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Changes in sedentary time are associated with changes in mental wellbeing over 1 year in young adults

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ABSTRACT

Excessive sedentary time is related to poor mental health. However, much of the current literature uses cross-sectional data and/or self-reported sedentary time, and does not assess factors such as sedentary bout length. To address these limitations, the influence of objectively measured sedentary time including sedentary bout length (i.e. < 30 min, ≥ 30 min) on mood, stress, and sleep, was assessed in 271 healthy adults (49% women; age 27.8 $\pm$ 3.7) across a 1-year period between 2011 and 2013 in Columbia, SC. Participants completed the Profile of Mood States and the Perceived Stress Scale, and wore a Sensewear Armband to assess sedentary time, physical activity, and sleep for ten days at baseline and one year. A series of fixed-effects regressions was used to determine the influence of both baseline levels and changes in daily sedentary time (total and in bouts) and physical activity on changes in mood, stress, and sleep over one year. Results showed that across the year, decreases in total sedentary time, and time in both short and long bouts, were associated with improvements in mood, stress and sleep ($p < 0.05$). Increases in physical activity were only significantly predictive of increases in sleep duration ($p < 0.05$). Thus, reductions in sedentary time, regardless of bout length, positively influenced mental wellbeing. Specifically, these results suggest that decreasing daily sedentary time by 60 min may significantly attenuate the negative effects of high levels of pre-existing sedentary time on mental wellbeing. Interventions manipulating sedentary behavior are needed to determine a causal link with wellbeing and further inform recommendations.

1. Introduction

Much of the chronic disease burden in the United States is attributed to modifiable behavioral risk factors (e.g. diet, exercise) (Bauer et al., 2014). One such factor, excessive sedentary behavior, has recently received significant attention with evidence demonstrating deleterious effects for cardiometabolic health and all-cause mortality that may be independent of physical inactivity (Koster et al., 2012; Matthews et al., 2012). Sedentary behavior, defined as waking time spent sitting or reclining without being otherwise active (Sedentary Behaviour Research Network, 2012), is highly prevalent in the United States. Recent data from a sample of younger adults showed that this population sits for > 9 h/day (Unick et al., 2017). Moreover, young adults have shown the largest increase in sedentary time coupled with the largest decrease in moderate to vigorous physical activity over the preceding decades, in comparison to other age groups, placing them at greater risk for development of chronic disease (Nelson et al., 2008).

Sedentary time also negatively influences mental health including increased risk for anxiety (Teychenne et al., 2015), depression (Teychenne et al., 2010), and lower levels of emotional wellbeing (Atkin et al., 2012a; Endrighi et al., 2015) in diverse populations including younger adults. Accumulating large amounts of sedentary time has also been linked with sleep disorders (Kline et al., 2016), which are frequently comorbid with mental health issues (Krystal, 2006).

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However, this research has largely relied on cross-sectional data. While longitudinal studies examining sedentary behavior and outcomes related to mental wellbeing exist (Hamer and Stamatakis, 2013; Lucas et al., 2011; Sanchez-Villegas et al., 2008; Teychenne et al., 2014), these have been conducted primarily in older populations and have relied on self-report and surrogate measures for sedentary time (e.g. hours of TV viewing), which typically have poor validity (Atkin et al., 2012b). Additionally, these measures do not usually consider the potential health consequences of different accumulation patterns of sedentary time. For example, previous research suggests that sedentary behavior accumulated in prolonged bouts (e.g. > 30 min duration) may be a better predictor of cardiometabolic health outcomes than total sedentary time (Diaz et al., 2016; Dunstan et al., 2012; Honda et al., 2016; Júdice et al., 2015). However, given the limitations of the sedentary assessments used to date, it is unknown whether the total amount of sedentary time or the amount accumulated in longer bouts is most problematic for mental wellbeing. Lastly, research conducted in this area has largely focused on diagnosed mental health conditions (e.g. major depressive disorder) and less is known about the influence of sedentary time on sub-clinical mental health symptoms that affect a much larger segment of the population.

The purpose of this study was to address these limitations by examining the longitudinal association of changes in objectively measured sedentary time with changes in mood, stress, and sleep in a cohort of healthy young adults. Based on previous research demonstrating the detrimental health consequences of accumulating sedentary time in prolonged bouts, the influence of sedentary time accumulated in longer (≥30 min) and short (< 30 min) bouts was also examined. It was hypothesized that as sedentary time increased, mood disturbance and stress would increase, while sleep duration would decrease, whereas these markers of wellbeing would improve with decreased sedentary time. Additionally, it was hypothesized that sedentary time accumulated in prolonged bouts (≥30 min) would have a greater influence on mental wellbeing than sedentary time accumulated in shorter bouts.

2. Methods

2.1. Participants

These data were drawn from a larger project designed to examine factors influencing energy balance in young adults (Hand et al., 2013). Participants were included in the present study if they had complete data at baseline and the 1-year follow up. Briefly, participants were healthy adults, ages 21 to 35 years, with a body mass index (BMI) between 20 and 35 kg/m^2. Exclusionary criteria for the larger study included use of weight-loss medications, recent change of smoking status, planned weight-loss surgery, hypertension, high blood glucose, or a current chronic disease diagnosis requiring daily medication. Individuals were also excluded for a history of depression, anxiety, or panic disorder. All women were eumenorrheic, and those who gave birth in the previous year or were planning to become pregnant were excluded. All procedures were approved by the Institutional Review Board of the University of South Carolina and informed consent was obtained from each participant before data collection.

2.2. Procedures

At baseline participants completed a demographic and health history form and questionnaires to assess mood and stress. Approximately one week later, height and weight were measured and participants were issued an activity monitor to objectively measure physical activity, sedentary behaviors, and sleep. Identical procedures were completed at a one-year follow-up.

2.3. Measures

2.3.1. Physical activity and sedentary behaviors

Physical activity and sedentary time were objectively measured using the SenseWear Mini Armband (SWA; BodyMedia Inc. Pittsburgh, PA), worn on the upper arm. Using a tri-axial accelerometer, and sensors for heat flux, galvanic skin response, and skin temperature with a proprietary algorithm, the SWA estimates time spent in different activity intensities and steps/day. This device has been validated for assessing energy expenditure against doubly-labeled water in a similar sample of young adults (intraclass correlation 95% confidence interval of 0.68–0.89) (St-Onge et al., 2007). Further, the SWA also has acceptable levels of validity for estimating energy expenditure during typical sedentary and light intensity activities when compared to indirect calorimetry under laboratory conditions with an ICC of 0.90 (Reece et al., 2015).

Participants were asked to wear the armband 24 h a day for 10 consecutive days, except during water-based activities (e.g., swimming or bathing) and were deemed compliant if they completed 7 days of wear (including two weekend days) with ≥21 h of wear time on each of the days (Hand et al., 2013). Average daily steps were used as a measure of physical activity. Sedentary time was calculated as total time spent ≤1.5 METs while awake. Lastly, sedentary time was divided into time accumulated in bouts of ≥30 (prolonged bouts) and < 30 min (short bouts). Thirty minutes was chosen as the cut-point for dividing prolonged from short bouts of sedentary time as this is a common operational definition used in previous literature (e.g. Diaz et al., 2016; Sloan et al., 2018) and all participants in the present study accumulated sedentary time in bouts of this length.

2.4. Sleep

Sleep duration was operationally defined as total nighttime sleep. This metric was derived from minute-by-minute sleep epoch data from the SWA. The SWA is a valid instrument for assessing sleep duration as well as several metrics of sleep quality (e.g. sleep onset latency, wake-after-sleep-onset) in comparison to polysomnography (Shin et al., 2015).

2.5. Mood

The Profile of Mood States (POMS) was used to assess mood over the past week (McNair et al., 1971). The POMS has six subscales (tension, depression, anger, vigor, fatigue, and confusion) and provides a summary score for total mood disturbance (TMD; tension + depression + anger + fatigue + confusion – vigor + 100). The POMS has acceptable levels of reliability and validity for use with the general adult population (McNair et al., 1971; Nyenhuis et al., 1999). Internal consistency reliability coefficients range from α = 0.63–0.96 with test–retest reliability estimates of 0.65 to 0.74 (McNair et al., 1971).

2.6. Stress

Stress was assessed using the Perceived Stress Scale (PSS) which measures the stressful perception of various life situations over the past month (Cohen et al., 1983). Validity and high internal consistency were demonstrated in the initial publication (r = 0.84–0.86) and the test-retest reliability was 0.55–0.85 (Cohen et al., 1983).

2.7. Statistical analyses

Demographic characteristics, baseline levels and changes in physical activity, sedentary time, and mental wellbeing-related outcomes were calculated using means and standard deviations for continuous variables and percentages for categorical variables. For descriptive purposes and to provide data to help inform future recommendations