



Original Article

Caregiver perception of sleep-disordered breathing-associated symptoms in children of rural Andean communities above 4000 masl with chronic exposure to biomass fuel



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ABSTRACT

Background: Previous studies have uncovered a very high prevalence of sleep disorders in general, and of sleep-disordered breathing in particular among children exposed to indoor biomass fuel pollution. However, despite the significant symptomatology, parents are unlikely to report these issues during health-care visits.

Objective: The objective of this study was to determine whether reduced caregiver perception of sleep disorders may account for the infrequent diagnosis and treatment of such problems in children residing at high altitudes and exposed to high biomass pollution.

Methods: Parents of children aged 9–15 years of three communities residing in the Pasco region in Peru located between 3800 and 4200 meters above sea level were surveyed using a validated questionnaire instrument focused on symptoms associated with sleep-disordered breathing as well as whether caregivers perceived that their child suffered from a sleep disorder.

Results: Among the 77 children included, 48.1% had nocturnal awakenings and 46.8% had repetitive movements and restless sleep. Habitual snoring was present in 33.8% of all children. However, only 10.4% of mothers considered that their children had sleep problems, and all of their children had positive answers for ≥ 4 sleep symptoms.

Conclusions: Children residing at high altitudes and exposed to traditional biomass-fueled stoves exhibit an extremely high frequency of sleep symptoms that are misperceived by their mothers as being “normal.” Interventions aimed at increasing parental recognition and awareness of sleep problems will be essential to foster improved diagnosis and treatment.

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1. Introduction

Indoor pollution from biomass fuel exposure is the most important preventable risk factor to general health in developing countries. In Peru, 93% of people residing in rural areas use biomass-fueled stoves for cooking and heating, specifically solid fuel (wood and dung) [1]. Women have the highest level of exposure due to the time spent cooking and in other household activities, and, accordingly, young children also have a high level of exposure. Chronic

biomass fuel exposure has been associated with various diseases in the pediatric population, including increased asthma exacerbations [2], and incidence of upper and lower respiratory tract infections [3].

In previous studies, we found that sleep apnea symptoms were particularly frequent among children exposed to traditional biomass stoves, and that interventions aimed at implementing less polluting, innovative low-cost stoves resulted in significant decreases in such sleep-associated symptoms [4]. One of the major contributors to these biomass exposure-associated disorders is systemic inflammation [5–7].

In that same study from our group, we also observed that snoring was present in 52.5% of children, and 42.4% had nighttime awakenings [4]. Nonetheless, Peruvian physicians working in rural communities at high altitudes infrequently evaluate children for these

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problems due to poor parental perception and knowledge of sleep disorders. This mismatch between the high prevalence of symptoms and the inadequate seeking of medical attention led us to hypothesize about the underestimation of sleep disorders and their associated symptoms by parents.

High-altitude exposure is related to sleep disorders, the prevalence of which increases when people reside at higher altitudes [8–10]. Thus, in children residing above 4000 meters above sea level (masl) in households with traditional biomass-fueled stoves, two factors could contribute to sleep disorder development: biomass and high altitude. We present a study of symptoms associated with sleep disorders among children from rural communities of Pasco, Peru, and their correlation with the perceived presence of a sleep disorder by their parents.

2. Methods

2.1. Participants

We designed a cross-sectional study to determine whether parents of children from three rural communities (Chango, San Miguel de Cuchis, and San Juan Banos de Rabi) of the Pasco region in Peru, located in the Peruvian Central Andes between 3800 and 4200 masl, consider their children to have sleep disorders and how this perception correlates with the symptoms they report.

Recruitment to the study was performed through convenience sampling in the three communities. All the participants were approached during their registration to participate in a 1-day activity from Program “Juntos,” a Peruvian national initiative against poverty.

Sixty-six caregivers of 77 children of both genders were recruited. We included children between the ages of 9 and 15 years who had resided for their entire lifetime in the targeted communities. The caregivers included were 18 years and older. They were only included if they lived with the child, were the primary caregivers, and exclusively used traditional biomass-fueled stoves.

Younger subjects were excluded because in preliminary assessments in similar communities the reliability of the answers reported by the caregivers was unacceptable (Accinelli R, unpublished observations). Participants with congenital malformations or chronic medical problems receiving regular administration of pharmacological treatments were also excluded.

The study was approved by the Human Subject Ethics Committee of the Universidad Peruana Cayetano Heredia. Informed consent and assent were obtained from all parents and children.

2.2. Study procedures

A previously validated survey [4] was conducted by five trained physicians through in-person interview of the caregivers of the included children. It considered 10 questions about symptoms associated with sleep-disordered breathing: sore throat, snoring, difficulty breathing during sleep, apneic episodes, need to shake the child to resume breathing, nocturnal awakenings, repetitive movements, mouth breathing, daytime somnolence, and somnolence during school hours. The questions specified the presence of these signs and symptoms during the past six months. Finally, the question “Do you think your child has a sleep problem?” was asked.

Indoor pollution was evaluated by measurement of particulate matter 2.5 (PM_{2.5}) and carbon monoxide (CO). Families chosen for this evaluation were selected by the Program “Sembrando” (convenience sampling), a national Peruvian initiative for installation of “Inkawasi”-improved stoves. The measurement was performed during a 24-h period, starting in the early morning and using Aeroqual© portable indoor monitors (series 300, New Zealand) and Berkeley Air© UCB-PATS particle monitors (Model P3, Berkeley, CA).

CO was measured in parts per million (ppm) and PM_{2.5} in micrograms per meter cube.

2.3. Data analysis

Data were analyzed using SPSS® statistical software (version 22.0, Chicago, IL, USA). The results are presented as percentages. Abnormally distributed data are presented in median and interquartile ranges (IQRs). χ^2 tests were utilized for comparing the presence or absence of symptoms with caregiver perception of a sleep problem. A linear trend test was used to evaluate the total number of symptoms (ordinal variable) and the caregiver perception. A *p*-value of <0.05 was considered significant.

3. Results

3.1. Children characteristics

Seventy-seven children from 66 different families were included. The mean age was 11.8 ± 1.4 years (standard deviation, SD), ranging between 9 and 14 years. Of these, 34 were girls (44.2%). No children were excluded due to congenital malformations, chronic medical conditions (eg, asthma and respiratory diseases), or regular use of medications.

3.2. Caregiver characteristics

Sixty-six caregivers were surveyed. Sixty-four were mothers, two grandmothers, and two older sisters. The mean age was 39.8 ± 7.2 years (SD), ranging from 24 to 65 years of age. All caregivers exclusively used traditional biomass-fueled stoves. Two out of the 66 caregivers were daily regular cigarette smokers, but they reported smoking only one cigarette a day.

3.3. Sleep problem-associated symptoms

Among the 77 children included, 37 (48.1%) had nocturnal awakenings and 36 (46.8%) had the second more frequent symptom: repetitive movements. Snoring was present in 26 (33.8%) of all children. Twelve (15.6%) surveyed mothers considered their children stopped breathing during sleep (Table 1).

3.4. Indoor pollutants

Among the 77 children included, 19 had their households subjected to indoor pollution measurements. PM_{2.5} was measured in 16 of these, and CO was measured in all of them. The indoor pollution levels were high, as shown by the increased CO levels (median: 16.8 ppm; IQR 6.8–61.5 ppm) and PM_{2.5} levels (median 3,732.13 µg/m³; IQR 1,168.3–12,937.8 µg/m³). In this small sample, no statistically significant associations emerged between the levels of indoor pollutants and the 10 symptoms surveyed.

3.5. Caregiver perception of sleep problem

A small number of sleep disorder-related symptoms exhibited an association with a positive caregiver perception of a sleep problem, namely difficulty breathing during sleep and presence of apneic episodes showing the strongest associations (*p* < 0.0001 and *p* = 0.005, respectively) (Table 2).

Only eight (10.4%) mothers out of the 77 considered that their children had sleep problems. The children of these eight mothers represented 30.8% of the 27 who had four symptoms or more, which was significantly different from the group with less than four symptoms, in which none of the caregivers considered their child to have a sleep-related disorder ($\chi^2 = 16.5$, *p* < 0.0001) (Tables 3 and 4).

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