

TO SIT OR NOT TO SIT? – A RANDOMISED CONTROLLED TRIAL OF ADJUSTABLE HEIGHT DESKS IN THE OFFICE

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ABSTRACT

Evidence-based literature indicates that prolonged (excessive) sitting at work may be reduced by interruption of occupational sitting and minimising prolonged periods of sedentary behaviour - such as alternating sitting/standing, active sitting, walking, cycling. Interventions which target multiple aspects of an office work system are likely to be more effective than those targeting just a single aspect. In a New Zealand case study, the use of electronic adjustable height desks was significantly associated with increases in workplace activity for average and daily pedometer step counts ($p < 0.001$) and self-reported light intensity activity during work ($p < 0.001$). It was therefore concluded that the introduction of electronic adjustable height desks in offices could increase physical activity levels.

KEYWORDS

Sit, Stand, Sedentary, Physical activity, Desks, Computer, Workstations.

INTRODUCTION

'To sit or not to sit - that is the question. Whether 'tis nobler in the mind to stand or to suffer the slings and arrows of outrageous posture, or to arise and take arms against a sea of convention, and by opposing, end it?'

Our adaptation above of the opening lines of Hamlets' (Shakespeare, 1604: Hamlet, Act III Scene 1) famous speech captures the essence of the current debate about the relative health benefits of sitting, standing and physical activity – in short, the debate about 'sedentariness'.

In the original version, Hamlet's famous question: *'To be or not to be?'* is adapted by us to: *'To sit or not to sit?'* Our version addresses the future of musculoskeletal and metabolic morbidity rather than death (by suicide). Nevertheless it is a very relevant question for modern society, where sitting and sedentariness is highly prevalent and its consequences are being re-assessed.

This paper summarises current evidence-based international literature about sitting (sedentariness), standing and physical activity at work and describes a case study illustrating the effects of introducing electronic adjustable height desks (AHDs) for office workers in a medium-sized company in New Zealand in order to address the populist question: 'Are adjustable height desks in offices a fad or the future?'

SUMMARY OF EVIDENCE-BASED LITERATURE ON SITTING (SEDENTARINESS), STANDING AND PHYSICAL ACTIVITY AT WORK

With the advancement of mechanisation and expansion of computerisation, particularly with changes in information technology, more workers are engaged in desk-based occupations and are becoming increasingly sedentary (Ellegast et al. 2012). Prolonged static postures have been recognised as a contributor to musculoskeletal discomfort (MSD) since Ramazzini's observations in the 17th Century (Franco 1999). The human body requires movement both to nourish structures by increasing blood flow and to provide periodic rest for muscles to prevent fatigue. Thus standing, used alternatively as a rest from sitting, could form a basis for musculoskeletal injury prevention for desk-based workers. Since work time accounts for almost half of the daily total (Parry and Straker 2013) the workplace provides an opportunity for reducing overall sedentary time and for introducing physical activity.

The most recent evidence review of sedentary work (Straker et al 2016) identifies it as an emergent health and safety issue. It links sedentary behaviour with increased risk of premature mortality, chronic health disorders and detrimental work outcomes associated with rapid advances in technology and environmental change. Sedentariness is likely to increase but there is no clear definition of excessive occupational sitting exposure. Straker et al's (2016) report identifies multi-component interventions targeting multiple elements of work systems as most successful. There is evidence of the effectiveness of occupational exposure assessments and workplace interventions for office work but not yet for non-office settings. The report identifies ways to reduce sitting time and sedentary behaviour (Table 1). It shows potential substitution alternatives to sitting (standing, active sitting, walking, cycling), potential options to interrupt occupational sitting and minimise prolonged periods of sedentary behaviour and the effectiveness of interventions to reduce occupational sitting in office and non-office workplaces.

Table 1. Ways to reduce sitting time and sedentary behaviour (Straker et al 2016)

<p>Potential substitution alternatives to sitting</p> <ul style="list-style-type: none"> • Standing, walking and desk-based cycling • The long term feasibility and extent to which these alternatives can be used in 'white' and 'blue' collar workplaces is yet to be determined • Most 'active' sitting options probably provide little cardio-metabolic benefit, although they may provide some musculoskeletal benefit • Active commuting and being active during non-productive breaks at work • Substitution of work and non-work sitting tasks with standing and moving tasks throughout the day
<p>Potential options to interrupt occupational sitting and minimise prolonged periods of sedentary behaviour</p> <ul style="list-style-type: none"> • Keep sedentary task bouts to no longer than 20-30 minutes in order to obtain musculoskeletal and metabolic benefits • Use task variation to interrupt prolonged sitting by either the substitution of sitting with a productive or non-productive non-sedentary task, or by a brief non-sedentary activity. • Examples of substitution tasks to interrupt sedentary tasks include: switching to work on a computer at a standing or walking workstation, switching to stand to read a document, switching to a standing meeting, switching to a walk with friends at lunch time, switching to stand for some of the public transport work commute. • Examples of brief activities which can act as interruptions include: standing while talking on the phone, walking to deliver a message to a colleague rather than emailing, walking to get a drink or visit the bathroom. • Good job design can use substitution and interruption to minimise the harm from excessive occupational sitting

Effectiveness of interventions to reduce occupational sitting in office and non-office workplaces

- Most intervention trials have been conducted on office workers
- Interventions to reduce occupational sitting of office workers can be effective, and reduce exposure by over an hour each work day
- Interventions which target multiple aspects of the office work system are likely to be more effective than those targeting just a single aspect
- Qualitative studies suggest that concern about productivity is likely to be the most significant barrier to change
- Preliminary data suggests interventions can successfully reduce sitting exposure in highly sedentary non-office based occupations such as truck drivers
- Evidence on the implementation of changes to create sustainable work systems is limited
 - Substantial work system changes are more likely to be sustainable than increasing worker education and awareness
 - Participative approaches that engage workers and develop a sense of ownership and commitment to change by managers/supervisors and employees working as a team are important in developing, implementing and promoting effective sitting reduction interventions
 - Generating a social and physical environment that supports and facilitates employees to sit less, communicating the purpose and associated evidence for the intervention and, having champions to role model and support the intervention messages appear to be important

ARE ADJUSTABLE HEIGHT DESKS (AHD) IN OFFICES A FAD OR THE FUTURE? – A CASE STUDY

Adjustable height desks (AHD) have been promoted as an environmental intervention to reduce workplace sitting. The premise is that the use of an AHD will promote movement by allowing the worker to switch between sitting and standing whilst engaged in work (Buckley et al. 2015). There is a growing body of evidence to support the beneficial effects of the use of AHDs at work (Healy et al. 2013; Neuhaus et al. 2014). This case study was to determine if the allocation of AHDs in a real world office setting would influence activity during work hours by increasing light physical activity and reducing sitting.

Methods

The study was a randomised controlled field trial of the introduction and use of AHDs in a branch of a medium sized energy company in Hastings, New Zealand. The study was approved as a Low Risk Notification by Massey University Human Ethics Committee. Before the start of the study, all staff used fixed sitting height desks (FSHDs). Twenty four (12 female, 12 male) met the inclusion criteria (< 0.8 Full Time Equivalent and ambulatory with no history of significant illness or injury) and were selected to participate. None had previously used an AHD. All were either professional or administrative staff and most of their work was computer based.

The participants were randomly divided into two groups of twelve – an Intervention group (7 females, 5 males) who were allocated AHDs (Espace Blake electronically height adjustable workstation 2000x1200x700mm with left or right hand returns) and a Control group who retained their FSHDs. The Control group comprised 5 females and 6 males (one male withdrew due to a non-work-related injury).

Prior to the start of the trial all participants were allocated individual pedometers (Keep Walking-Stay Fit, made in China) and physical activity diaries (PADs) and briefed on how and when to use them. Pedometer and PADs data were collected on

one working day at fortnightly intervals over 16 weeks. Physical activity was assessed by step counts, self-reported activity on PADs and comparison between pre- and post-trial questionnaires. Total day step counts were self-recorded for the time they were at the workplace. Average step counts were calculated for each participant and daily averages for each group. The PAD data comprised the predominant activity for the preceding 15 minutes for: sitting; standing still; standing and moving <1.5m; standing and moving >1.5m. From the PADs, frequency count was obtained for each of the activity levels.

The impact of group (Intervention or Control), gender, activity type, pre/post-desk allocation and week were analysed using R3.1.2 (R Core Team, 2014). A generalised linear model with a log link function was used for all response variables that were counts. Statistical hypotheses were deemed significant if p was <0.05. Frequency counts of the four activities were analysed with the other variables of group (Intervention or Control), gender, week and individual using Fisher's Exact Test, because of the small sample size. Mean counts were examined and proportions were calculated for group (Intervention or Control) and gender for each week.

Results

The use of AHDs was significantly associated with increases in workplace activity for average and daily pedometer step counts ($p<0.001$) (Table 2), self-reported light intensity activity during work ($p<0.001$) (Table 3).

Table 2: Mean [SD] pedometer step counts for Intervention and Control Groups

Week	Intervention AHD ¹		Control FHSD ²	
1#	3553	[678]	3114	[553]
2#	2931	[357]	4857	[1392]
Average 1# and 2#	3242	[380]	3985	[754]
3	4053	[542]	3813	[963]
4	3841	[478]	3681	[778]
5	5140	[1079]	4655	[956]
6	5072	[716]	4578	[1053]
7	3997	[483]	3542	[699]
8	3620	[452]	3701	[701]
Average 3 - 8	4287	[270]	3988	[347]

¹ Adjustable height desks, ² Fixed height sitting desks, [#]Weeks 1 – 2: all participants used FHSD

Table 3: Proportion of work day in different activity levels for Intervention and Controls

Activity Level	Intervention Male	Intervention Female	Control Male	Control Female
Walk >1.5m				
Weeks 1-2#	26%	27%	15%	20%
Weeks 3-8	35%	28%	14%	19%
Walk <1.5m				
Weeks 1-2#	14%	5%	8%	6%
Weeks 3-8	15%	28%	6%	3%
Stand				
Weeks 1-2#	1%	1%	0	2%
Weeks 3-8	32%	14%	<1%	<1%
Sit				
Weeks 1-2#	59%	67%	77%	72%
Weeks 3-8	17%	30%	80%	77%

¹ Adjustable height desks, ² Fixed height sitting desks *due to rounding of numbers some totals exceed 100%;

[#]Weeks 1 – 2: all participants used FHSD

CONCLUSIONS

A recent evidence review report on sedentary work identified the main ways to reduce sitting time and sedentary behaviour as substitution alternatives to sitting (standing, active sitting, walking, cycling) and options to interrupt occupational sitting and minimise prolonged periods of sedentary behaviour. Whilst the effectiveness of interventions to reduce occupational sitting in office and non-office workplaces can be effective in reducing sitting time by over an hour for each work day, interventions which target multiple aspects of an office work system are likely to be more effective than those targeting just a single aspect.

A case study of introducing adjustable height desks as a specific intervention in a small business office environment in New Zealand was associated with increased physical activity and reduced sitting time. A more widespread knowledge and appreciation amongst companies and organisations, in New Zealand and internationally, of the outcomes of the present study and of the importance of decreasing sedentariness and its' associated cost-benefits, may strengthen their interest in increasing their use of AHD's in offices. It is concluded that the use of AHDs in office setting may have real benefits for physical activity and therefore should not be considered as merely a fad, but should be used more widely in the future.

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