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Assessing the influence of obesity on longitudinal executive functioning performance in patients with obstructive sleep apnea syndrome

Chelsea A. Hilsendager^{a,*}, Duan Zhang^a, Cynthia McRae^a, Mark Aloia^b

^a University of Denver Morgridge College of Education Department of Research Methods and Statistics, United States

^b National Jewish Health, United States

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KEYWORDS

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Summary

Objective: To investigate longitudinal performance on an executive functioning task among individuals with obstructive sleep apnea syndrome (OSAS) and the impact of obesity on performance.

Methods: Participants completed the Trail Making Test Part B (TMT-B), which is an executive functioning task that measured cognitive flexibility, at baseline, 3-, 6-, and 12-month follow-ups. Hierarchical linear modeling (HLM) analyses were used to assess participants' initial performance on the task, as well the trajectories of growth on the task across time points. Additionally, body mass index (BMI) was included in the estimations of fixed and random effects as a predictor of performance.

Results: There were no significant differences between obese and non-obese individuals on the cognitive flexibility task at baseline. However, obese and non-obese individuals differed significantly in their linear and quadratic rates of growth across time points.

* Corresponding author. Tel.: +1 973 879 2022.

E-mail addresses: chelsea.a.hilsendager@gmail.com (C.A. Hilsendager), Duan.Zhang@du.edu (D. Zhang), cmcrae@du.edu (C. McRae), AloiaM@NJHealth.org (M. Aloia).

Conclusions: This study suggests that obese and non-obese individuals may differentially respond to Continuous Positive Airway Pressure (CPAP) treatment (as related to cognitive flexibility). Future research should examine the impact of weight loss on the neuropsychological sequelae of obese individuals with OSAS.

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Introduction

The prevalence of obesity has increased substantially over the past four decades, and is currently considered one of the foremost causes of preventable death in the United States [1]. More than two thirds of adults in the United States are now classified as overweight or obese, which has led to predictions that obesity will cause the first decline in life expectancy in the past 100 years [2]. The risk of death associated with obesity is primarily a result of associated health complications, including type 2 diabetes, hypertension, cardiovascular disease, certain types of cancer, and sleep-disordered breathing [3].

Obstructive sleep apnea (OSAS) affects 2% of middle-aged women and 4% of middle-aged men in the United States [4]. Obesity is present in approximately 70% of individuals with OSAS and is considered the most prominent and only reversible risk factor. Though the underlying mechanisms pertaining to the association between obesity and OSAS are somewhat unclear, it is hypothesized that increased weight decreases the size of the upper airway, and thus, increases the propensity for apnea events [5].

Considering the prevalence of obesity in patients with OSAS, some investigators have analysed the impact of weight loss as a treatment. Veasey et al. [6] found that a sufficient amount of weight loss through dietary modification can result in significant improvement in OSAS symptomatology among overweight and obese individuals. These investigators acknowledged that improvements in weight loss programs are warranted. At present, Continuous Positive Airway Pressure (CPAP) is considered the most effective and preferred treatment for OSAS [7]. The CPAP device provides positive air pressure to the upper portion of the airway, which prevents it from collapsing during sleep, and thus, reduces or completely eliminates nocturnal respiratory disturbances. The decrease or absence of upper airway collapse results in minimized sleep fragmentation and nocturnal hypoxemia [8].

Untreated OSAS is associated with several neuropsychological deficits, including impaired executive functioning [9–14]. Additionally, a growing

body of literature suggests that obesity is related to negative neurocognitive outcomes, including executive dysfunction, independent of other health problems [15–17]. Strauss et al. [18] described executive functions as a set of complex processes mediated by the frontal lobe of the brain. Broadly, they allow persons to respond adaptively to their environment, particularly in novel situations. Executive dysfunction may manifest as a collection of problems in everyday life, such as difficulty with decision-making, problems following through and shifting plans, difficulty in circumstances involving different aspects of memory (e.g., remembering to carry out a goal directed activity at a later time), and poor organizational ability, among others.

Taken together, the studies assessing executive functioning in obese persons and OSAS patients suggest both are related to deficits in this domain of cognitive functioning. The specific aspects of executive functioning that may be impacted by both obesity and OSAS are the following: cognitive flexibility, planning, and problem solving. Considering the evidence that obesity is independently associated with executive functioning impairments, the current study hypothesized that obese participants would demonstrate poorer performance on the executive functioning task at baseline compared to non-obese participants. Additionally, it was hypothesized that obesity status would be a significant predictor of performance on the executive functioning task following CPAP treatment.

Methods

Participants

Three hundred participants were recruited to participate in a randomised clinical trial, referred to as Project Breathe [19]. Project Breathe aimed to identify methods to increase adherence to CPAP treatment and assessed the neuropsychological functioning of participants over time. Participants for Project Breathe were recruited from the Sleep Center at National Jewish Health and were between the ages of 30 and 80 years. All participants were

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