ARTÍCULO ORIGINAL

Arterial Stiffness Is Not Independently Associated With Nighttime Sleep Duration In Community-Dwelling Older Adults. Results From The Atahualpa Project.

La Rigidez Arterial no se Encuentra Asociada con la Duración del Sueño Nocturno en Adultos Añosos Que Viven en la Comunidad. Resultados del Proyecto Atahualpa.

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Abstract

Objectives: We aimed to assess the association between arterial stiffness and nighttime sleep duration in community-dwelling older adults living in rural Ecuador. **Methods**: Aortic pulse wave velocity (PWV) determinations were used to assess arterial stiffness. Nighttime sleep duration was assessed by a single question. A generalized linear model—adjusted for demographics, cardiovascular risk factors and psychological distress—was fitted to assess the independent association between the aortic PWV and nighttime sleep duration (dependent variable). **Results**: A total of 303 individuals were enrolled. Univariate analysis showed a significant association between the aortic PWV and long sleep duration (p=0.034), which vanished in a multivariate linear model (p=0.524). The single covariable remaining significant was anxiety (p=0.013). **Conclusion**: Lack of independent association between arterial stiffness and nighttime sleep duration might be more likely related to lack of reliability of evaluation of sleep duration by means of a single question.

Keywords: Self-reported sleep duration; Atherosclerosis; Arterial stiffness; Aortic pulse wave velocity; Population-based study.

Resumen

Objetivos: En el presente estudio se evaluó la asociación entre rigidez arterial y duración del sueño nocturno en adultos mayores que viven en la comunidad en una zona rural de la costa Ecuatoriana. **Métodos:** Se utilizaron determinaciones de velocidad de onda de pulso aórtico (PWV) para evaluar la rigidez arterial. La duración del sueño nocturno se evaluó mediante una sola pregunta. Un modelo lineal generalizado, ajustado por variables demográficas, factores de riesgo cardiovascular y distress psicológico, evaluó la asociación independiente entre el PWV aórtico y la duración del sueño nocturno (variable dependiente). **Resultados:** Se registraron un total de 303 individuos. El análisis univariado mostró una asociación significativa entre el PWV aórtico y larga duración del sueño (p=0.034), que desapareció en un modelo lineal multivariado (p=0.524). La única covariable que permaneció significativa fue la ansiedad (p=0.013). **Conclusión:** La falta de asociación independiente entre rigidez arterial y duración del sueño nocturno podría estar relacionada con la falta de confiabilidad de la evaluación de la duración del sueño mediante una sola pregunta.

Palabras clave: Duración del sueño; aterosclerosis; rigidez arterial; velocidad de onda de pulso aórtica; estudio poblacional.

Rev. Ecuat. Neurol. Vol. 28, No 2, 2019

Introduction

Evidence on a relationship between atherosclerosis and sleep-related symptoms is growing.[1] Cardiovascular correlates of sleep-related symptoms have been mostly evaluated in people living in urban centers, but there is limited information from remote rural settings, where living conditions and cardiovascular risk factors are different.[2]

Several studies aiming to assess a correlation between sleep-related symptoms and cardiovascular risk factors measured sleep duration by a single question (how many hours of sleep do you get on an average night?). It is possible that many people – particularly illiterate individuals – may not correctly answer this subjective question,

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thus explaining heterogeneous results.[3-10] In this study, we aimed to assess the association between the aortic pulse wave velocity (PWV) – used as a surrogate of atherosclerosis – and self-reported nighttime sleep duration, in community-dwelling older adults living in Atahualpa, a rural village located in coastal Ecuador, where previous studies on sleep-related symptoms have been conducted.[11-13]

Methods

Atahualpa residents aged ≥60 years identified during door-to-door surveys were invited to participate, and those who signed a comprehensive informed consent and had no contraindications for the practice of aortic PWV determinations were included. In addition, participants were interviewed to assess nighttime sleep duration (how many hours do you sleep on an average night?). Using a population-based cross-sectional study design, we assesses whether the aortic PWV was associated with nighttime sleep duration (as the dependent variable), after adjusting for relevant clinical confounders (see below).

As detailed elsewhere, Atahualpa residents are homogeneous regarding ethnicity, socioeconomic status and overall living conditions.[2] Shift working is limited and nighttime light pollution is low. These consistencies reduce the possibility of hidden confounders at the time of analysis. The I.R.B. of Hospital-Clínica Kennedy, Guayaquil, Ecuador (FWA 00006867) approved the study.

For arterial stiffness determinations, individuals were instructed to avoid caffeine-containing products, nicotine, and alcohol for 24 hours before the test. Arterial stiffness was evaluated by the use of a Mobil-O-Graph NG (IEM, Stolberg, Germany) device. This device estimates the aortic PWV based on the oscillometric detection of the brachial pressure wave with a single cuff. The Mobil-O-Graph NG has demonstrated good repeatability for PWV assessment and a higher repeatability than devices measuring carotid-femoral PWV in elderly populations.[14]

Demographics, cardiovascular risk factors and psychological distress were chosen as clinical confounding variables. These variables were selected as they have been shown to modify sleep-related symptoms in Atahualpa Residents.[11-13] To assess cardiovascular risk factors, we used criteria proposed by the American Heart Association to assess smoking status, physical activity, diet, body mass index, blood pressure, fasting glucose, and total cholesterol blood levels.[15] Psychological distress was evaluated by the use of a Spanish version of the Depression-Anxiety-Stress Scale (DASS-21), a previously validated field instrument comprising three sets of questions evaluating symptoms of depression, anxiety and stress.[16]

Data analyses were carried out by using STATA version 15 (College Station, TX, USA). In univariate analyses, continuous variables were compared by linear models and categorical variables by the x2 or Fisher exact test as appropriate. To assess the independent association between the aortic PWV and self-reported nighttime sleep duration, we fitted a generalized linear model, adjusted for the aforementioned covariables.

Results

Of 437 community-dwelling individuals aged ≥60 years identified during door-to-door surveys, 303 (69%) accepted the practice of aortic PWV measurements. The mean age of participants was 70.3±7.8 years (median age: 69 years; age range: 61 to 95 years) and 178 (59%) were women. Six (2%) individuals were current smokers, 14 (5%) had a poor diet, 22 (7%) had poor physical activity, 40 (13%) had total cholesterol levels ≥240 mg/dL, 69 (23%) had a body mass index ≥30 kg/m2, 91 (30%) had fasting glucose ≥126 mg/dL, and 132 (44%) had blood pressure ≥140/90 mmHg. Symptoms of depression were present in 32 (11%) individuals, anxiety in 42 (14%) and stress in 16 (5%). The mean value of the aortic PWV was 10.4±1.8 m/s (median aortic PWV: 9.9 m/s; range: 7.7 to 16.2 m/s). The

Table 1. Characteristics of Atahualpa residents aged ≥60 years across categories of obstructive sleep apnea (univariate analysis).

	Total series (n=303)	Sleep ≤6 hours (n=89)	Sleep 7-8 hours (n=187)	Sleep ≥9 hours (n=27)	p value
Pulse wave velocity, m/s (mean±SD)	10.4±1.8	10.5±1.9	10.2±1.6	11.1±2.3	0.034*
Age, years (mean±SD)	70.3±7.8	70.9±8	69.5±7.2	73.4±10	0.033*
Women, n (%)	178 (59)	48 (54)	113 (60)	17 (63)	0.529
Current smokers, n (%)	6 (2)	0	5 (3)	1 (4)	0.263
Poor diet, n (%)	14 (5)	7 (8)	5 (3)	2 (7)	0.122
Poor physical activity, n (%)	22 (7)	9 (10)	10 (5)	3 (11)	0.261
Total cholesterol ≥240 mg/dL, n (%)	40 (13)	8 (9)	27 (14)	5 (19)	0.318
Body mass index ≥30 Kg/m2, n (%)	69 (23)	22 (25)	40 (21)	7 (26)	0.759
Glucose levels ≥126 mg/dL, n (%)	91 (30)	24 (27)	54 (29)	13 (48)	0.094
Blood pressure ≥140/90 mmHg, n (%)	132 (44)	40 (45)	75 (40)	17 (63)	0.078
Symptoms of depression, n (%)	32 (11)	13 (15)	15 (8)	4 (15)	0.188
Anxiety, n (%)	42 (14)	20 (22)	18 (10)	4 (15)	0.015*
Stress, n (%)	16 (5)	9 (10)	7 (4)	0	0.038*

mean nighttime sleep duration was 7.2±1.2 hours (median sleep duration: 7 hours; range: 4 to 12 hours), with 89 (29%) individuals reporting ≤6 hours of night sleep, 187 (62%) between 7-8 hours, and the remaining 27 (9%) ≥9 hours.

For univariate analyses, self-reported nighttime sleep duration was stratified in three groups: ≤6 hours, 7-8 hours, and ≥9 hours. Characteristics of participants across these categories are summarized in Table 1. The PWV was significantly lower in persons sleeping 7-8 hours (p=0.034). Persons with ≥9 hours of sleep duration were older (p=0.033) than those in the other categories. In addition, anxiety (p=0.015) and stress (p=0.038) were significantly more common among individuals who reported ≤6 hours of sleep duration.

A generalized linear model, adjusted for all clinical covariables, revealed no association between the aortic PWV and self-reported nighttime sleep duration as a continuous value (β: 0.06; 95% C.I.: 0.12 to -0.23; p=0.524); in this multivariate model, age and stress lost independent significance, and the single covariable remaining significant was anxiety (p=0.013).

Discussion

Despite the association between higher aortic PWV values and long (≥9 hours) sleep duration found in univariate analysis, this study shows no independent association between aortic arterial stiffness and self-reported nighttime sleep duration. These results cast doubts on the reliability of this single question for assessing correlates of sleep-related symptoms, or might suggest that the association was tempered by the effect of confounders.

As previously mentioned, there have been many studies assessing the relationship between atherosclerosis and sleep-related symptoms. However, such studies gave inconsistent results, including: a) both short and long sleep duration are associated with atherosclerosis;[5,6] b) association between short (but not long) sleep duration and atherosclerosis;[7,8] c) association confined to long sleep duration;[3,9] and d) lack of association between short or long sleep duration and atherosclerosis.[4,10]

Further studies should not rely in self-reported nighttime sleep duration for assessing the relationship between atherosclerosis and sleep disorders. Instead, the use of well-structured field instruments, such as the Pittsburgh Sleep Quality Index, may provide more reliable results, as it is more difficult that a perceived misunderstanding in one single question changes the total score of the instrument.[17] In addition, objective assessment of sleep duration by actigraphy has shown to be more reliable than subjective assessment for evaluating the relationship between atherosclerosis and sleep duration[1] When both, objectively and subjectively sleep duration have been assessed in the same study, the former has been more coherently associated with atherosclerosis.[18]

Pathogenetic mechanisms involved in the association between atherosclerosis and sleep-related symptoms are not well understood. From the available literature, it could be abstracted that upregulation of inflammatory markers, hormonal factors, lipid metabolism, dysfunction of the sympathetic nervous system, endothelial dysfunction and psychological distress may be in the path of this association.[19,20] Results from our study are in line with the hypothesis that psychological distress play a role in this association, since anxiety remained independently significant in the fitted multivariate generalized linear model.

The present study has limitations, including the cross-sectional design and the lack of objective assessment of sleep duration by actigraphy. It is also possible that Atahualpa residents are not representative of people living in other regions. Major strengths include the population-based design and the unbiased selection of participants sharing important characteristics for the study of sleep disorders.

In summary, this population-based study shows lack of association between self-reported sleep duration and atherosclerosis, which could be related to poor reliability of a single question used to assess sleep duration. Further studies focusing on the association between atherosclerosis and sleep-related symptoms should rely in well-structured questionnaires that reduce the risk of errors at the time of analyses.

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