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# The associations between sleep disorders and anthropometric measures in adults from three Colombian cities at different altitudes

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ABSTRACT

*Background:* Sleep disorders are common but underdiagnosed conditions, which are associated with obesity. In Colombia, the distribution of sleep disorders remains unclear. We aimed to describe the distribution of sleep disorders, according to demographic, geographic and anthropometric characteristics, in adult Colombian populations.

*Methods:* A multicenter study was conducted with 5474 participants recruited from three Colombian cities at different altitudes. A two-stage cluster sampling method was applied. Participants' mean age was 40.2 years and 53.8% were female. Collected data included demographic information and anthropometric characteristics of adiposity such as body mass index, neck circumference and waist circumference, as well as participants' scores on five scales used to assess sleep disorders. Disorders included sleepiness, obstructive sleep apnea (OSA), insomnia, poor sleep quality and restless legs syndrome; the scales were the Epworth Sleepiness Scale, Berlin questionnaire, STOP-Bang questionnaire, Pittsburgh Sleep Quality Index and diagnostic criteria for the restless legs syndrome set out by the International Restless Legs Syndrome Study Group.

*Results:* Nearly two-thirds of the population reported at least one sleep disorder according to their results on the five scales (59.6% [95%CI 57.4; 61.81)]. This proportion was similar by sex. Prevalence of overweight was 34.8% and of obesity was 14.4%. Sleep disorders were more frequent among those aged 65 years or more (91.11 [95%CI 86.1; 94.43]), those who were obese (83.71% [95%CI 78.94; 87.56]) and those who resided in the cities at the lowest altitude (72.4% [95%CI 70.2; 74.5]). Waist circumference showed a stronger association with sleep disorders among women than among men.

*Conclusions:* Sleep disorders are common in Colombia, irrespective of sex and geographical location. They are associated with obesity. Abdominal obesity could explain the high frequency of sleep disorders among women.

We believe that this part of the study will substantially contribute to the understanding of sleep disorders. Further research is needed to identify key factors behind the high prevalence rates of sleep disorders and obesity in Colombia.



## 1. Introduction

Current patterns of lifestyle, linked to technological and social development, have led to an increased prevalence of sleep disorders [1]. The prevalence of sleep disorders in the general population is estimated to be as high as 56% in the United States, 31% in Western

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Europe and 23% in Japan [2]. Among the most common sleep disorders are insomnia, followed by restless legs syndrome (RLS) and sleep-disordered breathing, such as obstructive sleep apnea (OSA) [3]. However, over 80% of those with moderate to severe OSA are never diagnosed [4]. Sleep disorders are associated with cardiovascular and cerebrovascular disease, metabolic syndrome, diabetes, and depression [3].

Obesity is considered a main risk factor for sleep disorders, but this association is likely to be bidirectional [4,5]. That is, obesity worsens the symptoms and severity of sleep-disordered breathing [6,7], and OSA promotes weight gain and obesity [4]. Similar findings have been reported for the association between obesity and sleep quality and duration [5].

Anthropometric measurements of obesity, like body mass index (BMI) and waist and neck circumference, are considered strong predictors of sleep disorders [4]. However, this association appears to be modified by behavioral, environmental and ethnicity factors [5,8,9]. Thus, there is a growing interest in understanding the role of these factors in the distribution of sleep disorders and obesity across diverse populations, in order that useful interventions may be found, to reduce the burden of these conditions [5].

Colombia's population is widely heterogeneous in terms of ethnic mix, culture, lifestyle and geographical terrain. There is little national information on sleep disorders and their potential association with anthropometric measurements. People who reside at high altitude experience increased fragmentation of sleep through frequent brief arousal and irregular breathing; sleep problems have been reported to be associated with both higher altitudes and the duration of stay or residence [10]. Reported changes in sleep architecture include a shift to lighter sleep [11].

Finally, some authors recommend that polysomnograms be recorded the altitude at which the patient resides [12]. There are concerns that a stay at high altitude will expose susceptible OSA patients, in particular those of advanced age and with comorbidities, to an excessive risk of cardiovascular and other adverse events [13].

Another important issue is the relationship between menopausal status and subjective sleep disturbance. It has been reported that perimenopausal, postmenopausal, and surgical-menopausal white and Asian women, but not Hispanic women, are more likely to experience sleep disturbance than premenopausal women. It would seem, therefore, that culture and ethnicity may influence the extent of sleep disturbance associated with menopause transition [14].

Some studies have found that menopause status may have little or no effect on sleep quality (particularly in Latino populations) during midlife, and there are other reasons for sleep disturbances in women in that age group. For example, the increased prevalence of clinical conditions such as breast cancer, arthritis, fibromyalgia, and hypothyroidism can adversely affect sleep [14].

Therefore, we aimed to describe the associations between sleep disorders and the demographic and anthropometric characteristics of adults from three cities at different altitudes in Colombia.

## 2. Methods

An observational, descriptive, multicenter study was conducted between February and July 2013. To provide a general representation of a diverse population, we selected three Colombian cities at different altitudes: Bogota (2640 m above sea level (MASL)), Bucaramanga (959 MASL) and Santa Marta (15 MASL).

### 2.1. Sampling

Enrollment was conducted using a school- and community-based strategy with a two-stage cluster sampling method. The sampling strategy was applied independently in each city. Sample selection took account of the city population's age distribution.

First, we randomly selected 28 public schools on the database of the National Ministry of Education (up to December 2011). From each school grades were randomly selected, and from each grade all children aged between 5 and 12 years were identified. Those children were termed the 'index children'. The parents of each index child were invited to participate, if aged 18 years or older. A second sampling strategy was based on targeting communities, where children aged between 2 and 4 years were identified, and adults (including parents and other adults) living in the same household as the index child were invited to participate. Subsequently, the interviewer registered the houses around the block in which the index child's house was located and adults from registered houses were invited to participate. Where there were no eligible adults, the procedure was repeated in adjacent blocks.

### 2.2. Survey

Study participants filled in a questionnaire and their anthropometric variables were measured by one of our trained interviewers; this was done at the house of each participant.

The questionnaire had 40 items, covering contact information, demographic and anthropometric characteristics, and the following sleep scales: the Epworth Sleepiness Scale (ESS) [15], Berlin questionnaire for sleep apnea [16], Pittsburgh Sleep Quality Index (PSQI) [17], STOP-Bang questionnaire for sleep apnea [18] and the diagnostic criteria for restless legs syndrome proposed by the International Restless Legs Syndrome Study Group (IRLSSG) [19].

Demographic characteristics included age and sex (male or female). Anthropometric variables were weight (measured using a calibrated weighing scale), height (measured using a measuring tape), waist circumference (WC, measured with the participant standing upright, using a stretch-resistant measuring tape, at the midpoint between the lower costal border and the iliac crest, with mid-axillary line, at the end of exhalation) and neck circumference (NC, measured above the laryngeal prominence, perpendicular to the neck axis).

For analysis, anthropometric variables were classified according to recognized classifications of obesity and overweight. WC cut-off points for abdominal obesity were defined by the International Diabetes Federation (IDF) [20] for ethnic South and Central American populations (for men, 90 cm or more; and for women, 80 cm or more). These values had also been adopted in the Colombian Consensus for Metabolic Syndrome [21]. BMI was estimated by dividing the weight in kilograms by the square of the height in centimeters, and the following cut-off points were used: BMI lower than 20 $kg/m^2$ is considered underweight, BMI between 20 and 24.9 $kg/m^2$ is normal weight, BMI between 25 and 29.9 $kg/m^2$ is overweight, and BMI equal to or higher than 30 $kg/m^2$ is obesity [22]. An NC larger than 40.64 cm among women and 43.18 cm among men was considered abnormal [23]. These are reference values for the United States, but they were used because NC has not been standardized in Colombia.

### 2.3. Scales to assess sleep disorder

The Epworth Sleepiness Scale (ESS) [15] was designed to measure average daytime sleepiness, by self-rating how likely the subject was to doze in eight different situations. The scoring of the answers ranges between 0 (would never doze) and 3 (high chance of dozing). A sum of 11 or more from the eight individual scores indicates an abnormal level of daytime sleepiness. The scale was validated in Colombia by Chica et al. [24] and all of the questions were used.