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Autism characteristics in older adults with depressive disorders

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Abstract

Objectives: To study (1) the prevalence of Autism spectrum disorder (ASD) characteristics in older adults with and without depressive disorders, and (2) the social network and past negative life events in those with a high number of ASD characteristics and those without a large number of these characteristics.

Design: A large multi-site naturalistic prospective cohort study.

Setting: Data of the Netherlands Study of Depression in Older persons was used.

Participants: Older adults (aged 60 to 90 years) with (N=259) and without (N=114) a depressive disorder according to DSM-IV criteria.

Measurements: ASD characteristics were measured with the abbreviated Autism Spectrum Quotient with a cut off score of 70. Additional measures were the Composite International Diagnostic Interview (CIDI), the Inventory of Depressive Symptomatology (IDS-SR), the Becks Anxiety Inventory (BAI), the Close Person Inventory and the life events questionnaire.

Results: Of the older adults with a depressive disorder 31% showed elevated ASD characteristics, which is much higher than the observed 6% in the comparison group. High ASD characteristics were associated with elevated depression and anxiety symptoms, and more comorbid anxiety disorders. But those with a high number of ASD characteristics did not differ in the size of their social network or the number of negative life events as compared to those with less ASD characteristics.

Conclusion: ASD might be overlooked in older adults and especially within geriatric psychiatry when diagnosing and treating depression and anxiety in older patients one should be attentive to ASD.

KEY WORDS: Depression, Autism traits, Older adults

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Objective

Approximately one in hundred persons across the world¹ meets the criteria for autism spectrum disorder² a psychiatric neurodevelopmental disorder. ASD is a debilitating disorder, and difficulties in social interaction and communication, stereotyped or repetitive behaviours and interests are at the core of this diagnosis. While ASD was originally perceived as a childhood disorder, nowadays we know that the prevalence of ASD is similar across the lifespan³ and that ASD is a lifelong disorder. Only relatively recently it has been recognized that ASD can also be diagnosed in (late) adulthood^{5,6}. When the current older adults were children, ASD was not yet broadly known. Moreover, ASD was thought to be mainly prevalent in people with low intellectual functioning, while currently we know that ASD can be present among all possible intelligence levels. Therefore, many of the older (intellectually able) adults with ASD have probably remained unrecognized and undiagnosed^{7,8}. These adults with unrecognized ASD are often diagnosed with a secondary psychiatric condition whereas the ASD diagnoses were often missed in standard diagnostic assessments^{7,9,10}. The most common secondary psychiatric diagnoses are mood (primarily depression) and anxiety disorders⁹. Hence, we expect that especially among older adults with depression there will be undiagnosed cases of ASD. If this is indeed the case, one would expect that the prevalence of ASD characteristics will be higher in a group of older adults with depression as compared to controls without a depression within a similar age range. This hypothesis will be tested in the current study.

Another reason why we expect a relatively high prevalence of ASD characteristics in (older) adults with a mood disorder stems from the literature on the relationships between ASD and depression. Both mood (especially depression) and anxiety disorders are highly prevalent comorbid diagnoses in those with an ASD diagnosis¹¹⁻¹⁴. Moreover, in non-clinical adult samples a positive relationship between ASD characteristics and depressive and anxiety symptoms^{15,16} has been observed. In line with these findings, high rates of ASD characteristics has been reported in clinical samples of children with a mood and/or anxiety disorder, but without ASD¹⁷. It is, therefore, highly likely that a similar pattern emerges when focusing on adults with depression. Indeed, recently it was shown that 37% of adults with a major depressive disorder (25 to 59 years) showed high ASD-like traits¹⁸. However, to our knowledge it has yet not been tested whether this is also the case in older adults (60+) with a depressive disorder. Given the earlier findings, our second hypothesis is that reporting more ASD characteristics is associated with more depressive and anxiety symptoms.

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In addition, risk factors for developing late-life depression are thought to be common in (young) adults with ASD which strengthens the hypothesis that ASD characteristics will be more prevalent in adults with a known depressive disorders as compared to those without such a disorder. For example, low perceived social support, inadequacy of social activity as well as actual low social participation status, loneliness, high number of negative life events, and multi-morbidity (i.e., having more than one psychiatric diagnosis) are known vulnerability factors for developing late-life depressive symptoms^{19,20}. Similar psychosocial factors are thought to be common in individuals with ASD^{21,22}. For example, given the day-to-day struggles people with ASD experience with respect to relationships, education, work, and housing they might encounter more negative life events as compared to those without ASD. However, while there are, to our knowledge, no systematic ASD studies focusing on negative life events across the life span, several studies did focus on the social network of individuals with ASD. In children with ASD only 34% has at least one good friend²³ and in adulthood 40% reported not to have any close friends at all²⁴. This suggests that their social network is relatively small. Our third hypothesis is that those with many ASD characteristics will have a smaller social network. Moreover, we will explore whether this specific subgroup will also experience more negative life events.

In summary, the purpose of the current study is to examine the presence and role of ASD symptoms in older adults (60+ years) with and without depressive disorders. First, we will determine how many persons score above the clinical cut off on a short version of a widely used ASD screening instrument (AQ-28)²⁵. We hypothesize that while in healthy older adults approximately 1% will score above the ASD cut off; this percentage will be much higher in older adults with a depressive disorder diagnosis. Second, that there is a positive relation between the number of ASD characteristics and the number of depression and anxiety symptoms. Third, we predict that those with a score above the AQ-28 cut off, will not just have more depressive and anxiety symptoms, but will also have more actual mood and anxiety disorders, have a smaller social network, and have experienced more negative life events than those with a score below the AQ-28-cut off.

Methods

Participants

Five hundred and ten older adults (> 60 years) took part in a large multi-site naturalistic longitudinal cohort study (2007-2010), the Netherlands Study of Depression in Older persons

Please refer to as: Geurts, H.M. , Stek, M. & Comijs, H. (2015). Autism characteristic in older adults with depressive disorders. *American Journal of Geriatric Psychiatry*. (NESDO). The aim of NESDO is to study the course and consequences of depressive disorders in older adults and, therefore, participants (378 depressed older adults and 132 controls) in this prospective cohort were extensively tested. Please note that the study design of NESDO has been described elsewhere²⁶. In short, only individuals that had a good command of Dutch language, scored 18 or higher on the Mini Mental State Examination (MMSE)²⁷, and were not suspected of having dementia according to clinicians were included. Persons with a bipolar or psychotic disorder were excluded. For the current study, participants (N= 376) were included when they filled out the shortened version of the Autism Spectrum Quotient (AQ-28)²⁵ which was included in a 6 month follow-up measurement between 2011 and 2012. These participants also filled out the Dutch versions of the Inventory of Depressive Symptomatology Self Report (IDS-SR)²⁸, the Becks Anxiety Inventory (BAI)²⁹. Informed consent was obtained from all participants before they participated in NESDO and please note that none of the participants had an MMSE score below 21 and were able to give both oral and written informed consent²⁶. The study was approved by the medical ethical committee of the VU University Medical Center and all participating institutes.

Depression group: 259 older adults with a depressive disorder in the past 6 months participated at baseline in the study. Descriptives (see Table 1) are presented for 258 participants (M=70 years [range 60-90], 83 males/167 females), one participant's AQ score was three standard errors above the group mean and was, therefore, excluded. The older adults with late-life depression in various developmental and severity stages were recruited for inclusion in NESDO via mental health care institutes and general practitioners. Those with a primary diagnosis of major or minor depression or dysthymia or after a positive screening with the Geriatric Depression Scale (GDS-15)³⁰ who could give written informed consent were interviewed to determine whether they indeed met depression criteria. The Composite International Diagnostic Interview (CIDI; WHO version 2.1; lifetime version,)³¹ was used to assess the presence of a depressive disorder (major depression [MDD], dysthymia, and minor depression) and/or comorbid anxiety disorder (generalized anxiety disorder [GAD], social phobia, panic disorder, and agoraphobia) according to the DSM-IV criteria in the last six months prior to the measurement day. The CIDI revealed that at baseline 26% (N=67) met criteria for dysthymia, 94% (N=243) for MDD, and 3.9% (N=10) for minor depression. With respect to the comorbidity with anxiety, the CIDI showed that 17.3% (N=25) met the diagnostic criteria for GAD, 33.3% (N=48) for social phobia, 12.5% (N=18) with

Please refer to as: Geurts, H.M. , Stek, M. & Comijs, H. (2015). Autism characteristic in older adults with depressive disorders. *American Journal of Geriatric Psychiatry*. agoraphobia, 9.7% (N=14) for panic disorder without agoraphobia, and 13.9% (N=20) for agoraphobia.

Comparison group: 117 older adults who had no lifetime depression participated and were recruited via general practices. Descriptives (see Table 1) are presented for 114 participants (M=69.2 years [60-85], 44 males/73 females) as of three participants IDS-SR score during follow-up was three standard errors above the group mean and two of these participants also had a BAI score of three standard errors above the group mean.

Measures

The IDS-SR²⁸ consists of 30 items related to key symptoms of depression, such as items related to mood, motivation, and somatic symptoms. All items were answered on a four-point scale (0 to 3). A higher score on the IDS-SR indicates more serious depression (see Table 1, potential score range is 0 to 84 as 28 of the 30 items are scored). The psychometric properties of this self-report scale are sound³⁷.

The BAI²⁹ consists of 21 items, which measures the emotional, physiological, and cognitive symptoms of anxiety. All items were answered on a four- point-scale (0 to 3). A higher score on the on the BAI indicates the presence of more severe anxiety symptoms (see Table 1, potential score range is 0 to 63). The BAI was found to have sound psychometric properties³⁸.

The AQ-28²⁵ consists of 28 items related to ASD characteristics such as impaired social relationships, impaired communication, and the need for a structured environment. All items were answered on a four-point scale (1 to 4). For the current study we use the AQ-28 total score. A higher score on the AQ means that more severe ASD characteristics are present (see Table 1, potential score range is 28 to 112). The AQ-28 is based on the 50-item AQ³² and this abridged version of the AQ is recommended to be used in large scale studies when filling out the full AQ version is to demanding. Other validated adult ASD questionnaires consists of a larger number of items as compared to the AQ-28 and, therefore, we choose to use the AQ-28 to ensure that we kept the additional time investment of the participants to a minimum. The test–retest and interrater reliability and validity of the AQ-28 are acceptable to good²⁵. We used a cutoff of 70 to determine the percentage of individuals that have relatively severe ASD characteristics. This stringent cut-off has a sensitivity of .94 and a specificity of .91 when distinguishing between an ASD and healthy control adult samples (mean age between 21 and 45 years)²⁵.

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Besides the above mentioned three questionnaires we used information from two other questionnaires that are filled out by the participants: the Close Person Inventory (CPI)³³ and the life events questionnaire (LEQ)³⁴. The CPI consists a series of questions related to details about present social support from the four most intimate persons of the participant. For the current study we used the reported number of persons in the network of the participant with who the participant has regular and important contact and is older than 18 years of age. The LEQ consists of a series of questions related to different types of life events that are experienced as negative by most people (such as illness, dead of a family member, financial problems). For the current study we used the number of negative life events across the last five years.

Statistical analyses

To determine whether in the depression group more participants score ASD positive on an ASD screener, percentages were calculated of those scoring above the 70 points cut off on the AQ-28 per group. A Chi square test was conducted to compare these percentages. Second, we ran Pearson correlation analyses to explore the relationship between AQ-28 and the depression and anxiety questionnaire scores in each of the two groups. Third, we compared those individuals with a score above the AQ-28 cut off with those with a score below the AQ-28 cut off. The inclusion in these two groups was independent of whether or not they had a depression diagnosis when the study started. We conducted an MANOVA with group as between subject factor and the total scores of the questionnaires (except for the AQ-28) as dependent measures. We also conducted Chi square test and ANOVAs to test whether these two groups differed in gender distribution, CIDI scores, social support, and negative life events.

All analyses were conducted with SPSS version 21. Confidence intervals for the percentages were calculated via <http://vassarstats.net/prop1.html> (i.e., we used the so-called Wilson procedure without correction for continuity, see³⁵) and confidence intervals for correlations via http://onlinestatbook.com/lms/estimation/correlation_ci.html³⁶). Partial eta squared was reported as effect size.

Results

Those of the original NESDO cohort (N=134) excluded from the current study due to missing AQ-28 data were slightly older ($F(2, 504)=7.77, p<.001, partial \eta^2=.03$), but did not differ on

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the IDS-SR and BAI total scores from those that did fill out the AQ-28 (respectively, $F(2, 504)=1.55, p=.21, partial \eta^2=.01$ and $F<1, p=.87, partial \eta^2=.00$). Hence, there seems no selection bias in the current sample that might confound our interpretation of the presented AQ-28 analyses. Moreover, the depression and the comparison group did not differ from each other with respect to gender and age, suggesting that on a group level the two groups were well matched on gender and age. We did, as expected, found significant differences, with respect to all anxiety and depression measures, Wilks Lambda=.50, $F(2,349)=171,8, p<.001, partial \eta^2=.70$. With respect to the MMSE the depression group had a slightly lower score, but the effect size was rather small (see Table 1).

In the comparison group 2.6 % (N=3; CI 0.9%- 7.5%) had a score above the AQ-28 cutoff of 70, while in the depression group 31.0% (N=80; CI 25.7%- 37.0%) scored above this cutoff, which is significantly more, $\chi^2(1, N=372) = 36.73, p<.001$. In both groups we observed positive, but small correlations between the AQ-28 total score and respectively the IDS-SR total score (Comparison group $r(108) = .12, p(2\text{-tailed}) = .20$; Depressive group $r(241) = .29; p(2\text{-tailed}) <.001$) and the BAI total score (Comparison group $r(108) = .17, p(2\text{-tailed}) = .07$; Depressive group $r(241) = .28, p(2\text{-tailed}) <.001$; see Figure 1 and 2 for details). These low correlations implies that there is hardly any overlap between the constructs we intend to measure with the AQ-28 and the IDS-SR and BAI.

The high ASD group (i.e., group scoring above AQ-28 cut off; N=83) and low ASD group (i.e., group scoring below AQ-28 cut off; N=284) did not differ from each other with respect to age, but we observed significant differences. There were relatively more males in the high ASD group as compared to the low ASD group. Moreover, and by definition in line with the former group analyses, on the IDS-SR and BAI total scores the high ASD group showed more symptoms as the low ASD group. With respect to the diagnosis at inclusion (i.e., CIDI scores) major depressions, dysthymia, general anxiety disorders, social phobia, and agoraphobia were more common in the high ASD group as compared to the low ASD group (see Table 2). In contrast to our hypothesis, there were no significant differences between the two groups in the size of the social network (CPI score). The exploratory analyses revealed that also the number of negative life events (LEQ score) did not differ between the high and low ASD group.

Conclusion

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As predicted, a larger proportion of older adults with a current depressive disorder showed relatively high number ASD characteristics as compared to those without depressive disorders. Moreover, an increase in the severity of the ASD characteristics was related to an increase in self-reported anxiety and depressive symptoms, but given the low to medium correlations between ASD and depression and anxiety symptoms the elevated prevalence of ASD characteristics in older adults with a depressive disorder does not seem to be due to item overlap of the questionnaires. Those with high ASD characteristics did have more comorbid disorders, but, in contrast with our expectations, neither had a smaller social network or experienced more negative life events as compared to those with a low number of ASD characteristics.

Approximately 31% of the older adults score above the ASD cut off, which is slightly lower than the percentage (36%) of those with high ASD traits in much younger adult population with depressive disorders¹⁸. In the relatively small Matsuo study not only another ASD questionnaire was used, the used cut off was far more liberal. If we use a similarly liberal cut off (i.e., 65) 43% of the older adults show elevated ASD characteristics. This more liberal cut off of 65 is recommended to use in a clinical setting when one suspects ASD²⁵ and when using this cut off approximately 6.1% of the older adults without a history of mood or anxiety disorders did show elevated ASD characteristics. This is much higher as the expected 1% prevalence of ASD across the life-span which might suggest that this ASD questionnaire (AQ-28) might overestimate ASD characteristics in older adults. Nonetheless in the aforementioned adult study¹⁸ the social responsiveness scale for adults was used and with this ASD measure even 14% of the young and middle aged healthy controls did show elevated ASD traits. As with increasing age (societal) withdrawal is considered adaptive and the mean age of the validation sample of the AQ-28 is much lower as compared to the current study, the question that remains to be answered is how many of these individuals with elevated ASD characteristics or traits will actually might meet the ASD diagnostic criteria. The observed increased prevalence of ASD characteristics in older adults with depressive disorders, the earlier observation that adults with unrecognized ASD are often diagnosed with a secondary psychiatric condition such as depressive disorders and anxiety disorders^{7,9,10}, and the observation that having more traits is associated with more comorbidities and a higher risk for mental health problems³⁷ do all suggest that also within geriatric psychiatry settings one should be attentive to ASD.

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There are some potential caveats in the current study. First, while ASD is often more common in males than females³⁸, depressive disorders are more common in females than males³⁹. The majority of the current sample is female and whether a similar picture emerges in older depressed males needs to be answered in future studies. In line with the literature though, also in the current study those with elevated ASD characteristics were relatively often males. Second, participants were included based on a current depression, and when anxiety was the primary diagnosis people were not included, but having a comorbid anxiety disorder was not an exclusion criteria. In the high ASD characteristics group social phobia was rather common (30%). The differential diagnosis of social phobia and ASD is not an easy endeavor and it, although speculative, it might be that some of those with social phobia are misdiagnosed cases of ASD⁴⁰. Third, we focused on older adults with a depressive diagnosis in the past six months, but some might be currently in remission. The proportion of adults with high ASD traits was much lower in a remitted major depressive disorder group (22%) as compared to an unremitted group (46%)¹⁸. Exclusion of those in remission will, therefore, probably even enhance the prevalence of those with high ASD characteristics. One could hypothesize that those that have a life time history of depression might even have more ASD symptoms as comorbidity of ASD with depression is already common at a young age¹⁸. Fourth, although we excluded persons with (possible) dementia according to the clinician, we recognize that diagnosing dementia in persons that are severely depressed can be very difficult. Therefore, we cannot be sure that we did not include persons in an early phase dementia. However, given that there is no differences between the high and the low AQ group in the number of participants with these relatively low MMSE scores, this does not seem to be a likely explanation for our pattern of findings.

To conclude, ASD symptoms are more common in older adults with a known history of depression than in a comparison group without lifetime depression, which suggest that clinicians need to be attentive to ASD symptomatology within geriatric psychiatry setting. Whether this also implies that ASD diagnoses are missed in this specific group of older adults needs to be determined in future studies as for a clinical diagnosis established diagnostic assessments are essential. However, in such a study it is of importance to take into account the differential diagnosis with social phobia as the question remains to be answered whether especially those formerly diagnosed with a social phobia are missed ASD cases.

References

Please refer to as: Geurts, H.M. , Stek, M. & Comijs, H. (2015). Autism characteristic in older adults with depressive disorders. *American Journal of Geriatric Psychiatry*.

1. Baxter AJ, Brugha TS, Erskine HE, Scheurer RW, Vos T, Scott JG. The epidemiology and global burden of autism spectrum disorders. *Psychol Med*. 2015; 45: 601-613.
2. American Psychiatric Association. *Diagnostic and Statistical Mental Disorders (5th ed.)*. Washington, DC: Author; 2013.
3. Brugha TS, McManus, S, Bankart J, et al. Epidemiology of autism spectrum disorders in adults in the community in England. *Arch Gen Psychiat*. 2011; 68: 459-465.
4. Howlin P, Moss P, Savage S, Rutter M. Social outcomes in mid-to later adulthood among individuals diagnosed with autism and average nonverbal IQ as children. *J Am Acad Child Psy*. 2013; 52: 572-581.
5. Happé F, Charlton RA. Aging in autism spectrum disorders: a mini-review. *Gerontology*. 2011; 58: 70-78.
6. Piven J, Rabins P. Autism spectrum disorders in older adults: toward defining a research agenda. *J Am Geriatr Soc*. 2011; 59: 2151-2155.
7. James IA, Mukaetova-Ladinska E, Reichelt FK, Briel R, Scully, A. Diagnosing Aspergers syndrome in the elderly: a series of case presentations. *Int J Geriatr Psych*. 2006; 21: 951-960.
8. van Niekerk ME, Groen W, Vissers CTW, van Driel-de Jong D, Kan CC, Oude Voshaar RC. Diagnosing autism spectrum disorders in elderly people. *Int Psychogeriatr*. 2011; 23: 700-710.
9. Geurts HM, Jansen MD. A retrospective chart study: The pathway to a diagnosis for adults referred for ASD assessment. *Autism*. 2012; 16: 299-305.
10. Hofvander B, Delorme R, Chaste P, et al. Psychiatric and psychosocial problems in adults with normal-intelligence autism spectrum disorders. *BMC Psychiatry*. 2009; 9: 35.
11. Buck TR, Viskochil J, Farley M, Coon H, McMahon WM, Morgan J, Bilder DA. Psychiatric comorbidity and medication use in adults with autism spectrum disorder. *JADD*. 2014; 44: 3063-3071.
12. Ghaziuddin M, Ghaziuddin N, Greden J. Depression in persons with autism: Implications for research and clinical care. *JADD*. 2002; 32: 299-306.
13. Joshi G, Wozniak J, Petty C, et al. Psychiatric comorbidity and functioning in a clinically referred population of adults with autism spectrum disorders: a comparative study. *JADD*. 2013; 43: 1314-1325.
14. Lugnegård T, Hallerbäck MU, Gillberg C. Psychiatric comorbidity in young adults with a clinical diagnosis of Asperger syndrome. *Res Dev Disabil*. 2011; 32: 1910-1917.
15. Liew SM, Thevaraja N, Hong RY, Magiati I. The relationship between autistic traits and social anxiety, worry, obsessive-compulsive, and depressive symptoms: Specific and non-specific mediators in a student sample. *JADD*. 2015; 45: 858-872.
16. Scherff A, Taylor M, Eley TC, Happé F, Charman T, Ronald A. What causes internalising traits and autistic traits to co-occur in adolescence? A community-based twin study. *J Abnorm Child Psychol*. 2014; 42: 601-610.
17. van Steensel FJ, Bögels SM, de Bruin EI. Psychiatric comorbidity in children with autism spectrum disorders: a comparison with children with ADHD. *J Child Family Stud*. 2013; 22: 368-376.
18. Matsuo J, Kamio Y, Takahashi H, et al. Autistic-Like Traits in Adult Patients with Mood Disorders and Schizophrenia. *PloS one*. 2015; 10: e0122711.
19. Ellwardt L, van Tilburg T, Aartsen M, Wittek R, Steverink N. Personal networks and mortality risk in older adults: a twenty-year longitudinal study. *PloS one*, 2015; 10: e0116731.
20. Vink D, Aartsen MJ, Schoevers RA. Risk factors for anxiety and depression in the elderly: a review. *J Affect Disorders*. 2008; 106: 29-44.
21. Autism Europe. *Towards a better quality of life. The rights of ageing people with autism*. Brussel, Belgium: MM team; 2012.

- Please refer to as: Geurts, H.M. , Stek, M. & Comijs, H. (2015). Autism characteristic in older adults with depressive disorders. *American Journal of Geriatric Psychiatry*.
22. Orsmond GI, Shattuck PT, Cooper BP, Sterzing PR, Anderson KA. Social participation among young adults with an autism spectrum disorder. JADD. 2013; 43: 2710-2719.
 23. Rowley E, Chandler S, Baird G, et al. The experience of friendship, victimization and bullying in children with an autism spectrum disorder: Associations with child characteristics and school placement. *Res Autism Spect Dis*. 2012; 6: 1126-1134.
 24. Mazurek MO. Loneliness, friendship, and well-being in adults with autism spectrum disorders. *Autism*. 2014; 18: 223-232.
 25. Hoekstra RA, Vinkhuyzen AA, Wheelwright S, et al. The construction and validation of an abridged version of the autism-spectrum quotient (AQ-Short). JADD. 2011 41: 589-596.
 26. 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*. 2011; 4: 524.
 27. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": a practical method for grading the cognitive state of patients for the clinician. *J Psychiat Res*. 1975; 12: 189-198.
 28. Rush AJ, Gullion CM, Basco MR, Jarrett RB, Trivedi, MH. The inventory of depressive symptomatology (IDS): psychometric properties. *Psychol Med*. 1996; 26: 477-486.
 29. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol*. 1988; 56: 893-897.
 30. Yesavage, JA. Geriatric Depression Scale. *Psychopharmacol Bull*. 1988; 24: 709-711.
 31. World Health Organization. Composite International Diagnostic Interview, version 2.1. WHO, Geneva; 1997.
 32. Baron-Cohen S, Wheelwright S, Skinner R, Martin J, Clubley E. The autism-spectrum quotient (AQ): Evidence from asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. JADD. 2001; 31: 5-17.
 33. Stansfeld S, Marmot M. Deriving a survey measure of social support: the reliability and validity of the Close Persons Questionnaire. *Soc Sci Med*. 1992; 35: 1027-1035.
 34. Brugha T, Bebbington P, Tennant C, Hurry J. The List of Threatening Experiences: a subset of 12 life event categories with considerable long-term contextual threat. *Psychol Med*. 1985; 15: 189-194.
 35. Newcombe RG. Two-sided confidence intervals for the single proportion: comparison of seven methods. *Stat Med* 1998; 17: 857-872.
 36. Online Statistics Education: A multimedia course of study (<http://onlinestatbook.com/>). Project leader: David M. Lane, Rice University.
 37. Lundström S, Chang Z, Kerekes N, et al. Autistic-like traits and their association with mental health problems in two nationwide twin cohorts of children and adults. *Psychol Med*. 2011; 4: 2423-2433.
 38. Werling DM, Geschwind DH. Sex differences in autism spectrum disorders. *Curr Opin Neurol*. 2013; 26: 146.
 39. Seney ML, Sibille E. Sex differences in mood disorders: perspectives from humans and rodent models. *BSD*. 2014; 5: 17.
 40. Cath DC, Ran N, Smit JH, van Balkom AJ, Comijs HC. Symptom overlap between autism spectrum disorder, generalized social anxiety disorder and obsessive-compulsive disorder in adults: a preliminary case-controlled study. *Psychopathology*, 2008; 41: 101-110.

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Author contributions and former presentations

The first author (HMG), designed the current study, analysed the data, interpreted the data and drafted the manuscript. HC and MX were two of the major designers of the NESDO cohort study and responsible for the infrastructure of the study. All authors read and approved the final manuscript and take full responsibility for the content of the manuscript. Preliminary analyses of the current dataset has been presented at the IMFAR May 2013, San Sebastian, Spain.

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Table 1 Descriptives of two groups of elderly: a group with depressive disorders and control group

	Group		Statistics
	Depression (N=258)	Comparison (N=114)	
Gender (M/F)	83/175	44/70	$\chi^2 (1, N=372) = 1.45, p = .23$
Age in years (M [SD]) ¹	70.1 (7.2) 95% CI (69.2-70.9)	69.2 (6.5) 95% CI (68.0-70.5)	$F (1, 371) = 1.12, p = .29, \eta^2 < .01$
MMSE ² (M [SD])	28.0 (1.8) 95% CI (27.7-28.2)	28.5 (1.4) 95% CI (28.2-28.8)	$F (1, 370) = 8.55, p < .005, \eta^2 = .02$
IDS-SR TotSc ³ (M [SD])	29.6 (12.8) 95% CI (28.2-30.9)	6.6 (4.2) 95% CI (4.6-8.7)	$F (1, 366) = 342.5, p < .001, \eta^2 = .48$
BAI TotSc ⁴ (M [SD])	17.0 (10.7) 95% CI (15.9-18.2)	3.4 (3.6) 95% CI (1.7-5.1)	$F (1, 351) = 170.1, p < .001, \eta^2 = .33$
AQ-28 TotSc (M [SD])	63.8 (10.4) 95% CI (62.6-65.0)	53.0 (8.0) 95% CI (51.2-54.8)	$F (1, 371) = 97.6, p < .001, \eta^2 = .21$

M=Male; F=Female; CI=Confidence Interval; MMSE=Mini Mental State Examination; CIDI=Composite International Diagnostic Interview; IDS-SR=Inventory of Depressive Symptomatology Self Report; TotSc=Total Score; BAI=Becks Anxiety Inventory; AQ-28=28-item Autism Spectrum Quotient.

¹Depression group: <70 N=157, 70-80 N=73, >80 N=28; Comparison group: <70 N=157, 70-80 N=73, >80 N=28

²Depression group: MMSE score <24 or equals 24 N=10, >24 N=248; Comparison group: MMSE score <24 or equals 24 N=0, >24 N=117

³As not all participants filled out the IDS-SR, the descriptive of this total score are based on 255 participants in the depression group and 112 in the control group.

⁴As not all participants filled out the BAI, the descriptive of this total score are based on 242 participants in the depression group and 110 in the control group.

Table 2 Descriptives of two groups of elderly: those scoring above the AQ-28 cut off and those with a score below this cut off.

	Group		Statistics
	high ASD (N=83)	low ASD (N=289)	
Gender (M/F)	37/46	90/199	$X^2 (1, N=372) = 5.18, p=.02$
Age in years (M [SD])	68.6 (6.6)	70.2 (7.1)	$F (1,371) = 3.42, p=.07, \eta^2=.01$
	95% CI (67.1-70.1)	95% CI (69.4-71.0)	
CIDI (n [%]) at baseline			
Mood disorders			
MDD	76 (91.6)	167 (57.8)	$X^2 (1, N=372) = 32.5, p<.001$
Dysthymia	29 (34.9)	38 (13.1)	$X^2 (1, N=372) = 20.7, p<.001$
Minor dep	4 (4.8)	12 (4.2)	$X^2 (1, N=372) = .07, p=.79$
Comorbid anxiety			
GAD	10 (12.0)	15 (5.2)	$X^2 (1, N=372) = 4.8, p=.028$
Social Phobia	25 (30.1)	23 (8.0)	$X^2 (1, N=372) = 28.2, p<.001$
Panic w. agoraphobia	7 (8.4)	11 (3.8)	$X^2 (1, N=372) = 3.0, p=.083$
Panic w/o agoraphobia	3 (3.6)	11 (3.8)	$X^2 (1, N=372) = .01, p=.94$
Agoraphobia	10 (12.0)	10 (3.5)	$X^2 (1, N=372) = 9.35, p=.002$
IDS-SR TotSc ¹	32.9 (13.6)	19.6 (14.3)	$F (1,366) = 57.2, p<.001, \eta^2=.14$
(M [SD])	95% CI (29.8-35.9)	95% CI (17.9-21.2)	
BAI TotSc ²	20.3 (12.1)	10.5 (9.8)	$F (1,351) = 55.7, p<.001, \eta^2=.14$

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(M [SD])	95% CI (18.1-22.6)	95% CI (9.3-11.8)	
No of Neg life events (past 5 years) ³	1.7 (1.3) 95% CI (1.4-2)	1.6 (1.3) 95% CI (1.4-1.7)	$F(1,368) = .56, p = .46, \eta^2 = .00$
Network of persons (n [%]) ⁴	49 (59.1)/ 22 (26.5)/	129 (45.4)/ 88 (31.0)/	$\chi^2(1, N=367) = 5.39, p = .145$
0-5/6-10/11-15/>16)	6 (7.2)/ 6 (7.2)	32 (11.3)/ 35 (12.3)	

M=Male; F=Female; CI=Confidence Interval; CIDI=Composite International Diagnostic Interview; MDD=Major Depressive Disorder; Minor dep=Minor Depressive Disorder; GAD=Generalized Anxiety Disorder; IDS-SR=Inventory of Depressive Symptomatology Self Report; TotSc=Total Score; BAI=Becks Anxiety Inventory; AQ-28=28-item Autism Spectrum Quotient.

¹As not all participants filled out the IDS-SR, the descriptive of this total score are based on 367 participants.

²As not all participants filled out the BAI, the descriptive of this total score are based on 352 participants.

³As not all participants filled out the LEQ and there were two outliers, the descriptive of this total score are based on 369 participants.

⁴As not all participants filled out the CPI and there were two outliers, the descriptive of this total score are based on 367 participants.

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Figure 1. The relationship between the ASD characteristics (AQ-28 total score) and depression symptoms (IDS-SR total score) for depressed older adults (grey) and comparison group (black). The cut off of the AQ-28 (short autism spectrum questionnaire) is 70, see bold line.

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Fig 1.

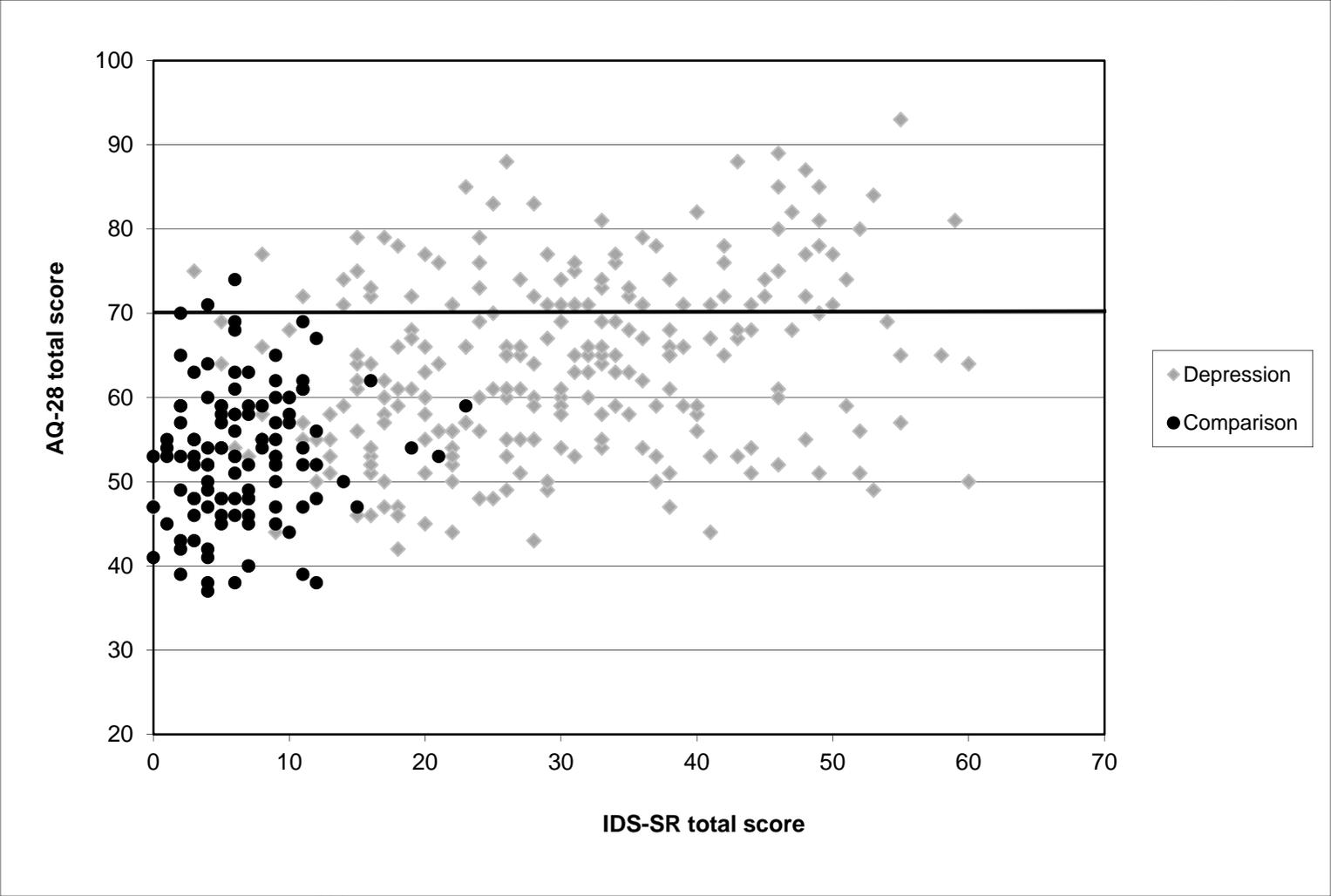
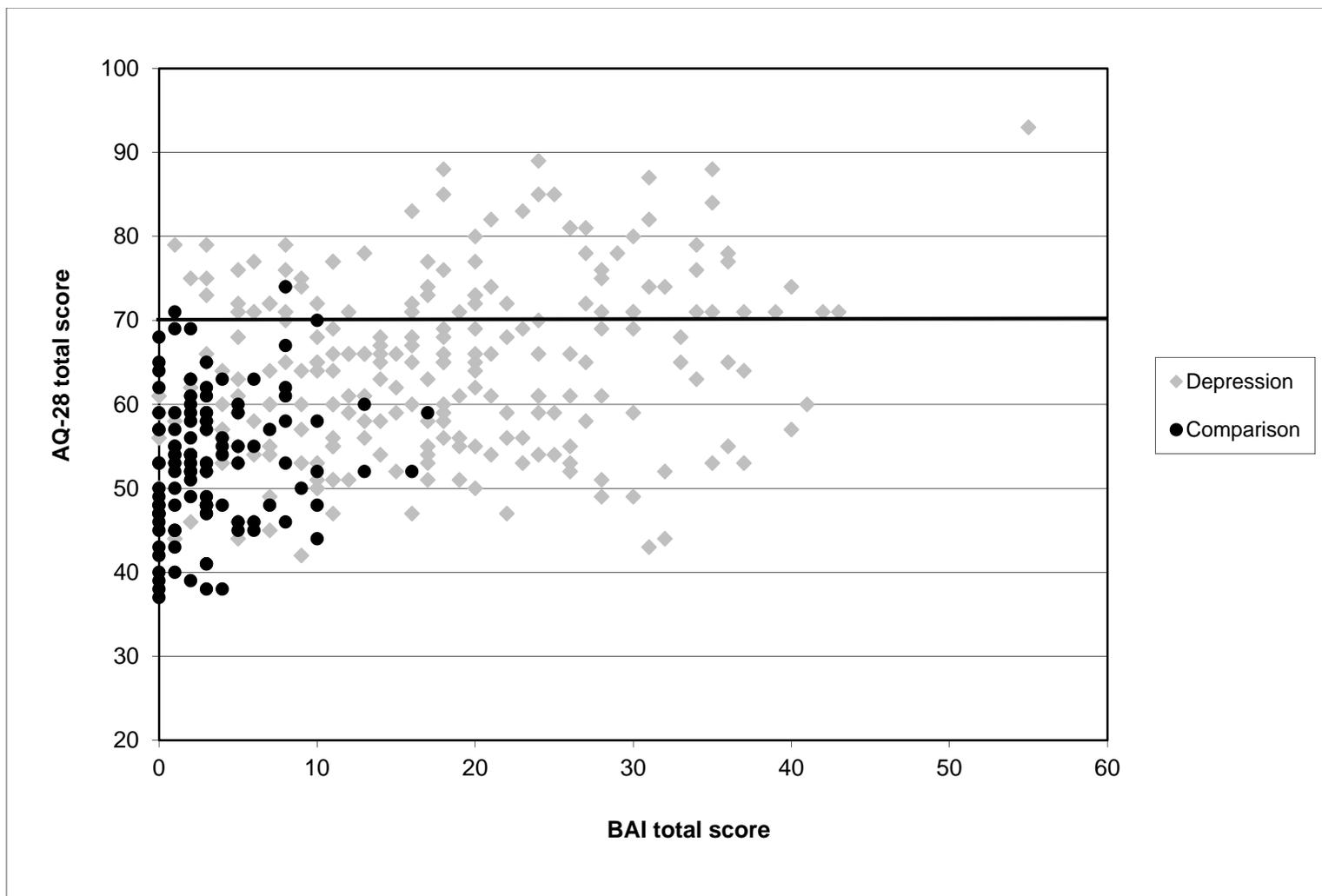


Figure 2. The relationship between the ASD characteristics (AQ-28 total score) and anxiety symptoms (BAI total score) for depressed older adults (grey) and comparison group (black). The cut off of the AQ-28 (short autism spectrum questionnaire) is 70, see bold line. Please note that the participant in the upper right corner is not an outlier (i.e., within 3SE from groups mean), and excluding this participant did not alter the main pattern of findings.

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