Big Five personality characteristics are associated with depression subtypes and symptom dimensions of depression in older adults

A.M.L. Koorevaar[1], J.M. Hegeman[2], F. Lamers[1], A.D.F. Dhondt[3], R.C. van der Mast[4,5], M.L. Stek[1] and H.C. Comijs[1]

[1]Department Psychiatry, EMGO Institute for Health and Care Research, GGZinGeest/VU University Medical Center, Amsterdam, The Netherlands
[2]Department of Psychiatry, St Antonius Hospital, Utrecht, The Netherlands
[3]Department of Geriatric Psychiatry, GGZ Noord Holland Noord, Alkmaar, The Netherlands
[4]Department of Psychiatry, Leiden University Medical Center, Leiden, The Netherlands
[5]Department of Psychiatry, Collaborative Antwerp Psychiatric Institute (CAPRI), University of Antwerp, Antwerp, Belgium
Correspondence to: L. Koorevaar, MSc, E-mail: koorevaar@gmail.com

Objective: This study examined the associations of personality characteristics with both subtypes and symptom dimensions of depression in older adults.

Methods: Three hundred and seventy-eight depressed older adults participated in the Netherlands Study of Depression in Older Persons. Personality characteristics were assessed by the NEO-Five Factor Inventory. Subtypes and symptom dimensions of depression were determined using the Composite International Diagnostic Interview and the Inventory of Depressive Symptomatology (IDS). Multinomial logistic regression analyses were performed to examine the associations between personality and atypical, melancholic, and unspecified subtypes of major depression. Linear regression analyses examined the associations between personality and the IDS mood, somatic, and motivation symptom dimensions. The analyses were adjusted for confounders and additionally adjusted for depression severity.

Results: Neuroticism, Extraversion, Conscientiousness, and Agreeableness were associated with specified (atypical or melancholic) major depression compared with unspecified major depression in the bivariate analyses but lost their significance after adjustments for functional limitations and severity of depression. Neuroticism was positively associated with the IDS mood and motivation symptom dimensions, also in the adjusted models. Further, Extraversion and Agreeableness were negatively associated with the IDS mood symptom dimension, and Extraversion and Conscientiousness were negatively associated with the IDS motivation symptom dimension. None was associated with the IDS somatic symptom dimension.

Conclusions: This study demonstrated the association of personality characteristics with mood and motivational symptoms of late-life depression. The lacking ability of personality to differentiate between melancholic and atypical depression seems to be largely explained by severity of depressive symptoms. Copyright © 2017 John Wiley & Sons, Ltd.

Introduction

During the last decades, the Five-Factor Model has been widely accepted in both clinical practice and scientific research to conceptualize personality (McCrae and Costa, 2013). Empirical research has demonstrated that these 'Big Five' personality factors are associated with human functioning in general and more specifically with well-being and mental health (Malouff *et al.*, 2005; McCrae and Costa, 2013). In recent years, a large body of empirical studies has found an association between Big Five personality factors and mental disorders, including mood disorders. Particularly higher levels of Neuroticism, and lower levels of Extraversion and Conscientiousness have been associated with depression in younger adults (Kotov *et al.*, 2010; Malouff *et al.*, 2005). In older adults, similar associations have been found (Hayward *et al.*, 2013; Koorevaar *et al.*, 2013; Weber *et al.*, 2010, 2012). These previous studies defined depression broadly, in terms of major depressive disorders or even mood disorders including unipolar and bipolar depression without distinguishing subtypes of depression. However, depression appears to be a heterogeneous disorder that makes it important to further specify its diagnostic and classification criteria (e.g. Baumeister and Gordon, 2012; Gili *et al.*, 2012; Lamers *et al.*, 2010; Rhebergen, 2012) and to examine personality factors in relation to different subtypes of depression. To date, few studies have investigated the relation between Big Five personality and subtypes of depression, based on the classification of the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 2001) or derived from data-driven methods. While higher levels of Neuroticism as well as lower levels of Extraversion and Conscientiousness were all found to be associated with chronic depression compared with episodic depression (Wiersma *et al.*, 2011), Extraversion seemed to be the most robust personality factor in differentiating chronic depression from episodic depression in younger adults (Wiersma *et al.*, 2011). The ability of Big Five personality to differentiate between atypical and melancholic (in the following text also referred as "specified") major depression on the one hand, and non-atypical and non-melancholic ("unspecified") major depression on the other hand, has hardly been studied. In younger adults, no differences in Neuroticism and Extraversion between melancholic depression and atypical depression were found (Lamers *et al.,* 2010, 2012). Instead, differences on Neuroticism and Extraversion were found between depressive subtypes that differed on depression severity. In another study, no differences on Extraversion were found between atypical depression and melancholic

depression, but atypically depressed had higher scores on Neuroticism compared with melancholically depressed (Angst *et al.*, 2007). In older adults, studies on the role of Big Five personality in atypical and melancholic depression are lacking. With this study, we aimed to contribute to a further specification of late-life depression diagnostics and treatment by examining the potential of personality characteristics to differentiate between depression subtypes in older adults.

Another way of studying heterogeneity of depression is to study symptom dimensions of depression instead of depression subtypes based on DSM criteria. Criticism exists on the classification of depression based on DSM criteria, because of the dichotomous character and the arbitrary composition of the criteria (e.g. Parker, 2000; Thase, 2009). In line with this current view, the association of Big Five personality with depression should also be examined using a more dimensional approach of depression, such as the severity of symptoms on specific depression dimensions, for example, based on mood or somatic aspects. In this study therefore, both approaches (DSM-based depression subtypes and symptom dimensions of depression) will be applied.

The aim of the present study was twofold. First, we studied whether Big Five personality factors are differently associated with depression subtypes comparing specified depression and unspecified major depression. On the basis of findings in previous studies, we hypothesized that Big Five personality characteristics, particularly Neuroticism and Extraversion, differentiate between specified major depression and unspecified major depression because of the expected differences in depression severity but not between atypical depression and melancholic depression. Further, examining the association between the Big Five personality factors and the Inventory of Depressive Symptomatology (IDS) depression symptom dimensions, we expected more robust associations between the Big Five personality factors and the IDS symptom dimensions, compared with the depression subtypes, because of the more homogeneous composition of the IDS symptom dimensions. Especially IDS mood and motivation symptom dimensions of depression were expected to be associated with the Big Five personality factors.

Methods

Study sample

The Netherlands Study of Depression in Older persons (NESDO) is a multisite, naturalistic longitudinal

cohort study aimed to examine the determinants, course, and consequences of late-life depression. The design of NESDO has been described in detail by Comijs *et al.* (2011). In short, from 2007 until 2010, 378 depressed and 132 non-depressed persons, aged 60 through 93 years, were recruited from mental health care institutes and general practitioners. Inclusion criterion for the patient group was the presence of a current (preceding 6 months) diagnosis of depression, including major depression, minor depression, dysthymia, and a double diagnosis of major depression and dysthymia. Exclusion criteria were dementia (based on clinical judgment), another primary serious psychiatric disorder, such as a psychotic or bipolar disorder, a mini-mental state examination score under 18 (out of 30 points), and poor Dutch language skills. For the present study, we used baseline data from the depressed participants only. The study protocol of NESDO was approved centrally by the Ethical Review Board of the VU University Medical Center and subsequently by the local ethical review boards of the participating centers.

Measurements

The baseline assessment included both diagnostic interviews and written self-report questionnaires, all being internationally accepted, commonly used measures for personality and depression.

Assessment of personality

To assess personality characteristics, the NEO-Five Factor Inventory (NEO-FFI; Costa and McCrae, 1995; Dutch version, Hoekstra *et al.*, 1996) was used. The NEO-FFI is a shortened version of the NEO Personality Inventory-Revised (Costa and McCrae, 1995). The 60-item questionnaire measures the main Big Five domains: Neuroticism (easily upset, maladjusted), Extraversion (energetic, assertive, talkative), Conscientiousness (responsible, dependable, orderly), Agreeableness (good-natured, cooperative, trusting) and Openness to Experience (imaginative, independent-minded, intellectual) (McCrae and Costa, 2013). The extent to which a statement applies to the participant is rated on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." Total scores on each separate domain range from 12 till 60.

Assessment of depression subtypes, Inventory of Depressive Symptoms symptom dimensions and depression severity

Depression diagnoses according to DSM-IV criteria were determined by the Composite International Diagnostic Interview (CIDI, WHO version 2.1; lifetime version). The CIDI is a structured clinical interview designed for use in research settings and has a high reliability, including inter-rater agreement (Wittchen *et al.*, 1991). The self-report IDS (Rush *et al.*, 1996) was used to determine both DSM-based subtypes (melancholic depression and atypical depression) and symptom dimensions of depression. The IDS consists of 28 items with a possible score of 0–3 on each item, and higher scores indicating more severe depressive symptoms. Melancholic depression, consisting of lack of mood reactivity or loss of pleasure and at least three of the following symptoms: distinct mood quality, mood worse in the morning, early morning wakening, psychomotor retardation or agitation, anorexia/weight loss, and guilt feelings, was constructed by comparing IDS items with DSM-IV criteria for melancholic depression following Khan's algorithm (Khan *et al.*, 2006). Atypical depression, consisting of mood reactivity and at least two of the following symptoms: significant weight gain or increased appetite, hypersomnia, leaden paralysis, and interpersonal rejection sensitivity, was constructed by comparison of items of the IDS with DSM-IV criteria for atypical depression using the algorithm of Novick *et al.* (2005). The participants, all meeting DSM-IV criteria for current (preceding 6 months) major depressive disorder, were categorized as either having atypical depression ($n = 26$), melancholic depression ($n = 43$), or unspecified depression, defined as major depressive disorder with no atypical or melancholic features ($n = 309$).

In addition, the IDS symptom dimensions Mood, Motivation, and Somatic were used. These homogeneous symptom dimensions were previously identified through factor analyses within the NESDO sample (Hegeman *et al.*, 2012) as being specific to older adults. The mood symptom dimension consists of the following IDS items: feeling sad, feeling irritable, feeling anxious or tense, reactivity of mood, quality of mood, interpersonal sensitivity, future pessimism, panic/phobic symptoms, and suicidal thoughts. The somatic symptom dimension includes the IDS items: aches and pains, sympathetic arousal, early morning awakening, interest in sex, initial and middle insomnia, appetite disturbance, and weight disturbance. The motivation symptom dimension

contains the IDS items: self-criticism and blame, psychomotor retardation, sleeping too much, interest in people or activities, and energy/fatiguability (Hegeman *et al.*, 2012).

Assessment of covariates

Socio-demographic characteristics included age, sex, and educational level. Other psychosocial and clinical variables that were assessed comprised severity of depression, age of depression onset, number of comorbid anxiety disorders, childhood trauma, and functional limitations, as these were associated with personality and/or depression in earlier studies in older people (Koorevaar *et al.*, 2013; Weber *et al.*, 2011). The total IDS score determined the severity of depressive symptoms. The CIDI was used to assess age of depression onset and the number of comorbid anxiety disorders. Childhood trauma, including emotional neglect as well as psychological, physical, and sexual abuse, was assessed using a structured inventory previously used in the Mental Health Survey and Incidence Study (de Graaf *et al.*, 2004) and the Netherlands Study of Depression and Anxiety (Penninx *et al.*, 2008). Functional limitations were assessed by means of the World Health Organization-Disability Assessment Scale, consisting of six domains of functioning: understanding and communicating, getting around, self-care, getting along with other people, household activities, and participation in society (Chwastiak and Von Korff, 2003).

Statistical analyses

As we had nearly 15% missing values on the NEO-FFI, the IDS and the covariates, the potential risk for bias and the loss of information were handled by using multiple imputation. By comparison, of participants with and without missing values on the personality and depression measures, we determined whether the data were missing at random (Rubin, 1987). We included all covariates and variables associated with missingness in the imputation model (van Buuren *et al.*, 1999). Fifteen datasets were generated, on the basis of the percentage of missing values (Li *et al.*, 2015). The pooled outcomes of the imputed data and the unimputed data were compared to determine whether the outcomes deviated from each other.

Multinominal logistic regression analyses were applied to investigate the associations of Big Five personality factors with melancholic and atypical depression when compared with unspecified depression (reference group). Linear regression analyses were performed to study the association between Big Five personality factors and the IDS dimensions mood, motivation, and somatic.

Next, all analyses were adjusted for relevant confounders. Besides socio-demographic characteristics (including age, sex, and educational level), age of depression onset, number of comorbid anxiety disorders, childhood trauma, and functional limitations were taken into account as possible confounders. For each individual association between the Big Five factor and the depression subtypes and symptom dimensions, it was determined which of these covariates were actually confounders. Covariates that changed the strength of the association between the individual Big Five personality factors and the depression subtypes and symptom dimensions for more than 10% were considered confounders and were included in the model. Because of the large range of the age of the participants (60–93 years), the possible interaction of age on the associations between the Big Five personality factors and the depression subtypes and symptom dimensions was also examined by adding the interaction terms age*personality to the regression models.

Because former studies showed that depression severity plays an important role in the association between personality and depression both in younger adults (e.g. Lamers *et al.*, 2010, 2012; Rhebergen, 2012) and older adults (Hayward *et al.*, 2013; Koorevaar *et al.*, 2013) and could be considered as an explanatory factor, the analyses were additionally adjusted for depression severity in a third model.

All analyses were performed using IBM SPSS statistics version 20.0.

Results

Characteristics of the study sample

The socio-demographic, clinical, and psychosocial characteristics of the study sample are shown in Table 1. As can be seen, patients with an atypical or melancholic depression had the highest scores on severity of depression (IDS total score). Further, some participants had missing data on the NEO-FFI, the IDS, and the covariates. Participants with missing values on any of these variables ($N = 55$) had significant higher scores on the IDS total score and the IDS somatic symptom dimension. On the basis of these outcomes, we assumed that the data were missing at random (Rubin, 1987; Sterne *et al.*, 2009), and multiple imputations were applied. Comparison of the

Table 1 Characteristics of the study sample (patients with a current major depressive disorder, N = 378)

	N	Total patient group (N = 378)	Unspecified depression (N = 309)	Atypical depression (N = 26)	Melancholic depression (N = 43)
Age, years, M (SD)	378	70.74 (7.41)	71.07 (7.24)	68.69 (7.95)	69.58 (8.08)
Gender, female, n (%)	378	250 (66.1)	200 (65)	19 (73)	31 (72)
Educational level, years, M (SD)	378	10.42 (3.45)	10.43 (3.37)	10.88 (4.76)	10.12 (3.08)
Severity of depressive symptoms (IDS), M (SD)	373	30.14 (13.02)	26.96 (11.70)	40.69 (8.52)	46.69 (7.16)
IDS mood dimension, M (SD)	372	8.96 (5.21)	7.69 (4.71)	12.46 (3.89)	15.28 (3.45)
IDS motivation dimension, M (SD)	365	5.01 (3.13)	4.38 (2.91)	7.85 (2.75)	7.76 (2.32)
IDS somatic dimension, M (SD)	373	9.79 (4.22)	9.13 (3.94)	11.38 (3.83)	13.52 (4.34)
Comorbid anxiety disorder present y/n (n, %)	378	147 (38.9)	112 (36)	11 (42)	24 (56)
Number of chronic diseases (M, SD)	377	2.12 (1.49)	2.05(1.42)	2.85 (1.89)	2.23 (1.56)
Age of onset of depression (M, SD)	378	48.39 (20.63)	49.52 (20.42)	43.28 (21.63)	43.44 (20.86)
Childhood trauma index, M (SD)	375	1.02 (1.20)	0.90 (1.15)	1.77 (1.31)	1.40 (1.31)
Childhood trauma index	375				
score 0		175 (47)	157 (51)	5 (19)	13 (30)
score 1 or more		200 (53)	149 (49)	21 (81)	30 (70)
Functional limitations (WHO DAS total score), M (SD)	364	25.65 (12.39)	23.49 (12.06)	34.69 (9.59)	35.05 (8.93)
Neuroticism, M (SD)	351	39.05 (7.00)	38.10 (6.71)	42.77 (6.92)	43.66 (6.68)
Extraversion, M (SD)	350	33.65 (6.44)	34.407 (6.15)	31.58 (6.48)	29.56 (6.84)
Conscientiousness, M (SD)	350	36.66 (5.69)	37.12 (5.57)	35.23 (5.45)	34.23 (6.05)
Openness, M (SD)	348	29.19 (5.46)	29.15 (5.53)	30.35 (4.10)	28.67 (5.71)
Agreeableness, M (SD)	349	44.11 (5.24)	44.47 (4.97)	42.58 (5.22)	42.54(6.64)

M, mean; SD, standard deviation; IDS, Inventory of Depressive Symptoms; WHO DAS, World Health Organization Disability Assessment Schedule.

pooled outcomes of the imputed data and unimputed data showed that the outcomes did not substantially differ from each other. Because the multiple imputation model was expected to be more valid (less biased) than the original model, the results discussed in the next sections are the outcomes of analyses performed on the imputed data.

Big Five personality factors and Diagnostic and Statistical Manual of Mental Disorders-IV-based subtypes of depression

In the unadjusted analyses, Neuroticism was positively associated and Extraversion was negatively associated with both atypical and melancholic depression, compared with unspecified depression (Table 2, Models 1). Further, Conscientiousness and Agreeableness were negatively associated with melancholic depression compared with unspecified major depression. None of the Big Five factors significantly differentiated between atypical and melancholic depression (Neuroticism: Odds ratio [OR] = 0.97, 95% confidence interval [CI] = 0.90–1.05, $p = 0.456$; Extraversion: OR = 1.06, 95% CI = 0.98–1.14, $p = 0.183$; Conscientiousness: OR = 1.01, 95% CI = 0.95–1.13, $p = 0.443$; Openness: OR = 1.06, 95% CI = 0.97–1.16, $p = 0.194$; Agreeableness: OR = 0.99, 95% CI = 0.91–1.09, $p = 0.960$).

Next, all analyses were adjusted for functional limitations, because functional limitations, and not the other covariates, proved to be a confounder in all associations that were examined (Models 2). In the adjusted analyses, both Neuroticism and Extraversion differentiated between melancholic depression and unspecified depression. None of the interaction terms with age was statistically significant.

Subsequently, the analyses were additionally adjusted for severity of depression (Models 3). None of the Big Five factors differentiated between specified depression (melancholic or atypical) and unspecified depression. Comparison of atypical and melancholic depression on personality characteristics showed no significant differences on any of the Big Five personality factors.

Big Five personality factors and symptom dimensions of depression

Exploring the associations of the Big Five personality factors with the IDS symptom dimensions, the unadjusted models showed that Neuroticism was positively associated, and Extraversion and Conscientiousness were negatively associated with all IDS symptom dimensions, whereas Agreeableness was negatively associated with the IDS mood and motivation symptom dimension (Table 3). In the adjusted models

Table 2 Unadjusted and adjusted models of linear regression analyses associating Big Five personality factors with atypical depression (N = 26) and melancholic depression (N = 43) versus unspecified depression (N = 309, reference group) in older adults (N = 378)

	Atypical depression versus unspecified depression			Melancholic depression versus unspecified depression		
	OR	95% CI	p	OR	95% CI	p
Neuroticism						
Model 1	1.11	1.04–1.18	0.001	1.14	1.08–1.21	<0.001
Model 2	1.06	0.99–1.13	0.094	1.09	1.03–1.16	0.003
Model 3	–	–		0.998	0.93–1.07	0.953
Extraversion						
Model 1	0.93	0.87–.99	0.031	0.88	0.84–0.93	<0.001
Model 2	0.97	0.91–1.04	0.343	0.92	0.87–0.97	0.004
Model 3	–	–		0.95	0.90–1.02	0.137
Conscientiousness						
Model 1	0.94	0.88–1.01	0.108	0.91	0.86–0.97	0.003
Model 2	–	–	–	0.94	0.89–1.01	0.103
Model 3	–	–	–			
Openness						
Model 1	1.04	0.97–1.12	0.302	0.98	0.92–1.04	0.486
Model 2	–	–	–	–	–	–
Model 3	–	–	–	–	–	–
Agreeableness						
Model 1	0.94	0.87–1.01	0.085	0.94	0.88–0.999	0.048
Model 2	–	–	–	0.97	0.91–1.04	0.364
Model 3	–	–	–	–	–	–

OR, odds ratio; CI, confidence interval.
Model 1: unadjusted model.
Model 2: adjusted for functional limitations.
Model 3: additionally adjusted for severity of depression.

(Model 2), functional limitations being again an important confounding covariate, besides sex and childhood trauma, Neuroticism remained significantly associated with the IDS somatic symptom dimension, while Extraversion and Conscientiousness were no longer associated with the somatic symptom dimension. Neuroticism, Extraversion and Conscientiousness were still associated with the IDS mood and motivation symptom dimension, and Agreeableness with the IDS motivation symptom dimension, also when the analyses were additionally adjusted for severity of depression (Model 3). Age did not interact with any of these associations; none of the interaction terms with age were statistically significant.

Discussion

This study investigated the associations of Big Five personality factors with DSM-IV-based subtypes and IDS symptom dimensions of late-life depression. In accordance with our expectations, personality characteristics differentiated between melancholic depression and unspecified major depression (Neuroticism, Extraversion, Conscientiousness, and, be it less convincing, Agreeableness) and between atypical

depression and unspecified major depression (Neuroticism and Extraversion). However, as expected, none of the Big Five personality factors differentiated between specified depression (melancholic and atypical depression) and unspecified major depression, or between atypical and melancholic depression when the analyses were adjusted for functional limitations and additionally adjusted for depression severity. By contrast, the associations between the Big Five personality factors and the IDS mood and motivation dimensions were hardly affected by confounders or explained by severity of depression. In line with our expectations, the Big Five personality factors were least associated with the IDS somatic symptom dimension.

Our finding that Big Five personality factors did not differentiate between atypical and melancholic depression, but instead differentiated between depressive subtypes characterized by more severe depressive symptoms (atypical and melancholic depression) and less severe depressive symptoms (unspecified major depression), is in line with results from recent studies in younger adults (Angst *et al.*, 2007, Lamers *et al.*, 2010,2012, Rhebergen, 2012). So, the finding that personality is particularly associated with the severity of depressive subtypes seems to apply to both younger and elderly depressed patients.

Table 3 Unadjusted and adjusted models of linear regression analyses associating Big Five personality factors with IDS symptom dimensions mood, somatic, and motivation in older adults (N = 378)

	IDS mood			IDS somatic			IDS motivation		
	B	95% CI	p	B	95% CI	p	B	95% CI	p
Neuroticism									
Model 1	0.45	0.39; 0.51	<0.001	0.21	0.15; 0.27	<0.001	0.21	0.17; 0.25	<0.001
Model 2	0.34[1]	0.28; 0.40	<0.001	0.09[2]	0.03; 0.15	0.003	0.11[1]	0.06; 0.14	<0.001
Model 3	0.26	0.20; 0.32	<0.001	−0.01	−0.09; 0.05	0.545	0.04	0.00; 0.08	0.058
Extraversion									
Model 1	−0.33	−0.40; −0.25	<0.001	−0.10	−0.17; −0.03	0.003	−0.19	−0.24; −0.15	<0.001
Model 2	−0.20[1]	−0.28; −0.13	<0.001	−0.01[1]	−0.06; 0.07	0.873	−0.10[1]	−0.14; −0.06	<0.001
Model 3	−0.15	−0.22; −0.08	<0.001	−	−	−	−0.06	−0.10; −0.02	0.002
Conscientiousness									
Model 1	−0.26	−0.36; −0.17	<0.001	−0.11	−0.19; −0.03	0.007	−0.19	−0.24; −0.13	<0.001
Model 2	−0.14[1]	−0.22; −0.05	0.001	−0.01	−0.08; 0.06	0.748	−0.10[1]	−0.14; −0.05	<0.001
Model 3	−0.08	−0.15; 0.00	0.054	−	−	−	−0.07	−0.11; −0.02	0.003
Openness									
Model 1	0.01	−0.10; 0.09	0.924	−0.06	−0.19; 0.14	0.191	−0.05	−0.11; 0.01	0.095
Model 2	−	−	−	−	−	−	−	−	−
Model 3	−	−	−	−	−	−	−	−	−
Agreeableness									
Model 1	−0.23	−0.33; −0.12	<0.001	−0.04	−0.13; 0.04	0.321	−0.09	−0.15; −0.03	0.005
Model 2	−0.10[3]	−0.19; −0.01	0.025	−	−	−	−0.01[1]	−0.06; 0.04	0.603
Model 3	−0.11	−0.19; −0.04	0.004	−	−	−	−	−	−

IDS, Inventory of Depressive Symptoms.
Model 1: [1]unadjusted model.
Model 2: [1]adj. Ffor functional limitations; [2]adj. for functional limitations and sex; [3]adj. for functional limitations and childhood trauma.
Model 3: additionally adjusted for the other IDS dimensions.

Further, we demonstrated that Big Five personality factors were associated with mood and motivation related symptom dimensions of depression, even in the fully adjusted analyses that were corrected for the other symptoms dimensions and thus corrected for severity of depression. By contrast, the Big Five personality factors were not associated with somatic symptoms of depression. Therefore, an explanation for the lack of an association between the Big Five personality factors and the DSM-IV-based depressive subtypes could be that these subtypes contain several somatic symptoms that apparently do not correlate with personality characteristics. Furthermore, the IDS symptom dimensions are composed of clustered symptoms and are, therefore, more homogeneous compared with the DSM-IV-based subtypes of atypical and melancholic depression. More specifically, Neuroticism was foremost associated with mood related symptoms of depression, Conscientiousness with motivational symptoms, and Extraversion with both mood and motivational symptoms of depression. The significant associations of Neuroticism, Extraversion, and Conscientiousness could be explained by the overlap between the depressive symptoms, as defined by the IDS mood and motivation dimensions, and the personality characteristics, as defined by the Big Five personality

factors. For example, it is not surprising that a strong association was found between the IDS mood symptom dimension, which implies more feelings of sadness, irritableness and pessimism (Hegeman et al., 2015), and Neuroticism, which is characterized by similar negative feelings. Alternatively, one can imagine that adverse personality traits could pose a risk for developing depressive symptoms in older adults, as has been demonstrated in previous studies (e.g. Steunenberg et al., 2009; Weber et al., 2012).

Surprisingly, Agreeableness had a significant negative association with the mood symptom dimension of depression. Contrary to Neuroticism, Extraversion, and Conscientiousness, this finding could not easily be explained by conceptual overlap with the IDS dimension mood. Previous meta-analyses in the adult-population showed that low Agreeableness is associated with clinical disorders in general and conduct disorders and substance abuse disorders in particular. Mood disorders were only weakly related to Agreeableness (Kotov et al., 2010; Malouff et al. 2005). The association of Agreeableness and mood related symptoms of late-life depression and the role of possible underlying factors such as childhood trauma and functional limitations (Koorevaar et al., 2013) deserve further examination.

Remarkably, functional limitations proved to be an important confounder in all associations between personality characteristics and respectively depression subtypes and symptom dimensions. Again, the overlap of symptoms between personality, depression and functional limitations could be an explanation for this finding. Because the occurrence of a depression often implies (temporary) limitations in daily functioning and because one might assume that more severe functional limitations are typical of more severe depression, functional limitations itself could be regarded as a severity measure for depression. Otherwise, although no causal relations can be inferred from this study, one might suppose that personality characteristics, especially high Neuroticism, low Extraversion, and low Conscientiousness, are risk factors for depression when facing functional limitations. All these possible explanations for our results refer to the debate on the stability of personality through the lifespan. Several studies have demonstrated that personality can change over time because of current psychiatric distress, by experiencing important life events or by aging (e.g. Jeronimus *et al.*, 2013; Roberts and Delvecchio, 2000; Spinhoven *et al.,* 2014). As this study had a cross-sectional design, no inferences can be drawn on this issue. In a future study, we will further examine the stability of personality in the course of depression in older adults, which hopefully sheds more light on the way in which personality and late-life depression are specifically intertwined.

Our study has several strengths. It was the first that examined the role of Big Five personality on both DSM defined subtypes of depression and symptom dimensions in older adults. Further, we were able to adjust our analyses for several psychosocial and clinical variables, including severity of depression. However, some limitations should also be noted. The analyses performed in this study were cross-sectional. Therefore, no causal relations can be inferred. The possibility of personality characteristics to predict the occurrence of depression subtypes or depressive symptoms should therefore be further examined in longitudinal analyses. Further, a relatively small number of the depressed patients met the criteria of a melancholic depression or an atypical depression, compared with the patients with an unspecified major depression. This might partly be due to the fact that in this study, the subtypes of melancholic and atypical depression were based on IDS symptoms covering a period of 7 days, while the unspecified major depression covered a period of 6 months. This could have led to an underestimation of the number of patients with an atypical or melancholic depression and,

consequently, an underestimation of the association between personality and atypical and melancholic depression. Because of the wide age range in our study, we examined whether the association between personality and depression were the same for all ages. However, no interaction with age was found, which means that the associations that were found apply to all ages in our sample.

To summarize, the main conclusion that can be derived from the results of our study is that Big Five personality characteristics are associated with severity of depressive symptoms and, more specifically, are related to mood and motivational symptoms and not somatic symptoms of late-life depression. Indirectly, this finding also seems to demonstrate the heterogeneity of the depression concept. This might have implications for clinical practice and stresses the necessity to involve personality assessment besides other relevant clinical variables in diagnosing and treating distinct aspects of late-life depression.

Conflict of interest

All authors declare that they have no conflicts of interest concerning the scope of this manuscript.

Key points

- In older adults, personality characteristics do not differentiate between melancholic, atypical, and unspecified major depression.
- Personality is associated with mood and motivational symptoms of late-life depression and not with somatic symptoms of late-life depression.

Acknowledgements

References

American Psychiatric Association. 2001. *Diagnostic and Statistical Manual of Mental Disorders*. fourth edn. American Psychiatric Publishing: Washington, DC.

Angst J, Gamma A, Benazzi F, Ajdacic V, Rössler W. 2007. Melancholia and atypical depression in the Zurich study: epidemiology, clinical characteristics, course, comorbidity and personality. *Acta Psychiatr Scand Suppl* **433**: 72–84.

Baumeister H, Gordon P. 2012. Meta-review of depressive subtyping models. *J Affect Disord* **139**(2): 126–140.

Chwastiak LA, Von Korff M. 2003. Disability in depression and back pain: evaluation of the World Health Organization Disability Assessment Schedule (WHO DAS II) in a primary care setting. *J Clin Epidemiol* **56**(6): 507–514.

Comijs HC, van Marwijk HW, van der Mast RC, *et al.* 2011. The Netherlands Study of Depression in Older Persons (NESDO); a prospective cohort study. *BMC Res Notes* **4**(1): 524.

Costa PT Jr, McCrae RR. 1995. Domains and facets: hierarchical personality assessment using the revised NEO personality inventory. *J Pers Assess* **64**(1): 21–50.

de Graaf R, Bijl RV, Ten Have M, Beekman AT, Vollebergh WA. 2004. Pathways to comorbidity: the transition of pure mood, anxiety and substance use disorders into comorbid conditions in a longitudinal population-based study. *J Affect Disord* **82**: 461–467.

Gili M, Roca M, Armengol S, *et al.* 2012. Clinical patterns and treatment outcome in patients with melancholic, atypical and non-melancholic depressions. *PLoS One* **7**(10): e48200.

Hayward RD, Taylor WD, Smoski MJ, Steffens DC, Payne ME. 2013. Association of five-factor model personality domains and facets with presence, onset, and treatment outcomes of major depression in older adults. *Am J Geriatr Psychiatry* **21**(1): 88–96.

Hegeman JM, Wardenaar KJ, Comijs HC, *et al.* 2012. The subscale structure of the Inventory of Depressive Symptomatology Self Report (IDS-SR) in older persons. *J Psychiatr Res* **46**(10): 1383–1388.

Hegeman JM, de Waal MW, Comijs HC, Kok RM, van der Mast RC. 2015. Depression in later life: a more somatic presentation? *J Affect Disord* **170**: 196–202.

Hoekstra HA, Ormel J, Fruyt de F. 1996. *Dutch Manual of NEO-PI-R & NEO-FFI*. Swets & Zeitlinger: Lisse, the Netherlands.

Jeronimus BF, Ormel J, Aleman A, Penninx BW, Riese H. 2013. Negative and positive life events are associated with small but lasting change in neuroticism. *Psychol Med* **43**(11): 2403–2415.

Khan AY, Carrithers J, Preskorn SH, *et al.* 2006. Clinical and demographic factors associated with DSM-IV melancholic depression. *Ann Clin Psychiatry* **18**(2): 91–98.

Koorevaar AML, Comijs HC, Dhondt ADF, *et al.* 2013. Big Five personality and depression diagnosis, severity and age of onset in older adults. *J Affect Disord* **51**(1): 178–185.

Kotov R, Gamez W, Schmidt F, Watson D. 2010. Linking "big" personality traits to anxiety, depressive, and substance use disorders: a meta-analysis. *Psychol Bull* **136**(5): 768–821.

Lamers F, de Jonge P, Nolen WA, *et al.* 2010. Identifying depressive subtypes in a large cohort study: results from the Netherlands Study of Depression and Anxiety (NESDA). *J Clin Psychiatry* **71**(12): 1582–1589.

Lamers F, Rhebergen D, Merikangas KR, *et al.* 2012. Stability and transitions of depressive subtypes over a 2-year follow-up. *Psychol Med* **42**(10): 2083–2093.

Li P, Stuart EA, Allison DB. 2015. Multiple imputation: a flexible tool for handling missing data. *JAMA* **314**(18): 1966–1967.

Malouff JM, Thorsteinsson EB, Schutte NS. 2005. The relationship between the five factor model of personality and symptoms of clinic disorders: a meta-analysis. *J Psychopathol Behav* **27**: 101–114.

McCrae R, Costa PT Jr. 2013. Introduction to the empirical and theoretical status of the Five-Factor Model of personality traits. In *Personality Disorders and the Five-Factor Model of Personality*, Widiger TA, Costa PT (eds.). 3rd edn. American Psychological Association: Washington, DC, US; 15–27.

Novick JS, Stewart JW, Wisniewski SR, *et al.* 2005. Clinical and demographic features of atypical depression in outpatients with major depressive disorder: preliminary findings from STAR*D. *J Clin Psychiatry* **66**(8): 1002–1011.

Parker G. 2000. Classifying depression: should paradigms lost be regained? *Am J Psychiatry* **157**(8): 1195–1203.

Penninx BW, Beekman AT, Smit JH, *et al.* 2008. The Netherlands Study of Depression and Anxiety (NESDA): rationale, objectives and methods. *Int J Methods Psychiatr Res* **17**(3): 121–140.

Rhebergen D, 2012. Insight into the heterogeneity of depressive disorders. Doctoral thesis, VU medical Center, Amsterdam.

Roberts BW, DelVecchio WF. 2000. The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. *Psychol Bull* **126**(1): 3–25.

Rubin DB. 1987. *Multiple Imputation for Nonresponse in Surveys*. John Wiley & Sons: New York.

Rush AJ, Gullion CM, Basco MR, Jarrett RB, Trivedi MH. 1996. The Inventory of Depressive Symptomatology (IDS): psychometric properties. *Psychol Med* **26**(3): 477–486.

Sterne JA, White IR, Carlin JB, *et al.* 2009. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. *BMJ* **29**: 338.

Steunenberg B, Braam AW, Beekman AT, Deeg DJ, Kerkhof AJ. 2009. Evidence for an association of the Big Five personality factors with recurrence of depressive symptoms in later life. *Int J Geriatr Psychiatry* **24**: 1470–1477.

Spinhoven P, Penelo E, de Rooij M, Penninx BW, Ormel J. 2014. Reciprocal effects of stable and temporary components of neuroticism and affective disorders: results of a longitudinal cohort study. *Psychol Med* **44**(2): 337–348.

Thase ME. 2009. Atypical depression: useful concept, but it's time to revise the DSM-IV criteria. *Neuropsychopharmacology* **34**(13): 2633–2641.

van Buuren S, Boshuizen HC, Knook DL. 1999. Multiple imputation of missing blood pressure covariates in survival analysis. *Stat Med* **18**(6): 681–694.

Weber K, Giannakopoulos P, Delaloye C, *et al.* 2010. Volumetric MRI changes, cognition and personality traits in old age depression. *J Affect Disord* **124**(3): 275–282.

Weber K, Giannakopoulos P, Canuto A. 2011. Exploring the impact of personality dimensions in late-life depression: from group comparisons to individual trajectories. *Curr Opin Psychiatry* **24**(6): 478–483.

Weber K, Giannakopoulos P, Bacchetta JP, *et al.* 2012. Personality traits are associated with acute major depression across the age spectrum. *Aging Ment Health* **16**(4): 472–480.

Wiersma JE, van Oppen P, van Schaik DJ, *et al.* 2011. Psychological characteristics of chronic depression: a longitudinal cohort study. *J Clin Psychiatry* **72**(3): 288–294.

Wittchen HU, Robins LN, Cottler LB, *et al.* 1991. Cross-cultural feasibility, reliability and sources of variance of the Composite International Diagnostic Interview (CIDI). The Multicentre WHO/ADAMHA Field Trials. *Br J Psychiatry* **159**: 645–653.