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Sedentary behavior and sleep efficiency in active community-dwelling older adults

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ABSTRACT

Objectives: Previous studies have demonstrated that aerobic exercise interventions have a positive impact on sleep efficiency in older adults. However, little work has been done on the impact of sedentary behavior (sitting, watching television, etc.) on sleep efficiency.

Methods: 54 Community-dwelling men and women >65 years of age living in Whistler, British Columbia (mean 71.5 years) were enrolled in this cross-sectional observational study. Measures of sleep efficiency as well as average waking sedentary (ST), light (LT), and moderate (MT) activity were recorded with Sensewear accelerometers worn continuously for 7 days.

Results: From the univariate regression analysis, there was no association between sleep efficiency and the predictors LT and MT. There was a small negative association between ST and sleep efficiency that remained significant in our multivariate regression model containing alcohol consumption, age and gender as covariates. (standardized β correlation coefficient -0.322, $p=0.019$). Although significant, this effect was small (an increase in sedentary time of 3 hours per day was associated with an approximately 5% reduction in sleep efficiency).

Conclusions: This study found a small significant association between the time spent sedentary and sleep efficiency, despite high levels of activity in this older adult group.

1. Introduction

Only approximately 5% of North Americans meet current guidelines for physical activity, due to high levels of sedentary behavior (such as sitting, or watching television) [1]. This high level of inactivity is one possible etiology for difficulty sleeping, a problem which afflicts large numbers of North Americans [2,3]. Advancing age is characterized by increasing levels of sedentary time [4] and increasing impairments in sleep duration and sleep quality [5]. Poor sleeping is recognized as a "nontraditional" cardiovascular risk factor and is associated with increased cardiovascular risk, increased rates of diabetes, and increased rates of obesity [3].

Much work has been done previously in community-dwelling older adults on the relationship between the level of physical activity and sleeping. These studies have involved direct comparisons between physically fit and unfit groups [6,7], cross-sectional observational studies [8–11], and randomized controlled trials of aerobic training [12–15]. The endpoints used in these investigations have included sleep quality scales [6,8,9,13,16], accelerometer-based measures of sleep efficiency [17] and the number of awakenings during

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sleep lab studies [7,12,14]. The time spent in sedentary behaviors is being increasingly recognized as an independent cardiometabolic risk factor (even after accounting for times spent being physically active [18]). Whether the amount of time spent sedentary is an independent predictor of poor sleep efficiency in older adults remains unexamined.

In order to more fully isolate the effects of sedentary time on sleep efficiency, we chose to recruit a group of older adults that were extremely physically active. By examining a group that was already meeting or exceeding current guidelines for physical activity, we sought to examine the relationship between sedentary behaviors (as quantified by accelerometer measures) and sleep efficiency in an active older adult population. We hypothesized that increased sedentary time would continue to be associated with poor sleep even in the setting of concomitant high levels of exercise.

2. Methods

This was a cross-sectional observational study. This study was approved by the Human Subjects Committee of the University of British Columbia, and all subjects gave written informed consent.

2.1. *Subjects and recruitment*

55 community dwelling men and women >65 years of age were screened through their affiliation with the Whistler Seniors Ski Team of British Columbia, Canada, via a study poster and information session. Subjects were enrolled between October of 2011 and June of 2012.

2.2. *Inclusion/exclusion criteria*

All subjects had to be able to independently perform all basic activities of daily living, climb one flight of stairs and walk 2 blocks without assistance. Current smokers, users of recreational drugs, those with known diabetes mellitus or cardiovascular disease in the form of prior strokes, transient ischemic attacks, angina, myocardial infarction or coronary revascularization in the last 2 years were non-eligible.

2.3. *Research procedures*

A minimum of one study visit was required by each participant to collect anthropomorphic, blood pressure, laboratory and clinical data, and to apply the accelerometer. Anthropomorphic measurements were recorded including height without shoes measured by stadiometer to the nearest 0.1 cm. Weight was measured by mechanical beam balance scale to the nearest 0.1 kg while the subject was wearing light clothes but no shoes. Waist circumference was measured to the nearest 0.1 cm by a plastic tape measure held at the level of the umbilicus directly against the skin. Blood pressure was measured by digital sphygmomanometer while the subject was seated quietly, recording the average of 3 readings taken 5 min apart, after 20 min of quiet rest. Blood was drawn in private affiliated laboratories according to standard methods.

Each subject on entry to the study was screened by a research nurse, who took a nursing history including past medical history, medication list and substance use.

Sensewear Pro armband triaxial accelerometers (BodyMedia, Sword Medical Limited, Blanchardstown, Dublin) were fitted snuggly around the right upper triceps and used to monitor levels of physical activity 24 h a day for 7 full days. Subjects were instructed to wear it continuously, including during sleep, except when bathing or swimming. The Sensewear Pro measures triaxial acceleration, skin temperature, galvanic skin response, and heat flux from the body, which is then processed by algorithms to calculate and report physical activity and sleep duration. Minute-by-minute epoch data from the Sensewear Pro was analyzed by algorithms using Body Media InnerView Research Software (Version 5.1, BodyMedia, Inc.).

2.4. *Data collection and processing*

To be included in the analysis, participants were required to comply with wearing the accelerometer for at least 5 valid days. A valid day was defined as at least 21 h of recorded activity on the accelerometer.

2.5. *Accelerometer measures of activity*

Accelerometer data was recorded in one second epochs. Sedentary behavior was defined as "any waking behavior characterized by an energy expenditure ≤1.5 METs while in a sitting or reclining posture" [19]. Light activity, meaning time spent standing or walking slowly, was categorized as 1.5–3.0 METs. Moderate to vigorous activity such as brisk walking or more intense exercise was categorized as >3.0 METs. Subjects qualified as meeting target guidelines for physical activity when more than 150 min in the 7 days was spent at a moderate to vigorous level of activity. Average time per day spent in sedentary (ST), light (LT) and moderate to vigorous activity levels (MT) was recorded as minutes per day. Based on a systematic review of accelerometry practice for older adults [20], the following cut points were used: ≤99 counts/min as sedentary time, 100–1951 counts/min as light physical activity, and ≥1952 counts/min for moderate to vigorous level of activity [21].

2.6. *Accelerometer measures of sleep efficiency*

Accelerometers were also worn during the night to provide a measure of sleep efficiency, which is defined as the number of minutes of sleep divided by the number of minutes in bed. The Sensewear Pro can distinguish between lying down and sleep time by using algorithms that detect the characteristic combination of orientation, motion, temperature, and skin conductivity with each state (Body Media InnerView Research Software, Version 5.1). The activity monitor has been validated to examine sleep efficiency against polysomnography [22,23] in adult subjects and has been used previously to evaluate sleep efficiency in older subjects [24,25].