Influence of depression, anxiety and stress on cognitive performance in community-dwelling older adults living in rural Ecuador: Results of the Atahualpa Project

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Aim: To assess the relationship between cognitive status and self-reported symptoms of depression, anxiety and stress of older adults living in an underserved rural South American population.

Methods: Community-dwelling Atahualpa residents aged ≥60 years were identified during a door-to-door census, and evaluated with the Depression Anxiety Stress Scale-21 (DASS-21) and the Montreal Cognitive Assessment (MoCA). We explored whether positivity in each of the DASS-21 axes was related to total and domain-specific MoCA performance after adjustment for age, sex and education.

Results: A total of 280 persons (59% women; mean age, mean age 70 ± 8 years) were included. Based on established cut-offs for the DASS-21, 12% persons had depression, 15% had anxiety and 5% had stress. Mean total MoCA scores were significantly lower for depressed than for not depressed individuals (15.9 ± 5.5 vs 18.9 ± 4.4, P < 0.0001). Depressed participants had significantly lower total and domain-specific MoCA scores for abstraction, short-term memory and orientation. Anxiety was related to significantly lower total MoCA scores (17 ± 4.7 vs 18.8 ± 4.5, P = 0.02), but not to differences in domain-specific MoCA scores. Stress was not associated with significant differences in MoCA scores.

Conclusion: The present study suggests that depression and anxiety are associated with poorer cognitive performance in elderly residents living in rural areas of developing countries. Geriatr Gerontol Int 2014; ••: ••–••.

Keywords: anxiety, Atahualpa, cognitive decline, depression, developing countries, Ecuador, Montreal Cognitive Assessment, population-based study.

Introduction

The prevalence of mild cognitive impairment (MCI) and dementia is growing at an alarming rate among older adults living in many low- and middle-income countries.1 In addition, the contribution of psychiatric and neurological disorders to the total burden of illness has increased almost threefold in Latin America during the past few years.2 Accurate estimates of the numbers of persons with MCI and dementia are necessary for public health planning in these underserved populations. However, such assessment might be complicated by cross-cultural factors and illiteracy, which could make some of the most widely-used screening instruments non-reliable.3

Depression, anxiety and stress are extremely common functional disorders that interfere with quality of life, and might trigger or worsen a number of medical conditions that are detrimental to health. The relationship between psychological distress, especially depression, and cognitive decline has been extensively evaluated in developed countries,4 but the effects of this association have been less well studied in middle- and low-income countries. People living in these regions do not
seek medical attention for depression or anxiety, which they considered as a normal part of their lives, or even a proxy for a better socioeconomic status.¹

Regional epidemiological surveys could provide useful insights into the impact of psychological distress on cognition in rural populations of developing countries. In the present study, we take advantage of the uniqueness of the Atahualpa Project to assess the influence of symptoms related to depression, anxiety and stress on the cognitive performance of older adults living in a village that is representative of rural Ecuador.⁶ Better understanding of the problem would allow public health administrators to develop cost-effective strategies for reducing the burden of MCI and dementia.

**Methods**

**Study population**

Atahualpa is located in coastal Ecuador, and more than 95% of the population belongs to the Native/Mestizo ethnic group (Amerindians). Its residents have better cardiovascular health than people in urban centers as a result of their rural lifestyle.⁷ Crime rates are low, inhabitants do not migrate and a sizable proportion of them have never even visited large urban centers, which are more than 100 km apart.

**Study design**

Ethics considerations of the study and informed consent forms were approved by the institutional review board of Hospital-Clinica Kennedy, Guayaquil, Ecuador. Trained field personnel – including general physicians – carried out a door-to-door survey to identify all Atahualpa residents aged ≥60 years, defined as those persons who had lived in the community for the 3 months preceding the start of the survey (15 June 2013). A standard field instrument was used to assess sociodemographic characteristics, including age, sex, race/ethnicity, education and occupation. Consenting individuals were then evaluated by questionnaires that assessed symptoms consistent with depression, anxiety and stress, as well as cognitive status.

Cognitive performance was assessed using the Spanish version of the Montreal Cognitive Assessment (MoCA) test (http://www.mocatest.org; © Z Nasreddine MD, version 7 November 2004). The MoCA evaluates major cognitive domains: visuospatial-executive (trail making B task, 3-D cube copy and clock drawing) for a maximum of 5 points; naming (unfamiliar animals) for a maximum of 3 points; language (sentence repetition and a phonemic fluency task) for a maximum of 3 points; short-term memory (delayed recall or words) for a maximum of 5 points; abstraction (verbal abstraction) for a maximum of 2 points; attention and calculation (digits forward and backward, target detection using tapping, serial 7s subtraction) for a maximum of 6 points; and orientation (time and space) for a maximum of 6 points.⁸

The Depression Anxiety Stress Scale (DASS-21) provided quantitative measures of depression (dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involve, anhedonia and inertia), anxiety (autonomic arousal, skeletal muscle effects, situational anxiety and subjective experience of anxious affect) and stress (chronic non-specific arousal, difficulty relaxing, nervous tension, and being easily upset, irritable and intolerant). The DASS-21 is a reliable field instrument comprising three sets of questions (seven in each set). The responses are rated on a four-point Likert scale ranging from 0 (not at all) to 3 (almost always) with a maximum total score of 21 for each axis.⁹

As people living in Atahualpa speak Spanish, we used the validated Spanish version of the MoCA that is posted on the original web site as developed by Z Nasreddine (http://www.mocatest.org/), and previously tested in other Spanish-speaking communities of South America, including Atahualpa.¹⁰,¹¹ We did not use a cut-off score for defining cognitive impairment, but the continuous MoCA score (total and domain-specific) to compare performance in the test across persons with and without psychological distress, to avoid problems related to poor reliability of specific cut-offs in less well-educated populations.¹⁰,¹¹ The DASS-21 questionnaire was independently translated and back-translated from its original English version to Spanish by bilingual physicians from our group (OHD and GEM). Disagreements in translation were resolved through discussion and consensus. Then, the Spanish version of the DASS-21 was culturally adapted – including vernacular Spanish words used by local people – with the aid of Atahualpa’s community leaders and rural doctors that had been working in the village, and tested in a random sample of the population before the study.

**Statistical analyses**

Descriptive statistics are presented as means with standard deviations for continuous variables and as percentages for categorical variables. We examined the associations between demographic variables (age, sex, education) and each of the axes of the DASS-21 with the total MoCA score using linear regression, and with the domain-specific scores using ordinal logistic regression. Univariate analyses were examined, and we evaluated the relationship between each of the axes of the DASS-21 with total and domain-specific MoCA scores after adjustment for age, sex, and education. All analyses were carried out using STATA software version 13 (STATA Corp, College Station, TX, USA).
Results

The door-to-door census identified 323 Atahualpa residents aged ≥60 years, of whom 17 declined to participate. A total of 26 persons were additionally excluded because of severe visual impairment (14 cases), deafness (6 cases) or aphasia (6 cases), which prevented them for completing the MoCA or the DASS-21. The 280 participants included 116 men and 164 women with a mean age of 70 ± 8 years. Of the 116 men, 90 were actively working (58 as carpenters) and 26 were retired. Of the 164 women, 135 were homemakers, 26 remained at home, but were not involved in caregiving activities, and just five worked outside the home. Mean school years of the entire group was 6 ± 3 years. A total of 227 (81%) of participants only completed primary school or less, and 53 had secondary school education or higher.

The mean MoCA score was 18.5 ± 4.6 for the whole study group (including an extra point given for education of ≤12 years in 271 out of 280 persons). Table 1 shows the distribution of scores across the specific domains of cognition. Total MoCA performance was better for persons aged 60–74 years, for men of all ages and for those with secondary school education or higher. Younger participants had higher scores in all specific cognitive domains except abstraction. Men had higher scores than women in naming, attention/calculation and language domains, whereas women had better short-term memory scores. More educated persons scored higher in the domains of language, short-term memory, naming and attention/calculation (Table 2).

Results in the DASS-21 indicated that 33 individuals had depression, 41 had anxiety and 14 had stress. Depression was more common in women than in men, but was not influenced by age or education. Patients with anxiety were older than those without anxiety and were more frequently women, but anxiety was not influenced by education. Stress was not influenced by age, sex or education.

Participants with depression had significantly lower total MoCA scores and significantly lower scores for short-term memory, attention/calculation and orientation than non-depressed participants (Table 3). Participants with anxiety also had lower total MoCA scores and significantly lower scores for orientation than non-anxious participants. Stress did not influence total MoCA scores, but stressed participants had significantly lower scores for orientation.

Table 4 shows the results of the multivariable model, with the total MoCA score as a dependent variable and adjusted for age, sex and education, confirmed that participants with depression had significantly lower total MoCA scores ($P = 0.006$) and domain-specific scores for abstraction, short-term memory, and orientation than non-depressed participants. A multivariable model with anxiety score as a continuous variable, and after
### Table 2  Total and domain-specific Montreal Cognitive Assessment scores in relation to age, sex and education

<table>
<thead>
<tr>
<th>Scores</th>
<th>Age</th>
<th>Sex</th>
<th>Education</th>
<th>P-value (age)</th>
<th>P-value (sex)</th>
<th>P-value (education)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60–74 years</td>
<td>Men</td>
<td>Primary</td>
<td>19.4 ± 4.2</td>
<td>0.0001</td>
<td>17.9 ± 4.6</td>
</tr>
<tr>
<td></td>
<td>≥75 years</td>
<td>Women</td>
<td>Secondary</td>
<td>15.7 ± 4.6</td>
<td>0.0001</td>
<td>17.7 ± 4.8</td>
</tr>
<tr>
<td></td>
<td>n = 210</td>
<td>n = 116</td>
<td>n = 227</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n = 70</td>
<td>n = 164</td>
<td>n = 53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visuospatial-executive (max 5)</td>
<td>Ref</td>
<td>0.43 (0.26–0.71)</td>
<td>0.001</td>
<td>Ref</td>
<td>0.88 (0.57–1.35)</td>
<td>0.55</td>
</tr>
<tr>
<td>Naming (max 3)</td>
<td>Ref</td>
<td>0.47 (0.29–0.78)</td>
<td>0.003</td>
<td>Ref</td>
<td>0.27 (0.17–0.43)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Attention/calculation (max 6)</td>
<td>Ref</td>
<td>0.28 (0.17–0.46)</td>
<td>&lt;0.0001</td>
<td>Ref</td>
<td>0.30 (0.19–0.46)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Language (max 3)</td>
<td>Ref</td>
<td>0.54 (0.32–0.89)</td>
<td>0.02</td>
<td>Ref</td>
<td>0.65 (0.42–1.00)</td>
<td>0.05</td>
</tr>
<tr>
<td>Abstraction (max 2)</td>
<td>Ref</td>
<td>1.22 (0.59–2.54)</td>
<td>0.59</td>
<td>Ref</td>
<td>1.03 (0.56–1.91)</td>
<td>0.92</td>
</tr>
<tr>
<td>Short-term memory (max 5)</td>
<td>Ref</td>
<td>0.42 (0.25–0.69)</td>
<td>0.001</td>
<td>Ref</td>
<td>1.55 (1.01–2.39)</td>
<td>0.04</td>
</tr>
<tr>
<td>Orientation (max 6)</td>
<td>Ref</td>
<td>0.34 (0.20–0.57)</td>
<td>&lt;0.0001</td>
<td>Ref</td>
<td>0.76 (0.49–1.20)</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Data presented as odds ratio (95% confidence interval) per 1 point score increase, unless otherwise stated. Max, maximum score; MoCA, Montreal Cognitive Assessment; Ref, reference group.

### Table 3  Comparison of total and domain-specific Montreal Cognitive Assessment for participants with and without depression, anxiety and stress

<table>
<thead>
<tr>
<th>Scores</th>
<th>Depression Depressed (n = 33)</th>
<th>Non-depressed (n = 247)</th>
<th>P-value (depression)</th>
<th>Anxiety Anxious (n = 41)</th>
<th>Non-anxious (n = 239)</th>
<th>P-value (anxiety)</th>
<th>Stress Stressed (n = 14)</th>
<th>Non-stressed (n = 266)</th>
<th>P-value (stress)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MoCA total, max 30 (mean ± SD)</td>
<td>15.9 ± 5.5</td>
<td>18.9 ± 4.4</td>
<td>&lt;0.0001</td>
<td>17 ± 4.7</td>
<td>18.8 ± 4.5</td>
<td>0.019</td>
<td>16.7 ± 5.1</td>
<td>18.6 ± 4.6</td>
</tr>
<tr>
<td></td>
<td>Visuospatial-executive (max 5)</td>
<td>1.80 (0.93–3.48)</td>
<td>Ref</td>
<td>0.08</td>
<td>1.05 (0.58–1.91)</td>
<td>Ref</td>
<td>0.88</td>
<td>1.00 (0.38–2.65)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Naming (max 3)</td>
<td>1.64 (0.85–3.16)</td>
<td>Ref</td>
<td>0.14</td>
<td>1.28 (0.70–2.33)</td>
<td>Ref</td>
<td>0.42</td>
<td>0.89 (0.34–2.36)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Attention/calculation (max 6)</td>
<td>2.04 (1.08–3.88)</td>
<td>Ref</td>
<td>0.03</td>
<td>1.72 (0.96–3.09)</td>
<td>Ref</td>
<td>0.07</td>
<td>1.55 (0.60–3.99)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Language (max 3)</td>
<td>1.15 (0.59–2.24)</td>
<td>Ref</td>
<td>0.68</td>
<td>1.57 (0.85–2.91)</td>
<td>Ref</td>
<td>0.15</td>
<td>1.83 (0.67–4.97)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Abstraction (max 2)</td>
<td>2.24 (1.00–5.02)</td>
<td>Ref</td>
<td>0.05</td>
<td>1.67 (0.77–3.64)</td>
<td>Ref</td>
<td>0.20</td>
<td>1.42 (0.40–5.07)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Short-term memory (max 5)</td>
<td>2.81 (1.39–5.66)</td>
<td>Ref</td>
<td>0.004</td>
<td>1.60 (0.87–2.94)</td>
<td>Ref</td>
<td>0.13</td>
<td>1.96 (0.72–5.39)</td>
<td>Ref</td>
</tr>
<tr>
<td></td>
<td>Orientation (max 6)</td>
<td>2.81 (1.44–5.48)</td>
<td>Ref</td>
<td>0.003</td>
<td>1.95 (1.06–3.60)</td>
<td>Ref</td>
<td>0.03</td>
<td>2.74 (1.03–7.27)</td>
<td>Ref</td>
</tr>
</tbody>
</table>

Data presented as odds ratio (95% confidence interval) per 1 point score increase, unless otherwise stated. Max, maximum score; MoCA, Montreal Cognitive Assessment; Ref, reference group.
adjusting for age, sex and education, showed that anxious participants had significantly lower total MoCA scores than non-anxious participants (difference = 2 SD; \( P = 0.026 \)). Results of the multivariable model with the stress score as a continuous variable, and after adjustments for age, sex and education, showed that stressed participants only had significantly lower scores for orientation (\( P = 0.03 \)).

**Discussion**

The results of the present study showed that self-reported symptoms of depression and anxiety have an adverse influence on performance in cognitive testing, and are related to significant reductions in mean values of total MoCA score. Scores in some specific domains of cognitive functions, including short-term memory, attention/calculation and orientation, are also negatively influenced by depression.

The relationship between psychological distress and cognitive decline is bidirectional and complex. The causal relationship between these conditions remains uncertain, because the prevalence of both increases with advancing age, and there is a paucity of prospective studies. Some studies have found that depression does not precede cognitive decline, whereas others concluded that depression is a risk factor for incident dementia. Irrespective of whether depression co-occurs with or leads to cognitive impairment, it is important to recognize the detrimental effect on the performance in cognitive screening tests that occur in persons with psychological distress.

Most field instruments used to detect cognitive impairment were created and used in developed countries, where people have higher levels of education than in the developing world. These tests might overestimate the prevalence of cognitive impairment in subjects from rural areas of developing countries, who have low literacy but are functioning normally within their native environment. Lower cut-off scores for cognitive impairment or the use of tests that are less influenced by literacy have been proposed for these populations. However, there has been no attempt to correct for the impact of psychological distress on cognition. The present results suggest that adjustments of already established cut-off scores for individuals with depression or anxiety are indeed necessary to avoid overestimation of cognitive impairment in rural populations of developing countries.

In general, responsibilities placed on persons living in rural areas are not as high as in those living in the urban setting, where pressure to achieve a higher socioeconomic status often comes at the price of increased levels of depression and anxiety. Nevertheless, depression and anxiety could also exist at the rural level, and its...
occurrence might adversely influence performance in cognitive testing among community-dwelling older adults. Community-based surveys carried out in underserved populations have shown prevalence rates of geriatric depression ranging from 11% to 13%, which are similar to that found in the present survey. Most of these studies, however, have not assessed the prevalence of anxiety and stress, and have not correlated the occurrence of psychological distress with cognitive status. In this regard, the present study is unique as it assessed the prevalence of the different axes of psychological distress and their correlation with cognitive performance in an unbiased population of community-dwelling older adults living in a rural village.

Psychological distress and cognitive impairment in the elderly could be related to cerebrovascular disease. We did not evaluate that possibility in our study as a result of the small number of persons with a clinically overt stroke, and because some of our stroke patients were not enrolled because aphasia prevented them for completing the MoCA or the DASS–21. An ongoing study in which all community-dwelling older adults living in Atahualpa will be studied with magnetic resonance imaging will allow determining whether silent strokes, asymptomatic white matter lesions or cardiovascular risk factors could account for some cases of psychological distress or poor performance in cognitive tests. In addition, as we assessed psychological distress and cognition in a cross-sectional survey, the present results cannot confirm whether the former was the cause or the result of poor cognitive performance, and this could be a potential limitation of our study. Nevertheless, the present results strongly support adjustment of cut-off scores used to evaluate cognitive decline in the presence of depression or anxiety. Longitudinal studies in these underserved populations are required to show the cause-and-effect relationship of the association between psychological distress, cognition and cerebrovascular disease.

Acknowledgement

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Disclosure statement

The authors declare no conflict of interest.

References


