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Original research

Risk of obstructive sleep apnoea is associated with glycaemia status in South Asian men and women in the United States

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ABSTRACT

Aims: To examine the association between glycaemia status and the risk for obstructive sleep apnoea (OSA) in a cohort of South Asians living in the United States.

Methods: A secondary analysis of a community based cohort of 899 participants from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) study. The Berlin Questionnaire was used to screen for OSA.

Results: Almost one in four (24%) South Asians was at high risk for OSA. Compared to the normal glucose tolerance group (18%), high risk of OSA was significantly more likely in the prediabetes (24%) and diabetes (32%) groups ($p = 0.007$). More men (28%) than women (18%) were at high risk of OSA. Risk for OSA was also associated with higher haemoglobin A1c values, hypertension, large waist circumference, and BMI > 27.5 kg/m^2. In a multivariate regression analysis, sleep disordered breathing (SDB) remained significantly associated with higher haemoglobin A1c values, even after controlling for waist circumference and other demographic and clinical factors.

Conclusions: The risk for SDB and OSA was high among South Asian men and women. Given the association between dysglycaemia and risk for OSA, these health issues require simultaneous clinical assessment. Future studies using objective sleep measures such as polysomnography are warranted in the diagnosis and treatment of OSA in the South Asian adult population already at high risk for dysglycaemia.

1. Introduction

With the epidemic of obesity in the United States (USA), sleep disordered breathing (SDB) is a growing medical problem. Obstructive sleep apnoea (OSA) is the most serious end of the spectrum of SDB, and is characterised by loud snoring with repeated upper airway occlusions during sleep that result in specific physiological changes, including frequent arousals from sleep in response to each hypoxic event, and chronic sleep loss that manifests as excessive daytime sleepiness. Sleep loss can alter fat and glucose metabolism and together these changes lead to a cascade of events that increase risk for cardiovascular disease, hypertension, metabolic syndrome and Type 2 diabetes (Peppard et al., 2000; Punjabi et al., 2009; Young et al., 2008).

In the USA, it is estimated that 10–17% of men and 3–9% of women between 30 and 70 years of age have moderate to severe OSA (Peppard et al., 2013). Furthermore, results from several large studies suggest that OSA is an independent risk factor for development of Type 2 diabetes, and that as many as 15–30% of patients with OSA have Type 2 diabetes (Pamidi and Tasali, 2012). As the severity of SDB increases, so does the likelihood of worsening glycaemia status (Peppard et al., 2000; Marin et al., 2005; Mehra et al., 2006; Yaggi et al., 2005; Gottlieb et al., 2010; Kent et al., 2014).

South Asians (persons of Indian, Pakistani, Bangladeshi, Sri Lankan, or Nepali origin) have a high prevalence of Type 2 diabetes and dyslipidaemia (McKeigue et al., 1989; Palaniappan et al., 2004). The prevalence of Type 2 diabetes in South Asian adults is reportedly between 16 and 18%. (Karter et al., 2013; Venkataraman et al., 2004; Misra et al., 2010), yet there is limited research on SDB and its association with type 2 diabetes or glycaemia in older adults. Considering the potential link between SDB and Type 2 diabetes, the purpose of this secondary analysis was to describe SDB and the risk for OSA associated with haemoglobin A1c (HbA1c) in a cohort of South Asian men and women previously categorised with normal glucose tolerance, prediabetes or diabetes.

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2. Material and methods

2.1. Design

We conducted a cross-sectional analysis of data from the Mediators of Atherosclerosis in South Asians Living in America (MASALA) study. There were 906 participants enrolled from October 2010 through March 2013 and primary findings on prevalence of the glucose tolerance categories have been reported elsewhere (Kanaya et al., 2014; Shah et al., 2015).

2.2. Sample

The sample for this analysis included 899 South Asian men and women from the San Francisco Bay area and from the greater Chicago metropolitan area who had complete data for glycaemic status. The institutional review board at the University of California, San Francisco and Northwestern University, Chicago approved the study protocol. All participants provided written informed consent. To be included in the study, participants were: 1) of South Asian ancestry (defined as at least three grandparents born in either India, Pakistan, Bangladesh, Nepal, or Sri Lanka); 2) 40–84 years of age; and 3) able to speak and/or read English, Hindi, or Urdu.

Potential participants were excluded if there was: 1) physician-diagnosed MI, stroke or TIA, HF, angina, use of nitroglycerin; 2) history of a cardiovascular procedure such as CABG, angioplasty, valve replacement, pacemaker/defibrillator; 3) current atrial fibrillation; 4) active treatment for cancer; 5) impaired cognitive ability; 6) less than 5-year life expectancy; 7) potential to be out of the study geographic region within 5 years of enrolling; 8) in nursing home residence or on waiting list for nursing home residency; and 7) body weight greater than 136 kg (due to CT scanner limitation).

2.3. Measures

Demographic data were obtained from a detailed socio-demographic questionnaire that included items on age, sex, smoking status, alcohol intake per week, geographic location (Illinois or California), and years living in the USA. Clinical measures included height and weight to calculate BMI (kg/m^2), waist circumference (cm), systolic and diastolic blood pressure (mm/Hg). After a requested-12 h fast, fasting blood samples for HbA1c levels and fasting plasma glucose were obtained and a 2-h oral glucose tolerance test (OGTT) was conducted for participants who were not known to have diabetes. The Berlin Questionnaire, developed at the 1966 Berlin Conference on Sleep in Primary Care, was used to screen for SDB and risk of OSA (Netzer et al., 1999).

2.3.1. Glycaemia status

Based on American Diabetes Association criteria, participants were categorised into one of the three groups: 1) normal, defined as having a fasting plasma glucose (FPG) $<$ 100 mg/dL and 2-h OGTT $<$ 140 mg/dL; 2) prediabetes, defined as having a FPG between 100 and 125 mg/dL or a 2-h OGTT between 140 and 199 mg/dL; or 3) diabetes, defined as having a FPG $\geq$ 126 mg/dL, having a 2-h OGTT $\geq$ 200 mg/dL, or using medication for Type 2 diabetes (American Diabetes Association, 2008).

2.3.2. Sleep disordered breathing and risk of obstructive sleep apnoea

The Berlin Questionnaire (BQ) was used to screen for SDB and risk of OSA. The BQ consists of ten questions in three categories. The first category addresses SDB and consists of an initial question about snoring, (yes, no, or don't know). If the response is yes, there are four follow up questions about their snoring. This SDB category is scored as positive if the participant is symptomatic more than 3–4 times a week with two or more of the four follow up questions. The second category consists of three items on daytime sleepiness and is scored positive if the participant is symptomatic 3–4 times a week on at least two of the three questions. The third category has two questions on history of HTN and BMI $\geq$30 kg/m^2 and is scored positive if either condition is reported (Netzer et al., 1999). Having two positive categories on the BQ indicates a high probability of OSA. In addition to the BMI 30 kg/m^2 criterion for obesity as specified in BQ Category 3, we used current recommendations for the Asian population to classify obesity as BMI $>$ 27.5 kg/m^2 (World Health Organization, 2004).

Regardless of the responses in the first category about SDB, a high risk of OSA on the BQ is identified by any two of the three categories being positive. The BQ has 78.6% sensitivity and 50.5% specificity for detecting moderate or severe OSA (Chung et al., 2012). Each BQ category was included to assess their unique associations with HbA1c and glycaemic status.

2.4. Statistical analysis

Means and standard deviations (SD) were used to describe measures of central tendency, and comparisons were tested with independent sample *t*-tests. Frequencies and percentages (%) were used to describe categorical data. Chi square (X^2) analyses were used to test associations between glycaemia status (normal, prediabetes or diabetes) and each of the three BQ risk categories. To describe the rate of SDB and risk for OSA in South Asians, we evaluated the association between the three BQ categories and categorical variables (sex, geographic location, education, income, smoking status, alcohol use) using X^2. We compared the prevalence of SBD and risk for OSA using the standard BMI category ($>$ 30 kg/m^2) for obesity and the lower BMI category for obesity ($>$ 27.5 kg/m^2) recommended for Asians (World Health Organization, 2004).

To determine the strength of the association between dysglycaemia and OSA risk, a linear multiple regression analysis was performed with HbA1c as the dependent variable. Square root transformation was sufficient to normalise the distribution of HbA1c values. To account for the variance in HbA1c, each BQ OSA risk category was examined while controlling for demographic and clinical variables. Demographic variables included age, sex, geographic research site, years in the USA, income and education. Clinical variables included smoking, alcohol use, waist circumference, systolic blood pressure, diastolic blood pressure, and BMI. SPSS (version 23) was used for all analyses and statistical significance was set at $p < 0.05$.

3. Results

3.1. Sample characteristics, glycaemia status, and OSA risk

Demographic and clinical characteristics are detailed in Table 1 by glycaemia status group, and are similar to the characteristics previously reported for the entire sample (Shah et al., 2015). Ages ranged from 40 to 83 years (mean 55 $\pm$ 9 years), 46% were women, and residence in the USA ranged 2–58 years (mean 27 $\pm$ 11 years). A little more than half the sample (55%) lived in California. Participants had an average BMI of 26 $\pm$ 4.3 kg/m^2, and only 13.5% had a BMI $>$ 30 kg/m^2 (Table 1). Overall, 28% of the participants had a BMI $>$ 27.5 kg/m^2; 23% in the normal glucose tolerance group were classified as obese using this lower cutpoint, compared to 36% in the prediabetes group, and 32% in the diabetes group (Table 2).

HbA1c values ranged from 4.7 to 13.7%, [28–126 mmol/mol] with a mean of 6.06 $\pm$ 0.86% [42 $\pm$ 9.4 mmol/mol] and a median of 5.8 [40 mmol/mol]. There were 42% with normal glucose tolerance, 33% with prediabetes and 25% with diabetes. Men were significantly more likely to be in the diabetes category and women were more likely to be in the normal glucose tolerance category (Table 1).

Overall, 213 (24%) South Asians were at high risk for OSA (positive in 2 or more BQ categories) and the risk was significantly higher for