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Comparison of subjective and objective measures of office workers' sedentary time

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ABSTRACT

Sedentary behavior is an independent and prominent risk factor for chronic disease. Occupational sitting is likely to be the largest determinant of overall daily sitting time. Gathering accurate data on sedentary behaviors is essential to determine prevalence and effectiveness of interventions to reduce sedentary time. The purpose of this research was to determine whether self-reported sedentary time assessed by the Paffenbarger Physical Activity Questionnaire (PPAQ) and the Occupational Sitting and Physical Activity Questionnaire (OSPAQ) was related to objectively assessed sedentary time by the activPAL3 activity monitor. In the spring of 2015, 44 women employed full-time at Slippery Rock University participated in this study. Participants were predominantly Caucasian (95%), middle-aged (48 ± 10 years), and had an average BMI of 30.5 ± 8.2. A positive, weak correlation was found in sedentary time between the PPAQ (14.65 ± 2.77 h) and the activPAL3 (17.71 ± 1.46 h) over a 24 hour day (r = 0.253; p = 0.098; n = 44). Thirty-nine of the 44 participants significantly underestimated their sedentary time as compared to the activPAL3 (3.06 ± 2.76 h; p = 0.001). A positive, weak correlation was also found in sedentary time between the OSPAQ (5.96 ± 1.11 h) and the activPAL3 (5.69 ± 1.06 h) during the 8.5 hour work day (r = 0.100; p = 0.518; n = 44). Future studies examining sedentary behaviors should use caution when only considering the use of subjective recall surveys. This is especially true when self-reported behaviors are used to inform health promotion programs and create universal recommendations aimed to reduce sedentary time.

1. Introduction

Scientific evidence supports that regular exercise and physical activity (PA can improve health and reduce the risk of chronic disease and premature mortality (Bauer et al., 2014; Center for Disease Control and Prevention, 2014; Thompson, 2010). Sedentary behavior has been identified as an independent and prominent risk factor for chronic disease, even for those who meet the guidelines for exercise and PA (Cooley and Pederson, 2013; Ellingson et al., 2013; Peterson et al., 2014). The term "sedentary" can be defined based on metabolic cost of activity or inactivity that requires low levels of energy expenditure (≤ 1.5 METS), or as a distinct group of behaviors characterized by time spent sitting, lying, or reclined during waking hours (Sedentary Behaviour Research Network, 2012). Evidence suggests that a large volume of sedentary tome increases the risk of chronic disease and all-cause mortality, after adjusting for time spent in moderate to vigorous physical activity (World Health Organization, 2014; Katzmarzyk, 2014; Pate et al., 1995; Thompson, 2010).

Sitting time can be monitored during the work hours as part of a comprehensive assessment of total daily sedentary time. Occupational sitting is likely to be the largest determinant of overall daily sitting time (Ryan et al., 2011; Thorp et al., 2011). Previous studies report office workers were sedentary for an average range of 66%–82% of work hours (Ryan et al., 2011; Bird et al., 2015; Castillo-Retamal and Hinckson, 2011; Parry and Straker, 2013; Ryde et al., 2013; Thorp et al., 2012; Toomingas et al., 2012). Large amounts of occupational sitting are perpetuated by screen time, inactive commutes, and the use of labor-saving information and communication devices, which has led to the decrease of daily occupational energy expenditure, by approximately 100 kcal/day, over the last five decades (Church et al., 2011; Owen et al., 2011).

The activPAL3 has been identified as a valid measure of posture, motion, and sedentary behavior in adults, as it offers a superior accuracy compared to many self-report measures (Thorp et al., 2012; Oliver et al., 2010; Grant et al., 2006; Kozey-Keadle et al., 2012; Hart et al., 2011). Similarly, the Paffenbarger Physical Activity Questionnaire (PPAQ) and Occupational Sitting and Physical Activity Questionnaire (OSPAQ) have been reported to be valid and reliable to assess sedentary

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behavior in similar adult populations (Paffenbarger et al., 1993; Ainsworth et al., 1993; Chau et al., 2012; Paffenbarger et al., 1978). Self-report measures that show convergence when conducted simultaneously with objective measures such as the activPAL3 may provide researchers with less costly options to further study sedentary behavior (Hart et al., 2011). Accordingly, questionnaires that measure domain-specific sitting time may be acceptable to estimate population based associations between sitting time and subsequent health outcomes (Marshall et al., 2010). Thus, there continues to be a need to compare questionnaires that assess sedentary time to a valid criterion measure (Kozey-Keadle et al., 2012).

Therefore, gathering accurate data on sedentary behaviors in and out of the workplace is essential to determine prevalence and effectiveness of interventions to reduce or disrupt sedentary time (Oliver et al., 2010). Given that both subjective and objective instruments capture important aspects of sedentary behavior, utilizing both types of measures seems warranted. Ideally, the instruments chosen should allow for comparison across time and integrate multiple levels of information to provide the greatest contextual understanding associated with sedentary behaviors. The purpose of this research was to determine whether self-reported sedentary time assessed by the PPAQ and OSPAQ was related to objectively assess sedentary time by the activPAL3 activity monitor.

2. Methods

2.1. Participants

Forty-four women who were at least 18 years of age, employed full-time at a university campus and had a sedentary job description were included in this investigation (Fig. 1). All participants worked a verified schedule of 8:00 am–4:30 pm, Monday–Friday. Participants were predominantly Caucasian (95%), middle-aged (48 ± 10 years), and had an average BMI of 30.5 ± 8.2). Individuals were excluded if they had any disability that would inhibit wearing the activity monitors or participating in physical activity. Participants in this study were the same group described in a previously published study that examined the effect of a workplace intervention to reduce sedentary time (Urda et al., 2016). This study was approved by the University Institutional Review Board, and all participants provided written informed consent.

2.2. Design and procedures

At bassline, all participants completed the PPAQ and OSPAQ. An activPAL3 activity monitor (v7.2.32PAL Technologies Ltd., Glasgow, UK) was placed on each participant and detailed instructions on proper use and placement were provided. Participants continuously wore the activPAL3 activity monitor for seven consecutive days and were asked to maintain their current level of physical activity. At the end of the seven days, participants completed the PPAQ and OSPAQ again and returned their activPAL3 activity monitor.

2.3. Instrumentation

Height was measured using a wall-mounted stadiometer to the nearest 0.25 in. Weight was measured using a calibrated balance-beam scale to the nearest 0.25 lb. Body mass index (BMI) was calculated as body weight (kg) divided by height squared (m^2). The activPAL3 activity monitor is a validated light-weight, credit card sized uniaxial piezoresistive activity monitor that measures movement in three planes: sitting, standing, and stepping activities, as the activPAL3 incorporates both accelerometer and inclinometer functions (Grant et al., 2006; Kozey-Keadle et al., 2012; Edwardson et al., 2016). The monitor was worn on the midline anterior aspect of the thigh, covered by a waterproof finger cot and adhered to the skin with the non-allergenic adhesive tape. The activPAL3 can be worn for a period up to 10 consecutive days. Proprietary software was used to summarize data as time spent sitting/lying in total hour/week and while at work (8.5 h).

The PPAQ (Paffenbarger et al., 1993; Ainsworth et al., 1993) was utilized to assess subjective sedentary time during the previous seven days. The questions elicit duration for vigorous, moderate, and light PA, as well as sedentary time, which is considered any time spent sitting and sleeping/reclined. Subjective estimates of the amount of time over the past week in hours/day on a weekday and weekend day were self-reported for vigorous, moderate, and light PA, and total sedentary time, or sitting and lying/reclined time over a 24-hour period. Sedentary time was reported for a typical weekday and weekend day.

The OSPAQ (Chau et al., 2012) was utilized to collect subjective sedentary time for participants while at work (8.5 h) over the previous seven days. The questions elicit percentages of time spent sitting, standing, walking, and in physically demanding tasks or hard labor throughout a typical workday. Travel to and from work and leisure time while at work were excluded. Hours per workday spent sitting was determined using the equation presented by Chau et al. (2012). Data were recorded in hours/week and hours/day.

2.4. Statistical analysis

Statistical analysis was conducted utilizing SPSS software (IBM, version 19). The significance level was set at 0.05 for all data analyses. A Pearson Product Correlation was utilized to examine if a relationship existed between sedentary time subjectively assessed from the PPAQ and objectively measured by the activPAL3 in hours per week over 24 h. A Pearson Product Correlation was also utilized to examine the relationship between sedentary time subjectively assessed from the OSPAQ and objectively measured by the activPAL3 during work hours. Additionally, error scores were calculated to assess the difference in agreement between the objective (activPAL3) and subjective (OSPAQ and PPAQ) assessments, and a Bland-Altman analysis was conducted to explore systematic bias.

3. Results

A positive, weak, non-significant correlation was found in sedentary time between the PPAQ (14.65 ± 2.77 h) and the activPAL3 (17.71 ± 1.46 h) over a 24-hour day ($r = 0.253$; $p = 0.098$; $n = 44$). Further, variation in self-reported sedentary time only explains 6% ($r^2 = 0.064$) of the variation in actual sedentary time. Self-reported sedentary time was systematically underestimated as determined by the Bland-Altman analysis. Thirty-nine of the 44 participants significantly underestimated their sedentary time as compared to the activPAL3 (3.06 ± 2.76 h; $p = 0.001$), with 19 participants having a difference > 3 h during a 24-hour period. Fig. 2 represents the error included in the self-reported sedentary time estimated by the PPAQ.

A positive, weak, non-significant correlation was also found in sedentary time between the OSPAQ (5.96 ± 1.11 h) and the activPAL3 (5.69 ± 1.06 h) during the 8.5 hour work day ($r = 0.100$; $p = 0.518$; $n = 44$). The mean error of the estimation was approximately one-quarter of an hour (0.27 ± 1.46), with 24 of the participants overestimating and 18 underestimating their sedentary time while at work. Nineteen of the 44 participants estimated more than an hour (1.1–4.2 h) difference between their sedentary time during their workday and what was objectively measured. Error included in self-reported sedentary time estimated by the OSPAQ is illustrated in Fig. 3. There was no systematic bias ($p = 0.743$) in the OSPAQ subjective assessment relative to the activPAL3 objective assessment as demonstrated by the Bland-Altman analysis (Fig. 4).

4. Discussion

Due to previously established criterion validity of the subjective and objective measures used in the present study, convergence was