Introducing sit-stand desks increases classroom standing time among university students

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ABSTRACT

Excessive sedentary behavior has been associated with many negative health outcomes. While an understudied health topic, there is evidence that university students are excessively sedentary. Sit-stand desks have been shown to reduce sedentary time among pre-university students (ages 5–18 years) and sedentary workers but have not been tested in university classrooms. This study tested the effects of introducing sit-stand desks into a university classroom on student's classroom sitting and standing behaviors. Using a cross-over design, students received access to both traditional seated desks and sit-stand desks for six weeks. Data were collected between September and December, 2016. We recruited 304 healthy undergraduate university students enrolled in one of two small (25 seats) classrooms at a large Midwestern university during the fall of 2016. Average minutes of standing/hour/student, average percent class time spent standing, and the number of sit-stand transitions/student/hour were directly observed with video camera surveillance. Participants stood significantly more (p < 0.001) when provided access to sit-stand desks (7.2 min/h/student; 9.3% of class time spent standing) compared to when they had access to seated desks (0.7 min/h/student; 1.6% of class time spent standing) but no differences were observed for the number of sit-stand transitions (p = 0.47). Students reported high favorability for the sit-stand desks and improvements in several student engagement and affective outcomes while using the sit-stand desks. These findings support introducing sit-stand desks in university classrooms as an approach to reduce sedentary behaviors of university students.

1. Introduction

Excessive sedentary behavior (e.g. any wakeful activity expending ≤ 1.5 METs in a reclining or sitting position) has been associated with several chronic diseases including cardiovascular disease, diabetes and obesity independent of physical activity levels (Healy and Owen, 2010; Katzmarzyk et al., 2009; Tremblay et al., 2017; Tremblay et al., 2010; Wilmot et al., 2012). Additionally, evidence suggests breaking up sedentary time with light intensity activities such as standing, may be sufficient to improve important health risk factors (Healy et al., 2015; Thorp et al., 2014). Specifically, at the same level of sedentary behavior, individuals who replace more sitting time with standing time are more likely to have improved fasting plasma glucose levels, lower triglycerides, lower total/HDL cholesterol ratios, and higher HDL cholesterol ratios. These data support interventions focused on replacing sitting time with standing time as a simple approach for improving the health profiles of populations at risk for sedentary lifestyles (Manini et al., 2015).

While an understudied health topic, there is evidence that university students are excessively sedentary and that the college/university years are a critical transition time characterized by increasing sedentary behaviors (Keating et al., 2005; Nelson et al., 2008). For example, a cross-sectional study conducted in the UK concluded university students spent more than 8 h per day sitting (Rouse and Biddle, 2010). A study conducted in Argentina found 50% of university students reported sitting 6 to 10 h per day with 34% sitting > 10 h per day (Farinola and Bazan, 2011). Further, Johnston and colleagues found university student's daily sitting time significantly increased by 75 min/day from the first year to the final year (Johnston et al., 2010). Collectively, these findings support interventions aimed at reducing sedentary behaviors of university students.

Ecological models of health behavior change suggest aspects of the environment play a critical role in shaping health behaviors (Stokols, 1996). Given the large amount of time university students spend in classroom environments (roughly 15 h per week for a full-time U.S. student), which usually require students to sit, the university classroom may be an ideal setting for intervention aimed at reducing university students' sedentary time. In a qualitative study exploring the major

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determinants of sedentary behaviors of university students, Deliens et al. identified individual (e.g., norms), social (e.g., modeling, peer support), and environmental factors (e.g., availability and accessibility) that would support a classroom based intervention (Deliens et al., 2015). For example, students reported that much of their sitting time is due to the time they spend sitting in classes and that their own sedentary behaviors are often influenced by those of their peers (Deliens et al., 2015). Given sit-stand desks have been found to be both acceptable (Hinckson et al., 2013) and effective for reducing sitting time among younger school aged (5–18 years) students (Clemes et al., 2016) and sedentary office workers (Shrestha et al., 2016), it is possible sit-stand desks could also be effective for reducing sedentary behaviors of university students. To date, however, sit-stand desks have not been tested in the university classroom environment.

A recent study explored the acceptability and feasibility of introducing sit-stand desks into university classrooms. Out of 993 undergraduate university students surveyed, only 2.8% reported ever having taken a class in which sit-stand desks were available (Benzo et al., 2016). The large majority of students (83%) and instructors (87%) reported being in favor of introducing sit-stand desks into university classrooms. Interestingly, more than half of students and instructors also predicted having access to sit-stand desks would improve student's "physical health", "attention", and "restlessness". These findings were supportive of further studies testing the effect of introducing sit-stand desks in university classrooms. Therefore, the purpose of the present study was to test the effect of retrofitting a traditional seated university classroom with sit-stand desks on university student's classroom standing time, classroom sitting time, and sit-stand transitions. As exploratory aims, we also sought to examine student's perceived impact of standing on health and student engagement outcomes, student's acceptability of sit-stand desks, and student's reasons for using/not using the desks when they were provided.

2. Methods

2.1. Participants

A purposive sample of students enrolled in 1 of 14 classes being taught in two classrooms (referred to as classroom A and B) at a large Midwestern university was recruited. All data was collected between September and December 2016. The two classrooms were chosen as they were of the same size, had the same number of desks (25) and were located near each other on the same floor. Students under 18 years of age were excluded. A total 304 students were enrolled in the 14 classes and eligible to participate in the study. Students were recruited for participation and explained the study during a presentation on the first day of class. During the presentation, students were provided a letter and verbal description of the study. Students were informed that the purpose of the study was to explore the influence of classroom designs on student behaviors and that the classrooms would be observed via video camera surveillance on two separate occasions. Students were asked to provide an email address if they wanted to participate in the study. A total of 257 students (84.5% recruitment rate) chose to enroll in the study. Students were given the option to opt out of the study (i.e., sit in section of class not captured by video and not complete surveys) if they objected to being observed with video cameras and were given a full week to consider their participation. No students enrolled in any of the classes chose to opt out. Thus all students who attended class on the video observation days were included in the final video analysis. Students who completed the study in full were entered into a lottery for a chance to win one of ten $50 gift cards. Free and informed consent of participants was obtained and the Institutional Review Board approved the study.

Fig. 1. Image of sit-stand desk and stool provided to students.

2.2. Study design

The study utilized a crossover design to test the question of whether students stood more and/or took more standing breaks when provided access to sit-stand desks compared to seated desks. The intervention consisted of replacing 25 traditional seated desks with armrests with 25 height adjustable sit-stand desks (BALT Up-Rite Student Table, MooreCo Inc.) that were accompanied by stools (see Fig. 1). The Up-Right desks were chosen because they were height adjustable (26–43 in.), included a foot rest, were mobile on two casters, and were priced comparably to seated desks ($240 each). The stools were provided to ensure students had the opportunity to either stand or sit during class. Participants were not provided specific goals related to sitting or standing in class but a point-of-decision prompt was placed on top of each sit-stand desk that included language designed to encourage more standing (i.e. "Did you know that standing burns up to 50 more calories/hour than sitting?"). The rationale for including the point-of-decision prompt was based on previous research which has found decisional prompts to be effective for promoting behavior change and research suggesting college student's motivation to be active tends is often related to weight loss/maintenance (Kilpatrick et al., 2005; Soler et al., 2010). Class instructors did not play a role in the study and thus did not offer participants any additional encouragement or incentive to stand during class.

The study was conducted over 12 weeks and included two evaluation time points for each participant. At the beginning of the study, classroom A was retrofitted with 25 sit-stand desks and stools while classroom B began the study with 25 traditional seated desks. The desks then remained in the respective classrooms for six weeks. The first observation of sitting and standing behavior was conducted during week six of the study. Immediately following the first observation, the sit-stand desks were moved to classroom B and the seated desks were moved to classroom A. Six weeks later, the second observation of sitting and standing behavior was conducted in both classrooms. Immediately following completion of the 12 week intervention, participants were emailed an online post-intervention survey (Qualtrics, Provo, UT) that asked questions about: 1) participant characteristics; 2) participant's