Chapter 3

Symptom dimensions and subscales of the Inventory of Depressive Symptomatology Self Report (IDS-SR) in older persons

J.M. Hegeman*
K.J. Wardenaar*
H.C. Comijs
M.W.M. de Waal
R.M. Kok
R.C. van der Mast

Journal of Psychiatric Research 2012; 46:1383-1388

* These authors contributed equally as shared first authors

Abstract

Background

Using symptom dimensions may be more effective than using categorical subtypes when investigating clinical outcome and underlying mechanisms of late-life depression. Therefore, this study aims to identify both the factor and subscale structure of late-life depression underlying the Inventory of Depressive Symptomatology Self Report (IDS-SR) in older persons.

Method

IDS-SR data of 423 participants in the Netherlands Study of Depression in Older Persons (NESDO) were analyzed by exploratory (EFA) and confirmatory factor analysis (CFA). The best-fitting factor solution in a group of older persons with a major depressive disorder diagnosis in the last month (n=229) was replicated in a control group of older persons with no or less severe depression (n=194). Multiple group (MG-CFA) was performed to evaluate generalizability of the best-fitting factor solution across subgroups, and internal consistency coefficients were calculated for each factor.

Results

EFA and CFA show that a 3-factor model fits best to the data [comparative fit index (CFI)=0.98; Tucker Lewis Index (TLI)=0.99; and root mean square error of approximation (RMSEA)=0.052], consisting of a 'mood', 'motivation' and 'somatic' factor with adequate internal consistencies (alpha coefficient 0.93, 0.83 and 0.70, respectively). MG-CFA shows a structurally similar factor model across subgroups.

Conclusion

The IDS-SR can be used to measure three homogeneous symptom dimensions that are specific to older people. Application of these dimensions that may serve as subscales of the IDS-SR may benefit both clinical practice and scientific research.

Introduction

In many aspects, late-life depression is a heterogeneous disorder that has a negative effect on the quality of life in older persons. Unfortunately, research has been unable to identify underlying etiological mechanisms of (late-life) depression which could serve as a target for novel treatments.[1] This might (in part) be due to the common use of the overly restrictive diagnostic DSM-IV categories, which are problematic for reasons related to e.g. comorbidity, arbitrary boundaries and diagnostic heterogeneity.[1-4] Moreover, the applicability and validity of the DSM-IV diagnoses, including depression, might be even more problematic in older persons. The DSM classification tends to focus on younger persons and takes little account of changes in symptomatology that may be seen with aging, such as less expression of sadness and a more pronounced role of somatic symptoms.[5-7] Consequently, using solely DSM-IV diagnoses in older persons may lead to undiagnosed late-life depression.[8,9]

A promising approach to improve recognition of late-life depression, and the search for underlying mechanisms, would be to focus more on the variations in symptomatology in older persons with depression. To reveal such variations in symptomatology in late-life depression, different methodological approaches can be used. A *categorical* approach using latent class analysis aims to define *subtypes* of late-life depression based on clustering of persons with similar characteristics. Such research has revealed several clusters of older depressed persons, which differed mainly by overall symptom severity as well as the nature of the depressive symptoms, such as somatic symptoms and suicidal thoughts.[10,11]

However, it is argued that a *dimensional* approach may offer additional benefits compared with a categorical approach. A *symptom dimension* can be defined as a continuous spectrum of severity on a specific symptom domain of late-life depression. In a *symptom profile* various symptom dimensions are used together to describe an individual's clinical picture. Advantages of a dimensional approach, as opposed to a categorical approach, include its high diagnostic specificity in combination with its continuous nature, which increases statistical power to detect small effects.[12] In addition, dimensions do more justice to the continuous distribution of psychopathology in the general population as no fixed threshold is set between ill and non-ill, preventing the exclusion from analyses of individuals with sub-threshold, but clinically relevant, symptoms. Conveniently, symptom dimensions and symptom profiles offer a way to circumvent categorical co-morbidity.[13] Therefore, using *symptom dimensions* may be more effective than using categorical *subtypes* when investigating underlying mechanisms of late-life depression.[1,13-15]

A practical method for defining dimensions of late-life depression is to use existing depression measures that are widely administered. Factor analytical studies of these psychiatric measures to identify symptom domains are available for the adult psychiatric

population,[14] but are less frequent for older persons with late-life depression.[16,17]

A widely-used instrument that covers both the key symptoms of depression and somatic/vegetative symptoms is the Inventory of Depressive Symptomatology Self Report (IDS-SR), originally developed to measure severity of overall depression (www.ids-qids.org).[18] Factor analytical studies of the IDS-SR in younger persons revealed different numbers of symptom domains with considerable overlap.[18-21] Recently, in younger persons a 3-factor model was found to have optimal fit, including a 'mood/cognition', an 'anxiety/arousal' and a 'sleep' symptom domain.[22] However, as age-related features may cause heterogeneity in the phenomenology of late-life depression, symptom dimensions found in younger persons cannot be generalized to older persons.

Therefore, the present study explores the factor structure of the IDS-SR at old age using an integrated approach of exploratory and (multiple group) confirmatory factor analyses (EFA and CFA) in two different samples of older persons (total n=423). Also, the question as to whether the resulting factors could serve as more specific subscales of the IDS-SR to measure symptom dimensions is being examined.

Methods

Participants

Data were obtained from the baseline assessment of the Netherlands Study of Depression in Older Persons (NESDO). The NESDO is a multi-site naturalistic cohort study, aimed to examine the course and consequences of depressive disorders in older persons. The study design of the NESDO is described in detail elsewhere.[23] From 2007 until 2010, 378 depressed (diagnoses within the last 6 months according to the DSM-IV criteria) and 132 non-depressed persons aged 60-93 years were recruited from mental healthcare and primary healthcare settings to create a sample reflecting all different stages of the disease (total n=510). Excluded were persons with a Mini Mental State Examination score (MMSE) under 19, a primary diagnosis of dementia and insufficient command of the Dutch language. The study protocol of NESDO was approved by the ethical review boards of all participating study centers.

All participants with complete data on the IDS-SR were included in our analyses (n=423) and divided into two non-overlapping study groups: persons with a DSM-IV diagnosis of major depressive disorder (MDD) diagnosis during the last month (Group 1: n=229), and a control group consisting of healthy older persons and older persons with a minor depressive, dysthymic or anxiety disorder, according to the DSM-IV (Group 2: n=194). Group 1 was used to explore the factor structure of the IDS-SR and Group 2 was used to independently replicate this factor solution.

In Group 1, of all 275 participants in NESDO with a MDD diagnosis during the last month, 46 (16.7%) were excluded because of missing responses on the IDS-SR, leaving a total of 229 participants. For the same reason, of the 235 participants in Group 2, 41 (17.4%) were excluded, resulting in a total of 194 participants. We decided not to impute missing data, as new sources of bias cannot be ruled out, and the sample size would still remain adequate. Participants with incomplete data on the IDS-SR were more often women (p=0.002) and had marginally fewer years of education (p=0.022) compared to included participants of the pooled sample.

Instruments

Demographic information was assessed with standard questions concerning age, gender and years of education. The Composite International Diagnostic Interview (CIDI; WHO version 2.1; lifetime version) was used to assess the presence of a depressive disorder (major depression, dysthymia and minor depression) or anxiety disorder (panic disorder, agoraphobia, social phobia and generalized anxiety disorder) according to the DSM-IV criteria in the month prior to the measurement day.

All participants were administered the Dutch translation of the IDS-SR.[18] In the IDS-SR, items are scored on a four-point scale, with each item equally weighted and summed to a total score. A higher total score indicates more serious depression with a maximum score of 84. The item pairs 11-12 and 13-14 were each rescored into one variable: '11/12: change of appetite' and '13/14: change of weight', respectively. This was done because each subject can only endorse one possibility of each item pair (e.g. either increased or decreased appetite).

Statistical analyses

Exploratory factor analysis

To investigate the factor structure of the IDS-SR, in Group 1 we performed exploratory factor analysis (EFA) on a matrix of polychoric correlations. To determine the number of factors, the resulting Eigen Values were compared with Eigen Values extracted from 1000 random data sets that paralleled the original data set (same N, same number of variables). In this *parallel analysis*, the number of factors was determined by finding the last factor with an Eigen Value that was higher than the 95th percentile random Eigen Value (using the SPSS syntax, provided by O'Connor, 2000).[24] The extracted factors were rotated to simple structure using an oblique rotation method (PROMAX), allowing for inter-correlated factors. The EFA was conducted with Mplus 5.1.[25] Random Eigen Value were generated with SPSS 17.0.

Confirmatory factor analysis

CFA was used to evaluate the fit of the EFA model in Group 2. In the input model, all factors

were allowed to co-vary freely. On each factor, all factor loadings were set to be free, except for one item per factor that had its loading fixed to 1 to set the scale of the model. Because the items were categorical and had a skewed distribution, fit was determined with a Weighted Least Squares (WLSMV) estimator, based on polychoric correlation matrices using a diagonal weight matrix with standard errors, and mean- and variance adjusted chi-square test statistics that use a full weight matrix.[25] Because WLSMV is intended for categorical data, it estimates the threshold locations between adjacent categories of each indicator variable instead of single intercepts, which are only informative for continuous indicator variables.[25] Several fit indices were used to evaluate model fit: the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA). A CFI and TLI >0.90 indicates adequate fit (>0.95 indicates good fit). An RMSEA <0.08 indicates adequate fit (<0.06 indicates good fit), with values approaching zero indicating better fit.

Multiple group confirmatory factor analyses

To evaluate the generalizability of the model across different population-strata, multiple group CFA (MG-CFA) was performed with gender and age (<70 years/≥70 years). Different MG-CFA models with increasing constraint were fit to the data in sample 2. First, models were fit without restrictions across groups (e.g. men and women) to test fit of the basic model structure. Second, models were fit with the constraint of equal thresholds across groups. Third, models were fit with thresholds and factor loadings constrained across groups. Fourth, models were fit with thresholds, factor loadings and (co)variances constrained across groups. To determine whether model constraints resulted in a significant change of model fit, the DIFFTEST procedure of Mplus was used. When using WLSMV, a regular χ^2-difference test is not possible because the distribution of the difference does not follow a normal χ^2 distribution. The DIFFTEST procedure was developed to enable difference testing with WLS estimated nested models.[26] A significant difference in model fit when constraints are applied ($p<0.05$) indicates that the model parameters differ across subsamples. All MG-CFAs were conducted with Mplus version 5.[25]

Internal Consistency

Internal consistency coefficients (alpha's) were computed for each of the factors, using the computation method for ordinal data based on polychoric correlations (computed with EQS; Multivariate software Inc, Encino, CA, USA) between the items (following Zumbo et al., 2007; Gadermann *et al*, 2012).[27,28] An alpha ≥0.70 was considered to indicate adequate internal consistency.

Results

Demographic and psychiatric characteristics

The demographic and psychiatric characteristics of both study groups are presented in Table 1. In Group 1, all participants had MDD and 107 participants (46.7%) also had an anxiety disorder. In Group 2, 22 participants (11.3%) had a dysthymic or minor depressive disorder and 16 participants (8.2%) had an anxiety disorder. The mean total IDS-SR score in Group 1 was 32.7 (SD=12.4) and in Group 2 was 14.4 (SD=11.8), indicating a considerable difference in overall depression severity.

Table 1. Demographic and psychiatric characteristics of the two study groups.

Sample	Group 1 (n=229)	Group 2 (n=194)
Mean age in years (SD)	70.2 (7.2)	70.4 (7.2)
Age range (years)	60-80	60-93
Women (%)	141 (61.6%)	121 (62.4%)
Mean years of education (SD)	10.5 (3.4)	11.8 (3.7)
Depressive disorders in past month, n (%)		
Dysthymia	69 (30.1%)	5 (2.6%)
Minor depression	1 (0.4%)	17 (8.8%)
Major depression	229 (100%)	0
Anxiety disorders in past month, n (%)		
Panic with agoraphobia	21 (9.2%)	4 (2.1%)
Social phobia	38 (16.6%)	6 (3.1%)
Panic without agoraphobia	9 (3.9%)	0
Agoraphobia	20 (8.7%)	0
Generalized anxiety disorder	24 (10.5%)	6 (3.1%)
IDS-SR total score, mean (SD)	32.7 (12.4)	14.4 (11.8)

IDS-SR = Inventory of Depressive Symptomatology-Self Report

Exploratory factor analyses

Parallel analysis in Group 1 suggested the retention of 3 factors (see Table 2). After rotation, the model consisted of one factor with mostly mood items (9 items, ´Mood´), a factor with mostly motivational items (5 items, ´Motivation´), and a factor with somatic symptom items

Table 2. Factor-loadings in a 3-factor model of the IDS-SR in group 1 with MDD in last month (n=229).

IDS-SR item		Somatic	Mood	Motivation
25	Aches and pains	**0.64**	-0.11	-0.17
26	Sympathetic arousal	**0.59**	0.05	-0.08
3	Early morning awakening	**0.56**	0.03	0.13
22	Interest in sex	**0.41**	-0.02	-0.29
1	Initial insomnia	**0.35**	0.24	0.15
2	Middle insomnia	**0.34**	0.16	0.14
11/12	Appetite disturbance	**0.29**	0.14	-0.07
13/14	Weight disturbance	**0.30**	-0.08	-0.03
5	Feeling sad	0.05	**0.83**	-0.01
6	Feeling irritable	-0.04	**0.74**	0.05
7	Feeling anxious or tense	0.34	**0.60**	0.14
8	Reactivity of mood	0.02	**0.58**	-0.11
10	Quality of mood	0.01	**0.51**	0.00
29	Interpersonal sensitivity	-0.09	**0.51**	-0.10
17	Future pessimism	0.09	**0.48**	-0.20
27	Panic/phobic symptoms	0.30	**0.45**	-0.07
18	Suicidal thoughts	0.13	**0.39**	-0.16
16	Self-criticism and blame	0.02	0.28	**-0.43**
23	Psychomotor retardation	0.01	0.20	**-0.45**
4	Sleeping too much	-0.29	-0.03	**-0.46**
19	Interest in people/activities	-0.11	0.24	**-0.65**
20	Energy/fatiguability	0.25	-0.16	**-0.72**
30	Leaden paralysis/physical energy	0.44	-0.03	-0.43
21	Pleasure or enjoyment (not sex)	0.12	0.41	-0.36
15	Concentration/decision making	0.00	0.30	-0.37
28	Constipation/diarrhoea	0.26	-0.12	-0.30
24	Psychomotor agitation	0.22	0.17	-0.23
9	Diurnal variation of mood	-0.03	0.11	-0.12
EFA Eigen Value		8.003	1,979	1,598 (1,470)*
Random Eigen Value		1,784	1,638	1,548 (1,473)*

Factor Analysis based on polychoric correlations. IDS-SR = Inventory of Depressive Symptomatology-Self Report; the primary loading for each item is printed **bold**. MDD = Major Depressive Disorder.
*) Eigen Values for the next highest factor.

(8 items, ´Somatic´). Six items (items 9, 15, 21, 24, 28 and 30) loaded on more than one item and were therefore not included in the subsequent factor model. The Somatic and Mood factors were positively correlated (r=0.48). Both of these factors were negatively correlated with the Motivation factor (r=-0.31 and r=-0.53), indicating that the third factor represents 'presence of motivation' instead of 'lack of motivation'. These factor-correlations indicated sufficient differentiation between the factors.

Confirmatory factor analyses

The CFA results are shown in Table 3. CFA in the complete sample 2 (n=194) showed that the EFA-identified factor structure fit the data well (CFA=0.98, TLI=0.99, RMSEA=0.052).

Table 3. Confirmatory factor analyses of a 3-factor structure for the IDS-SR in a sample of older persons (n=194).

Analysis	Equality Constraints*:	CFI	TLI	RMSEA	Tested model differences	Δχ2(Δdf)**	p-value
Complete Sample	-	0.98	0.99	0.052	-	-	-
Males only	-	0.96	0.96	0.097	-	-	-
Females only	-	0.98	0.99	0.056	-	-	-
Multiple Group CFA: Gender	Unconstrained	0.96	0.96	0.070	-	-	-
	1.Thresholds	0.95	0.96	0.072	1 vs. unconstrained	33.25 (20)	0.03
	2.Thresholds + FL	0.96	0.97	0.064	2 vs. 1	11.50 (13)	0.57
	3. FL + thresholds + (co)variances	0.97	0.97	0.062	3 vs. 2	2.93 (3)	0.40
<70 years	-	0.98	0.99	0.062	-	-	-
≥70 years	-	0.97	0.97	0.079	-	-	-
Multiple Group CFA: Age	Unconstrained	0.96	0.97	0.070	-		
	1. Thresholds	0.96	0.97	0.062	1 vs. unconstrained	19.83 (23)	0.65
	2. Thresholds + FL	0.97	0.98	0.065	2 vs. 1	11.72 (12)	0.47
	3. FL + thresholds + (co)variances	0.97	0.97	0.061	3 vs. 2	79.18 (2)	0.06

CFI = Comparative Fit Index; TLI=Tucker Lewis Index; RMSEA=Root Mean Square Error of Approximation;

*) Constraints in CFA with polychoric correlations and model estimation with weighted least squares (WLSMV) for categorical non-normal data: Multiple Group CFA with equality constraints on item thresholds (instead of intercepts), factor loadings (FL) and (co)variances.

**) Difference testing based on the DIFFTEST procedure for nested models with WLSMV (Mplus 5).

Multiple group CFA

MG-CFA with gender-groups showed that model fit significantly changed when the item thresholds were constrained to be equal in men and women (p=0.03) (see Table 3). Subsequent constraints of the factor loadings and (co)variances across men and women did not further change model fit. These results indicated that only the thresholds of the items differed substantially across men and women. Inspections of the thresholds in the unconstrained model indeed revealed that some items had higher threshold of endorsement in men (e.g. feeling sad [item 5], interpersonal sensitivity [item 29]) and some items had higher thresholds in women (e.g. reactivity of mood [item 8]). However, for many item thresholds, gender differences were minimal (e.g. appetite change [item 12/13]). These results indicated that response tendencies of individual items can differ to a certain extent across gender. For the MC-CFA with age groups, Group 2 was split at the 50th age percentile into a '<70 years' group and a '≥70 years' group. Constraining the thresholds, factor loadings and (co)variances to be equal across these groups did not affect model-fit, indicating that these model-parameters could be generalized across the two different age-strata.

Internal consistency

All three factors had adequate internal consistencies, although the Mood and Motivation factors performed better than the Somatic factor. The internal consistencies were largely similar across gender and age-groups, except for the Somatic factor, which had and alpha of 0.60 in the >70 group.

Table 4. Internal consistency coefficients for the IDS-SR factors.

	IDS-SR factor		
Sample	Mood	Motivation	Somatic
Complete	0.93	0.83	0.70
Men	0.93	0.81	0.70
Women	0.93	0.84	0.72
Age ≤70	0.94	0.84	0.78
Age >70	0.92	0.83	0.60

Coefficients are alphas for ordinal data, based on polychoric correlations between the items in each factor. IDS-SR=Inventory of Depressive Symptomatology-Self Report.

Discussion

The present study aimed to define a factor model and specific subscales representing symptom dimensions of the IDS-SR in older persons. EFA resulted in a 3-factor solution of the IDS-SR, representing a distinct mood, motivation and somatic factor. The 3-factor solution, as found in a sample of older persons with MDD, was replicated with additional CFA in a sample of healthy and less severely depressed older persons. MG-CFA showed that the identified model was structurally similar across gender and age-groups, but response tendencies of some individual items can differ to a certain extent across gender. This should be taken into account when using symptom dimensions as subscales. Subsequent calculation of the ordinal alpha coefficients indicated that the factors could potentially serve as subscales of the IDS-SR in older persons with major depression, and in older persons who are less severely depressed, anxious, or healthy.

Regarding other depression measures, factor analytical studies in older persons showed both overlap and differences in the factor solutions compared to each other, and to our study.[16,17,29-34] In general, the present finding of a distinct mood symptom domain (including feelings of sadness) is in line with other studies,[33] whereas other symptoms, such as suicidal thoughts or anxiety, vary across the different mood symptom domains.[16,17,31]

In most cases, a separate symptom domain of somatic symptoms, or categorized as vegetative symptoms, was recognized in older persons. For example, our results are in line with factor analytical studies of the Hamilton Anxiety Rating Scale (HAM-A) in older persons with dysthymia[33] and of the HAM-D in physically ill older persons with major depression[31], both revealing a distinct somatic symptom domain. Similarly, factor analysis of the MADRS in an older population with major depression showed a 3-factor structure with a distinct symptom domain of vegetative symptoms,[17] whereas an 'anxiety-vegetative' symptom domain was found in an older population with major depression and mild cognitive impairment[16]. Again, a somatic symptom domain was found for the Center for Epidemiological Studies Depression Scale (CES-D) in an older general population, besides symptom domains concerning depressed affect, positive affect and interpersonal problems.[34] Our results also show, in line with previous research that somatic symptoms seem to manifest themselves independently from other symptom domains in older patients. However, the relatively low observed internal consistency of the somatic subscale compared to the other subscales may be a consequence of a less homogeneous content due to overlap of the somatic symptoms of depression and medical comorbidity. Also, internal consistency of the somatic subscale was markedly decreased in the age group ≥70 years, indicating that the properties of the somatic factor as a subscale changes with age.

Regarding our motivation symptom domain, the items 'energy/fatiguability' and 'interest

in people/activities' resemble apathy symptoms, which is in line with the withdrawal-apathy-vigor factor of the 30-item Geriatric Depression Scale (GDS).[35] At the same time, the factor dysphoric mood showed little overlap with our finding, but other symptom domains of the GDS, such as hopelessness, cognitive impairment and anxiety, were not found in our study.[29] Furthermore, factor analyses of the SCL-90-R Depression and Additional Symptom Scale in a community-based sample of older women revealed a depletion symptom domain corresponding to our motivation symptom domain, but feelings of guilt and self-blame were related to a depressive symptom domain.[32] A separate motivation symptom domain was not found for the MADRS as only the item 'lassitude' of this scale reflects apathy.[16,17,33]

As hypothesized in the Introduction, the factors identified in our population of older persons differed from those found earlier in younger persons.[22] In younger persons a 'mood/cognition' and 'anxiety/arousal' factor were found, whereas in our study among older persons a 'mood' factor and separate factors concerning motivation and somatic symptoms were found. The 'mood/cognition' factor found in younger persons differed mainly from our 'mood' subscale by including motivation items and cognitive items such as interest in people/activities, energy/fatiguability, concentration/decision making and self-criticism and blame. Anxiety items were exclusively related to the mood factor in older persons in contrast to younger persons. The item 'psychomotor retardation' was included in the 'motivation' factor in older persons, whereas in younger persons it was included in the 'anxiety/arousal' factor. Importantly, these results of identical studies in a younger and older population may indicate that late-life depression is made up of different symptom domains compared to early-life depression, and may thus have partly different underlying aging-related aetiologies. For example, it has been found that psychomotor retardation and motivational symptoms were related to vascular and neurodegenerative risk-indicators, whereas suicidal thoughts, sleep and appetite disturbances were related to inflammatory risk-indicators.[36] Other factor analytical studies of the IDS-SR in a younger population resulted in factor solutions that show partial overlap with our mood and somatic symptom domains, but again did not comprise a distinct motivation factor.[18,19] Similarly, a meta-analyses of the factor structures of the CES-D, HAM-D, Beck Depression inventory (BDI) and Zung Self-Rating Depression Scale (SRDS) in a younger population revealed a mood and somatic factor for all four instruments; but, again, a separate motivation factor was not found and the somatic factor of the CES-D was not in line with ours.[14] Therefore, the presently observed distinction between mood and motivation related symptoms could be typical for older persons.

Although the ongoing debate as to whether age affects the phenomenology of depression remains inconclusive,[5] our results seem to support the view that age does have an impact. Moreover, in a recent meta-analysis, a partly different phenomenology was found in late-life compared to early-life depression, with older adults showing less guilt and more somatic symptoms.[6] In addition, not only age at the current depressive episode but also

age at onset of a first episode may affect the phenomenology of late-life depression.[37] In contrast to our finding of an age-specific dimensional structure of depression, no age-specific subtypes were found using a categorical approach with latent class analysis in a population of middle-aged and older depressed persons.[38]

An important issue in diagnosing late-life depression is the overlap of somatic symptoms of depression and symptoms of age-related medical illness. The GDS was developed to measure depression in older adults, in part by leaving out somatic symptoms to prevent overestimation of depression severity due to comorbid somatic illnesses.[39] Furthermore, it was shown that the MADRS was more appropriate in a medically ill older population compared to the HAM-D.[31] However, in order to effectively compare the phenomenology of depression between older and younger persons, it is more informative to use a measure that is broadly used in all age groups. Clearly, such an instrument should cover all main aspects of depression including depressive somatic symptoms, which is the case for the IDS-SR. Finally, the question arises whether a distinct somatic dimension partly represents age-related medical illnesses. It is reported that the role of somatic symptoms in old-age depression may be unbiased by age-related medical illnesses.[40,41] However, to answer this question, future research should compare healthy depressed older people and depressed older people with somatic comorbidity.

This study has several strengths. First, due to the substantial sample size, we were able to conduct EFA and CFA in independent samples and had enough data to conduct MG-CFA to check generalizability of the identified model across subgroups. Second, our results are generalizable to an extensive older population, as our sample reflects all different stages of depression, different healthcare settings, and a broad range of old age.

Some limitations also need mentioning. First, the results of this study cannot be generalized to depressed older persons with dementia or severe cognitive impairment since these persons were excluded. Second, the extent of the differences between excluded participants due to missing IDS-SR data and the included participants indicates that there may have been some selection bias. Third, the MG-CFA showed that item thresholds differ across men and women, although for most items only minimally. This indicates that gender-specific norms have to be developed.

In summary, this study identifies three homogeneous factors of the IDS-SR in older persons reflecting a mood, motivation and somatic symptom dimension. These symptom dimensions may potentially serve as subscales of the IDS-SR. The use of these symptom dimensions in clinical practice and future research may improve diagnostic specificity as well as the search for determinants of early onset *v.* late onset late-life depression. Finally, the results of our study provide insight into the phenomenology of depression in older persons compared to younger persons, as a qualitatively different factor structure of late-life depression was found.

Reference List

1. van Praag HM. Kraepelin, biological psychiatry, and beyond. Eur Arch Psychiatry Clin Neurosci 2008; 258:29-32.

2. Cairney J, Corna LM, Veldhuizen S et al. Comorbid depression and anxiety in later life: patterns of association, subjective well-being, and impairment. Am J Geriatr Psychiatry 2008; 16:201-208.

3. Steffens DC. A multiplicity of approaches to characterize geriatric depression and its outcomes. Curr Opin Psychiatry 2009; 22:522-526.

4. Widiger TA, Samuel DB. Diagnostic categories or dimensions? A question for the Diagnostic And Statistical Manual Of Mental Disorders--fifth edition. J Abnorm Psychology 2005; 114:494-504.

5. Baldwin RC. Depressive disorders. In: Oxford Textbook of Old Age Psychiatry (Jacoby R, Oppenheimer C, Denig T, et al, eds):529-556. Oxford University Press 2008.

6. Hegeman JM, Kok RM, van der Mast RC, Giltay EJ. Phenomenology of late-life depression compared to early-life depression: a meta-analysis. Br J Psychiatry 2012; 200:275-281.

7. Husain MM, Rush AJ, Sackeim HA et al. Age-related characteristics of depression: a preliminary STAR*D report. Am J Geriatr Psychiatry 2005; 13:852-860.

8. Charney DS, Reynolds CF, Lewis L et al. Depression and bipolar support alliance consensus statement on the unmet needs in diagnosis and treatment of mood disorders in late life. Arch Gen Psychiatry 2003; 60:664-672.

9. Jeste DV, Blazer DG, First M. Aging-related diagnostic variations: need for diagnostic criteria appropriate for elderly psychiatric patients. Biol Psychiatry 2005; 58:265-271.

10. Hybels CF, Blazer DG, Landerman LR, et al. Heterogeneity in symptom profiles among older adults diagnosed with major depression. Int Psychogeriatr 2011;1-17.

11. Hybels CF, Blazer DG, Pieper CF et al. Profiles of depressive symptoms in older adults diagnosed with major depression: latent cluster analysis. Am J Geriatr Psychiatry 2009; 17:387-396.

12. MacCallum RC, Zhang S, Preacher KJ, et al. On the practice of dichotomization of quantitative variables. Psychol Methods 2002; 7:19-40.

13. Helzer JE, Kraemer HC, Krueger RF. The feasibility and need for dimensional psychiatric diagnoses. Psychol Med 2006; 36:1671-80.

14. Shafer AB. Meta-analysis of the factor structures of four depression questionnaires: Beck, CES-D, Hamilton, and Zung. J Clin Psychol 2006; 62:123-146.

15. Goldberg D. Plato versus Aristotle: categorical and dimensional models for common mental disorders. Compr Psychiatry 2000; 41:8-13.

16. Gabryelewicz T, Styczynska M, Pfeffer A et al. Prevalence of major and minor depression in elderly persons with mild cognitive impairment--MADRS factor analysis. Int J Geriatr Psychiatry 2004; 19:1168-1172.

17. Parker RD, Flint EP, Bosworth HB et al. A three-factor analytic model of the MADRS in geriatric depression. Int J Geriatr Psychiatry 2003; 18:73-77.

18. Rush AJ, Gullion CM, Basco MR et al. The Inventory of Depressive Symptomatology (IDS): psychometric properties. Psychol Med 1996; 26:477-86.

19. Bernstein IH, Rush AJ, Thomas CJ et al. Item Response Analysis of the Inventory of Depressive Symptomatology. Neuropsychiatr Dis Treat 2006; 2:557-564.

20. Rush AJ, Giles DE, Schlesser MA et al. The Inventory for Depressive Symptomatology (IDS): preliminary findings. Psychiatry Res 1986; 18:65-87.

21. Trivedi MH, Rush AJ, Ibrahim HM et al. The Inventory of Depressive Symptomatology, Clinician Rating (IDS-C) and Self-Report (IDS-SR), and the Quick Inventory of Depressive Symptomatology, Clinician Rating (QIDS-C) and Self-Report (QIDS-SR) in public sector patients with mood disorders: a psychometric evaluation. Psychol Med 2004; 34:73-82.

22. Wardenaar KJ, van Veen T, Giltay EJ et al. The structure and dimensionality of the Inventory of Depressive Symptomatology Self Report (IDS-SR) in patients with depressive disorders and healthy controls. J Aff Dis 2010; 125:146-154.

23. Comijs HC, van Marwijk HW, van der Mast RC et al. The Netherlands study of depression in older persons (NESDO); a prospective cohort study. BMC Res Notes 2011; 4:524.

24. O'Connor BP. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. Beh Res Methods, Instrumentation, and Computers 2000; 32: 396–402.

25. Muthén LK, Muthén BO. Mplus User's Guide. Sixth Edition. Los Angeles, CA: Muthén & Muthén 1998-2010.

26. Asparouhov T, Muthén B. Robust Chi Square Difference Testing with mean and variance adjusted test statistics. Mplus Web Notes 2006; 10.

27. Zumbo BD, Gadermann AM, Zeisser C. Ordinal versions of coefficients alpha and theta for Likert rating scales. J Mod Appl Stat Methods 2007; 6:21-29.

28. Gadermann AM, Guhn M, Zumbo BD. Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. Practical Assessment, Research & Evaluation 2012; 17.

29. Adams KB, Matto HC, Sanders S. Confirmatory factor analysis of the geriatric depression scale. Gerontologist 2004; 44: 818-826.

30. Galinowski A, Lehert P. Structural validity of MADRS during antidepressant treatment. Int Clin Psychopharmacol 1995; 10:157-161.

31. Hammond MF. Rating depression severity in the elderly physically ill patient: reliability and factor structure of the Hamilton and the Montgomery-Asberg Depression Rating Scales. Int J GeriatrPsychiatry 1998; 13:257-261.

32. Newmann JP, Engel RJ, Jensen JE. Changes in depressive-symptom experiences among older women. Psychol Aging 1991; 6:212-222.

33. Seretti A, Cusin C, Lattuada E et al. Serotonin transporter gene (5-HTTLPR) is not associated with depressive symptomatology in mood disorders. Mol Psychiatry 1999; 4:280-283.

34. Zhang B, Fokkema M, Cuijpers P et al. Measurement invariance of the Center for Epidemiological Studies Depression Scale (CES-D) among Chinese and Dutch elderly. BMC Med Res Methodol 2011; 11:74.

35. Adams KB. Depressive symptoms, depletion, or developmental change? Withdrawal, apathy, and lack of vigor in the Geriatric Depression Scale. Gerontologist 2001; 41:768-777.

36. Naarding P, Schoevers RA, Janzing JG et al. A study on symptom profiles of late-life depression: the influence of vascular, degenerative and inflammatory risk-indicators. J Aff Dis 2005; 88:155–162.

37. Corruble E, Gorwood P, Falissard B. Association between age of onset and symptom profiles of late-life depression. Acta Psychiatr Scand 2008; 118:389-394.

38. Hybels CF, Landerman LR, Blazer DG. Age differences in symptom expression in patients with major depression. Int J Geriatr Psychiatry 2011; doi: 10.1002/gps.2759.

39. Yesavage JA, Brink TL, Rose TL et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res 1982; 17:37-49.

40. Downes JJ, Davies AD, Copeland JR. Organization of depressive symptoms in the elderly population: hierarchical patterns and Guttman scales. Psychol Aging 1988; 3:367-374.

41. Kessler RC, Birnbaum H, Bromet E et al. Age differences in major depression: results from the National Comorbidity Survey Replication (NCS-R). Psychol Med 2010; 40:225-237.

Supplementary Material

Results of the four subsequent Exploratory Factor Analyses

Table S1. Factor-loadings in a 1-factor model of the IDS-SR in group1 (n=229).

IDS-SR items	Depression
05 Feeling sad	**0.73**
21 Pleasure or enjoyment (not sex)	**0.66**
07 Feeling anxious or tense	**0.62**
17 Future pessimism	**0.59**
27 Panic/phobic symptoms	**0.58**
30 Leaden paralysis/physical energy	**0.57**
08 Reactivity of mood	**0.55**
19 Interest in people/activities	**0.55**
06 Feeling irritable	**0.54**
20 Energy/fatiguability	**0.53**
16 Self-criticism and blame	**0.52**
15 Concentration/decision making	**0.50**
18 Suicidal thoughts	**0.50**
23 Psychomotor retardation	**0.47**
26 Sympathetic arousal	**0.47**
22 Interest in sex	**0.45**
25 Aches and pains	**0.44**
29 Interpersonal sensitivity	**0.44**
24 Psychomotor agitation	**0.42**
10 Quality of mood	**0.37**
01 Initial insomnia	**0.32**
03 Early morning awakening	**0.30**
11/12 Appetite disturbance	**0.30**
28 Constipation/diarrhoea	0.27
02 Middle insomnia	0.24
13/14 Weight disturbance	0.14
09 Diurnal variation of mood	0.12
04 Sleeping too much	0.10

IDS-SR = Inventory of Depressive Symptomatology Self Report; the primary loading for each item is printed in bold font.

Table S2. Factor-loadings in a 2-factor model of the IDS-SR in group1 (n=229).

IDS-SR items	Mood	Somatic
19 Interest in people/activities	**0.81**	-0.26
16 Self-criticism and blame	**0.62**	-0.09
20 Energy/fatiguability	**0.59**	-0.04
23 Psychomotor retardation	**0.59**	-0.12
21 Pleasure or enjoyment (not sex)	**0.58**	0.12
05 Feeling sad	**0.56**	0.24
15 Concentration/decision making	**0.54**	-0.03
04 Sleeping too much	**0.52**	-0.49
06 Feeling irritable	**0.45**	0.14
29 Interpersonal sensitivity	**0.45**	0.01
08 Reactivity of mood	**0.44**	0.16
17 Future pessimism	**0.43**	0.22
30 Leaden paralysis/physical energy	**0.40**	0.22
27 Panic/phobic symptoms	**0.36**	0.29
18 Suicidal thoughts	**0.35**	0.20
10 Quality of mood	**0.31**	0.10
24 Psychomotor agitation	**0.31**	0.15
03 Early morning awakening	-0.20	**0.61**
01 Initial insomnia	-0.07	**0.48**
07 Feeling anxious or tense	0.26	**0.46**
26 Sympathetic arousal	0.13	**0.43**
02 Middle insomnia	-0.10	**0.41**
25 Aches and pains	0.12	**0.40**
11/12 Appetite disturbance	0.07	0.29
22 Interest in sex	0.23	0.28
13/14 Weight disturbance	0.05	0.23
28 Constipation/diarrhoea	0.18	0.12
09 Diurnal variation of mood	-0.19	0.08

IDS-SR = Inventory of Depressive Symptomatology Self Report; the primary loading for each item is printed in bold font.

Table S3. Factor-loadings in a 3-factor model of the IDS-SR in group1 (n=229).

IDS-SR items	Mood	Motivation	Somatic
05 Feeling sad	**0.82**	0.03	-0.05
06 Feeling irritable	**0.69**	0.01	-0.12
07 Feeling anxious or tense	**0.59**	-0.13	0.23
08 Reactivity of mood	**0.59**	0.06	-0.04
29 Interpersonal sensitivity	**0.49**	0.13	-0.14
17 Future pessimism	**0.44**	0.12	0.11
10 Quality of mood	**0.39**	0.04	-0.03
27 Panic/phobic symptoms	**0.39**	0.08	0.21
21 Pleasure or enjoyment (not sex)	0.37	0.30	0.11
18 Suicidal thoughts	**0.33**	0.11	0.13
20 Energy level/fatiguability	-0.15	**0.62**	0.24
19 Interest in people/activities	0.22	**0.61**	-0.14
04 Sleeping too much	-0.06	**0.51**	-0.32
23 Psychomotor retardation	0.16	**0.43**	-0.02
16 Self-criticism and blame	0.20	**0.43**	-1.00
15 Concentration/decision making	0.25	0.33	-0.01
24 Psychomotor agitation	0.12	0.20	0.20
09 Diurnal variation of mood	0.04	0.14	-0.04
03 Early morning awakening	0.03	-0.23	**0.58**
25 Aches and pains	-0.09	0.11	**0.56**
26 Sympathetic arousal	0.06	0.04	**0.50**
30 Leaden paralysis/physical energy	-0.03	0.35	0.41
22 Interest in sex	-0.02	0.19	**0.41**
01 Initial insomnia	0.28	-0.24	0.32
13/14 Weight disturbance	-0.10	-0.01	**0.31**
02 Middle insomnia	0.17	-0.20	**0.30**
28 Constipation/diarrhoea	-0.12	0.20	0.27
11/12 Appetite disturbance	0.11	-0.02	0.27

IDS-SR = Inventory of Depressive Symptomatology Self Report; the primary loading for each item is printed in bold font.

Table S4. Factor-loadings in a 4-factor model of the IDS-SR in group1 (n=229).

IDS-SR items	Motivation/ Cognition	Mood	Somatic	Sleep
19 Interest in people/activities	**0.73**	0.08	-0.12	-0.12
20 Energy/fatiguability	**0.67**	-0.21	0.26	-0.09
15 Concentration/decision making	**0.52**	0.11	-0.10	0.08
23 Psychomotor retardation	**0.52**	0.07	-0.02	-0.07
21 Pleasure or enjoyment (not sex)	**0.46**	0.23	0.03	0.09
16 Self-criticism and blame	**0.43**	0.19	0.07	-0.16
04 Sleeping too much	**0.35**	0.04	-0.07	-0.45
17 Future pessimism	0.31	0.30	-0.01	0.17
05 Feeling sad	0.15	**0.74**	-0.09	0.05
10 Quality of mood	-0.23	**0.70**	0.15	-0.34
06 Feeling irritable	0.06	**0.65**	-0.10	-0.03
07 Feeling anxious or tense	-0.03	**0.54**	0.14	0.16
08 Reactivity of Mood	0.19	**0.48**	-0.10	0.08
29 Interpersonal sensitivity	0.21	**0.40**	-0.13	-0.02
27 Panic/phobic symptoms	0.17	**0.33**	0.15	0.09
18 Suicidal thoughts	0.16	**0.31**	0.09	0.03
25 Aches and pains	-0.02	0.00	**0.65**	-0.04
26 Sympathetic arousal	-0.01	0.12	**0.50**	0.04
30 Leaden paralysis/physical energy	0.27	0.05	**0.48**	-0.12
03 Early morning awakening	-0.17	0.04	**0.41**	0.27
22 Interest in sex	0.29	-0.10	**0.32**	0.14
01 Initial insomnia	-0.04	0.15	0.08	**0.39**
02 Middle insomnia	0.01	0.03	0.07	**0.38**
11/12 Appetite disturbance	0.16	-0.03	0.10	**0.27**
09 Diurnal variation of mood	-0.05	0.21	0.13	**-0.29**
04 Sleeping too much	0.35	0.04	-0.07	**-0.45**
13/14 Weight disturbance	-0.02	-0.08	0.27	0.07

IDS-SR = Inventory of Depressive Symptomatology Self Report; the primary loading for each item is printed in bold font.