Chapter 5

ADHD and personality characteristics in older adults in the general Dutch population


ABSTRACT

Objectives: To examine the association between Attention-Deficit/Hyperactivity Disorder (ADHD) and personality characteristics and the potential mediating role of these characteristics in the relationship between ADHD and depression in older adults in the general Dutch population.

Design: Data from the Longitudinal Aging study Amsterdam in 2008/2009 were used in a cross-sectional design on 231 participants with and without ADHD, aged 60-94 years. Questionnaires assessing self-esteem, self-efficacy, mastery, neuroticism and social inadequacy were administered. ADHD was measured by means of ADHD diagnosis and level of ADHD symptoms. Linear regression analyses were performed to assess the association between ADHD (symptoms) and personality characteristics. Single and multivariate mediation analyses were performed to examine the mediating role of personality characteristics in the relationship between ADHD (symptoms) and depressive symptoms.

Results: ADHD was significantly negatively associated with sense of mastery (B=-2.44, t=- 3.14, df=228, p= 0.002), self-esteem (B=- 1.16, t=- 2.27, df=228, p= 0.02), and self-efficacy (B=- 2.33, t =- 2.02, df = 228, p= 0.045) and positively associated with neuroticism (B= 0.99, t= 4.90, df= 228, p <0.001) and social inadequacy (B= 0.65, t = 3.32, df = 229, p= 0.001). In the single mediation analyses, all personality characteristics were mediators in the relationship between ADHD symptoms and depressive symptoms. In the multivariate analysis only mastery and self-esteem were mediators.

Conclusions: Older adults with ADHD reported lower self-esteem and sense of mastery and higher levels of neuroticism and social inadequacy than older adults without ADHD. Mastery and self-esteem partly explained the association between ADHD and depressive symptoms in old age. The results implicate that in treatment clinicians should pay attention to the personality characteristics of older adults with ADHD.
INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a chronic disorder which may persist into older age (1). ADHD negatively affects children and adults in their functioning in several fields, such as in friendships (2,3), relationships (4), education (5) and work (6). Furthermore, children, younger and older adults with ADHD often suffer from comorbid anxiety disorders (7), depression (8) and externalizing behaviors (9). Consequently, patients with ADHD will often undergo negative experiences which negatively affect the formation of personality characteristics such as the individual's self-esteem (10), self-efficacy (11) and mastery (12). In turn, these personality characteristics are necessary to adequately deal with stressful events (13). By using maladaptive coping strategies, such as aggressively confronting or avoiding the stressful situation (14), adults with ADHD maintain and reinforce their dysfunctional self-beliefs. Locked in this vicious circle of ongoing stressful situations and disappointments, the ADHD patient sees the negative view of the self confirmed (15), which may lead to depression and guilt (16). Since greater self-esteem, self-efficacy and mastery are associated with greater endurance, lower depression and general well-being (17), treatment has also focused on improvements of these personality characteristics in adults with ADHD (18).

Not only have self-esteem, self-efficacy and mastery been associated with both ADHD and depression, but neuroticism has also been associated with both ADHD and depression in several studies (19,20). Neuroticism reflects emotional lability, including vulnerability to fear, stress and depression (21). Although the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) criteria for ADHD does not include deficient mood regulation, individuals with ADHD exhibit more mood instability, more difficulty coping with stress and have a higher risk for anxiety and depression disorders than individuals without ADHD (14,22–24). Extraversion, another personality characteristic, has been negatively associated with depression (25). Conflicting results are found in the relationship between ADHD and extraversion; some studies found an association between adults ADHD and high extraversion, whereas others did not find these associations (26,27). In the relationship between ADHD and depression, it seems plausible that neuroticism may play a mediating role in the association between ADHD and depression, although this role is not so very likely for the personality trait extraversion.

To our knowledge, nothing is known about the association between ADHD and personality characteristics, and the role of personality characteristics in the relationship between ADHD and depression in older age. In older age, there is an increased probability for physical illness, decline in cognitive functioning and negative life events such as loss of significant others.
Possibly due to these physical and social changes, ageing is also accompanied with change in personality characteristics; studies on the life-span development of self-esteem showed that self-esteem increases from adolescence to middle adulthood, and then decreases in old age (28). In addition, older adults with functional limitations or chronic diseases experience lower sense of mastery (29). In contrast, the neuroticism and extraversion personality characteristics are quite consistent traits in (old) adult life (30), although neuroticism tends to increase in old age (31). The combination of negative consequences of ageing and the accumulation of lifelong negative experiences may lead to lower self-esteem and sense of mastery in older adults with ADHD.

There are two aims this study. First, to obtain more insight in personality characteristics among older adults with ADHD compared to older adults without ADHD. Second, to examine the putative mediating role of personality characteristics in the relationship between ADHD and depressive symptoms in older adults with ADHD.

METHODS

Study sample
Data for the present study were collected in the Longitudinal Aging Study Amsterdam (LASA), an ongoing study of changes in autonomy and well-being with aging in The Netherlands. Full details on sampling are described elsewhere (32). In summary, a random sample of older men and women (55-85 years), stratified by age and sex, was drawn from the population registries of eleven municipalities in three geographic areas of the Netherlands. Data collection started in 1992-1993 (N=3,107) with respondents born in 1908–1937. Follow-ups were carried out every three years since then. In 2002-2003 a new cohort was sampled (birth years 1938-1947, N=1,002) with the same sampling frame as the earlier cohort. Both samples were combined and follow-up was carried out every three years. Every wave consisted of two parts, a main and a medical interview, in which tests were performed and structured questionnaires were administered. In the present study, data were used from the follow-up wave in 2008-2009.

The ADHD side study started in 2008-2009. In the 2008-2009 wave of LASA an ADHD screening instrument was part of the medical interview (N=1,494). In order to limit the number of diagnostic interviews, a two-phase non-proportional stratified random sampling procedure was used. On the basis of the results of the screener (phase one) the sample was divided into tertiles with low (group 1), intermediate (group 2) and high a priori likelihood of ADHD (group 3). These tertiles were randomly, but non-proportionally sampled for respondents
who were approached for the diagnostic interview (phase two). Three exclusion criteria were implemented. First, low cognitive functioning, measured with the Mini-Mental State Examination, a frequently used screening instrument for global cognitive dysfunction (33). The scale consists of 23 items and scores range from 0 to 30, with higher scores indicating better cognitive functioning. Respondents with an MMSE score ≤18 were excluded. Second, those who experienced cognitive decline, which was defined as a difference in score of more than one standard deviation on the MMSE (≥3 points) over a period of 3 years were excluded. Finally, respondents with a history of cerebrovascular accident were excluded. In phase two, all of the participants in group 3, and random samples of the participants in groups 1 and 2 (N=271) were approached for a diagnostic interview. In total 85 respondents of group 1 (90%), 80 of group 2 (86%) and 69 of group 3 (82.3%) consented to be interviewed. Three respondents were excluded from statistical analyses due to too many missing values on the diagnostic interview, a cerebral vascular accident or not being able to recollect childhood conditions. Thus, the total study sample consisted of 231 older adults.

Full details of the ADHD side study on sampling, measurements and non-response are described elsewhere (34). All interviews were conducted in the homes of respondents by specially trained and closely supervised interviewers. All interviews were tape-recorded in order to check the quality of the data. Informed consent was obtained from all participants, and approval of the Ethical Review Board of the VU University Medical Center (VUMc) was obtained.

**Measures**

**ADHD diagnosis**

To diagnose ADHD, the Diagnostic Interview for ADHD in Adults, second edition, (Diagnostisch Interview Voor ADHD bij volwassenen, DIVA 2.0) was used (35). This semi-structured interview was administered in 2010 and consists of two parts: one to assess the presence of all 18 DSM-IV TR criteria in childhood (primary school, ages 6-12 years) and at present; the other to assess impairment in five areas of functioning (work, education, family, social/relationships and self-confidence) in childhood and at present, related to the ADHD symptoms. The test-retest reliability of the DIVA 2.0 has not been examined yet.

In this study the cut-off point for current symptoms suggested by Kooij et al. (36) and Barkley et al. (37) was used. For the ADHD diagnosis it was required to have four or more symptoms of either inattention and/or hyperactivity-impulsivity during the 6 months prior to the interview (36), and to have six symptoms of either inattention and/or hyperactivity-impulsivity in childhood (DSM-IV criterion A). It was also required to have clinically significant impairment in at least two areas of daily life during the past 6 months prior to the interview.
and in childhood (criterion C and D).

**ADHD symptoms**
To increase the power of statistical analyses a sum score of all the ADHD symptoms at present and in childhood was calculated. The score ranged from 0-36, where higher scores indicated more ADHD symptoms.

**Outcome measures**

**Personality characteristics**

**Self-esteem** reflects the individual's positive or negative attitude toward the self as a totality and was measured by an adapted version of Rosenberg Self-esteem scale (38), which consisted of 4 items, with categories ranging from 1=strongly agree to 5=strongly disagree. The scale score is the sum of the ratings, with a range from 4 to 20 such that a higher rating indicates more self-esteem (Cronbach’s α = 0.93 in the complete LASA sample, wave 2008-2009, N=1,601).

**Self-efficacy** reflects the belief of a person in his or her ability to organize and execute certain behaviors that are necessary in order to attain a desired outcome and was measured with the 12-item version of the General Self-Efficacy Scale (GSES)(39). Response categories range from 1 =strongly disagree to 5=strongly agree. This scale, ranging from 12 to 60, with higher score indicating higher sense of self-efficacy, had a good reliability in the complete LASA sample in 2008-2009 (Cronbach’s α = 0.97).

**Mastery** (or sense of mastery) reflects the extent to which one regards one’s life-chances as being under one’s own control. (13) Mastery was measured by the Pearlin Mastery Scale. (13) A 5-item shortened version was used, a instead of the original 7-items (29). Response categories range from 1=strongly disagree to 5=strongly agree. This scale, ranging from 5 to 25, with higher score indicating higher sense of mastery, had a good reliability in the complete LASA sample in 2008-2009 (Cronbach’s α = 0.94).

**Neuroticism** was measured with a neuroticism scale consisting of 15-items derived from the Nederlandse Persoonlijkheids Vragenlijst (DPQ, the Dutch Personality Questionnaire) (40). Respondents scoring high on neuroticism experience a broad range of negative moods, including emotions such as fear, sadness/depression and self-dissatisfaction. Respondents were asked to indicate whether various similar statements applied to them (yes, do not know, no). A previous study in the LASA-sample showed the 15-item scale had a good reliability in measuring Neuroticism in an older population (Cronbach’s α = 0.83)(41).

**Social Inadequacy** was measured with a 10-item social inadequacy scale derived from
Social Inadequacy is highly negatively correlated with the extraversion scale of the Five-Factor Personality Inventory, a list based on the Big Five factors of personality \( r = -0.71 \) \((42)\). Respondents scoring high on the social inadequacy scale experience anxiety in social situations. A previous study in the LASA-sample showed the 10-item scale had a good reliability (Crohnbach’s \( \alpha = 0.82 \))\((41)\).

Neuroticism and social Inadequacy were assessed in 2001-2003. Since personality characteristics are quite stable over time, it was expected that the characteristics were similar in 2008-2009.

**Depressive symptoms**
Depressive symptoms were measured with the Center for Epidemiologic Studies Depressive Scale (CES-D)\((43)\). The CES-D is a self-report scale and consists of 20 items covering depressive symptomatology experienced in the past week. Each answer is rated on a 4-point scale ranging from 0 = rarely or never to 3= mostly or always. The total score of the 20 items ranges from 0 to 60, higher scores indicating more depressive symptoms. This scale has been shown to have good psychometric properties \((44)\) with a Crohnbach’s alpha of 0.87 \((45)\).

**Statistical Analysis**
Differences in the characteristics of the respondents according to diagnostic status were examined with independent samples t-test or Mann Whitney U test, and chi-squared tests for categorical variables.

Neuroticism and Social Inadequacy were transformed with the natural logarithm \( \ln(1+\text{neuroticism}) \) to obtain a near-normal distribution. Linear regression analyses were performed to assess the association between ADHD diagnosis and level of ADHD symptoms (independent variables) and continuous personality characteristics variables as dependent variables, adjusted for age. Since in the study sample older adults with ADHD were significantly younger than older adults without ADHD, age was included as a covariate in the analyses. Effect sizes of the linear regression analyses were measured with \( R^2 \). Effect sizes \( \geq 0.01 \) were considered small, effect sizes \( \geq 0.06 \) were considered medium, and effect sizes \( \geq 0.14 \) were considered large \((46)\).

In the associations between ADHD diagnosis and depressive symptoms, the personality characteristics were added separately as a mediator in the single mediator analyses. Depressive symptoms were transformed with the natural logarithm \( \ln(1+\text{CES-D score}) \) to obtain a near-normal distribution. A total of four regression parameters were estimated.
using bootstrap procedures as described by Preacher and Hayes (47): 1) of the mediator regressed on the predictor variable (a path); 2) of the mediator regressed on the outcome variable (b path); 3) of the outcome variable regressed on the predictor variable (direct effect, c path); and 4) the parameter representing the indirect effect of the predictor on the outcome via the mediator (c’ path). The indirect effect refers to the ab pathway. Figure 1 shows the model of the simple mediation.

Significant indirect effects (p<0.05) were considered as evidence consistent with mediation. A final model was fit that included all significant mediators to examine the unique contribution of each mediator. The reported results are based on 5,000 bootstrap samples and age was included as covariate. The same procedure was performed with level of ADHD symptoms. In addition, in a final step, the personality characteristics that were significant mediators in the relationship between level of ADHD symptoms and depressive symptoms were added in a multivariate mediation analysis. Due to low numbers in the ADHD diagnosis group (N=23), the multivariate mediation analysis was only performed with the level of ADHD symptoms. Effect sizes of the mediation analyses were calculated as followed; the R² of the linear analyses between ADHD/ADHD symptoms and depressive symptoms with age as covariate was subtracted from the model summary R² of the mediation analyses. Data were analyzed using IBM SPSS Statistics 20.

Figure 1. The simple mediation model in which X transmits an effect on Y directly as well as indirectly through M.
RESULTS

Descriptive statistics of the respondents are presented in Table 1. Of the 231 respondents, 137 were women (59%). The average age was 71 years (SD=7.7, range 60-94) and N=23 were diagnosed with ADHD. The respondents with ADHD were significantly younger and reported more depressive symptoms than the respondents without ADHD. In addition, older adults with ADHD reported lower sense of mastery, higher neuroticism and higher social inadequacy than older adults without ADHD.

Table 1: Personality characteristics in older adults with and without ADHD

<table>
<thead>
<tr>
<th></th>
<th>Without ADHD</th>
<th>With ADHD*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=208</td>
<td>N=23</td>
</tr>
<tr>
<td>Age in years (M, SD)</td>
<td>72.04</td>
<td>68.02</td>
</tr>
<tr>
<td></td>
<td>7.85</td>
<td>4.87</td>
</tr>
<tr>
<td>T, X^2, Z, d.f.</td>
<td>3.49, 36.1</td>
<td>3.54, 0.54</td>
</tr>
<tr>
<td>Female (N, %)</td>
<td>125, 60.1</td>
<td>12, 52.2</td>
</tr>
<tr>
<td>Number of depressive symptoms (Median, IQR)</td>
<td>7.00, 3-12</td>
<td>13.00, 9-23</td>
</tr>
<tr>
<td>Mastery (M, SD)^1</td>
<td>17.29</td>
<td>15.30</td>
</tr>
<tr>
<td></td>
<td>3.59</td>
<td>3.54</td>
</tr>
<tr>
<td>T, X^2, Z, d.f.</td>
<td>2.51, 227</td>
<td>2.54, 0.51</td>
</tr>
<tr>
<td>Self esteem (M, SD)^1</td>
<td>14.85</td>
<td>13.87</td>
</tr>
<tr>
<td></td>
<td>2.19</td>
<td>3.22</td>
</tr>
<tr>
<td>T, X^2, Z, d.f.</td>
<td>1.43, 24.3</td>
<td>1.49, 0.17</td>
</tr>
<tr>
<td>Social inadequacy (Median, IQR)^2</td>
<td>4.00, 1-8</td>
<td>8.00, 5-13.5</td>
</tr>
<tr>
<td>Neuroticism (Median, IQR)^2</td>
<td>4.00, 2-8</td>
<td>12.00, 7.5-20</td>
</tr>
</tbody>
</table>

* Analyzed with independent Samples Mann-Whitney U test
1 Of N=2 data is missing
2 Of N=1 data is missing

Table 2 shows the associations between ADHD diagnosis/ADHD symptoms and personality characteristics, with age as a covariate. The ADHD diagnosis and the level of ADHD symptoms were significantly negatively associated with self-esteem, self-efficacy and mastery and positively associated with neuroticism and social inadequacy. The associations had moderate effect sizes.

Table 3 shows the single mediation analyses of the relationship between ADHD diagnosis/level of ADHD symptoms and depressive symptoms, with age as a covariate. In Table 3 can be seen that the direct effect of ADHD on depressive symptoms (c path B=0.68, bootstrap p<0.001) became insignificant when neuroticism was added as mediator (c’ path B=0.30, bootstrap p=0.13, R^2 = 0.10). Results in Table 3 indicate that mastery, neuroticism and social inadequacy partially mediated the relationship between ADHD and depressive symptoms, since the confidence intervals of the indirect effect did not cross zero. The effect sizes ranged from small (R^2= 0.04 for social inadequacy) to large (R^2= 0.25 for mastery).
The single mediation analyses in the relationship between level of ADHD symptoms and depressive symptoms showed that the relationship was partially mediated by self-esteem, self-efficacy, mastery, neuroticism and social inadequacy. The effect sizes ranged from small ($R^2 = 0.03$ for social inadequacy) to large ($R^2 = 0.27$ for self-esteem).

<table>
<thead>
<tr>
<th>ADHD diagnosis</th>
<th>ADHD symptoms</th>
<th>B</th>
<th>d.f.</th>
<th>t</th>
<th>p</th>
<th>R$^2$</th>
<th>B</th>
<th>d.f.</th>
<th>t</th>
<th>p</th>
<th>R$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastery</td>
<td></td>
<td>-2.44</td>
<td>228</td>
<td>-3.14</td>
<td>0.002</td>
<td>0.09</td>
<td>-0.16</td>
<td>228</td>
<td>-4.73</td>
<td>&lt; 0.001</td>
<td>0.13</td>
</tr>
<tr>
<td>Self esteem</td>
<td></td>
<td>-1.16</td>
<td>228</td>
<td>-2.27</td>
<td>0.024</td>
<td>0.04</td>
<td>-0.07</td>
<td>228</td>
<td>-3.13</td>
<td>0.002</td>
<td>0.06</td>
</tr>
<tr>
<td>Self efficacy</td>
<td></td>
<td>-2.33</td>
<td>228</td>
<td>-2.02</td>
<td>0.045</td>
<td>0.06</td>
<td>-0.18</td>
<td>228</td>
<td>-3.40</td>
<td>0.001</td>
<td>0.09</td>
</tr>
<tr>
<td>Neuroticism$^1$</td>
<td></td>
<td>0.99</td>
<td>228</td>
<td>4.90</td>
<td>&lt; 0.001</td>
<td>0.10</td>
<td>0.06</td>
<td>228</td>
<td>6.84</td>
<td>&lt; 0.001</td>
<td>0.17</td>
</tr>
<tr>
<td>Social inadequacy$^1$</td>
<td></td>
<td>0.65</td>
<td>229</td>
<td>3.32</td>
<td>0.001</td>
<td>0.05</td>
<td>0.03</td>
<td>229</td>
<td>3.10</td>
<td>0.002</td>
<td>0.04</td>
</tr>
</tbody>
</table>

$^1$ variables are transformed with natural logarithm

The results of the multivariate mediation analyses in the relationship between level of ADHD symptoms and depressive symptoms are shown in Table 4. The results revealed that only self-esteem and mastery were statistically significant mediators.

DISCUSSION

To our knowledge, this is the first study that examines the association between ADHD and personality characteristics in old age and the first to examine the possible mediating role of personality characteristics in the association between ADHD and depressive symptoms. The findings of this study show that older adults with ADHD have lower self-esteem, lower self-efficacy, lower sense of mastery and higher levels of neuroticism and social inadequacy than older adults without ADHD. These associations had moderate effect sizes. The results also showed that mastery and self-esteem partly mediated the relationship between ADHD severity and depressive symptoms.

Our results are in line with previous studies among children and younger adults with ADHD, where individuals with ADHD reported lower self-esteem, self-efficacy and mastery than individuals without ADHD. The mechanism explaining the association between ADHD and lower self-esteem, self-efficacy and mastery in old age is as yet unknown. One possible explanation may be that an earlier developed negative view of the self continues to exist into late life. This lifelong poor self-belief may imply that older adults with ADHD experience
Table 3 Single mediation of the relationship between ADHD and depressive symptoms (LN transformed) through personality characteristics and age as covariate

<table>
<thead>
<tr>
<th>ADHD variables (X)</th>
<th>Mediating variable (M)</th>
<th>d.f.*</th>
<th>Total effect (c)</th>
<th>Effect of X on M (a)</th>
<th>Effect of M on Y (b)</th>
<th>Direct effect (c')</th>
<th>Indirect effect (ab)</th>
<th>95% CI (ab)</th>
<th>R^2 (model summary)</th>
<th>R^2 Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-esteem</td>
<td>225</td>
<td>0.68**</td>
<td>-1.16*</td>
<td>-2.27</td>
<td>-0.22**</td>
<td>-10.40</td>
<td>0.42*</td>
<td>2.67</td>
<td>0.25</td>
<td>(-0.05;0.55)</td>
</tr>
<tr>
<td>Mastery</td>
<td>225</td>
<td>3.52</td>
<td>-2.44*</td>
<td>-3.14</td>
<td>-0.13**</td>
<td>-8.93</td>
<td>0.37*</td>
<td>2.17</td>
<td>0.31</td>
<td>(0.11;0.53)</td>
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<tr>
<td>Self-efficacy</td>
<td>225</td>
<td></td>
<td>-2.33*</td>
<td>-2.03</td>
<td>-0.07**</td>
<td>-6.56</td>
<td>0.52*</td>
<td>2.52</td>
<td>0.16</td>
<td>(-0.01;0.34)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>225</td>
<td>7.48**</td>
<td>5.98</td>
<td>0.05**</td>
<td>5.26</td>
<td>0.30</td>
<td>1.52</td>
<td>0.38</td>
<td>(0.19;0.63)</td>
<td>0.17</td>
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<td>Social Inadequacy</td>
<td>226</td>
<td>4.08**</td>
<td>3.56</td>
<td>0.03*</td>
<td>3.09</td>
<td>0.54*</td>
<td>2.78</td>
<td>0.14</td>
<td>(0.05;0.30)</td>
<td>0.11</td>
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<td></td>
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<td>Self-esteem</td>
<td>225</td>
<td>0.05**</td>
<td>-0.07*</td>
<td>-3.13</td>
<td>-0.20**</td>
<td>-10.07</td>
<td>0.03**</td>
<td>4.72</td>
<td>0.015</td>
<td>(0.005;0.025)</td>
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<tr>
<td>Mastery</td>
<td>225</td>
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<td>-4.73</td>
<td>-0.12**</td>
<td>-8.18</td>
<td>0.03**</td>
<td>3.79</td>
<td>0.019</td>
<td>(0.010;0.030)</td>
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<td>Self-efficacy</td>
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<td>-0.18*</td>
<td>-3.40</td>
<td>-0.06**</td>
<td>-6.00</td>
<td>0.04**</td>
<td>4.71</td>
<td>0.01</td>
<td>(0.005;0.019)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>225</td>
<td>0.44**</td>
<td>8.15</td>
<td>0.04**</td>
<td>4.09</td>
<td>0.03*</td>
<td>3.18</td>
<td>0.02</td>
<td>(0.010;0.029)</td>
<td>0.20</td>
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<td>Social Inadequacy</td>
<td>226</td>
<td>0.18**</td>
<td>3.37</td>
<td>0.03*</td>
<td>2.79</td>
<td>0.04**</td>
<td>4.96</td>
<td>0.01</td>
<td>(0.001;0.011)</td>
<td>0.17</td>
</tr>
</tbody>
</table>

* p<0.05, ** p<0.001
1 ab-path was considered statistically significant when the 95% confidence interval (CI) did not include zero
2 Regression parameters were estimated by bootstrap procedures
3 Degrees of freedom of the model summary.
4 R^2 of the linear regression between ADHD diagnosis/ADHD symptoms (IV) and depressive symptoms (LN transformed), with age as covariate.
Table 4: Multiple mediation of the relationship between ADHD symptoms and depressive symptoms (LN transformed) through personality characteristics and age as covariate

<table>
<thead>
<tr>
<th>Mediating variables</th>
<th>d.f.</th>
<th>Total effect (c)</th>
<th>Direct effect (c')</th>
<th>Effect of IV on M (a)</th>
<th>Effect of M on DV (b)</th>
<th>Indirect effect (ab)</th>
<th>95% CI (ab)</th>
<th>R² (model summary)</th>
<th>R² Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=227</td>
<td>219</td>
<td>.05**</td>
<td>.03**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.140</td>
<td>0.32</td>
</tr>
<tr>
<td>Self-esteem</td>
<td></td>
<td>-0.07*</td>
<td>-0.16**</td>
<td>0.011</td>
<td></td>
<td>(0.004;0.020)</td>
<td></td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Mastery</td>
<td></td>
<td>-0.16**</td>
<td>-0.06**</td>
<td>0.010</td>
<td></td>
<td>(0.003;0.018)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td>-0.17*</td>
<td>-0.006</td>
<td>0.001</td>
<td></td>
<td>(-0.003;0.005)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroticism</td>
<td></td>
<td>0.44**</td>
<td>0.001</td>
<td>0.0004</td>
<td></td>
<td>(-0.010;0.010)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Inadequacy</td>
<td></td>
<td>0.18**</td>
<td>0.008</td>
<td>-0.002</td>
<td></td>
<td>(-0.005;0.002)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<.05,  ** p<.001,  ^ significant based on 95% confidence interval (CI)

^ significant based on 95% confidence interval (CI)

ª Regression parameters were estimated by bootstrap procedures

ª Degrees of freedom of the model summary.

ª R² of the linear regression between ADHD symptoms (IV) and depressive symptoms (LN transformed), with age as covariate.
their low self-esteem, self-efficacy and mastery as ego-syntonic and clinicians treating older adults with ADHD should be aware of the possible complex psychiatric presentation of ADHD with internalized poor self beliefs. Future (longitudinal) research may provide insight in the possible associations and pathways leading to low (ego-syntonic) self-esteem, self-efficacy and sense of mastery in older adults with ADHD.

The finding that older adults with ADHD have higher levels of neuroticism compared to older adults without ADHD is not surprising. Neuroticism is defined by anger, dysphoric mood and negative affect, which are often seen in clinical observations of patients with ADHD (48). Unexpectedly, older adults with ADHD reported higher levels of social inadequacy than older adults without ADHD. Higher levels of social inadequacy corresponds to being shy, inhibited, and being uncomfortable in company of others, while lower levels of social inadequacy include extraversion, being open, talkative and being active in group activities. Previous studies found mixed results concerning extraversion and ADHD, some studies found a relationship between ADHD and extraversion (49,50), while others did not (26,27). Although it could be expected that ADHD is related to low social inadequacy or high extraversion, especially as originally defined by Eysenck, who included impulsiveness along with sociability and activity, later on, impulsiveness was dropped from the extraversion construct (26). Extraverts tend to have better social skills than introverts, which is in contrast with the social characteristics of individuals with ADHD. Individuals with ADHD are often less well liked, more socially rejected, and have more friendship problems (2). The result of this study, that older adults with ADHD score higher on social inadequacy and thus probably lower on extraversion, is in line with the social characteristics of individuals with ADHD.

The mechanism underlying the relationship between ADHD and personality traits is still unknown; it is possible that personality traits share a common cause with ADHD, are influenced or changed by ADHD, or lie in the same continuum. Martel and his colleagues (51) examined personality traits as possible viable candidates for mediators of the relationship between genetic risk and ADHD. Several genes that are important for dopaminergic neurotransmission have been implicated in both ADHD and personality traits. For example, the DRD4 seven-repeat allele has been shown to be associated with ADHD symptoms as well as with high neuroticism and low conscientiousness (51). Longitudinal research would be helpful to determine the causal pathways of ADHD symptoms and the Big Five personality traits.

The second aim of the study was to examine the potential mediating roles of personality characteristics in the relationship between ADHD and depressive symptoms. The relationship between ADHD severity and depressive symptoms were partially mediated by all personal
personality characteristics in the single mediation analyses, where the effect sizes ranged from small ($R^2 = 0.03$ for social inadequacy) to large ($R^2 = 0.27$ for self-esteem). When all the personality characteristics were added in one model in the multivariate mediation analysis, the results showed that only self-esteem and mastery partially mediated this relationship. To our knowledge, this is the first study to examine the mediating role of personality characteristics between ADHD and depression. Previous studies in older adults did examine the possible predictors of depression; low self-esteem, low mastery and high neuroticism were found to be strongly related to becoming depressed (52,53). Surprisingly, neuroticism was not a significant mediator when all the personality characteristics were added in the final model, which could have been expected seen the strong relationship between level of ADHD symptoms and neuroticism (19) and between neuroticism and depression (20, 54). Self-esteem, self-efficacy and neuroticism are strongly related, and may even be markers of the same higher order concept (55). The overlap of the personality characteristics may be an explanation why neuroticism was not found to be a mediator in the multiple analysis.

Strengths and limitations
A strength of this study is that it uses data on ADHD and personality characteristics in a representative cohort of older adults. This study makes contributions by examining the relationship between ADHD and personality characteristics, and by adding personality characteristics as mediators in the association between ADHD and depressive symptoms in older age. However, the findings of this study should be interpreted in light of its limitations. First, only two of the Big Five personality traits could be examined. Other personality traits, such as low agreeableness and low conscientiousness have been shown to be associated with ADHD. Therefore, it is likely that this association persists into older age. However, data on these personality characteristics were not available. Second, due to the cross-sectional nature of the study, we are limited in drawing strong causal conclusions. Longitudinal studies are needed to further determine the direction of effects. Third, the role of ageing in the association between ADHD and personality characteristics was not examined. Although we did control for age, ageing and the accompanied decline of cognitive functioning and negative life events may also have played an important role in the association between ADHD and personality characteristics. Finally, a limitation is the relatively small sample size of the ADHD sample. However, the power of the regression analyses were 0.80 and higher, which can be considered as sufficient power levels. Therefore, the results seem reliable for interpretation.

Conclusions
The findings suggest that older adults with ADHD have low self-esteem and mastery, and high levels of neuroticism and social inadequacy. Self-esteem and mastery partly mediated
the relationship between ADHD severity and depressive symptoms. The results of this study imply that in treatment, clinicians should pay attention to the complex clinical picture of older adults with ADHD, who may have ego-syntonic poor self-beliefs that may play an important role in developing and/or maintaining depressive symptoms. Still, many unresolved issues remain. Future research should consider examining the mediating role of personality characteristics in children and younger adults with ADHD in relationship with depression and explore possible prevention of depression through increasing self-esteem and sense of mastery.

Acknowledgements
We thank Nicole Korten for her time and help with the statistical analyses.
REFERENCES


11. Newark PE, Elsässer M, Stieglitz R-D. Self-Esteem, Self-Efficacy, and Resources in Adults With ADHD. J Atten Disord [Internet]. 2012 [cited 2012 Dec 12]; Available from: http://jad.sagepub.com/content/early/2012/10/10/1087054712459561


35. Kooij JJS. Adult ADHD. Diagnostic Assessment and Treatment. Amsterdam: Pearson Assessment and Information; 2010.
36. Kooij JJS, Buitelaar JK, van den Oord EJ, Furer JW, Rijnders CAT, Hodiamont PPG. Internal and external validity of attention-deficit hyperactivity disorder in a population-based sample of


