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Call Center Productivity Over 6 Months Following a Standing Desk Intervention

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Abstract: Stand-capable desks have been shown to successfully reduce sedentary behavior in the modern office, but whether their utilization improves cognitive productivity is not known. We compared productivity between stand-capable desk users and traditional seated desk users in a call center environment. Data were collected daily over a continuous six-month period. We found that increased stand-capable desk use is a likely contributor to increased productivity over traditional seated desk use. These findings indicate that use of stand-capable desks as ergonomic interventions to improve physical health among employees may also positively impact their work productivity.

Keywords: call center, productivity, sit-stand

1. Introduction

It is estimated that most American adults spend 8–9 hours of their daily waking time sedentary, with most of this sedentary time due primarily from their office environment (Straker et al., 2013). Sedentary behavior has been linked to mortality and several negative health outcomes including obesity, cardiovascular disease, and cancer (Katmarzyk, et al., 2009; Tremblay et al., 2010). Research has indicated that this may be true even for those who are meeting recommended physical activity guidelines (Hamilton et al., 2008; Katmarzyk et al., 2009). In particular, call center operators have been observed spending ~ 90-95% of their work shift in their seats and work long hours without breaks (Rocha, et al., 2005; Pickens, 2016). Working adults in call centers spend nearly 90% of their work time sedentary as opposed to one-third or one-half for other office employees (Straker et al., 2013). Consequences of prolonged sitting include lower back pain and body discomfort (Rocha, et al., 2005; Marshall, et al., 2010). These outcomes can impact productivity; increased discomfort at daily work tasks has shown to result in perceived productivity losses of 10% to 20% (Hagberg, et al., 2002; Wahlström, et al., 2004).

Excess sedentary time has been linked to obesity, which in turn has been implicated in higher risks for cardiovascular disease, diabetes, and cancer (Katzmarzyk et al., 2009, Tremblay et al., 2010, Dunstan et al., 2012). Sit-to-stand desks, as an office ergonomics solution to this problem, have the potential to improve caloric expenditure and reduce sedentariness in the workplace (Alkhajah et al., 2012, Pronk et al., 2012, Grunseit et al., 2013; Commissaris et al., 2015). However, the sustainability of sit-to-stand desk usage in maintaining physical activity and reduction in sedentary time within occupational settings has been a challenge (Wilks et al., 2006; Toomingas et al., 2012; Straker et al., 2013). Nonetheless, the perceived benefits of stand-capable office environments, which include declines in musculoskeletal complaints, augment the health benefits reported in previous studies (Alkhajah et al., 2012, Pronk et al., 2012, Grunseit et al., 2013).

Among adults, the use of standing desks on modern office tasks in an experimental study has been shown to reduce discomfort over time (~15 weeks), which has been argued to positively affect task performance (Robertson et al., 2013). Thus, it is likely that stand-capable office environments facilitate work efficiency and productivity in adults, similar to that observed in adolescents. However, in a simulated office environment/work study, Husemann et al. (2009) reported that stand-capable offices do not significantly impact productivity. Because that study examined the impact of acute standing (~1 week) on efficiency of simulated work, it remains unknown whether continued exposure to standing affects work productivity in-situ occupational environments. It is important to examine this relationship in a naturalistic work environment, however, as the sustainability of office ergonomics solutions relies on whether these interventions present productivity and task interruption challenges.

The present study investigated the impact of stand-capable workstations (sit-to-stand and stand-biased) in a call-center on employee productivity over a six-month period. Productivity data, based on the number of successful encounters per hour, was collected by the company's proprietary software. It was hypothesized that employees assigned to stand-capable desks would demonstrate higher productivity than those in the traditional seated desks, and that these differences will be sustained over the six-month period.

2. Methods

2.1 Subjects

As part of normal business operations, data on employee's performance were collected daily and as a condition of employment, the company reserves the right to use that information for research purposes. Therefore, de-identified secondary data were provided to Texas A&M researchers for analysis without the need of informed consent from the employees. Study participants included 167 employees in a call center (118 females and 49 males) who provided telephonic health and clinical advising. The study participants' workstations consisted of traditional seated workstations, sit-to-stand workstations, and stand-biased workstations. A prior study on this population indicated small differences in standing behavior between participants using stand-biased and sit-to-stand workstations (Pickens, 2016). Therefore, for the purposes of this study, the stand-biased and sit-to-stand workstations were combined into one category and are referred to as stand-capable workstations going forward. In addition, the prior study (Pickens, 2016) administered online surveys that collected information as self-reported seated time, biometrics, body discomfort, and musculoskeletal symptoms (Pickens, 2016).

The intervention group consisted of 44 health advisors (Stand-HA: 23 females, 21 males) and 30 clinical advisors (Stand-CA: 28 females, 2 males), all of whom had stand-capable desks. The control group consisted of 58 health advisors (Sit-HA: 33 females, 25 males) and 35 clinical advisors (Sit-CA: 34 females, 1 male), all of whom had traditional seated desks. Because the call-center installed new desks for a new employee cohort, the Stand-CA and Stand-HA groups were new employees, having been with the company for 3 months or less, whereas the Sit-CA and Sit-HA employees had been employed for one year or more. To minimize confounds of employee experience, only those employees who had been employed for a minimum of 30 days and were working at the stand-capable or traditional seated workstations, were included in the study. Since this study occurred in an in-situ occupational environment, rather than in a controlled laboratory environment, attrition did occur. The retention rates were as follows: Stand-HA 93%, Sit-HA 93%, Stand-CA 83%, and Sit-CA 89%. In all attrition cases, employees left the company or transitioned to a different job within the 6-month period and thus had to be excluded from the study.

2.2 Equipment

Both the sit-to-stand and stand-biased workstations used a SteelCase™ (Grand Rapids, Michigan) Series 5 Desk that had an electric motor allowing it to adjust from 64.77cm to 129.54cm tall. This allowed the user to press an up or down button to adjust the desk surface to proper height for sitting (68.58-78.74 centimeters) and proper height for standing (93.95-116.84 centimeters) (ANSI/HFES 100, 2012). The sit-to-stand workstations had a standard height task chair, The SteelCase™ Think Chair Model 6205, which has a seat height that can be adjusted between 40.64 centimeters and 53.34 centimeters. The stand-biased workstations had a raised height or bar height task chair. The Neutral Posture Inc. (Bryan, Texas) U4IA4692 Mesh Back Stool was used, with attached foot platform at 15.24 and 25.4 centimeters and a seat height that can be adjusted between 64.77 and 91.44 centimeters.

Footrests that allow a user to prop one foot up at 20.32 or 30.48 centimeters were purchased for stand-biased desk users. Anti-fatigue mats were purchased for sit-to-stand users. Monitor arms for a dual monitor set-up were purchased and installed at each workstation. The seated comparison group was seated in groups of six at a traditional desk with monitor arms for a dual monitor set-up.

2.3. Data Collection and Analysis

The stand-capable desks were installed in the call center late January 2013 as part of a major addition of newly hired health and clinical advisors, and the new employees were relocated to the new facility the beginning of February 2013. Since the new employees were assigned to the stand-capable workstations by the company, the sample is one of convenience rather than random assignment. Following approval by the Texas A&M Institutional Review Board, data collected by the host company's proprietary software was de-identified and provided for analysis. Quantitative productivity data was collected daily over a continuous six-month period (March 2013 through August 2013). Productivity data, based on the number of successful encounters per hour by advisor, were collected by the company's proprietary software. As defined by the company, successful encounters were considered to be the completion of a call with a member in which the advisor reviews previous goals and sets a new goal. During a call, the advisor speaks with the member, takes notes, asks questions, and performs tasks within the computer system which includes updating the member's profile and goals. Specifically for health advisors, the company generates revenue on the number of reported successful calls. The company links calls and outcomes to the calls digitally and records related parameters such as time on the call. Revenue for the company is directly tied to successful calls and those calls average a value of $100 each which is comparable to national trends. A successful encounter per hour rate was calculated for each participant and means were obtained across each month for the six-month period.

Since the control groups had been employed with the company longer than the comparison groups and had the potential for higher accrued time off (vacation/sick leave) total time on dialer (TOD), which is a measure of an advisors availability to make or take calls, was calculated over the 6-month period and analyzed for group and job type differences.

The dependent variable, mean successful encounters per hour, was visibly checked for parametric assumptions and a follow up Shapiro-Wilk test determined that the data were normally distributed. Two clinical advisors (one each from Sit and Stand groups) were excluded from the study because their productivity data for four months were not available. A three-way mixed-factor analysis of variance (ANOVA) was performed to examine the effects of intervention group (control vs. stand-capable desks), job category (health vs. clinical advisor), and time period (6 months) on mean successful encounters per hour. An independent t-test was conducted to determine group and job type differences for TOD. Statistical significance was determined when $p < 0.05$. Significant interaction effects were examined using pairwise comparisons with Bonferroni corrections as required. All statistical analyses were conducted using SPSS 22 (IBM SPSS Statistics). Summary data are presented as means (SD).

3. Results

Based on the online survey data collected in the prior study (Pickens, 2016), self-reported seated time showed that those on the stand-capable side of the call center were seated for an average of 72-73% of their day compared to those on the seated control side that spent 91% of their day seated (Pickens, 2016). Additionally, at 6 months, nearly 75% of those with stand-capable workstations self-reported decreased body discomfort as a factor for continued stand-capable desk use (Pickens, 2016). Moreover, there was not a statistical significant difference in TOD between stand-capable and seated groups, with stand-capable groups having a higher TOD than seated groups, 6.93 ± 25.56, $t(101.18) = .271$, $p = .787$. A significant group x time interaction ($F_{(5, 111)} = 5.97$, $p < 0.0001$, partial $\eta^2 = 0.051$; Fig. 4) was found.

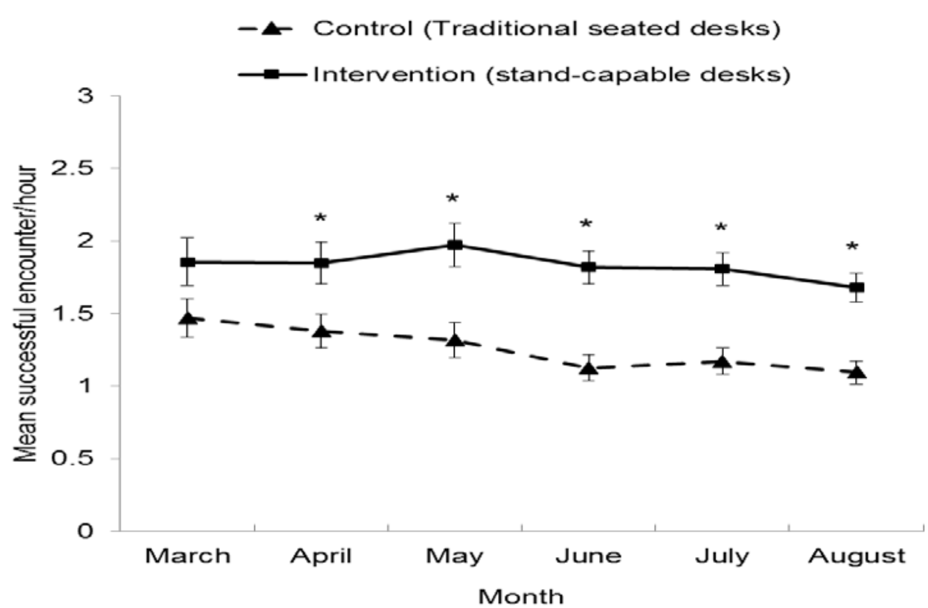

Figure 4: Effects of intervention group and time period on mean successful encounters/hour. * Represents significant differences between groups at each time period. Error bars represent 95% confidence intervals.

Pairwise comparisons between groups for each month revealed that the effect of the intervention was significant from the 2nd to the 6th time period (all $p < 0.005$). Main effects of group ($F_{(1, 111)} = 60.13$, $p < 0.0001$, partial $\eta^2 = 0.351$), job category ($F_{(1, 111)} = 65.52$, $p < 0.0001$, partial $\eta^2 = 0.375$), and time ($F_{(5, 555)} = 21.1$, $p < 0.0001$, partial $\eta^2 = 0.16$) were found on successful encounters. Productivity among employees with stand-capable desks was ~46% higher than that among those with traditional seated desks (1.26 (0.57) successful encounters/hr). Additionally, health advisors demonstrated ~49% increase in successful

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encounters/hour when compared to clinical advisors (1.24 (0.61) successful encounters/hr; Fig. 5). In general, productivity during the first three months was greater than during the last three months of the six-month period.

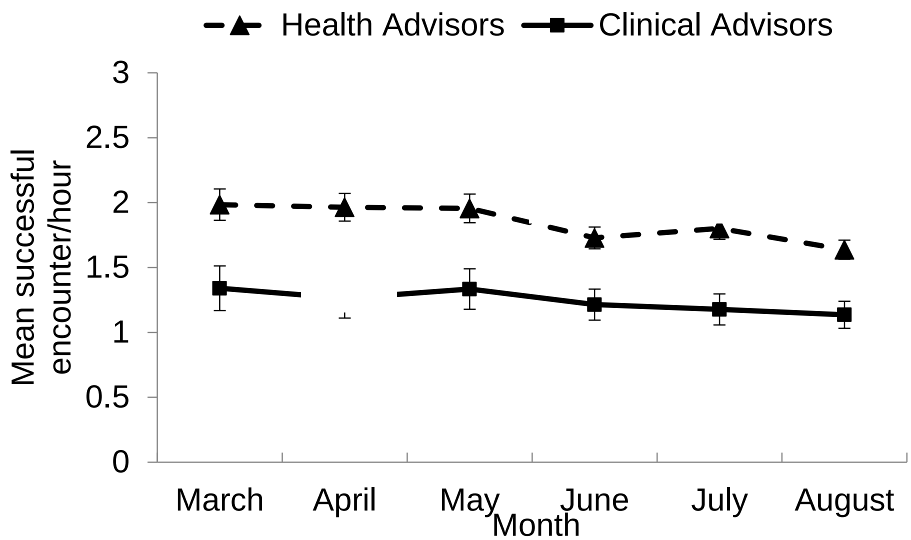

Figure 5: Main effects of job category and time period on mean successful encounters/hour. Error bars represent 95% confidence intervals.

4. Discussion

We compared the effects of stand-capable offices (sit-to-stand and stand-biased workstations) in a call-center on employee productivity over a six-month period. Productivity across two job categories, health advisors and clinical advisors, were obtained using the company's performance metric software. The main findings were that employees assigned to the stand-capable desks demonstrated higher productivity than those in the traditional seated desks, particularly from the 2nd to the 6th month, and that this trend was consistent across both the health and clinical advisors.

On average, stand-capable health advisors had 0.5 more successful calls per hour during the 6-month period than their seated counterparts. As the company generated revenue based on the completion of successful calls, significant additional revenue was realized. Similarly, stand-capable clinical advisors had 0.4 more successful calls per hour per clinical advisor during the 6-month period, compared to the traditional seated clinical advisors group. Clinical advisors do not generate revenue on a fee per successful call rate as health advisors; rather the reduction in health care utilization over the year determines the amount of fees paid to the company. As the stand-capable clinical advisors had a higher successful daily call rate than the traditional seated clinical advisors, the opportunity exists to decrease health care utilization costs at a significantly higher rate. While health advisors had significantly higher successful calls per hour than the clinical advisors (owing to the nature of their job), the positive impact of the intervention was similar across both job categories.

There are several studies that suggest an inverse relationship between productivity and body discomfort (Davis & Kotowski, 2014; Robertson, et al., 2013; Karakolis & Callaghan, 2014). Aligned with findings from these studies, Pickens et al. (2016), who collected data in tandem on the same study participant pool and followed the study design as the current study, found that employees assigned to the stand-capable workstations reported significantly lower body discomfort compared to the seated controls over the six-month period. Previous research on standing desks utilization and associated comfort requires a habituation period of few weeks (Pickens et al. 2016). It is likely that this habituation was associated with similar productivity levels between the two groups in the first month, with benefits beginning to show from the second month onwards. However, it can be counter argued that decreased body discomfort alone may not be indicative of increased productivity observed in this study. It is possible that the same productivity could have been achieved if body discomfort had been reduced even for those in the seated workstations through effective ergonomic improvements in the seated workstations. Moreover, it is possible that the change in discomfort observed in Pickens et al. (2016) may be attributed to time on job, or other factors that are related to the duration of employment, rather than the experience with the stand-biased workstations. The authors believe that the 90 days of pre baseline for the newer workers in the treatment group (60 days of training and 30 days of break-in doing their new jobs in the stand capable workstations) was more than adequate to minimize experience variation between groups. The fact that at 9 months total or 6 months into the measurement period the newer workers were still having less discomfort and more productivity points to the value of the workstation differences in the measured outcomes. As with any field research, more work is warranted to determine the relationship between discomfort and improved performance in real work scenarios with longer longitudinal investigations.

Previous studies have indicated that physical activity has substantial preventable and restorative properties for cognition and brain function (Kramer & Erickson, 2007). Specific to standing desk applications, cognitive benefits of standing desks have been previously established in school-based intervention studies. For example, reducing sedentariness in school children has been linked to improved student attention and focus (Koepp et al, 2012; Dornhecker et al., 2015), and a more recent study showed that it improves basic cognitive functioning via enhancements in the frontal regions of the brain (Mehta et al., 2015). While the current study focused on secondary data analyses on productivity outcomes, cognitive metrics to examine standing behavior benefits were not available. As such, future research should focus on obtaining potential cognitive effects of increased physical activity through the use of stand-capable workstations in both controlled laboratory and naturalistic field studies.

It is important to note both the strengths and limitations of this study. The study was conducted in a company whose business is in the health promotion domain; it is possible that the employees with stand-capable desks have a higher usage than other companies that are not focused on health (e.g., information technology). In addition, owing to constraints out of scope of the study, employees were not randomly assigned to the conditions and as such this may have introduced selection bias. However, because employees were assigned to their workstations, this is a strength of the study as it reduces or eliminates volunteerism bias therefore increasing the generalizability of the study results to other populations. One other limitation should be noted. Since the stand-capable advisors were dealing with new clients, it is possible that the client's population may have been highly motivated to engage with the advisors. It is possible that some of the variance between the stand-capable and traditional seated advisors could be attributed to differences in the populations they were attempting to engage. Moreover, employees assigned to the stand-capable desks had been with the company significantly less than the traditional seated advisors. However, to address this potential confound, study participation was limited to employees who had been working independently for a minimum of 30 days (following a 60 day training period) thus allowing new employees to habituate to sit-stand workstations as well as increase their familiarity with company procedures and work practices. To further address differences between groups, this study would have been strengthened considerably if pre-existing performance data on the control (seasoned coaches) were available. Having this information may have better addressed associated experience differences between the groups. Ongoing future studies that include prior performance data on the control groups will be able to address this particular limitation. Interestingly, even though advisors assigned to stand-capable desks had been with the company significantly less than the traditional seated advisors, they still were able to outperform the more experienced and seasoned advisors (who had been assigned to the seated desks).

Finally, productivity was measured using the company's proprietary software and thus productivity metric algorithms were not made available to the researchers. Even though the metric used to evaluate cognitive performance is specific to this company and potentially not generalizable to non-call center environments, previous studies have used task complexity and critical decision making as representations of cognitive demands and have reported increases in cognitive performance while using sit-stand desks (Robertson et al., 2013). A strength of this approach was that all the workers were monitored continuously and objectively thru digital software recording of the desired outcomes as opposed to more common subjective and sampling approaches used in other studies in this field. Our findings indicate that productivity improved with the stand-capable desks, and as such the company was provided with a very relevant, objective metric through which they can base strategic decisions on, whilst encouraging the physical health of their employees.

In summary, we found that individuals that have the opportunity to stand throughout the day can operate at higher productivity levels than those that do not have the capability to stand while working. Questions remain as to the underlying mechanism(s) that impacted the productivity results of these groups. It is possible that reduction in body discomfort, enhanced cognitive function due to physiological changes, or a combination of these factors played a role in the increased productivity for those in the stand-capable condition. Further work is warranted to examine the effects of stand-capable desks, preferably through randomized controlled trials, to establish their non-physical benefits, both at the basic (cognition) and at macro-organizational (productivity, employee morale, etc.) levels.

5. References

Alkhajah, T. A., Reeves, M. M., Eakin, E. G., Winkler, E. A., Owen, N., & Healy, G. N. (2012). Stand capable workstations: A pilot intervention to reduce office sitting time. *American Journal of Preventive Medicine, 43*(3), 298-303.

ANSI/HFES 100. 2012. *Human factors engineering of computer workstations (ANSI/HFES 100–2012)*, Santa Monica, CA: Human Factors and Ergonomics Society

Commissaris, D. A., Huysmans, M. A., Mathiassen, S. E., Srinivasan, D., Koppes, L. L., & Hendriksen, I. J. (2015). Interventions to reduce sedentary behavior and increase physical activity during productive work: a systematic review. *Scandinavian journal of work, environment & health*.

Davis, K. G., & Kotowski, S. E. (2014). Postural Variability: An Effective Way to Reduce Musculoskeletal Discomfort in Office Work. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 0018720814528003.

Dornhecker, M.; Blake, J.J.; Benden, M.; Zhao, H.; Wendel, M. The effect of stand-biased desks on academic engagement: An exploratory study. *International Journal of health Promotion and Education* **2015**, 1-10.

Dunstan, D.W., Kingwell, B.A., Larsen, R., Healy, G.N., Cerin, E., Hamilton, M.T., Shaw, J.E., Bertovic, D.A., Zimmet, P.Z., Salmon, J., Owen, N., 2012b. Breaking up prolonged sitting reduces postprandial glucose and insulin responses. Diabetes Care 35, 976-983.

Grunseit, A.C., Chau, J.Y., van der Ploeg, H.P., Bauman, A., 2013. "Thinking on your feet": A qualitative evaluation of stand capablestand-capable desks in an Australian workplace. BMC Public health 13, 365.

Hagberg, M., Tornqvist, E. W., & Toomingas, A. (2002). Self-reported reduced productivity due to musculoskeletal symptoms: associations with workplace and individual factors among white-collar computer users. *Journal of occupational rehabilitation*, *12*(3), 151-162.

Hamilton, M. T., Healy, G. N., Dunstan, D. W., Zderic, T. W., & Owen, N. (2008). Too little exercise and too much sitting: Inactivity physiology and the need for new recommendations on sedentary behavior. *Current Cardiovascular Risk Reports*, *2*(4), 292-298.

Husemann, B., Von Mach, C. Y., Borsotto, D., Zepf, K. I., & Scharnbacher, J. (2009). Comparisons of musculoskeletal complaints and data entry between a sitting and a stand capablestand-capable workstation paradigm. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *51*(3), 310-320.

Karakolis, T., & Callaghan, J. P. (2014). The impact of sit–stand office workstations on worker discomfort and productivity: a review. *Applied ergonomics*, *45*(3), 799-806.

Katzmarzyk, P. T., Church, T. S., Craig, C. L., & Bouchard, C. (2009). Sitting time and mortality from all causes, cardiovascular disease, and cancer. *Medicine and Science in Sports and Exercise*, *41*(5), 998-1005.

Koepp, G.A.; Snedden, B.J.; Flynn, L.; Puccinelli, D.; Huntsman, B.; Levine, J.A. Feasibility analysis of standing desks for sixth graders. *ICAN: Infant, Child, & Adolescent Nutrition* **2012**, *4*, 89-92.

Kramer, A. F., & Erickson, K. I. (2007). Capitalizing on cortical plasticity: influence of physical activity on cognition and brain function. *Trends in cognitive sciences*, *11*(8), 342-348.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sorensen, F., Andersson, G., & Jorgensen, K. (1987). Standardised nordic questionnaires for the analysis of musculoskeletal symptoms.*Applied Ergonomics*, *18*(3), 233-237.

Marshall, S., & Gyi, D. (2010). Evidence of health risks from occupational sitting: Where do we stand? *American Journal of Preventive Medicine*, *39*(4), 389-391.

Mehta, R. K., Shortz, A. E., & Benden, M. E. (2015). Standing Up for Learning: A Pilot Investigation on the Neurocognitive Benefits of Stand-Biased School Desks. *International journal of environmental research and public health*, *13*(1), 59.

Pickens, A. W., Kress, M. M., Benden, M. E., Zhao, H., Wendel, M., & Congleton, J. J. (2016). Stand-capable desk use in a call center: a six-month follow-up pilot study. *Public health*, *135*, 131-134.

Pronk, N.P., Katz, A.S., Lowry, M., Payfer, J.R., 2012. Reducing occupational sitting time and improving worker health: the Take-a-Stand Project, 2011. Prev. Chronic Dis. 9, E154.

Robertson, M. M., Ciriello, V. M., & Garabet, A. M. (2013). Office ergonomics training and a sit-stand workstation: Effects on musculoskeletal and visual symptoms and performance of office workers. *Applied ergonomics*, *44*(1), 73-85.

Rocha, L. E., Glina, D. M. R., Marinho, M. D. F., & Nakasato, D. (2005). Risk factors for musculoskeletal symptoms among call center operators of a bank in Sao Paulo, Brazil. *Industrial health*, *43*(4), 637-646.

Straker, L., Abbott, R. A., Heiden, M., Mathiassen, S. E., & Toomingas, A. (2013). Sit–stand desks in call centres: Associations of use and ergonomics awareness with sedentary behavior. *Applied ergonomics*, *44*(4), 517-522.

Toomingas, A., Forsman, M., Mathiassen, S. E., Heiden, M., & Nilsson, T. (2012). Variation between seated and standing/walking postures among male and female call centre operators. *BMC public health*, *12*(1), 1.

Tremblay, M. S., Colley, R. C., Saunders, T. J., Healy, G. N., & Owen, N. (2010). Physiological and health implications of a sedentary lifestyle. *Applied Physiology, Nutrition, and Metabolism = Physiologie Appliquee, Nutrition Et Metabolisme*, *35*(6), 725-740.

Wahlström, J., Hagberg, M., Toomingas, A., & Tornqvist, E. W. (2004). Perceived muscular tension, job strain, physical exposure, and associations with neck pain among VDU users; a prospective cohort study. *Occupational and environmental medicine*, *61*(6), 523-528.

Wilks, S., Mortimer, M., Nylen, P., 2006. The introduction of stand capable worktables; aspects of attitudes, compliance and satisfaction. Appl. Ergon. 37, 359-365.