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Short Communication

Stand-capable desk use in a call center: a six-month follow-up pilot study

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Introduction

Americans are spending more time seated at their jobs than ever before. It is estimated that adults spend over half of their time at work in the seated position, and this estimate may be closer to 90% for those who work in certain settings such as call centres.[1] Recent studies have shown that workplace sitting has a direct impact on overall daily sedentary time, defined as energy expenditure less than 1.5 METs (Metabolic Equivalents).[2] High daily durations of sitting or sedentary time are associated with morbidity, cardiovascular disease, and diabetes.[3] Research in the emerging field of inactivity physiology has further highlighted the metabolic consequences of uninterrupted sitting, and that these negative effects can be attenuated through short bouts of walking.[4]

Stand-capable workstations that allow computer workstation users to work in either a seated or standing position offer a potential solution to the problem of prolonged sitting. Several intervention studies assessing usage one to three months after sit-stand workstation implementation have found reductions in daily-seated time of approximately one to two h.[5,6] However, cross-sectional studies of work settings where sit-stand desks have been present for six months up to many years reveal much smaller impacts to seated time and lower daily usage of the stand function indicating that usage may decline after novelty of the desk wears off.[1] One potential way to encourage continued use of stand-capable workstations is to design them to bias the user towards standing. Stand-biased workstations are adjusted to individual worker height (96 cm+) rather than a permanent factory setting of 76 cm for a traditional seated workstation. In comparison to a sit-to-stand workstation that can be adjusted by the user to any posture between seated and standing during the day, the stand-biased workstation is adjusted to a range of standing heights.

The aims of the current study were to assess the physical activity levels, seated time, workstation usage, and overall perceptions of sit-to-stand and stand-biased workstations in a call centre. The research team recruited subjects from a call centre company in the Eastern United States. In total, 91 subjects were recruited for the stand-capable workstations. Forty-five (45) were assigned to the sit-to-stand workstation, and forty-six (46) were assigned to the stand-biased workstation. The control group consisted of call centre employees with the same mix of occupational classifications as the intervention groups. In total, forty-seven (47) subjects were recruited for the seated control group. The company's

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Human Resources Department emailed a copy of the study recruitment materials and a consent form for review to all eligible employees. Company managers also discussed the study during team meetings. The intervention groups both experienced about a 30% loss of initially enrolled subjects by the three-month follow-up and about a 45% loss of the initial enrollment by the six-month follow-up. This was not unexpected, due to the nature of the jobs. Team members routinely rotated in and out due to company needs and employee turnover, which is outside the control of the research team. All workers were traditional shifts and not multiple late night/overnight shifts. The company did stagger start times (three to four h each morning) to be able to cover the traditional eight to five workday across all US time zones. They referred to this as a 'staggered first shift'.

Workstation assignment was dependent upon company needs. While not completely random, management did their best to randomize employees between the workstation conditions. The call centre layout and team makeups consisted of groups of four to eight workstations. Because of this, and the arrangement within the facility, management kept the type of workstation within each group constant.

The workstations used for this intervention were the SteelCase™ (Grand Rapids, MI) Series 5 Desk (sit-to-stand) which were adjustable with an electronic motor from 65 cm to 130 cm, allowing the user to adjust the desk surface height for both sitting and standing; the stand-biased group used the same workstations, but were used only in individually set height ranges relative to the floor. The sit-to-stand group used a SteelCase™ Think Chair Model 6205 that had an adjustable seat height ranging from 40.5 cm to 53 cm and most were paired with anti-fatigue mats from Uline® (model H-2011). Stand-biased subjects used the Neutral Posture Inc. mesh back stool (seat height: 64.5 cm and 91.5 cm) with an attached footrest platform. Most stand-biased workstations (83%) were also equipped with an additional Wall-Saver footrest from Neutral Posture Inc. for under the desk. Monitor arms from Neutral Posture Inc. were purchased and installed for both types of stand-capable workstations for a dual monitor setup. All workstation equipment was purchased by the company after consultation with the research team. Employees received a brief training on their new workstations prior to moving into the area equipped with the stand-capable workstations. The seated control group kept the standard seated workstations and chairs they had previously been assigned.

The research team also used Sensewear® Pro model MF-SW by Body Media, (Pittsburgh, PA) accelerometer armbands for each subject to collect movement and caloric expenditure data. Numerous studies have validated the measurement in free-living conditions.[7] The Sensewear® armbands were calibrated to each individual using each participant's personal data. Prior to initial use, armbands were worn during a resting adjustment period, acclimatising to the environment and subject to calculate each subject's resting metabolic rate as per manufacturer instructions. Subjects wore the armband for a two-day collection period that was repeated at three and six-month follow-ups post baseline. Control group data were only collected at baseline since it was assumed there would be limited variability in the control group activity/discomfort etc., during the full-term of the study intervention.

Upon initiation of the study protocol, subjects were asked to complete a brief online survey regarding demographics seated and standing habits, perceptions of stand-capable workstations, musculoskeletal symptoms, and physical activity. The survey was developed based on the Nordic Musculoskeletal Questionnaire (NMQ), the International Physical Activity Questionnaire (IPAQ), and the Modified Occupational Sitting and Physical Activity Questionnaire (OSPAQ), all of which have repeatedly been shown to produce repeatable, reliable, and sensitive questionnaire results.[8,9] This was repeated for each subject at three and six months post baseline for subjects using stand-capable workstations.

All data were analyzed using STAT/IC version 13 (STATA Software, version 13.0, StataCorp LP, College Station, TX). Baseline descriptive statistics for each variable were calculated, stratified by workstation type. Distributions of variables were examined graphically with boxplots and histograms. The treatment groups were compared using one-way Analysis of Variance (ANOVA). Pearson's Chi-squared test was used to test for equality of categorical variables. A linear mixed effect model was fitted to the data overall the three time points, in order to assess the effect of desk types on the proportion of time sedentary, controlling for sex, age, race, and body mass index (BMI). Subject was used as a random effect. A similar model was built for the self-reported proportion of time spent seated.

Results indicated that at baseline the groups were only different by one measure, age. Stand-biased subjects (28.9 years) were slightly younger than the sit-to-stand (34.8 years) and the control (35 years). Full population characteristics can be seen in Table 1. All other measures such as gender, smoking status, BMI, physical activity levels, and race were not significantly different across groups.

A simple analysis of baseline data using one-way ANOVA revealed significant differences in self-reported seated time (75%, 65%, 91% for sit-to-stand, stand-biased, and control group respectively), percent time in METS-derived Moderate activity, and a higher number of steps for both stand-capable groups compared to the control (Table 2). This was to be expected, as numerous studies have indicated such data patterns. Control group data were only collected at baseline since it was assumed that there would be limited variability in the control group inactivity/calorie expenditure and discomfort/pain. This is due to the fact that it was their standard workstation prior to and during the full-term of the study intervention. Control group data were collected at baseline in order to evaluate the current study design against data patterns in previously published work. When compared to previously published works, the control group showed similar activity and discomfort patterns. However, unique to this study, results at the three and six-month follow-ups indicated no significant drop-off in measured activity levels or self-reported seated/standing habits in either stand-capable workstation (Table 2).

At three-month follow-ups, both stand-capable groups indicated similar self-reported seated time as compared to baseline (75% sit-to-stand; 69% stand-biased). By the six-month follow-up, a similar trend was revealed (78% sit-to-stand; 67% stand-biased). Results of the linear mixed effect model revealed no significant effect of workstation type on monitored sedentary behavior when controlling for demographics. However, results indicated a significant

Table 1 – Population demographic information.

	Sit-to-stand group (n = 45)	Stand-biased group (n = 46)	Seated control group (n = 47)	P-value
Mean (SD) age (years)	34.8 (11.5)	28.9 (6.8)	35.0 (13.2)	0.0106
% Female	71.1	58.7	70.2	0.371
% Smokers	2.2	6.5	4.3	0.783[a]
Handedness				
% Right	84.4	78.3	83.0	0.584[a]
% Left	15.6	15.2	12.8	
% Ambidextrous	0	6.5	4.3	
Mean (SD) Weight (kg)	81.2 (25.9)	77.3 (17.9)	80.8 (19.6)	0.3297
Mean (SD) Height (cm)	167.4 (10.4)	169.4 (8.6)	170.2 (9.1)	0.3953
Mean (SD) BMI (kg/m2)	29.0 (9.13)	26.8 (5.5)	27.8 (5.7)	0.6263
BMI categories				
% Normal weight/under weight	46.7	43.48	40.4	0.946
% Overweight	20.0	26.1	25.5	
% Obese	33.3	30.4	34.0	
Physical activity levels				
% Low	43.9	40.0	39.5	0.891
% Moderate	29.3	27.5	23.3	
% High	26.8	23.3	37.2	
Job types				
% Health coach	41.5	57.5	60.5	0.000[a]
% Customer service	31.7	22.5	0	
% Clinician	17.1	10.0	34.9	
% Other	9.8	10.0	4.6	
Race				
% African American	24.4	25.0	16.3	0.872[a]
% Non-Hispanic white	68.3	67.5	74.4	
% Other	7.3	7.5	9.3	

P-value is from t-test for means and Pearson chi-squared for percentages reported, or Fisher's exact test.
[a] If distributions had cell counts of 5 or less.

reduction in self-reported seated time for stand-biased workstations when controlling for sex, age, race, BMI, and time. The only statistically significant differences found in prevalence of pain reported between the two stand capable workstations was at six months with those in stand-biased workstations showing more people reporting neck pain.

Our results are similar to previous studies on energy expenditure and physical activity. As mentioned previously, several studies have noted that as the novelty of a stand-capable workstation wears off, the usage declines. Because participants were followed for six months, it was likely a long enough time with the stand-capable workstations for the novelty to wear off, and that habits and usage determined in this study were believed to be at steady state.

One of the major benefits of stand-capable workstations confirmed in this study is the impact on comfort. At baseline, nearly 75% of stand-capable desk users reported increased body comfort as a factor influencing them to stand. The findings of self-reported seated time are similar to previous study results.[5,6] Summarily, many of the prior studies documented self-reported seated time increasing back to near pre-intervention levels. This current study, while pilot in nature, is

Table 2 – Activity habits 3 and 6-month follow-up.

	Three-month follow-up			Six-month follow-up		
	Sit-to-stand group (n = 32)	Stand-biased group (n = 33)	P-value	Sit-to-stand group (n = 29)	Stand-biased group (n = 23)	P-value
Hours of armband use	16.0 (2.9)	15.6 (4.4)	0.6301	16.4 (4.42)	14.2 (4.88)	0.0932
Proportion of monitored time in each activity level						
Sedentary	0.75	0.76	0.8313	0.76	0.75	0.7618
Light	0.16	0.16	0.8583	0.16	0.16	0.9876
Moderate	0.09	0.08	0.7164	0.08	0.09	0.5968
Vigorous	0	0	0.8785	0	0	0.1949
Steps per minute	4.9 (2.6)	5.2 (3.0)	0.6202	4.2 (1.9)	5.2 (2.8)	0.1683
Calories per minute	1.8 (0.50)	1.9 (0.45)	0.7889	1.47 (0.47)	1.52 (0.40)	0.6708
METs per minute	1.5 (0.51)	1.5 (0.37)	0.8693	1.80 (0.46)	1.94 (0.49)	0.5594
Reported time at workstation on a typical day (hours)	7.3 (1.5)	6.3 (2.1)	0.0074*	7.33 (0.88)	6.8 (1.4)	0.8664
Proportion of time reported sitting	0.75	0.69	0.2857	0.78	0.67	0.1401

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unique with respect to prior studies in that we did not see similar drop-offs over time. Both follow-up periods held similar trend patterns for self-reported seated time for stand-capable workstations.

While analysis did not reveal strong indicators for this, there are several potential factors. The study group was a health-conscious workforce, due to their line of employment. This could potentially be aided by the fact that subjects had pre-existing knowledge about the potential effects of reducing sedentary time. Additionally, the use of footrests and anti-fatigue mats could have increased overall comfort while standing, thus potentially increasing the likelihood of standing over the follow-up periods.

One limitation of the current study is the high dropout rate at three months (30%) and six months (45%) follow-up times. While there is a potential for bias if the subjects who removed themselves from the study were mainly due to discomfort, or being unsatisfied with the study, in reality, the loss of subjects were primarily due to job reassignment/rotation initiated by the company, according to our investigation. The issue of high dropout rates, however, is important and needs to be taken into consideration when designing much larger cohort studies in the future.

Author statements

Ethical approval

TAMU-IRB for the Protection of Human Subjects approved all data collection and analysis procedures.

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Competing interests

None declared.

REFERENCES

1. Straker L, Abbott RA, Heiden M, Mathiassen SE, Toomingas A. Sit-stand desks in call centres: associations of use and ergonomics awareness with sedentary behavior. *Appl Ergon* 2013 July;**44**(4):517–22.
2. Parry S, Straker L. The contribution of office work to sedentary behaviour associated risk. *BMC Public Health* 2013;**13**:296.
3. Wilmot EG, Edwardson CL, Achana FA, Davies MJ, Corely T, Gray LJ, et al. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: a systematic review and meta-analysis. *Diebetologia* 2012;**55**:2895–905.
4. Dunstan DW, Kingwell BA, Larsen R, Healy GN, Cerin E, Hamilton MT, et al. Breaking up prolonged sitting reduces postprandial glucose and insulin responses. *Diabetes Care* 2012;**35**:976–83.
5. Pronk NP, Katz AS, Lowry M, Payfer JR. Reducing occupational sitting time and improving worker health: the Take-a-Stand project. *Prev Chronic Dis* 2011;**9**:E154.
6. Grunseit AC, Chau JY, van der Ploeg HP, Bauman A. Thinking on your feet: a qualitative evaluation of sit-stand desks in an australian workplace. *BMC Public Health* 2013;**13**:365.
7. Welk GJ, McClain JJ, Eisenmann JC, Wickel EE. Field validation of the MTI Actigraph and Bodymedia armband monitoring using the IDEEA monitor. *Obesity* 2007;**15**:918–28.
8. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country relibility and validity. *Med Sci Sports Exerc* 2003;**35**:1381–95.
9. Chau JY, van der Ploeg HP, Dunn S, Kurko J, Bauman AE. Validity of the occupational sitting and physical activity questionnaire. *Med Sci Sports Exerc* 2012;**44**:118–25.