

# Population-based study of facial morphology and excessive daytime somnolence

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## Abstract

Studies in patients seeking attention for nasal obstruction or pharyngeal disorders suggest that craniofacial abnormalities correlate with obstructive sleep apnea, but there is little information on the relevance of this association in the population at large. We aimed to determine whether characteristics of facial morphology correlate with excessive daytime somnolence (EDS) in a population-based, door-to-door survey. Residents of a village in rural Ecuador were screened with the Epworth sleepiness scale to assess EDS and underwent physical examination with attention to nasal septum deflection, mandibular retrognathia and presence of Friedman's palate position type IV. From 665 participants aged  $\geq 40$  years, 155 had EDS, 98 had nasal septum deflection, 47 had mandibular retrognathia and 528 had a Friedman's palate position type IV. In a logistic regression model adjusted for age, sex, body mass index, and nightly sleep hours, persons with nasal septum deflection were twice as likely to have EDS ( $p = 0.009$ ). The other two variables were not associated with EDS. Identification of nasal septum deflection may be a cost-effective method of detecting persons at risk for obstructive sleep apnea in remote areas where sophisticated technology is not readily available.

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## 1. Introduction

Obstructive sleep apnea (OSA) is a common medical condition that decreases quality of life and increases cardiovascular risk, stroke incidence, and all-cause mortality [1]. Conservative figures suggest that 10% of adults worldwide have OSA, but this condition remains undetected in rural areas of developing countries, where technology needed for its definitive diagnosis is not readily available.

To reduce the increasing burden of cardiovascular diseases in rural areas of low- and middle-income countries,

implementation of cost-effective strategies such as recognition of modifiable risk factors – including OSA – is mandatory [2]. In these regions, mass screening with field instruments designed to detect persons with probably OSA may be complicated by cross-cultural factors and illiteracy. There is a need for reliable screening tools to facilitate early detection of persons with risk of OSA in underserved populations.

Although the relationship between abnormal craniofacial characteristics and OSA has been documented in patients seeking attention for sleep-disordered breathing or a specific nasal or pharyngeal disorder [3–5], little is known about the relevance of this association in the population at large, particularly in underserved populations. We report the findings of a population-based study in rural Ecuador, designed to evaluate characteristics of facial morphology and to determine whether they can identify

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Fig. 1. Study subjects with nasal septum deflection (left), mandibular retrognathia (center), and Friedman palate position type IV (right).

persons at risk of OSA who should be referred for further evaluation.

## 2. Methods

The IRB of Hospital-Clínica Kennedy, Guayaquil, Ecuador (FWA00006867), approved the protocol and informed consent forms. Atahualpa is located in coastal Ecuador, and is representative of the rural villages of the region. More than 95% of the population belongs to the Ecuadorian Native/Mestizo ethnic group (Amerindians). Phenotypically, these persons are of short stature and most have abdominal obesity. The Atahualpa Project is a population-based cohort study that evaluates the relationships between sleep disorders and cardiovascular risk factors in rural Ecuador. Methodology has been detailed elsewhere [6].

For this part of the study, trained field personnel conducted a door-to-door survey to identify all Atahualpa residents aged  $\geq 40$  years. Consenting persons underwent a physical examination with attention to the height, weight, and characteristics of facial morphology that have been associated with an increased risk of OSA, including nasal septum deflection, mandibular retrognathia, and a Friedman's palate position type IV. We also assessed the number of nightly sleep hours and the presence of excessive daytime somnolence (EDS) (used as a proxy for OSA) by the use of the Epworth sleepiness scale [7].

Nasal septum deflection was characterized as significant when it was deviated  $\geq 5$  mm away from the midline causing external nasal deformity and associated with subjective report of nasal flow. Mandibular retrognathia was categorized as present when the anterior prominence of the chin was  $\geq 2$  mm behind a virtual line drawn from the vermilion border of the lower lip to the chin. A Friedman's palate position type IV was characterized as lack of visualization of the soft palate with the mouth open and the tongue resting inside the mouth (Fig. 1) [8,9]. The number of nightly sleep hours was assessed by self-report with the question: "during the past month, how many hours on average did you sleep each night?" The Epworth sleepiness scale consists of eight questions rated on a four point Likert scale ranging from 0

(no chance of falling asleep) to 3 (high chance of falling asleep) with a maximum total score of 24; a score  $\geq 10$  was considered positive [7].

Using a logistic regression model, we evaluated the association between a positive result in the Epworth sleepiness scale and the presence of significant nasal septum deflection, mandibular retrognathia and a Friedman's palate position type IV. The model was adjusted for age, sex, body mass index (BMI), and nightly sleep hours. Univariate and multivariate analysis were performed with an Epworth sleepiness scale  $\geq 10$  as the dependent variable. All analyses were performed using STATA software version 13 (STATA Corp, College Station, TX).

## 3. Results

The census identified 688 Atahualpa residents aged  $\geq 40$  years, of whom 23 declined to participate. Mean age of the remaining 665 persons was  $59.5 \pm 12.6$  years, 58% were women, mean BMI was  $26.9 \pm 4.9$  kg/m<sup>2</sup>, and mean nightly sleep hours was  $7.2 \pm 1.2$ .

The Epworth sleepiness scale was  $\geq 10$  in 155 persons (23%), 98 (15%) had nasal septum deflection, 47 (7%) had mandibular retrognathia and 528 (79%) had a Friedman's palate position type IV. Persons with Epworth sleepiness scale scores  $\geq 10$  were older than those with scores  $< 10$ , but the percentage of women, mean values of BMI, and nightly sleep hours were similar across both groups. In a logistic regression model, after adjusting for age, sex, BMI and nightly sleep hours, persons with nasal septum deflection were twice as likely to have an Epworth sleepiness scale score  $\geq 10$  ( $p = 0.009$ ). Mandibular retrognathia and a Friedman's palate position type IV were not associated with EDS, nor did they further increase the risk for EDS in persons with deflection of the nasal septum (Table 1).

## 4. Discussion

This study shows that Ecuadorian Natives/Mestizos with nasal septum deflection are twice as likely to have EDS,

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