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Cognitive changes and sleep disordered breathing in elderly Differences in race

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Abstract

Objectives: Sleep disordered breathing (SDB) is a highly prevalent sleep disorder in older persons. It is known to be associated with reductions in cognitive function. As part of a larger study examining SDB in African-Americans and Caucasians, it became possible to examine whether racial background may differentially affect the relationship between SDB and cognitive performance. **Methods:** Community-dwelling African-American and Caucasian elderly (ages 65+) at high risk for SDB were tested at two time points. During each visit, subjects were interviewed in their homes about their sleep and medical condition. The Mini-Mental Status Examination (MMSE) was used to assess cognitive function. Objective sleep studies were recorded in the subjects' homes and scored for sleep, apneic events, and oxygen saturation levels. **Results:** Increases in respiratory disturbance index (RDI) were associated with decreases in cognitive performance over time, after controlling for gender and education level. There were no differential effects of race on this relationship. There was no relationship between declining cognitive function and hypoxemia. **Conclusions:** Analyses of the data confirm that declining cognitive function in older persons with mild to moderate SDB is related to the amount of respiratory disturbances occurring at night, and suggest that the effect of SDB on cognitive decline is unrelated to race and measured hypoxemia. The large number of community-dwelling elderly with mild to moderate SDB may accrue considerable benefits (both cognitively and medically) from the treatment of SDB, even if they are not markedly hypoxemic.

Keywords: Sleep disordered breathing; Cognitive deficits; Race; Aging; Sleep fragmentation; Hypoxemia

Introduction

Sleep disordered breathing (SDB) is a condition characterized by frequent lapses in breathing (i.e. apneic events), which are associated with repeated nighttime awakenings, leading to sleep fragmentation, intermittent nighttime hypoxemia, and excessive daytime sleepiness (EDS). Several large epidemiological studies have consistently shown that SDB is highly prevalent in the elderly, with approximately 24% of community-dwelling elderly exhibiting at least five apneic events per hour of sleep [1], and 43% of institutionalized elderly exhibiting similar amounts of respiratory disturbances [2].

The prevalence and severity of SDB have also been found to be associated with race. In a case–control family study of SDB in African-American and Caucasian families, Redline et al. [3] found that the African-Americans developed SDB at a younger age. Our laboratory has also found that when compared to Caucasians, African-Americans had a twofold greater risk of developing severe SDB (respiratory disturbance index [RDI] ≥30) [4]. These findings suggest that African-Americans may be more susceptible to the development of SDB and may suffer from this disorder more severely and for a longer time period.

SDB is strongly associated with numerous medical comorbidities, including hypertension, arrhythmias, cardiovascular and cardiopulmonary diseases [5–7]. Recent reports have suggested a relationship between the intermittent nighttime hypoxemia or the repeated nighttime

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awakenings of patients with SDB with neurocognitive dysfunction in persons with SDB [8,9]. Several studies have linked SDB with impairments in multiple cognitive abilities, including executive function [10–12], attention and vigilance [13–16], and learning and memory [17,18].

Although the prevalence, severity, and risk for SDB differs by race, there have been no studies examining whether the cognitive deficits related to SDB may also differ across racial groups. As part of a larger study investigating SDB in community-dwelling older African-Americans and Caucasians, we examined the relationship between SDB and cognitive function over time between these racial groups.

Methods

Participants

Seventy (30 males; 40 females) African-American (mean age 73.7 years, S.D. 6.38, range 65–88) and 70 (30 males; 40 females) age- and gender-matched Caucasian (mean age 73.3 years, S.D. 5.7, range 65–93) community-dwelling elderly with high risk of having SDB were studied at two different time points over a 3-year span, from 1997 to 1999. All subjects were 65 years or older at recruitment.

The protocol was approved by the University of California, San Diego Institutional Review Board, and all participants signed informed consents prior to commencement of the study. Each participant was paid US$100 upon completion of each visit.

Apparatus

An ambulatory analog data recorder, the modified Respitrace/Medilog system (Ambulatory Monitoring, Ardsley, NY) [19], was used to record thoracic and abdominal respiration, tibialis electromyogram (EMG) and wrist activity (to identify sleep and wake). The data were played back onto a model 78B Grass polygraph (Grass Instruments, Quincy, MA). This ambulatory recording technique has been previously validated against traditional polysomnography; significant correspondence was found for sleep apnea index $r_s = .80$ ($P < .01$), total sleep period $r_s = .82$ ($P < .01$), and wake after sleep onset $r_s = .61$ ($P < .01$) [20]. In addition, blood oxygen saturation was recorded using a finger-pulse oximeter (Ohmeda 3700; Respironics, Morrisville, PA) and scored using the PROFOX oximetry program (PROFOX Associates, Escondido, CA) [21].

Procedures

Participants were recruited via flyers and newspaper advertisements. Participants were initially screened over the telephone to assess risk of having SDB, defined as suffering from EDS and/or loud snoring.

Participants were interviewed at length about their sleep, medical history, and medication intake at each home visit. In addition, cognitive status was measured using the Mini-Mental Status Examination (MMSE) [22,23]. The MMSE assesses several areas of cognitive functioning including orientation, attention, immediate and short-term recall, language and the ability to follow instructions.

Sleep was recorded in the subjects' homes for two consecutive nights. Sleep data were scored for total sleep time (TST), wake after sleep onset (WASO), and RDI (total number of apneas and hypopneas per hour of sleep). Apneas were defined as at least 90% reduction in respiratory effort, lasting for at least 10 s and hypopneas were defined as a 50% to 90% reduction in respiratory effort. Oximetry was recorded for one night usually on the first study night (if data collection failed, another attempt was made on the second study night). Oxygen saturation data were scored for oxygen desaturation index (ODI; total number of desaturations ≥4% per hour of sleep) and time spent at saturation level greater or equal to 90% ($SaO_2 \geq 90$). The identical protocol was repeated 2 years (±2 months) later for each subject.

Data analysis

Sample statistics

Univariate logistic regressions were conducted to examine differences on the independent variables (TST, WASO, RDI, ODI, $SaO_2 \geq 90$, and education level) between the African-American and Caucasian samples at baseline. An additional univariate logistic regression was conducted to examine whether differential dropout occurred between Visits 1 and 2. This resulted in a main effect of race ($R = .11$, $P = .048$), with more Caucasians ($n = 56$) completing the second visit than African-Americans ($n = 46$).

Within-visit analyses

An ANCOVA was conducted for all subjects completing Visit 1 ($n = 70$ African-Americans and $n = 70$ Caucasians), with MMSE score as the dependent variable and TST, WASO, RDI, ODI, and percent time at $SaO_2 \geq 90$ as independent variables. All analyses were controlled for race, gender, and education level (in years). All possible main effects and zero-order interactions were included in the model. Due to the differential dropout rate of African-Americans from Visit 1 to Visit 2, no within-visit analysis was conducted on Visit 2.

Between-visit analyses

Change scores (e.g. change in RDI = [(RDI (v2)−RDI (v1)]) and mean scores (e.g. mean value RDI = [(RDI (v1)+RDI (v2))/2]) were computed for all independent variables. Using both a change and a mean score for each independent variable ensured that these variables were nearly orthogonal to each other. An ANCOVA was conducted for all subjects completing Visit 1 and Visit 2 ($n = 46$