%	32.1%	90.2%	75.4%
25%	83.2%	39.0%	87.3%	35.9%	88.7%	79.8%
30%	88.9%	28.5%	92.1%	39.8%	87.6%	82.3%
35%	92.4%	21.3%	95.0%	43.6%	86.8%	83.6%
40%	95.0%	15.4%	96.9%	47.5%	86.2%	84.3%
45%	96.6%	10.9%	98.0%	50.3%	85.7%	84.5%
50%	97.9%	7.4%	98.9%	54.5%	85.4%	84.7%
55%	98.8%	4.5%	99.4%	55.4%	85.0%	84.7%
60%	99.3%	2.9%	99.7%	62.4%	84.9%	84.7%
65%	99.6%	1.7%	99.8%	65.7%	84.7%	84.7%
70%	99.8%	1.0%	99.9%	68.3%	84.6%	84.6%
75%	99.9%	0.3%	100.0%	NA	84.6%	84.5%
80%	100.0%	0.1%	100.0%	NA	84.5%	84.5%
85%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
90%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
95%	100.0%	0.0%	100.0%	NA	84.5%	84.5%

Table S7. Model performance of the Lean LR Model among participants without depression at baseline

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5%	0.0%	100.0%	0.0%	15.5%	NA	15.5%
10%	23.5%	93.7%	26.6%	19.0%	95.9%	37.0%
15%	58.2%	70.6%	63.5%	26.2%	92.2%	64.6%
20%	78.8%	44.6%	83.0%	32.5%	89.1%	77.1%
25%	89.4%	26.6%	92.3%	38.8%	87.3%	82.2%
30%	94.7%	15.4%	96.5%	45.0%	86.2%	84.0%
35%	97.4%	8.3%	98.5%	49.8%	85.4%	84.5%
40%	98.8%	4.0%	99.4%	54.1%	85.0%	84.6%
45%	99.5%	1.9%	99.7%	57.6%	84.7%	84.6%
50%	99.8%	0.9%	99.9%	64.3%	84.6%	84.6%
55%	99.9%	0.3%	100.0%	66.7%	84.6%	84.5%
60%	100.0%	0.2%	100.0%	NA	84.5%	84.5%
65%	100.0%	0.1%	100.0%	NA	84.5%	84.5%
70%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
75%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
80%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
85%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
90%	100.0%	0.0%	100.0%	NA	84.5%	84.5%
95%	100.0%	0.0%	100.0%	NA	84.5%	84.5%

Table S8. Parameters of the Lean Logistic Model among participants without depression at baseline

varname	varLabel	levelValue	levelLabel	coefficient
(Intercept)	Intercept			-1.660130193
ac012_	How satisfied with life			-0.092633884
ac014_	Age prevents from doing things	1	Often	NA
		2	Sometimes	-0.027663961
		3	Rarely	-0.046875038
		4	Never	-0.053107017
		NA	Refusal, Don't know	0.003874806
ac023_	Feel full of energy	1	Often	NA
		2	Sometimes	0.120451999
		3	Rarely	0.290856877
		4	Never	0.406267684
		NA	Refusal, Don't know	0.370578463
ac025_	Future looks good	1	Often	NA
		2	Sometimes	0.037790073
		3	Rarely	0.088245732
		4	Never	0.114620768
		NA	Refusal, Don't know	0.089671399
ac035d6	Activities in last year: taken part in activities of a religious organization	0	Not selected	NA
		1	Selected	-0.023070351
		NA	Refusal, Don't know	-0.086159279
ac035d9	Activities in last year: did word or number games (crossword puzzles/Sudoku...)	0	Not selected	NA
		1	Selected	-0.007034269
		NA	Refusal, Don't know	0.006843609
ac035dno	Activities in last year: none of these	0	Not selected	NA
		1	Selected	0.168993475
		NA	Refusal, Don't know	0.16592077
age_int	Age of respondent at the time of interview			0.007347056
dn042_	Male or female	1	Male	NA
		2	Female	0.272304935
euro1	Depression(part of EURO-D)			0.314195719
euro10	Concentration (part of EURO-D)			0.066076161
euro12	Tearfulness (part of EURO-D)			0.17091031
euro5	Sleep (part of EURO-D)			0.297796346
euro7	Irritability (part of EURO-D)			0.207514087
euro9	Fatigue (part of EURO-D)			0.109662601
hc002_	How often seen or talked to medical doctor last 12 months			0.000477331
mh037_	Feels lonely	1	Often	NA
		2	Some of the time	-0.171540522
		3	Hardly ever or never	-0.285533516
		NA	Refusal, Don't know	-0.028868734
ph003_	Health in general question 2	1	Excellent	NA
		2	Very good	0.001516957
		3	Good	0.004235388
		4	Fair	0.007805079
		5	Poor	0.01262336
		NA	Refusal, Don't know	0.015444789
ph011d10	Drugs for: anxiety or depression	0	Not selected	NA
		1	Selected	0.04071112
		NA	Refusal, Don't know	0.033279888
ph011d7	Drugs for: joint pain	0	Not selected	NA
		1	Selected	0.021739305
		NA	Refusal, Don't know	0.034887871

ph011d8	Drugs for: other pain		0	Not selected	NA
			1	Selected	0.009663834
		NA		Refusal, Don't know	0.012967127
ph011d9	Drugs for: sleep problems		0	Not selected	NA
			1	Selected	0.125340145
		NA		Refusal, Don't know	0.12008275
ph048d1	Difficulties: walking 100 metres		0	Not selected	NA
			1	Selected	0.094470449
		NA		Refusal, Don't know	0.03629908
ph048d4	Difficulties: climbing several flights of stairs		0	Not selected	NA
			1	Selected	0.106640911
		NA		Refusal, Don't know	0.079091805
ph048d5	Difficulties: climbing one flight of stairs		0	Not selected	NA
			1	Selected	0.063635626
		NA		Refusal, Don't know	0.027814033
ph048d6	Difficulties: stooping, kneeling, crouching		0	Not selected	NA
			1	Selected	0.014509601
		NA		Refusal, Don't know	0.011972203
ph048d8	Difficulties: pulling or pushing large objects		0	Not selected	NA
			1	Selected	0.086839004
		NA		Refusal, Don't know	0.040851524
ph048d9	Difficulties: lifting or carrying weights over 5 kilos		0	Not selected	NA
			1	Selected	0.080956462
		NA		Refusal, Don't know	0.048638329
ph048dno	Difficulties: none of these		0	Not selected	NA
			1	Selected	-0.037980867
		NA		Refusal, Don't know	0.002916993
ph049dno	Difficulties: none of these		0	Not selected	NA
			1	Selected	-0.017983277
		NA		Refusal, Don't know	-0.009761629
ph084_	Troubled with pain		1	Yes	NA
			5	No	-0.120872098
		NA		Refusal, Don't know	0.076729089
ph089d2	Bothered by frailty: fear of falling down		0	Not selected	NA
			1	Selected	0.026498495
		NA		Refusal, Don't know	0.02284706
ph089d3	Bothered by frailty: dizziness, faints or blackouts		0	Not selected	NA
			1	Selected	0.033519614
		NA		Refusal, Don't know	0.030841721
ph089d4	Bothered by frailty: fatigue		0	Not selected	NA
			1	Selected	0.147952945
		NA		Refusal, Don't know	0.158364512

Table S9. Parameters of the Full Logistic Model among participants without depression at baseline

varname	varLabel	levelValue	levelLabel	coefficient
(Intercept)	Intercept			-1.695012525
ac012_	How satisfied with life			-0.053672743
ac014_	Age prevents from doing things	1	Often	NA
		2	Sometimes	-0.06327609
		3	Rarely	-0.143068362
		4	Never	-0.184512183
		NA	Refusal, Don't know	-0.128896421
ac015_	Out of control	1	Often	NA
		2	Sometimes	0.014230755
		3	Rarely	-0.038342108
		4	Never	-0.033550348
		NA	Refusal, Don't know	0.068919538
ac017_	Do the things you want to do	1	Often	NA
		2	Sometimes	0.013655069
		3	Rarely	0.016244269
		4	Never	0.033198027
		NA	Refusal, Don't know	-0.011042926
ac018_	Family responsibilities prevent	1	Often	NA
		2	Sometimes	-0.078742375
		3	Rarely	-0.101649741
		4	Never	-0.118283968
		NA	Refusal, Don't know	-0.108365361
ac020_	Look forward to each day	1	Often	NA
		2	Sometimes	0.086708338
		3	Rarely	0.143990878
		4	Never	0.027686424
		NA	Refusal, Don't know	0.304456869
ac021_	Life has meaning	1	Often	NA
		2	Sometimes	0.050114502
		3	Rarely	0.062016192
		4	Never	0.024159148
		NA	Refusal, Don't know	0.016225167
ac022_	Look back on life with happiness	1	Often	NA
		2	Sometimes	0.015733073
		3	Rarely	0.239670987
		4	Never	0.07116449
		NA	Refusal, Don't know	-0.147669566
ac023_	Feel full of energy	1	Often	NA
		2	Sometimes	0.153138663
		3	Rarely	0.29939238
		4	Never	0.380756834
		NA	Refusal, Don't know	0.366627308
ac024_	Full of opportunities	1	Often	NA
		2	Sometimes	-0.005838396
		3	Rarely	-0.033037545
		4	Never	0.013351463
		NA	Refusal, Don't know	0.036191702
ac025_	Future looks good	1	Often	NA
		2	Sometimes	0.068115883
		3	Rarely	0.153408283
		4	Never	0.156720916
		NA	Refusal, Don't know	0.103364445

ac035d5	Activities in last year: gone to a sport, social or other kind of club		0	Not selected	NA
			1	Selected	-0.00340829
		NA		Refusal, Don't know	0.002028409
ac035d6	Activities in last year: taken part in activities of a religious organization		0	Not selected	NA
			1	Selected	-0.111976757
		NA		Refusal, Don't know	-0.254154347
ac035d8	Activities in last year: read books, magazines or newspapers		0	Not selected	NA
			1	Selected	-0.013947066
		NA		Refusal, Don't know	-0.00041344
ac035d9	Activities in last year: did word or number games (crossword puzzles/Sudoku...)		0	Not selected	NA
			1	Selected	-0.142431685
		NA		Refusal, Don't know	0.07555142
ac035dno	Activities in last year: none of these		0	Not selected	NA
			1	Selected	0.198353149
		NA		Refusal, Don't know	0.14062743
age_int	Age of respondent at the time of interview				0.009434478
bmi2	Bmi categories		1	Below 18.5 - underweight	NA
			2	18.5-24.9 - normal	-0.004987673
			3	25-29.9 - overweight	-0.009473417
			4	30 and above - obese	-0.01221838
		NA		Implausible/suspected wrong, Refusal, Don't know	-0.024790419
br002_	Smoke at the present time		1	Yes	NA
			5	No	-0.04244889
		NA		Refusal, Don't know	0.01897842
br015_	Sports or activities that are vigorous		1	More than once a week	NA
			2	Once a week	0.001452899
			3	One to three times a month	0.007724403
			4	Hardly ever, or never	0.007927413
		NA		Refusal, Don't know	-0.02040857
br016_	Activities requiring a moderate level of energy		1	More than once a week	NA
			2	Once a week	0.003478507
			3	One to three times a month	0.076935662
			4	Hardly ever, or never	0.131415214
		NA		Refusal, Don't know	-0.02517088
br023_	How often six or more drinks last 3 months		1	Daily or almost every day	NA
			2	Five or six days a week	-0.047943656
			3	Three or four days a week	0.032603025
			4	Once or twice a week	-0.007546411
			5	Once or twice a month	-0.060971154
			6	Less than once a month	-0.066535998
			7	Not at all in the last 3 months	-0.045237466
		NA		Refusal, Don't know	0.012344504
ch001_	Number of children				0.003385784
co007_	Is household able to make ends meet		1	With great difficulty	NA
			2	With some difficulty	-0.095914083
			3	Fairly easily	-0.075443959
			4	Easily	-0.105514061
		NA		Refusal, Don't know	-0.07068942
dn041_	Years education				-0.002506318
dn042_	Male or female		1	Male	NA
			2	Female	0.422644259
ep005_	Current job situation		1	Retired	NA
			2	Employed or self-employed (including working for family business)	-0.00042579
			3	Unemployed	-0.000894929
			4	Permanently sick or disabled	0.015806139
			5	Homemaker	0.028523063
			97	Other	0.017771164

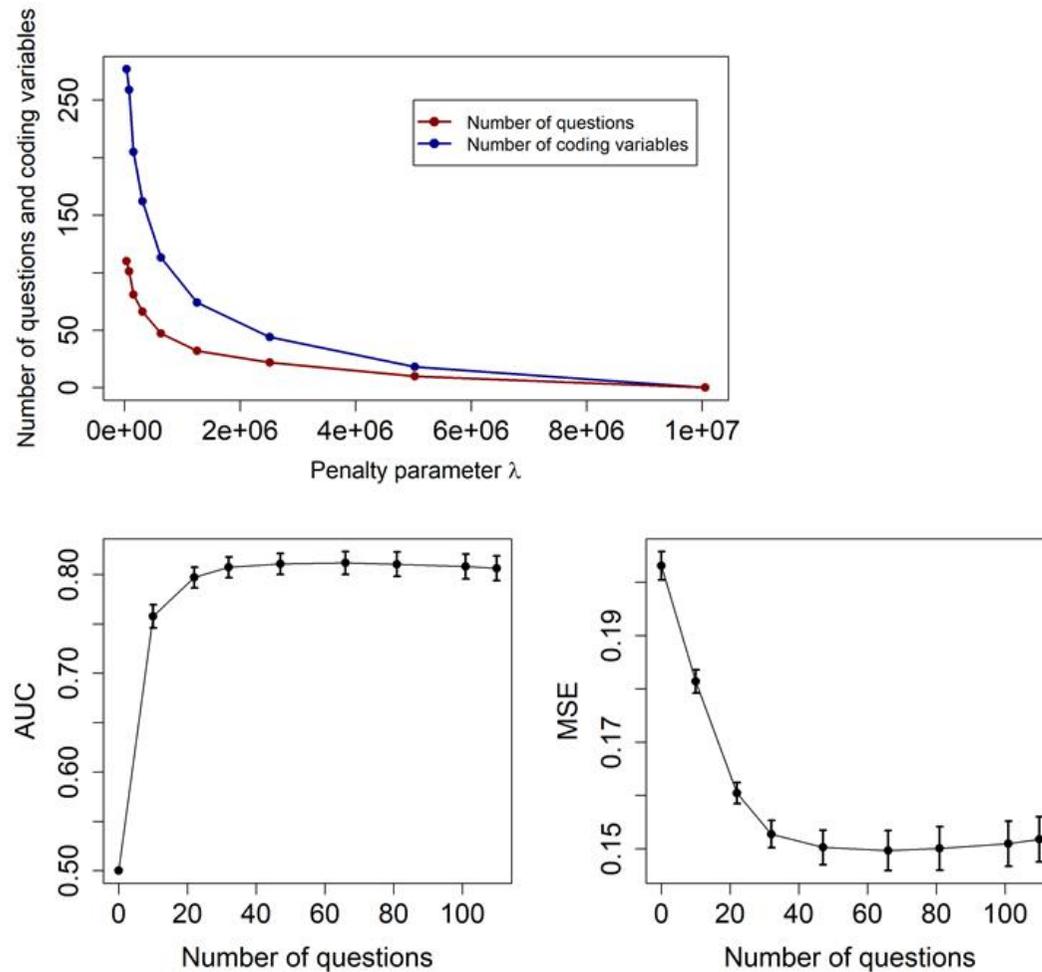
		NA	Refusal, Don't know	-0.05499394
euro1	Depression(part of EURO-D)			0.415899552
euro10	Concentration (part of EURO-D)			0.242886388
euro11	Enjoyment (part of EURO-D)			0.250490325
euro12	Tearfulness (part of EURO-D)			0.39123848
euro2	Pessimism (part of EURO-D)			0.154059356
euro3	Suicidality (part of EURO-D)			0.360532834
euro4	Guilt (part of EURO-D)			0.37543732
euro5	Sleep (part of EURO-D)			0.434817967
euro6	Interest (part of EURO-D)			0.082673723
euro7	Irritability (part of EURO-D)			0.426088984
euro8	Appetite (part of EURO-D)			0.288725574
euro9	Fatigue (part of EURO-D)			0.16311336
hc002_	How often seen or talked to medical doctor last 12 months			0.001712011
hc029_	In a nursing home during last 12 months		1 Yes, temporarily	NA
			3 Yes, permanently	-0.550498057
			5 No	-0.168207964
		NA	Refusal, Don't know	-0.24275149
hc114_	Could not see a doctor because of cost		1 Yes	NA
			5 No	-0.040341808
		NA	Refusal, Don't know	0.01807933
hc125_	Satisfaction with own coverage in basic health insurance/national health system		1 Very satisfied	NA
			2 Somewhat satisfied	-0.011131262
			3 Somewhat dissatisfied	0.023843605
			4 Very dissatisfied	0.023626073
		NA	Refusal, Don't know	-0.042743803
hhsz	Household size			0.019472753
it003_	Computer skills		1 Excellent	NA
			2 Very good	0.013199847
			3 Good	-0.020888796
			4 Fair	0.004547968
			5 Poor	0.002618517
			6 I never used a computer	0.052097837
		NA	Refusal, Don't know	-0.011550538
iv009_	NA		0 NA	NA
			1 A big city	0.013843862
		NA	Refusal, Don't know	0.009884673
mh037_	Feels lonely		1 Often	NA
			2 Some of the time	-0.274641845
			3 Hardly ever or never	-0.478274503
		NA	Refusal, Don't know	0.004722135
ph003_	Health in general question 2		1 Excellent	NA
			2 Very good	0.076094511
			3 Good	0.159747753
			4 Fair	0.188315683
			5 Poor	0.216404815
		NA	Refusal, Don't know	0.614463375
ph006d1	Doctor told you had: heart attack		0 Not selected	NA
			1 Selected	0.004487958
		NA	Refusal, Don't know	-0.008729179
ph006d12	Doctor told you had: parkinson disease		0 Not selected	NA
			1 Selected	0.399917794
		NA	Refusal, Don't know	-0.191994297
ph006d6	Doctor told you had: chronic lung disease		0 Not selected	NA
			1 Selected	0.146491807
		NA	Refusal, Don't know	-0.201625283
ph009_18	NA		0 NA	NA
			1 NA	-0.101694829

		NA	Refusal, Don't know	-0.158067491
ph011d10	Drugs for: anxiety or depression	0	Not selected	NA
		1	Selected	0.251838004
		NA	Refusal, Don't know	0.14959568
ph011d4	Drugs for: other heart diseases	0	Not selected	NA
		1	Selected	0.047429121
		NA	Refusal, Don't know	0.045991037
ph011d7	Drugs for: joint pain	0	Not selected	NA
		1	Selected	0.074796091
		NA	Refusal, Don't know	0.08420212
ph011d8	Drugs for: other pain	0	Not selected	NA
		1	Selected	0.110770332
		NA	Refusal, Don't know	0.101634613
ph011d9	Drugs for: sleep problems	0	Not selected	NA
		1	Selected	0.248364726
		NA	Refusal, Don't know	0.16801931
ph011dot	Drugs for: other	0	Not selected	NA
		1	Selected	0.025696211
		NA	Refusal, Don't know	0.03590546
ph043_	Eyesight distance	1	Excellent	NA
		2	Very good	0.078142326
		3	Good	0.017986237
		4	Fair	0.066044302
		5	Poor	0.110657922
		NA	Refusal, Don't know	0.259559186
ph044_	Eyesight reading	1	Excellent	NA
		2	Very good	-0.05066369
		3	Good	-0.033669023
		4	Fair	-0.01343027
		5	Poor	-0.059561762
		NA	Refusal, Don't know	0.272537642

Note. In the lean-LR model there were 132 events per parameter (9904 events, 75 parameters), while in the full-LR model there were 55 events per parameter (9904 events, 180 parameters), which is above the recommended threshold of 20 events per variable (Austin and Steyerberg 2017).

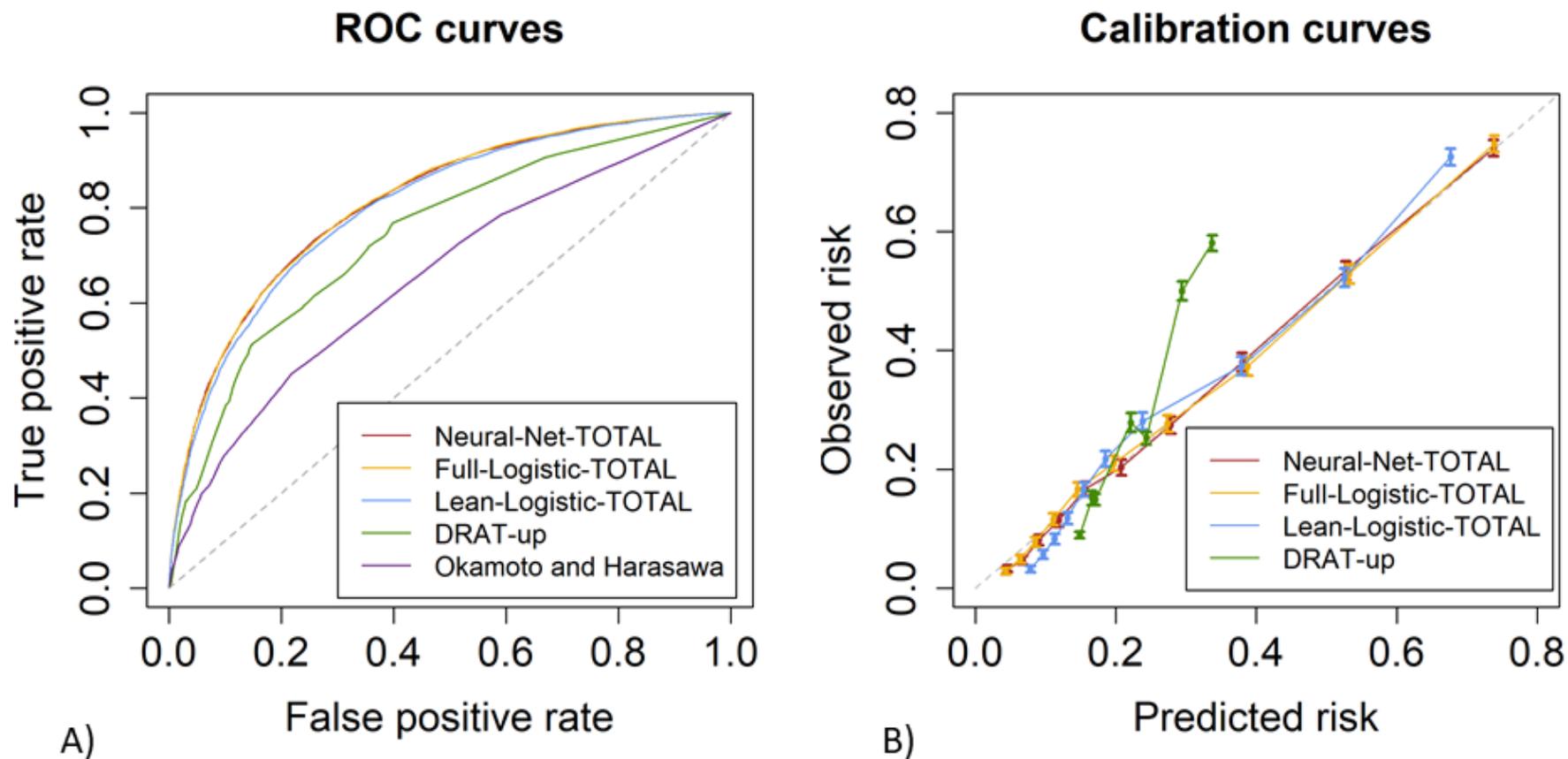
Supplementary eResults 3: RPMs run on participants from the combined sample

Figure S5. Analyses of logistic models' performance as a function of model complexity.



Dependence of model performance on model complexity for the group lasso logistic regression approach. Upper panel: decreasing values of the penalty parameter λ correspond to increasing number of predictors selected in the model. Questions that map to categorical variables with p levels are coded with $p-1$ dummy variables. Lower panels: validation curves showing AUC and MSE estimated with 10-fold cross-validation as functions of the number of predictors included in the model. Both validation scores show a steep improvement as the number of predictors included in the model rises from 0 to 30, followed by a substantial plateau.

Figure S6. Receiver Operation Curves and calibration curves (combined sample)



A) Receiver operating characteristic curve for the MANTO, DRAT-up and Okamoto and Harasawa models

B) In calibration curves, the dashed line indicates perfect calibration, i.e. correspondence between predicted and observed risk. Points above the line suggest under-prediction, whereas points below the line indicate over-prediction. Calibration plots were drawn according to risk score deciles for the ANN, full-LR, and lean-LR and according to risk score septiles for DRAT-up models. Error bars indicate 95% confidence intervals. Calibration could not be assessed for the Okamoto-Harasawa model because it did not present risk in a probabilistic way.

Table S10. Predictors retained in the risk prediction models (combined sample)

Predictor	ANN (n=35)	Full-LR (n=70)	Lean-LR (n=32)	Predictor	ANN (n=35)	Full-LR (n=70)	Lean-LR (n=32)
SOCIODEMOGRAPHIC				Anamnestic Parkinson's disease			
Age				Anamnestic hip or femoral fracture			
Sex				Recent diagnosis of cancer			
Ethnicity				Recent diagnosis of hip fracture			
Education				Use of glucocorticoids or steroids			
Marital status				Perceived Health			
LIVING CONDITIONS				BIOLOGICAL PARAMETERS			
Rural/Urban residence				Anamnestic hypercholesterolemia			
Household size				HEALTHCARE RELATED			
Relocation				Seeing a medical doctor			
Widowhood				Previous hospitalization			
Recent bereavement				Entering a nursing home			
SOCIAL CONTACTS				Unable to afford medical visit			
help from outside household				Unable to see doctor due to waiting times			
Given help				Satisfaction with the health system			
Number of children				Use of drugs for hypercholesterolemia			
Number of grandchildren				Use of drugs for osteoporosis			
Presence of siblings				Use of drugs for stomach burns			
EMPLOYMENT/ ECONOMIC				Use of drugs for chronic bronchitis			
Current occupation status				Use of antihypertensives			
Financial stability				Use of drugs for coronary diseases			
able to regularly buy groceries				Use of drugs for heart diseases			
ACTIVITIES				Use of drugs for diabetes			
Participation in voluntary or charity work				Use of drugs for joint pain			
Playing cards or games				Use of painkillers			
educational or training course				Use of hypnotics			
sport or a social or other kind of club				ph011dno (Drugs for: none.)			
activities in religious organizations				ph011dot (Drugs for: other.)			
activities in political organizations				PHYSICAL CONDITION			
Reading books newspapers				Visual function			
Playing word or number games				Reading ability			
No activities in last year ^a				Hearing function			
Computer skills				Dental problems			
MENTAL HEALTH				BMI			
Depression				Weight loss			
Concentration				Difficulties in walking 100m			

Enjoyment				Difficulties in picking up a small coin from table			
Tearfulness				Difficulties in sitting for two hours			
Pessimism				Difficulties in getting up from a chair			
Suicidalty				Difficulties several flights of stairs			
Guilt				Difficulties one flight of stairs			
Sleep				Difficulties stooping, kneeling, crouching			
Interest				Difficulties extending arms above shoulder			
Irritability				Difficulties pulling or pushing large objects			
Appetite				Difficulties carrying weights over 5kg			
Fatigue				No difficulties ^b			
Age of onset of affective disorders				Difficulties dressing			
Use of drugs for anxiety or depression				Difficulties using the telephone			
COGNITIVE				Difficulties taking medications			
Anamnestic Alzheimer's disease or other dementia				Difficulties doing work in house			
PSYCHOLOGICAL DIMENSIONS				Difficulties in managing money			
Life's satisfaction/Quality of life				Difficulties walking across a room			
Loneliness				Difficulties bathing or showering			
Age prevents from doing things				Difficulties eating, cutting up food			
Out of control				Difficulties getting in or out of bed			
Feel left out of things				Difficulties using toilet			
Do the things you want to do				Difficulties using a map in a strange place			
Family responsibilities prevent from doing things				Difficulties preparing hot meal			
Shortage of money stops				Difficulties shopping for groceries			
Look forward to each day				No difficulties ^c			
Life has meaning				Experience of falls			
Look back on life with happiness				Fear of falling			
Feel full of energy				Dizziness, faints or blackouts			
Full of opportunities				PHYSICAL SYMPTOMS			
Future looks good				Presence of pain			
PHYSICAL ILLNESSES				Fatigue			
Anamnestic heart attack				HABITS / LIFESTYLE			
Recent diagnosis of heart attack				Smoking			
Anamnestic stroke				Vigorous physical activity			
Recent diagnosis of stroke or cerebral vascular disease				Moderate physical activity			
Anamnestic diabetes or hyperglycaemia				Alcohol consumption			
Anamnestic chronic lung disease				Physical inactivity			

Table S11. Model performance of the Artificial Neural Network in the combined sample

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5%	12.4%	98.3%	16.1%	28.9%	96.4%	37.2%
10%	31.8%	93.0%	40.4%	35.1%	94.4%	53.9%
15%	44.2%	86.5%	54.8%	39.9%	92.1%	63.0%
20%	53.3%	80.3%	65.0%	44.3%	90.5%	69.0%
25%	61.0%	73.7%	73.0%	48.7%	88.9%	73.2%
30%	67.4%	67.0%	79.4%	53.0%	87.4%	76.2%
35%	72.7%	60.1%	84.1%	56.7%	85.9%	77.9%
40%	77.1%	54.2%	87.9%	60.9%	84.7%	79.2%
45%	80.7%	48.3%	90.8%	64.4%	83.5%	79.8%
50%	83.6%	42.7%	92.7%	67.1%	82.3%	79.8%
55%	86.1%	37.8%	94.3%	69.8%	81.4%	79.8%
60%	88.2%	32.9%	95.6%	72.0%	80.4%	79.4%
65%	90.3%	28.1%	96.6%	74.2%	79.5%	79.0%
70%	92.6%	21.8%	97.6%	76.1%	78.3%	78.1%
75%	95.3%	14.5%	98.7%	79.5%	76.9%	77.0%
80%	99.5%	1.9%	99.9%	NA	74.6%	74.7%
85%	100.0%	0.0%	100.0%	NA	74.2%	74.2%
90%	100.0%	0.0%	100.0%	NA	74.2%	74.2%
95%	100.0%	0.0%	100.0%	NA	74.2%	74.2%

Table S12. Model performance of Full-LR model in the combined sample.

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5.0%	2.6%	99.8%	3.5%	26.4%	97.7%	28.3%
10.0%	24.2%	95.5%	31.1%	32.5%	95.3%	47.7%
15.0%	41.3%	88.2%	51.6%	38.7%	92.7%	61.0%
20.0%	53.2%	80.2%	64.7%	44.1%	90.4%	68.7%
25.0%	62.0%	72.7%	74.0%	49.2%	88.7%	73.7%
30.0%	68.5%	65.4%	80.3%	53.6%	87.0%	76.5%
35.0%	73.7%	58.8%	85.0%	57.7%	85.6%	78.3%
40.0%	77.8%	52.9%	88.5%	61.5%	84.4%	79.3%
45.0%	81.3%	46.9%	91.1%	64.8%	83.2%	79.8%
50.0%	84.5%	41.0%	93.3%	68.1%	82.0%	79.9%
55.0%	87.2%	35.5%	95.0%	71.3%	80.9%	79.7%
60.0%	89.5%	30.3%	96.3%	74.0%	79.9%	79.3%
65.0%	91.4%	25.1%	97.2%	75.6%	78.9%	78.6%
70.0%	93.4%	19.9%	98.0%	77.4%	77.9%	77.9%
75.0%	95.0%	15.5%	98.6%	79.9%	77.1%	77.2%
80.0%	96.4%	11.3%	99.1%	81.5%	76.3%	76.5%
85.0%	97.7%	7.4%	99.5%	84.3%	75.6%	75.8%
90.0%	98.9%	3.9%	99.8%	88.0%	75.0%	75.1%
95.0%	99.8%	0.8%	100.0%	90.6%	74.4%	74.4%

Table S13. Model performance of the Lean Logistic Regression Model in the combined sample.

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5.0%	0.0%	100.0%	0.0%	25.8%	NA	25.8%
10.0%	9.4%	99.0%	12.2%	28.1%	97.2%	34.6%
15.0%	31.4%	93.0%	39.8%	34.9%	94.2%	53.5%
20.0%	47.4%	84.3%	58.4%	41.3%	91.5%	65.1%
25.0%	59.2%	74.9%	71.0%	47.3%	89.1%	72.0%
30.0%	67.9%	65.9%	79.6%	52.8%	87.1%	76.1%
35.0%	74.4%	57.4%	85.5%	57.8%	85.3%	78.2%
40.0%	79.8%	49.3%	89.9%	62.9%	83.6%	79.5%
45.0%	84.0%	41.6%	92.9%	67.2%	82.1%	79.7%
50.0%	87.6%	34.2%	95.2%	71.1%	80.7%	79.5%
55.0%	90.4%	27.5%	96.6%	74.0%	79.4%	78.8%
60.0%	92.8%	21.3%	97.7%	76.3%	78.2%	78.0%
65.0%	94.7%	16.2%	98.5%	78.8%	77.2%	77.3%
70.0%	96.4%	11.5%	99.1%	81.4%	76.4%	76.5%
75.0%	97.6%	8.0%	99.5%	84.8%	75.7%	75.9%
80.0%	98.7%	4.5%	99.7%	86.1%	75.1%	75.2%
85.0%	99.4%	2.0%	99.9%	88.8%	74.6%	74.7%
90.0%	99.8%	0.6%	100.0%	91.1%	74.4%	74.4%
95.0%	100.0%	0.0%	100.0%	NA	74.2%	74.2%

Table S14. Parameters of the lean Logistic Regression model

Variable name	Variable label	Level label (for categorical variables)	Coefficient
(Intercept)	Intercept		-1.569684488
ac012_	How satisfied with life (0-10)		-0.082632715
ac014_	Age prevents from doing things	Often	NA
		Sometimes	-0.070235536
		Rarely	-0.112238064
		Never	-0.119382339
		Refusal, Don't know	-0.073342458
ac015_	Out of control	Often	NA
		Sometimes	-0.01644892
		Rarely	-0.034512923
		Never	-0.036567913
		Refusal, Don't know	-0.028313677
ac016_	Feel left out of things	Often	NA
		Sometimes	-0.014727308
		Rarely	-0.032582273
		Never	-0.039128191
		Refusal, Don't know	-0.032902826
ac018_	Family responsibilities prevent	Often	NA
		Sometimes	-0.022884612
		Rarely	-0.03153039
		Never	-0.028769917
		Refusal, Don't know	-0.027373482
ac023_	Feel full of energy	Often	NA
		Sometimes	0.097926114
		Rarely	0.196039422
		Never	0.258890406
		Refusal, Don't know	0.114166859
ac025_	Future looks good	Often	NA
		Sometimes	0.034078299
		Rarely	0.075983233
		Never	0.129124295
		Refusal, Don't know	0.040423644
ac035d8	Activities: read books, magazines or newspapers	Not selected	NA
		Selected	-0.036230409
		Refusal, Don't know	-0.017419981
ac035dno	Activities: none of these	Not selected	NA
		Selected	0.114469785
		Refusal, Don't know	0.041472538
age_int	Age of respondent at the time of interview		0.009826092
dn042_	Male or female	Male	NA
		Female	0.305720876

euro1	Depression(part of EURO-D)	Not selected	NA
		Selected	0.348291054
		Refusal, Don't know	0.253195884
euro2	Pessimism (part of EURO-D)	Not selected	NA
		Selected	0.10752787
		Refusal, Don't know	-0.003710662
euro3	Suicidality (part of EURO-D)	Not selected	NA
		Selected	0.612325836
		Refusal, Don't know	0.173903666
euro4	Guilt (part of EURO-D)	Not selected	NA
		Selected	0.215307443
		Refusal, Don't know	-0.041593426
euro5	Sleep (part of EURO-D)	Not selected	NA
		Selected	0.321935682
		Refusal, Don't know	0.006301006
euro7	Irritability (part of EURO-D)	Not selected	NA
		Selected	0.310909841
		Refusal, Don't know	0.039534245
euro8	Appetite (part of EURO-D)	Not selected	NA
		Selected	0.064521096
		Refusal, Don't know	0.004589326
euro9	Fatigue (part of EURO-D)	Not selected	NA
		Selected	0.276062148
		Refusal, Don't know	0.127502575
euro10	Concentration (part of EURO-D)	Not selected	NA
		Selected	0.199811334
		Refusal, Don't know	0.141310693
euro11	Enjoyment (part of EURO-D)	Not selected	NA
		Selected	0.135391297
		Refusal, Don't know	0.044612903
euro12	Tearfulness (part of EURO-D)	Not selected	NA
		Selected	0.302829665
		Refusal, Don't know	0.223054783
mh037_	How much of the time do you feel lonely	Often	NA
		Some of the time	-0.128047962
		Hardly ever or never	-0.231110147
		Refusal, Don't know	-0.168425057
ph048d1	Difficulties: walking 100 metres	Not selected	NA
		Selected	0.03849232
		Refusal, Don't know	0.034126473
ph048d4	Difficulties: climbing several flights of stairs	Not selected	NA
		Selected	0.020329544
		Refusal, Don't know	0.029348121
ph048d5	Difficulties: climbing one flight of stairs	Not selected	NA

		Selected	0.019925564
		Refusal, Don't know	0.019376827
ph048d9	Difficulties: lifting or carrying weights over 5 kilos	Not selected	NA
		Selected	0.053470054
		Refusal, Don't know	0.067193892
ph048dno	Difficulties: none of these	Not selected	NA
		Selected	-0.102847227
		Refusal, Don't know	0.084960562
ph049dno	Difficulties: none of these	Not selected	NA
		Selected	-0.08152144
		Refusal, Don't know	0.015970032
ph084_	Troubled with pain	Yes	NA
		No	-0.161553233
		Refusal, Don't know	0.177144755
ph089d3	Bothered by frailty: dizziness, faints or blackouts	Not selected	NA
		Selected	0.094407006
		Refusal, Don't know	0.089280592
ph089d4	Bothered by frailty: fatigue	Not selected	NA
		Selected	0.085728248
		Refusal, Don't know	0.094836464

Table S15. Parameters of the full Logistic Regression model

Variable name	Variable label	Level value (for categorical variables)	Level label (for categorical variables)	Coefficient
(Intercept)	Intercept			-1.403103451
ac012_	How satisfied with life (0-10)			-0.050823141
ac014_	Age prevents from doing things	1	Often	NA
		2	Sometimes	-0.093481012
		3	Rarely	-0.183092274
		4	Never	-0.21016991
		NA	Refusal, Don't know	-0.121387235
ac015_	Out of control	1	Often	NA
		2	Sometimes	-0.041355898
		3	Rarely	-0.11683821
		4	Never	-0.110823028
		NA	Refusal, Don't know	-0.130523035
ac016_	Feel left out of things	1	Often	NA
		2	Sometimes	-0.039589753
		3	Rarely	-0.085607506
		4	Never	-0.109295333
		NA	Refusal, Don't know	-0.137485859
ac017_	Do the things you want to do	1	Often	NA
		2	Sometimes	0.010455102
		3	Rarely	0.000963282
		4	Never	-0.005145925
		NA	Refusal, Don't know	0.002487828
ac018_	Family responsibilities prevent	1	Often	NA
		2	Sometimes	-0.21201855
		3	Rarely	-0.319782023
		4	Never	-0.278466306
		NA	Refusal, Don't know	-0.356127972
ac020_	Look forward to each day	1	Often	NA
		2	Sometimes	0.093065478
		3	Rarely	0.160342797
		4	Never	0.024433672
		NA	Refusal, Don't know	0.278991635
ac022_	Look back on life with happiness	1	Often	NA
		2	Sometimes	0.018823206
		3	Rarely	0.163559561
		4	Never	0.091016824
		NA	Refusal, Don't know	-0.032816065
ac023_	Feel full of energy	1	Often	NA

		2	Sometimes	0.162536201
		3	Rarely	0.234453264
		4	Never	0.232689277
		NA	Refusal, Don't know	0.198301718
ac024_	Full of opportunities	1	Often	NA
		2	Sometimes	-0.022484703
		3	Rarely	-0.027487219
		4	Never	0.027674332
		NA	Refusal, Don't know	-0.04705983
ac025_	Future looks good	1	Often	NA
		2	Sometimes	0.062396783
		3	Rarely	0.111165903
		4	Never	0.203430631
		NA	Refusal, Don't know	0.053891557
ac035d4	Activities: attended an educational or training course	0	Not selected	NA
		1	Selected	-0.011026556
		NA	Refusal, Don't know	0.000282084
ac035d5	Activities: gone to a sport, social or other kind of club	0	Not selected	NA
		1	Selected	-0.05770632
		NA	Refusal, Don't know	-0.005419572
ac035d6	Activities: taken part in activities of a religious organization	0	Not selected	NA
		1	Selected	0.012190919
		NA	Refusal, Don't know	-0.101597934
ac035d8	Activities: read books, magazines or newspapers	0	Not selected	NA
		1	Selected	-0.080148661
		NA	Refusal, Don't know	-0.047242838
ac035d9	Activities: did word or number games (crossword puzzles/Sudoku...)	0	Not selected	NA
		1	Selected	-0.076728691
		NA	Refusal, Don't know	-0.017879383
ac035dno	Activities: none of these	0	Not selected	NA
		1	Selected	0.076951981
		NA	Refusal, Don't know	0.021366565
age_int	Age of respondent at the time of interview			0.012099989
br002_	Smoke at the present time	1	Yes	NA
		5	No	0.016699223
		NA	Refusal, Don't know	0.01409556
ch021_	Number of grandchildren			0.007169855
co007_	Is household able to make ends meet	1	With great difficulty	NA
		2	With some difficulty	0.000867151
		3	Fairly easily	-0.001155125
		4	Easily	-0.005458357
		NA	Refusal, Don't know	4.77E-05
co201_	Afford to regularly buy necessary groceries	1	Yes	NA

		5	No	0.030023868
		NA	Refusal, Don't know	0.015210172
dn014_	Marital status	1	Married and living together with spouse	NA
		2	Registered partnership	-0.012463655
		3	Married, living separated from spouse	-0.017810289
		4	Never married	-0.015714264
		5	Divorced	-0.007795463
		6	Widowed	-3.51E-03
		NA	Refusal, Don't know	0.001059164
dn041_	Years education			-0.005533022
dn042_	Male or female	1	Male	NA
		2	Female	0.410113384
ep005_	Current job situation	1	Retired	NA
		2	Employed or self-employed	0.000154496
		3	Unemployed	9.07E-06
		4	Permanently sick or disabled	0.000560251
		5	Homemaker	0.002592403
		97	Other	0.005318765
		NA	Refusal, Don't know	7.40E-05
euro1	Depression(part of EURO-D)	0	Not selected	NA
		1	Selected	0.359583582
		NA	Refusal, Don't know	0.547412708
euro10	Concentration (part of EURO-D)	0	Not selected	NA
		1	Selected	0.193534132
		NA	Refusal, Don't know	0.233816975
euro11	Enjoyment (part of EURO-D)	0	Not selected	NA
		1	Selected	0.237117742
		NA	Refusal, Don't know	0.138983028
euro12	Tearfulness (part of EURO-D)	0	Not selected	NA
		1	Selected	3.65E-01
		NA	Refusal, Don't know	0.56251175
euro2	Pessimism (part of EURO-D)	0	Not selected	NA
		1	Selected	0.170163577
		NA	Refusal, Don't know	-0.101538468
euro3	Suicidality (part of EURO-D)	0	Not selected	NA
		1	Selected	0.669972863
		NA	Refusal, Don't know	0.284048411
euro4	Guilt (part of EURO-D)	0	Not selected	NA
		1	Selected	0.425191812
		NA	Refusal, Don't know	-0.378299081
euro5	Sleep (part of EURO-D)	0	Not selected	NA
		1	Selected	4.03E-01
		NA	Refusal, Don't know	-0.299066751

euro7	Irritability (part of EURO-D)	0	Not selected	NA
		1	Selected	0.39072432
		NA	Refusal, Don't know	-0.116582254
euro8	Appetite (part of EURO-D)	0	Not selected	NA
		1	Selected	0.155593463
		NA	Refusal, Don't know	-0.003082228
euro9	Fatigue (part of EURO-D)	0	Not selected	NA
		1	Selected	0.246495187
		NA	Refusal, Don't know	0.095312714
hc029_	In a nursing home during last 12 months	1	Yes, temporarily	NA
		3	Yes, permanently	-0.028614797
		5	No	-0.014210207
		NA	Refusal, Don't know	-0.014800862
hc114_	Could not see a doctor because of cost	1	Yes	NA
		5	No	-0.016094115
		NA	Refusal, Don't know	0.003836965
hc115_	Could not see a doctor because of long waiting times	1	Yes	NA
		5	No	-0.007203951
		NA	Refusal, Don't know	0.012036407
iv009_	Which area building located	0	NA	NA
		1	A big city	6.70E-03
		NA	Refusal, Don't know	0.006637437
mh037_	Feels lonely	1	Often	NA
		2	Some of the time	-0.109559711
		3	Hardly ever or never	-2.45E-01
		NA	Refusal, Don't know	-0.14707785
ph003_	Health in general question 2	1	Excellent	NA
		2	Very good	-0.007222592
		3	Good	0.019743617
		4	Fair	0.091581155
		5	Poor	0.089038475
		NA	Refusal, Don't know	0.357516367
ph006d12	Doctor told you had: parkinson disease	0	Not selected	NA
		1	Selected	0.235386542
		NA	Refusal, Don't know	0.141680407
ph006d6	Doctor told you had: chronic lung disease	0	Not selected	NA
		1	Selected	0.109593298
		NA	Refusal, Don't know	0.187604942
ph009_18	Age affective or emotional disorders	0	NA	NA
		1	NA	-0.243692613
		NA	Refusal, Don't know	-0.335914779
ph011d10	Drugs for: anxiety or depression	0	Not selected	NA
		1	Selected	0.02915536
		NA	Refusal, Don't know	0.030612444

ph011d13	Drugs for: stomach burns	0	Not selected	NA
		1	Selected	0.062778613
		NA	Refusal, Don't know	0.079201606
ph011d14	Drugs for: chronic bronchitis	0	Not selected	NA
		1	Selected	0.126097704
		NA	Refusal, Don't know	0.090742837
ph011d2	Drugs for: high blood pressure	0	Not selected	NA
		1	Selected	0.000748972
		NA	Refusal, Don't know	0.001874703
ph011d7	Drugs for: joint pain	0	Not selected	NA
		1	Selected	0.012872215
		NA	Refusal, Don't know	0.022293418
ph011d9	Drugs for: sleep problems	0	Not selected	NA
		1	Selected	0.011713645
		NA	Refusal, Don't know	0.014039849
ph043_	Eyesight distance	1	Excellent	NA
		2	Very good	0.003402853
		3	Good	-0.01555768
		4	Fair	0.038317638
		5	Poor	0.087325532
		NA	Refusal, Don't know	-0.136421591
ph044_	Eyesight reading	1	Excellent	NA
		2	Very good	-0.118810528
		3	Good	-0.027158431
		4	Fair	-0.08302524
		5	Poor	0.047754977
		NA	Refusal, Don't know	0.189179526
ph046_	Hearing	1	Excellent	NA
		2	Very good	-0.023187967
		3	Good	-0.009045551
		4	Fair	0.004380057
		5	Poor	-0.014981585
		NA	Refusal, Don't know	-0.054819146
ph048d1	Difficulties: walking 100 metres	0	Not selected	NA
		1	Selected	0.072715335
		NA	Refusal, Don't know	0.011403802
ph048d2	Difficulties: sitting two hours	0	Not selected	NA
		1	Selected	0.008998522
		NA	Refusal, Don't know	0.001544335
ph048d3	Difficulties: getting up from chair	0	Not selected	NA
		1	Selected	0.002012775
		NA	Refusal, Don't know	0.000551105
ph048d5	Difficulties: climbing one flight of stairs	0	Not selected	NA
		1	Selected	0.014182542
		NA	Refusal, Don't know	0.002573389

ph048d9	Difficulties: lifting or carrying weights over 5 kilos	0	Not selected	NA
		1	Selected	0.016131221
		NA	Refusal, Don't know	0.004406993
ph048dno	Difficulties: none of these	0	Not selected	NA
		1	Selected	-0.099390313
		NA	Refusal, Don't know	-0.041829315
ph049d11	Difficulties: taking medications	0	Not selected	NA
		1	Selected	0.065194322
		NA	Refusal, Don't know	-0.005026299
ph049d7	Difficulties: using a map in a strange place	0	Not selected	NA
		1	Selected	0.05843061
		NA	Refusal, Don't know	-0.008297206
ph049dno	Difficulties: none of these	0	Not selected	NA
		1	Selected	-0.053901126
		NA	Refusal, Don't know	-0.061148006
ph065_	Check: lost weight	1	Yes	NA
		5	No	-0.021363838
		NA	Refusal, Don't know	0.185060181
ph084_	Troubled with pain	1	Yes	NA
		5	No	-0.158108418
		NA	Refusal, Don't know	0.133203458
ph089d3	Bothered by frailty: dizziness, faints or blackouts	0	Not selected	NA
		1	Selected	0.171531618
		NA	Refusal, Don't know	-0.046745999
ph089d4	Bothered by frailty: fatigue	0	Not selected	NA
		1	Selected	0.10091171
		NA	Refusal, Don't know	-0.02719304
recent_bereavement	NA	FALSE	NA	NA
		NA	NA	0.019147829
		TRUE	NA	-0.380726481
sp002_	Received help from others (outside hh)	1	Yes	NA
		5	No	-0.015927602
		NA	Refusal, Don't know	0.003552627

Table S16. Performance of other RPMs for comparison on the combined sample

	DRAT-up	Okamoto-Harasawa	Depression (yes/no) at baseline
AUC (95% CI)	0.743 (0.738 - 0.749)	0.657 (0.650 - 0.662)	0.701 (0.695 – 0.705)
MSE (95% CI)	0.174 (0.172 - 0.176)	--	--
Sensitivity	77%	--	55%
Specificity	60%	--	85%
PPV	40%	--	56%
NPV	88%	--	85%

Table S17. Drat up model validated on the combined sample

Risk threshold	Population below threshold	Sensitivity	Specificity	PPV	NPV	Accuracy
5%	0%	100%	0%	26%	NA	26%
10%	0%	100%	0%	26%	NA	26%
15%	27%	91%	33%	32%	91%	48%
20%	51%	77%	60%	40%	88%	65%
25%	71%	56%	80%	49%	84%	74%
30%	83%	38%	90%	57%	81%	77%
35%	94%	17%	97%	69%	77%	77%
40%	100%	0%	100%	64%	74%	74%
45%	100%	0%	100%	0%	74%	74%
50%	100%	0%	100%	NA	74%	74%
55%	100%	0%	100%	NA	74%	74%
60%	100%	0%	100%	NA	74%	74%
65%	100%	0%	100%	NA	74%	74%
70%	100%	0%	100%	NA	74%	74%
75%	100%	0%	100%	NA	74%	74%
80%	100%	0%	100%	NA	74%	74%
85%	100%	0%	100%	NA	74%	74%
90%	100%	0%	100%	NA	74%	74%
95%	100%	0%	100%	NA	74%	74%

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