Musculoskeletal Science and Practice 56 (2021) 102451

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.elsevier.com/locate/msksp

Original article

The effects of active break and postural shift interventions on recovery from and recurrence of neck and low back pain in office workers: A 3-arm cluster-randomized controlled trial

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ARTICLE INFO

Keywords:
Musculoskeletal disorder
Sedentary worker
Computer
Posture
Physical activity

ABSTRACT

Objectives: To investigate the efficacy of active break and postural shift interventions aimed to reduce sitting discomfort on recovery duration and recurrence of neck and low back pain among high-risk office workers.
Methods: A 3-arm cluster-randomized controlled trial with 12-month follow-up was conducted in 193 healthy but high-risk office workers. Participants in the intervention groups received custom-designed apparatus to facilitate either active breaks or postural shifts to reduce sitting discomfort at work. Participants in a control group received a placebo seat pad. Incidence of neck and low back pain with pain intensity and disability level was recorded monthly. Main outcome measures were recovery time and recurrent rate of neck and low back pain. Analyses were performed using log rank test and Cox proportional hazard models.
Results: Median time to recovery in those receiving active break and postural shift interventions (1 month) was significantly shorter than those in the control group (2 months). Neck and low back pain recurrent rates for the active break, postural shift, and control groups were 21%, 18%, and 44%, respectively. Hazard rate (HR) ratios after adjusting for biopsychosocial factors indicated a protective effect of active break and postural shift interventions for neck and low back pain recurrence (HR_{adj} 0.22, 95% CI 0.06–0.83 for active breaks and HR_{adj} 0.35, 95% CI 0.16–0.77 for postural shift).
Conclusion: Active break and postural shift interventions shortened recovery time and reduced recurrence of neck and low back pain among high-risk office workers.

1. Introduction

Musculoskeletal disorders pose a significant burden on society due to their high prevalence and substantial costs associated with lost work days and decreased work productivity. One-year prevalence rates for neck pain among office workers range between 42%-69% and 34%–49% of them develop new onset of neck pain every year (Janwantanakul et al., 2008; Cote et al., 2009; Korhonen et al., 2003). For low back pain, one-year prevalence rates range from 31% to 51%, while 14%–23% of office workers report new onset of low back pain annually (Juul-Kristensen et al., 2004; Janwantanakul et al., 2008; Sitthipornvorakul et al., 2015). Interventions are required to effectively guide the employment, healthcare, and vocational rehabilitation of these individuals (Lambeek et al., 2011).

Prognosis is fundamental to the management plan (Hansebout et al., 2009). The clinical course of non-specific neck and low back pain seems to be persistent or recurrent (i.e. with remission and exacerbations) over months and years (Côté et al., 2004; Henschke et al., 2008). Median time from treatment commencement to full recovery for neck and low back pain has been reported as 42–60 days (Henschke et al., 2008; Menezes et al., 2012). Only 52% of individuals with neck pain made full recovery during the 3-month follow-up (Leaver et al., 2013) and two-thirds of those with low back pain fully recovered within a year (Henschke et al., 2008). Neck and low back pain recurrence is well documented with estimates of the 1-year recurrent rate varying from 23% to 69% (Côté et al., 2004; da Silva et al., 2019). One previous study recorded median time to low back pain recurrence as 139 days (da Silva et al., 2019).

Office workers spend about one half to two thirds of their workday

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https://doi.org/10.1016/j.msksp.2021.102451
Received 6 July 2021; Received in revised form 14 August 2021; Accepted 17 August 2021
Available online 20 August 2021

seated within an office environment (Jans et al., 2007). Prolonged sitting has been shown to induce neck and low back discomfort over time (Waongenngarm et al., 2020) and perceived discomfort is a strong predictor for future onset of neck and low back pain (Hamberg-van Reenen et al., 2008). Interventions have been proposed to alleviate the adverse effects of prolonged sitting on discomfort, including rest breaks (Sheahan et al., 2016), postural shifts (O'Keeffe et al., 2013), and ergonomic intervention (Pillastrini et al., 2010). A recent study showed active break and postural shift interventions reduced new onset of neck and low back pain in high-risk office workers by 55–81% during 6-month follow-up (Waongenngarm et al., 2021). To date, no study has investigated the effects of active break and postural shift interventions on recovery from and recurrence of neck and low back pain in office workers. Thus, this study aimed to investigate whether active breaks and postural shift interventions aimed at reducing sitting discomfort shortened duration of recovery from neck and low back pain, and to determine the efficacy of interventions on the recurrence of neck and low back pain. A distinct group of office workers was selected for this study, i.e. those with high risk of neck or low back pain, to ensure participants will theoretically benefit from the interventions. We hypothesized that participants in the intervention groups, with increases in either rest breaks or postural shifts, show shortened recovery duration and reduced recurrence of neck and low back pain.

2. Methods

2.1. Participants and procedures

This study is part of a 12-month prospective cohort study with a 3-arm, parallel-group, cluster-randomized controlled trial in a convenience sample of office workers to evaluate the efficacy of active break and postural shift interventions to prevent and alleviate neck and low back pain. Individuals without neck and low back pain at baseline were followed for 12 months and those with incident neck or low back pain during follow-up were included in this study. The study was approved by the University Human Ethics Committee and registered in the Thai Clinical Trials Registry (TCTR20190111002). A change had been made to the methods after trial commencement, i.e. the age range of potential participants was shifted from between 23 and 45 years to between 23 and 55 years.

Office workers from six organizations in Bangkok, Thailand, participated in this study, including the government excise, public relations, and public transportation, the Metropolitan Waterworks Authority, and two private companies importing medical equipment and products (such as drugs and diagnostic reagents). Individuals were included if aged 23–55 years, working full-time, had a body mass index (BMI) of 18.5–25 kg/m^2, had at least 5 years experience in their current position, reported prolonged sitting as one of the aggravating factors of neck or low back pain in one of their previous episodes, and were at risk of non-specific neck pain as evaluated by the Neck Pain Risk Score for Office Workers (NROW) (sensitivity of 82%, specificity of 48%, positive predictive value of 29%, and negative predictive value of 91%) (Paksaichol et al., 2014) or non-specific low back pain as evaluated by the Back Pain Risk Score for Office Workers (BROW) (sensitivity of 65%, specificity of 68%, positive predictive value of 16%, and negative predictive value of 95%) (Janwantanakul et al., 2015). Exclusion criteria were musculoskeletal symptoms reported in the neck or low back in the past 6 months, reporting pregnancy or plan to become pregnant in the coming 12 months, having a history of trauma or accidents in the spinal region, or having either spinal, intra-abdominal or femoral surgery in the past 12 months. Individuals diagnosed with congenital anomaly of the spine, rheumatoid arthritis, infections of the spine or discs, ankylosing spondylitis, spondylolisthesis, spondylosis, spinal tumor, systemic lupus erythematosus, or osteoporosis were excluded.

Eligible participants provided informed consent. At baseline, they completed the self-administered questionnaire to gather exposure data and were randomly assigned at cluster level by a simple randomization method into one of three groups: the intervention A (active breaks), intervention B (postural shift), and control groups. Computer-generated randomization, which was concealed from the data collectors, was used to designate intervention. Clusters of participants were located in the same workplace to enhance compliance within the intervention group and avoid contamination of the intervention. A total of six clusters (two clusters each for intervention A, intervention B, and control groups) were identified and cluster size comprised 15–51 participants. Participants recorded incidence of neck or low back pain in a diary, including pain intensity and disability and were asked to strictly follow the group instructions until completing the 12-month follow-up or withdrawing from the study.

2.2. Questionnaires

A self-administered questionnaire was designed to gather data on individual, work-related physical, and psychosocial factors. Individual factors included gender, age, marital status, education level, frequency of regular exercise or sport, smoking habits, and number of driving hours per day. Work-related physical factors included current job position, number of working hours, years of working experience, frequency of using a computer, adopting working postures, performing various activities during work, rest breaks, perceived ergonomics of workstations and work environment conditions. Psychosocial work characteristics were measured by Job Content Questionnaire (Phakthongsuk 2009).

2.3. Description of intervention

A custom-designed apparatus was employed to deliver intervention A (active breaks) and intervention B (postural shift). Detailed descriptions of the interventions are published elsewhere (Waongenngarm et al., 2021). In brief, the custom-designed apparatus consisted of seat pad, processor, and smartphone application. The function of seat pad was to collect data regarding sitting and break duration as well as number of postural shifts. A processor calculated recommended active breaks and postural shifts for each individual. Instructions about active breaks were sent from the processor to smartphone application via Bluetooth during the workday and instructions were displayed as a notification message on the smartphone with a warning sound, which a user could opt to turn on or off. Instructions regarding postural shifts were sent from the processor to seat pad via a cord connected between them. Postural shifts were induced by the apparatus gradually pumping air into various parts of the seat pad placed underneath a participant's buttocks. Frequency and duration of breaks as well as of postural shifts were based on the literature review (Reenalda et al., 2009; Akkarakittichoke and Janwantanakul, 2017; Waongenngarm et al., 2018). Participants were requested to strictly adhere to the instructions. Participants in the control group received a placebo seat pad made of polypropylene foam to sit on. All participants were asked to keep the level of their leisure time physical activity unchanged.

2.4. Outcome measure

Non-specific neck or low back pain is defined as neck or low back pain (with or without radiation) without any specific systematic disease detected as the underlying cause of the complaints (Borghouts et al., 1998). Incidence of neck or low back pain was identified by a series of questions in a diary given to participants. Cases were defined as those reporting incident neck or low back pain lasting at least 24 h with pain intensity greater than 30 mm on a 100-mm visual analogue scale (VAS), with no weakness or numbness in upper or lower limbs. Disability level due to neck and low back pain was measured using the Neck Disability Index (NDI) (Uthaikhup et al., 2011) and Roland-Morris Disability Questionnaire (RMDQ) (Pensri et al., 2005), respectively.

Main outcome measures were time to recovery from neck and low back pain and recurrent rate of neck and low back pain. Full recovery was defined as being pain-free (VAS = 0) with no disability (NDI = 0 or RMDQ = 0) during the past month. Recurrence of neck and low back pain was defined as return of neck or low back pain lasting at least 24 h with pain intensity greater than 30 mm on a 100-mm VAS following at least 30 days pain-free (Stanton et al., 2011).

2.5. Statistical analysis

Baseline characteristics of participants in three groups were compared using one-way ANOVA for continuous data and χ^2 test for nominal and ordinal data. A Bonferroni post hoc comparison was employed to determine whether the two selected means differed significantly from each other. All analyses followed an intention-to-treat approach. Recurrent rate of neck or low back pain was calculated as the proportion of participants who had reported recurrence divided by total number of participants recovering fully (Machado et al., 2017). Further follow-up data of those initially identified as recovered or recurrent cases were not used any further.

The Kaplan-Meier survival curves were used to describe the median time to recovery and cases with recurrent neck and low back pain in three groups. Participants lost to follow-up were censored at the midpoint between last completed follow-up and next follow-up time (Dudley et al., 2016). Participants not recovered after 12 months were censored at this point. The survival curves were compared using the log rank test. Relationship between initial VAS score and recovery time was examined using Pearson correlation coefficients.

Hazard ratios (HR) with respect to recovery time from neck and low back pain and recurrent cases were calculated using the Cox proportional hazards model. The 45 possible covariates were each examined in multivariate models. If the tested covariate changed the HR of the intervention variable by ≥ 0.05 then it was also included in the final,

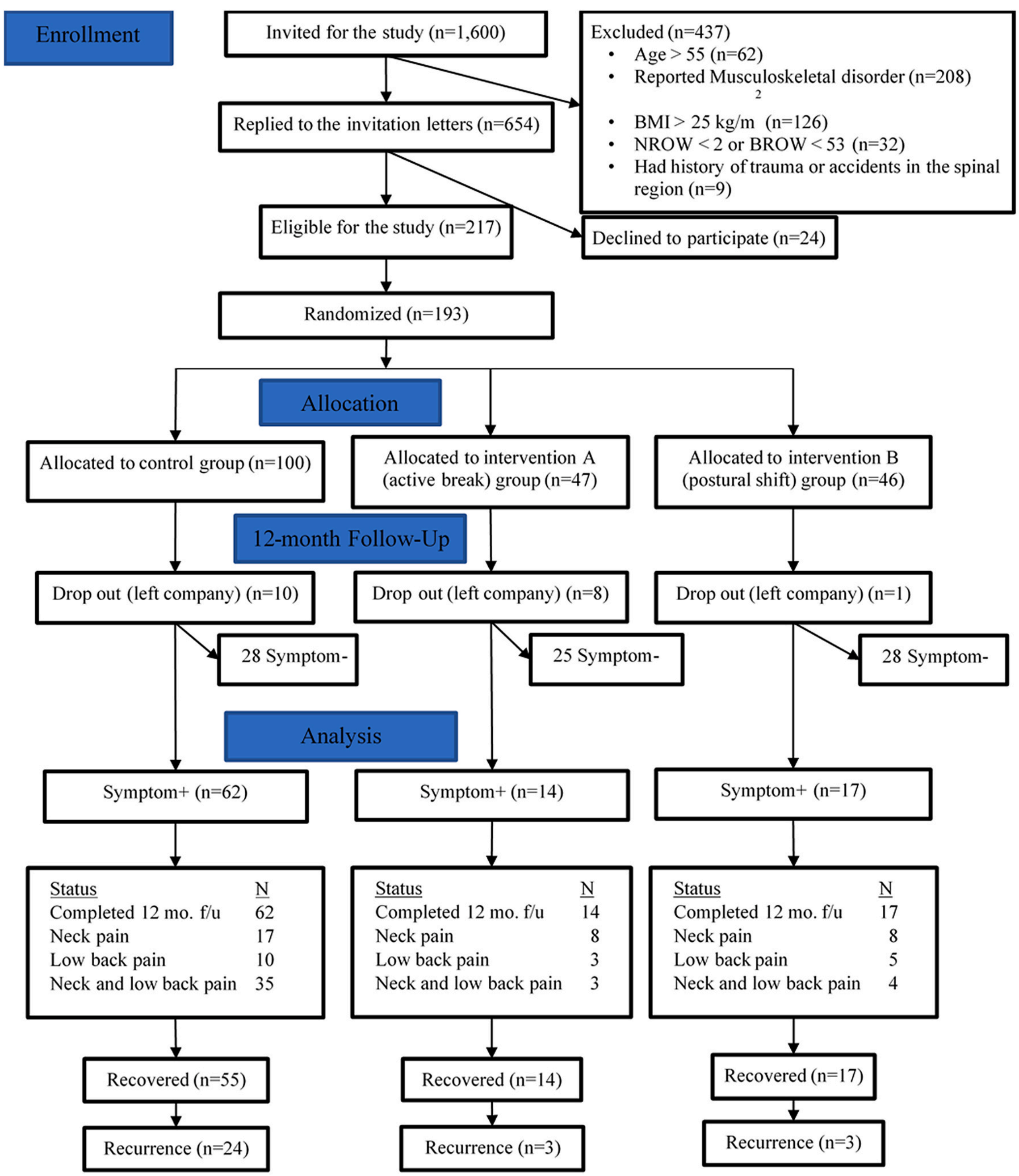

Fig. 1. Consolidated Standards of Reporting Trials (CONSORT) flowchart of the study.

adjusted model. All statistical analyses were performed using SPSS for Windows Version 25.0 (SPSS Inc, Chicago, IL). Statistical significance was set at the 5% level.

3. Results

The trial spanned June 2019–November 2020. Of 193 workers participating, 174 (88%) were successfully followed for 12 months and 19 (12%) were lost during the follow-up period (Fig. 1). No harm or unintended effect in all three groups was reported during the 12-month follow-up. Of the participants, 33, 18, and 42 reported neck, low back, and both neck and low back pain during follow-up, respectively. At baseline, there was no significant difference in any characteristics among three groups (Table 1), except for age, BMI, education level, duration of employment, psychological job demand, and social support. For those reporting neck and/or low back pain, there was no significant difference in any characteristics among three groups, except for BMI, education level, number of working hours, job security, and social support.

During March–June 2020, the COVID-19 outbreak in Thailand forced 68% (130/193) of participants to work from home. All participants did not bring the custom-designed apparatus for use at home. Thus, the status of working from home as a confounder was forced into the multivariate models.

3.1. Recovery time from neck and low back pain

Recovery from neck and low back pain among a sample population took a median time of 2 months (range: 1–8 months). The Kaplan-Meier survival curve indicated that the cumulative probability of recovery was 43%, 68%, and 93% at 1, 2, and 8 months, respectively. A significant difference in recovery time was found between intervention A (active break) and control group (log rank test probability = 0.001), and between intervention B (postural shift) and control group (log rank test probability = 0.001) (Fig. 2). Median duration of recovery in control group was 2 months, and 1 month in intervention A (active break) and intervention B (postural shift). The Cox proportional hazard model indicated significant difference in recovery time between intervention A (active break) and control group (HR_{adj} 2.07, 95% CI 1.05–4.07) and between intervention B (postural shift) and control group (HR_{adj} 1.57,

Table 1
Characteristics of office workers at baseline (n = 193) and those reporting neck and/or low back pain (n = 134).

Characteristic	Mean (SD)						*p* value (Baseline comparison)	*p* value (Case comparison)
	Intervention A (active break)		Intervention B (postural shift)		Control			
	At baseline (n = 47)	Cases (n = 14)	At baseline (n = 46)	Cases (n = 17)	At baseline (n = 100)	Cases (n = 62)		
Demographic characteristics								
Age (years)	31.6 (6.1)	33.4 (7.1)	35.0 (7.7)	35.7 (5.0)	34.1 (5.3)	34.6 (4.9)	***0.008***[a]	NS
Gender: female (%)	33 (70.2)	12 (85.7)	35 (74.5)	14 (82.4)	79 (79.0)	47 (75.8)	NS	NS
BMI	21.3 (2.3)	21.6 (2.1)	22.3 (2.3)	22.8 (2.0)	21.0 (2.0)	22.1 (2.1)	***0.002***[c]	***0.01***[a]
Pain intensity at 1st episode		4.1 (1.3)		3.6 (1.0)		4.4 (1.5)		NS
Marital status (%)							NS	NS
Single	36 (76.6)	6 (64.3)	31 (67.4)	12 (70.6)	64 (64.0)	36 (58.1)		
Married	10 (21.3)	4 (28.6)	13 (28.3)	3 (17.6)	35 (35.0)	25 (40.3)		
Divorced	1 (2.1)	1 (7.1)	2 (4.3)	2 (11.8)	1 (1.0)	1 (1.6)		
Education (%)								
Lower than Bachelor's degree	2 (4.3)	0 (0)	2 (4.3)	1 (5.9)	5 (5.0)	4 (6.5)	NS	NS
Bachelor's degree	40 (85.1)	13 (92.9)	38 (82.6)	14 (82.4)	53 (53.0)	29 (46.8)	***<0.001***[d] ***0.001***[e]	***0.014***[d] ***0.009***[e]
Higher than Bachelor's degree	5 (10.6)	1 (7.1)	6 (13.0)	2 (11.8)	42 (42.0)	29 (46.8)	***0.002***[d] ***0.001***[e]	***0.006***[d] ***0.009***[e]
Exercise frequency in the past 12 months (%)							NS	NS
Never	6 (12.8)	2 (14.3)	5 (10.9)	2 (19.4)	22 (22.0)	14 (22.6)		
Occasionally	34 (72.3)	9 (64.3)	30 (65.2)	9 (52.7)	56 (56.0)	31 (50.0)		
Regularly	7 (14.9)	3 (21.4)	10 (21.7)	5 (29.4)	22 (22.0)	17 (27.4)		
Not sure	0 (0)	0 (0)	1 (2.2)	1 (5.9)	0 (0)	0 (0)		
Work-related characteristics								
Duration of employment (years)	6.9 (4.3)	8.6 (5.2)	10.8 (5.3)	12.2 (6.0)	9.1 (4.8)	9.5 (4.7)	***<0.001***[a] ***0.039***[b]	NS
Working hours per day (hours per day)	8.0 (1.3)	8.1 (1.4)	8.7 (1.3)	8.9 (1.4)	7.8 (0.8)	7.9 (0.9)	NS	***0.004***[c]
Working days per week (days per week)	5.1 (0.3)	5.1 (0.5)	4.9 (0.6)	4.8 (0.5)	5.0 (0.2)	5.0 (0.3)	NS	NS
Psychosocial characteristics								
Job control	35.1 (4.5)	35.5 (5.6)	35.1 (5.2)	35.4 (3.6)	36.6 (4.3)	36.9 (3.8)	NS	NS
Psychological job demands	30.8 (4.4)	31.4 (3.8)	32.5 (4.2)	31.8 (4.8)	33.2 (4.4)	34.0 (4.2)	***0.007***[b]	NS
Physical job demands	13.2 (2.7)	13.7 (1.9)	13.4 (3.3)	13.4 (3.9)	14.1 (2.6)	14.5 (2.4)	NS	NS
Job security	16.3 (1.3)	16.0 (1.4)	16.3 (2.9)	15.6 (4.2)	16.9 (1.1)	17.0 (1.1)	NS	***0.042***[c]
Social support	33.1 (4.4)	32.1 (4.7)	30.4 (3.2)	29.7 (2.4)	32.9 (4.4)	33.1 (4.5)	***0.005***[a] ***0.003***[c]	***0.013***[c]
Hazards at work	15.9 (3.9)	16.9 (4.9)	15.5 (2.5)	16.0 (3.2)	17.0 (3.9)	17.5 (3.6)	NS	NS

NS = no significant difference among groups using ANOVA or Chi-square test.
[a] Significant difference after Bonferroni post hoc comparisons between the intervention A and intervention B groups.
[b] Significant difference after Bonferroni post hoc comparisons between the intervention A and control groups.
[c] Significant difference after Bonferroni post hoc comparisons between the intervention B and control groups.
[d] Significant difference after Chi-square test and pairwise comparisons between the intervention A and control groups.
[e] Significant difference after Chi-square test and pairwise comparisons between the intervention B and control groups.

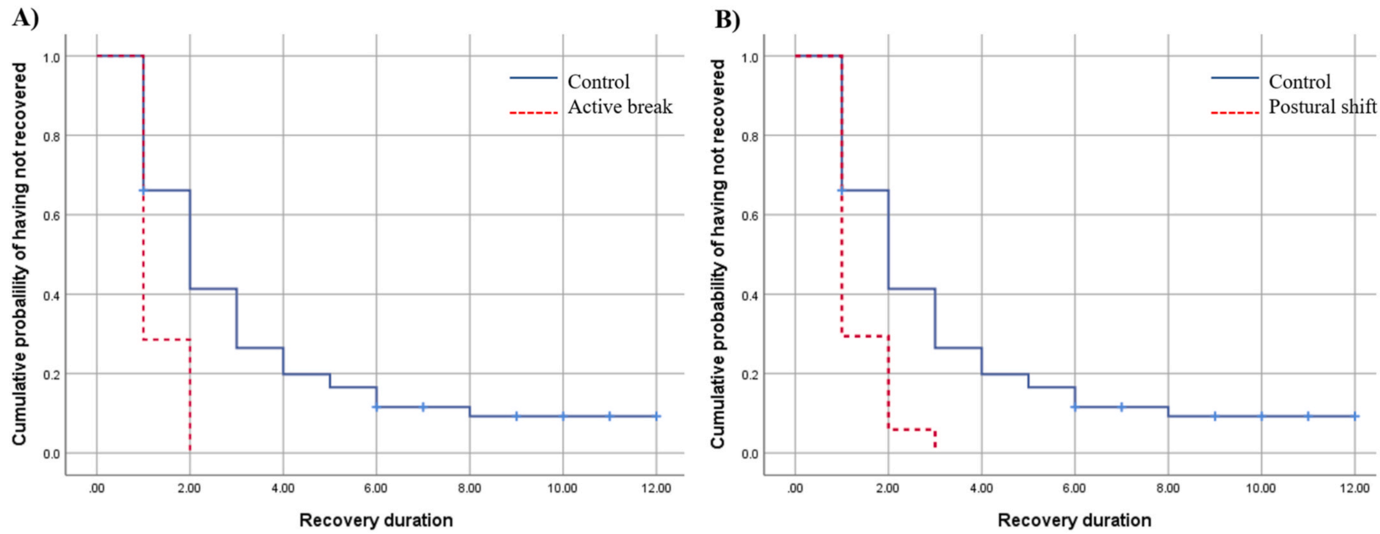

Fig. 2. Kaplan-Meier estimate of time to recovery from neck and low back pain among office workers: A) Intervention A (active break) and B) Intervention B (postural shift).

95% CI 1.09–2.27) (Table 2). Significant correlation between initial pain intensity and neck and low back pain recovery time was found (r = 0.6; $p < 0.05$), i.e. higher initial pain intensity indicated longer recovery time (Fig. 3).

3.2. Neck and low back pain recurrence

Over the 12-month follow-up, 21% (3/14), 18% (3/17), and 44% (24/55) of participants in intervention A (active break), intervention B (postural shift), and control groups reported incidence of neck and low back pain recurrence, respectively. Kaplan–Meier survival curves for the neck and low back pain cohort showed significant difference in time to recurrence between intervention A (active break) and control group (log rank test probability = 0.01), and intervention B (postural shift) and control group (log rank test probability = 0.014) (Fig. 4). Participants in the control group had greater risk of recurrence than those in the intervention groups.

The Cox proportional hazard model indicated the protective effects of intervention A (active break) and intervention B (postural shift) on recurrence. Intervention A (active break) and intervention B (postural shift) significantly reduced the risk of recurrence (HR_{adj} 0.22, 95% CI 0.06–0.83 for active break and HR_{adj} 0.35, 95% CI 0.16–0.77 for postural shift) (Table 3).

Table 2
Unadjusted and adjusted hazard rates (HR) evaluating the effects of intervention A (active break) and intervention B (postural shift) on recovery time from neck and low back pain (n = 93).

Variable	Unadjusted HR (95% CI)	*p* value	Adjusted HR (95% CI)	*p* value
Group assignment				
Control group (n = 62)	1.0		1.0	
Intervention A (active break) (n = 14)	2.27 (1.21–4.24)	***0.03***[c]	2.07 (1.05–4.07)[a]	***0.036***[c]
Intervention B (postural shift) (n = 17)	1.46 (1.1–1.95)	***0.01***[c]	1.57 (1.09–2.27)[b]	***0.016***[c]

[a] Covariates: Working from home was forced in the final, adjusted model. In the univariate analysis, four variables changed the HR of intervention A (active break) variable by ≥ 0.05, including pain intensity at the first episode, drug used, light intensity, and psychological demand.

[b] Covariates: Working from home was forced in the final, adjusted model. In the univariate analysis, eight variables changed the HR of intervention B (postural shift) variable by ≥ 0.05, including pain intensity at the first episode, current job position, number of working hours, lifting heavy objects, light intensity, psychological demand, social support, and hazards at work.

[c] p value < 0.05.

4. Discussion

The study demonstrated that active break and postural shift interventions delivered by the custom-designed apparatus enhanced neck and low back pain recovery. Median recovery time for those receiving active break or postural shift interventions (1 month) was significantly shorter than those in the control group (2 months). Recurrent rate of neck and low back pain was reduced by 65–78% with active break and postural shift interventions. However, this study recruited office workers at risk of neck and low back pain. Generalization of the findings to other working populations therefore should be made with caution.

4.1. Recovery time from neck and low back pain

Median recovery time from neck and low back pain in the control group (2 months) aligns with previous studies investigating the clinical course of non-specific neck and low back pain in office workers (median 2 months) (Areerak et al., 2018) and primary care patients (median 58 days) (Henschke et al., 2008). However, recovery time of those in the intervention groups is shorter than that of Leaver et al. (2013), who reported median recovery time of neck pain as 45 days in those receiving physical therapy treatment. The discrepancy between our and previous studies may be due to difference in inclusion criteria and intervention employed. Our participants were office workers and received a custom-designed apparatus to facilitate active breaks or postural shifts to reduce sitting discomfort. Participants in the previous study were a general population and received physical therapy treatment, i.e. manual therapy, multimodal physical interventions, and education.

The results showed that active break and postural shift interventions shortened recovery time from 2 months to 1 month. Our interventions aimed to improve sitting behavior by facilitating either active breaks or postural shifts during work. Bongers et al. (2006) proposed that behavioral aspects, such as work style, are important in the etiology of musculoskeletal symptoms. Bernaards et al. (2007) found that behavioral change with regard to body posture, workplace adjustment, breaks, and coping with high work demands was effective in improving recovery from neck-shoulder symptoms. Areerak et al. (2018) showed that the ability to utilize health information, a dimension of health literacy, reasonably predicted non-specific neck pain in office workers during

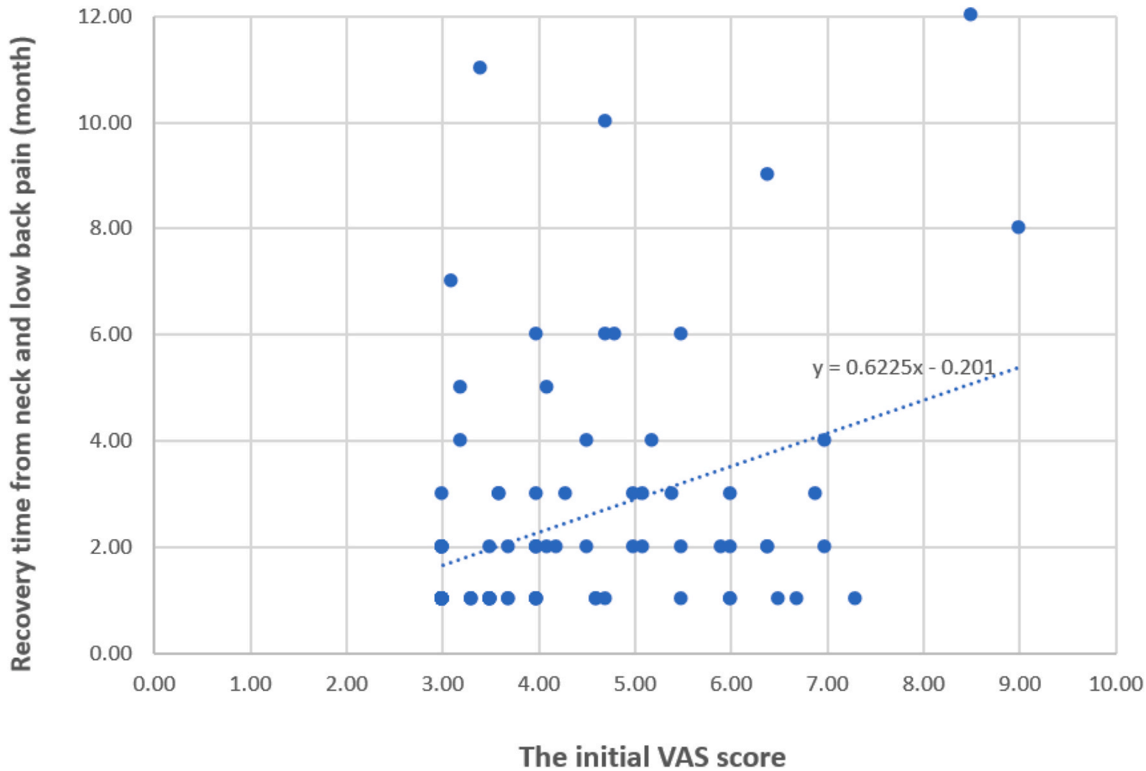

Fig. 3. Initial VAS score and time to recovery from neck and low back pain among office workers (n = 93).

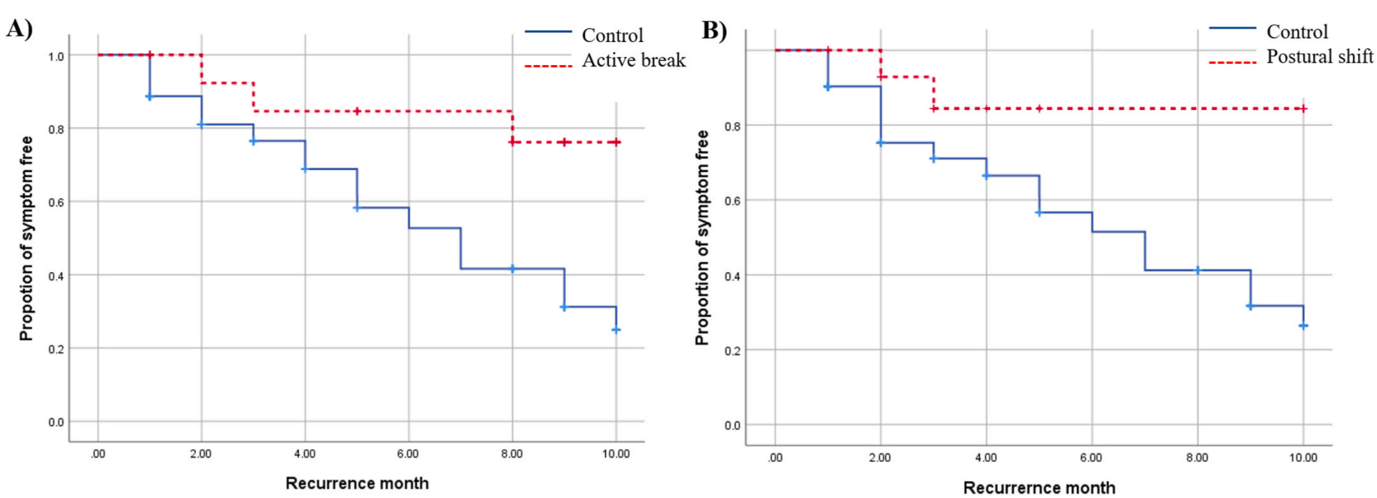

Fig. 4. Kaplan–Meier survival curves for incidence of neck and low back pain recurrence among office workers: A) Intervention A (active break) and B) Intervention B (postural shift).

1-year follow-up. Previous studies showed that active breaks enhanced recovery of muscle discomfort (Nakphet et al., 2014) and rest breaks after about 40 min of sedentary work were effective in reducing muscle fatigue (Ding et al., 2020). Postural shift has been shown to increase subcutaneous oxygen saturation on average by 2.2% with each posture adjustment, indicating positive effects on tissue viability (Reenalda et al., 2009). Postural shifts may allow periodic resting of musculature through load migration between passive tissues and to relieve fatigue (van Dieen et al., 2001; Maradei et al., 2017).

A positive correlation between initial pain intensity and recovery time was found among the sample population. Previous studies showed that baseline neck pain intensity was strongly associated with prolonged recovery (Walton et al., 2013) and more intense pain at baseline significantly reduced the probability of neck and shoulder pain recovery during 3-month follow-up (Bot et al., 2005). The findings support the notion that high initial pain intensity is a predictor for chronic neck and low back pain (Sihawong et al., 2016) and a treatment to alleviate perceived discomfort may effectively enhance neck and low back pain recovery.

4.2. Neck and low back pain recurrence

Recurrent rate of neck and low back pain in the control group was 44%. Estimates of 1-year incidence of neck or low back pain recurrence varied from 23% to 69% (Côté et al., 2004; Marras et al., 2007; da Silva et al., 2019). Large variation may be due to differences in defining a

Table 3
Unadjusted and adjusted hazard rates (HR) evaluating the effects of intervention A (active breaks) and intervention B (postural shift) on neck and low back pain recurrence (n = 86).

Variable	Unadjusted HR (95% CI)	*p* value	Adjusted HR (95% CI)	*p* value
Group assignment				
Control group (n = 55)	1.0		1.0	
Intervention A (active break) (n = 14)	0.25 (0.07–0.81)	***0.021****	0.22 (0.06–0.83)[a]	***0.025****
Intervention B (postural shift) (n = 17)	0.46 (0.22–0.94)	***0.03****	0.35 (0.16–0.77)[b]	***0.009****

[a]Covariates: Working from home was forced in the final, adjusted model. In the univariate analysis, two variables changed the HR of the intervention A (active breaks) variable by $\geq$ 0.05, including education level and number of working hours.
[b]Covariates: Working from home was forced in the final, adjusted model. In the univariate analysis, only number of working hours changed the HR of the intervention B (postural) variable by $\geq$ 0.05.
*p value $<$ 0.05, CI = confidence interval.

recurrent case. da Silva et al. (2019) defined an episode of low back pain recurrence as a return of low back pain following 7 consecutive days pain-free. Chaléat-Valayer et al. (2016) defined recurrent cases as more than one episode of disabling low back pain with sick-leave during 1-year follow-up. In this study, recurrent cases were defined as a return of neck or low back pain following a minimum period of 30 days pain-free (Stanton et al., 2011). Machado et al. (2017), using the same definition, reported the 1-year recurrent rate of low back pain as 33%.

Active break and postural shift interventions reduced recurrent rate by 65–78% compared to the control group. Exposure to awkward posture, longer time spent sitting, and previous episode(s) of low back pain have been independent prognostic factors for low back pain recurrence (da Silva et al., 2019; Stanton et al., 2008; Machado et al., 2017). A previous 12-month prospective cohort study showed that increasing daily walking steps can prevent onset of neck pain in those with sedentary jobs (Sitthipornvorakul et al., 2015). Active break and postural shift interventions have been found to reduce new onset of neck and low back pain among high-risk office workers by 55–81%, attributed to discomfort reduction during prolonged sitting (Waongenngarm et al., 2021).

4.3. Strengths and limitations of the study

The strength of this study is use of the placebo seat pad in the control group, which may have reduced the placebo or Hawthorne effect on the outcomes. However, several limitations should be considered when interpreting the results. First, most participants were female and several baseline characteristics differed among the three study groups. Participants were randomized as entire groups rather than as individuals (i.e. cluster randomization), posing a risk of baseline imbalance between groups. Pair-matched randomization of clusters or stratified method are suggested in the future. Second, although reporting prolonged sitting as one of the aggravating factors of neck or low back pain in one of the subject's previous episodes was one of the inclusion criteria, we did not request further detail. Previous studies have demonstrated that previous pain experiences might influence future pain (Palsson et al., 2018; Domennech-Garcia et al., 2018). Thus, future study should consider the inclusion of previous pain experiences as a confounder. Third, the nature of several biopsychosocial factors and the diagnosis of non-specific neck and low back pain were subjective, which poses the risk of bias in the estimation of exposure or health outcome. Future studies should include objective information from physical examination to increase data accuracy. Fourth, recovery duration was measured from the onset of neck and low back pain to fully recovered, or the completed follow-up. Data from participants who did not recover at the end of follow-up were treated as censors (Clark et al., 2003). Participants had unequal durations for follow-up, which may affect estimation of recovery rate. Equal follow-up time after the onset of neck and low back pain is recommended for future study. Last, daily occupational sitting behavior of participants in the control group was not monitored and the compliance of participants in the intervention groups during the follow-up period was not assessed, which may affect the internal validity of the study. Future study should validate the findings by examining the efficacy of active breaks and postural shifts on recovery time and recurrence of neck and low back pain in those with poor habitual sitting behavior.

5. Conclusion

The study showed that the active break and postural shift interventions delivered by the custom-designed apparatus effectively enhanced recovery time and reduced recurrence of non-specific neck and low back pain. Thus, active breaks and postural shifts during sitting may be recommended for effective management of neck and low back pain among office workers at high risk of developing non-specific neck or low back pain. Effects of active break and postural shift interventions on neck and low back pain recovery and recurrence should be assessed in normal office worker populations or other occupations.

Conflicts of interest

The authors developed the apparatus. The patent of the apparatus belongs to the university and funding agency. The authors declare that there are no other conflicts of interest.

Ethical approval

The study was approved by the University Human Ethics Committee.

Funding

This work was supported by Thailand Research Fund through the Royal Golden Jubilee Ph.D. Program (PHD/0180/2558 and PHD/0120/2559) and Industry Division (RDG6050058). Srithai Auto Seats Industry Company Limited partially provided financial support with no interference on methodology, data collection, and data analysis of the study.

Authors' contributions

The authors contributed in the following ways: NA provided the concept/research design, data collection, data analysis, and manuscript writing. PW and PJ contributed to the concept/research design, data analysis, and manuscript writing. All authors read and approved the final manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.msksp.2021.102451.

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