A Randomized Controlled Trial Evaluating the Effect of Two Task Chair Designs on Shoulder and Neck Pain among Sewing Operators

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This 4 month randomized controlled trail evaluated the effect of chair design on neck/shoulder pain among sewing machine operators. 277 sewing machine operators with neck/shoulder pain were assigned to receive (1) miscellaneous items (control group), (2) a chair with a flat seat pan plus miscellaneous items, or (3) a chair with a curved seat pan plus miscellaneous items. Participants who received the flat seat chair experienced a decline in pain of 0.14 (95% CI: 0.07 to 0.22) points per month compared to those in the control group, while those who received the curved seat experienced a decline of 0.34 (95% CI: 0.28 to 0.41) points per month compared to those in the control group. These findings demonstrate that an adjustable height task chair with a curved seat pan can reduce neck and shoulder pain severity among sewing machine operators.

INTRODUCTION

In 2000, the garment industry employed 11 million workers worldwide with approximately 350,000 workers in the US (1). Most of the work is done by minimum wage, nonunion, immigrant women who work in small shops. Sewing machine operators experience more chronic neck or shoulder pain and musculoskeletal disorders than most other working populations (2,3,4). Sewing machine operators perform precision tasks at a relatively fast pace with work cycles of 30 to 60 seconds. This repetitive, stereotyped work is typically performed on nonadjustable workstations and chairs. The task demands and the lack of adjustability of the workstations may lead to sustained cervical and thoracic spine flexion and shoulder elevation and abduction (Figure 1).

A pilot study by our group (5), carried out at sewing shops in Oakland, California, evaluated a variety of workstation interventions with the goal of reducing neck, thoracic and lumbar spine flexion, shoulder elevation and shoulder abduction during garment work. We studied: sloping of the work surface toward the operator; adding side tables to support the material and reduce reach; providing reading glasses; providing a foam wedge for the seat; providing a new chair; and adding a foot rest. The intervention that appeared most likely to reduce risk factors for neck and shoulder pain was a new task chair with a curved, 2-part seat pan (Figure 2) based on principles proposed for industrial work (6,7). Theoretically, the 2-part seat pan supports the forward leaning posture by allowing a more open thigh-torso angle thereby retaining the lumbar curvature and a less kyphotic thoracic spine. The seat was also adjustable in height and slope to accommodate different task demands and employees of different stature.

Figure 1. Typical posture of sewing operator. Note paper cones to elevate chair height.

The purpose of this study was to compare the impact of this new task chair, a conventional task chair, and a placebo intervention on neck/shoulder pain in industrial sewing operators. The null hypothesis was that the change in neck/shoulder pain scores would be the same in all three intervention groups over a 4 month period.

METHODS

Subjects and Shops

This is a randomized controlled trial with two treatment arms and one control arm with repeated outcome assessments over a 4 month period. Subjects were recruited from a convenience sample of 13 garment shops in Los Angeles, California. All employees were eligible to participate if they performed sewing machine work for more than 20 hours per week; were not in a probationary period; had worked for at least 3 months; and did not have an active workers' compensation claim. The study was approved by the Offices for the Protection of Research Subjects at the University of California, Los Angeles.

Interventions

A typical sewing workstation has a flat surface (51 x 122 cm) that can be adjusted by a mechanic to heights of 76 to 86 cm; but the height is usually fixed at 76 cm. The chairs are usually fixed height, made of metal or wood, with flat, padded seat pans. The work surface is usually above elbow height.

Subjects were randomized to 3 groups: (1) the control group which received miscellaneous items, (2) intervention group with curved seat pan chair and miscellaneous items, and (3) intervention group with flat seat pan chair and miscellaneous items. The curved seat pan chair (Figure 3) was custom designed for use in the garment industry. The seat pan had two surface elements, a horizontal rear half and downward sloping front half and included a fore/aft tilt mechanism. It included a short height back support with a lumbar curve (Soma Ergonomics, Berkeley, CA). The flat seat pan group received a conventional task chair with a flat seat pan and a flat backrest with minimal lumbar and sacral support (model BH3J, Soma Ergonomics). The back support was taller on this chair to provide the appearance of substantial support and importance. The other features of the chairs were identical: the chairs swiveled, had glides instead of casters, and the seat pans were adjustable in height (38 to 50 cm).

Figure 2. Task chair with flat seat pan on left and curved seat pan on right.

The miscellaneous items provided to all subjects were a footrest, a small table-top storage box for items such as scissors, a side table, a task lamp, and reading glasses. The miscellaneous items could be used or rejected by the subjects. If the sewing pedal was narrow and could only be used by one foot, a footrest was provided to support the other foot.

Those receiving a new chair were instructed to adjust the seat pan height and slope so that the feet were comfortably supported on the footrest and pedal, the table was slightly below the elbow height, and the pressure was evenly distributed under the thighs, and the backrest provided support in the lower back. The use of the assigned interventions by workers was confirmed at a visit to the worksite one month after the intervention.

Questionnaires

Participants completed a baseline questionnaire 1-2 months before the beginning of the intervention period, then completed four follow-up symptom questionnaires at 1 month intervals following the intervention. All information was collected in face-to-face interviews conducted in the language of the participant (Spanish, Cantonese, Mandarin Chinese, or English). The baseline questionnaire elicited information on: symptoms, demographic factors, work-organizational factors, and work-related psychosocial factors. Musculoskeletal

symptom intensity and frequency in the past 4 weeks were assessed by asking each subject to self-report pain frequency and pain intensity for six body regions. The monthly questionnaire was administered at the workplace and elicited information on: days and hours worked in the past month, machines used, sewing tasks performed, pain during the last month, and workplace changes. For six body regions, including neck/shoulder, subjects were asked if they had any pain that bothered them for one or more days in the past month. They rated the intensity of the pain on a 5 point numerical scale with 1 being 'a little painful' to 5 being 'very painful'.

Data Analysis

Data analysis followed an intention-to-treat approach applied to the subset of participants who at baseline reported having experienced neck/shoulder pain in the past month. The primary outcome was the change in pain intensity scores from the 4 monthly questionnaires following the intervention. Pain score change over time comparing the two treatment arms and the control arm was analyzed using a repeat-measures linear regression model with a first-order autoregressive covariance structure. Specifically, the slope of pain score change in the control group was set to zero, and the estimates for two intervention groups are presented here as the difference in the slope of pain score change comparing the two intervention groups and the control group. Missing data on the monthly symptom questionnaire was imputed by replacing the missing value with the mean pain score from the same treatment group at the corresponding time point. Potential effect modification, due to baseline pain, age, gender, days worked per week, was assessed in post-hoc stratified analyses to evaluate the non-uniformity of the intervention effects across categories of these factors.

RESULTS

From 13 participating shops, 560 subjects were contacted, 520 were eligible, agreed to participate in this study and completed the baseline questionnaire. Fourteen (2.5%) subjects refused to participate and 21 (3.8%) subjects did not meet the eligibility criteria. Detailed demographic data for the 520 subjects were presented elsewhere (18). Prior to randomization of these potential participants to our interventions, 40 dropped out, leaving 480 subjects for participation and randomization. Of the 480 participants that we randomized into three groups, 277 (57.7 %) reported neck/shoulder pain in the past month on the baseline questionnaire. The mean pain score at baseline was 2.4 (± 1.0). All participants were immigrant workers, with a mean age of 37.4 years (range 18-65); the majority were female (65.7%), Hispanic (73.3%) or Asian (23.8%). Differences in the demographic characteristics of the participants by treatment group were generally small; however, some potential risk factors were not evenly distributed across groups, including gender, age, ethnicity, BMI, education level, and years living in US.

From the time of randomization to the implementation of the interventions in the work places, 30 (10.8%) participants with neck/shoulder pain were lost to follow-up, leaving 247 subjects with neck/shoulder pain who received an intervention. Altogether, 25.4% of participants withdrew from the study after randomization: 30 (10.8%) before receiving an intervention, 0 (0%) at the first month, 9 (3.2%) at the second month, 5 (1.8%) at the third month, and 24 (8.7%) at the fourth month. During the 4 month follow-up, 24 monthly questionnaires (2.9% of all monthly questionnaires) were missing.

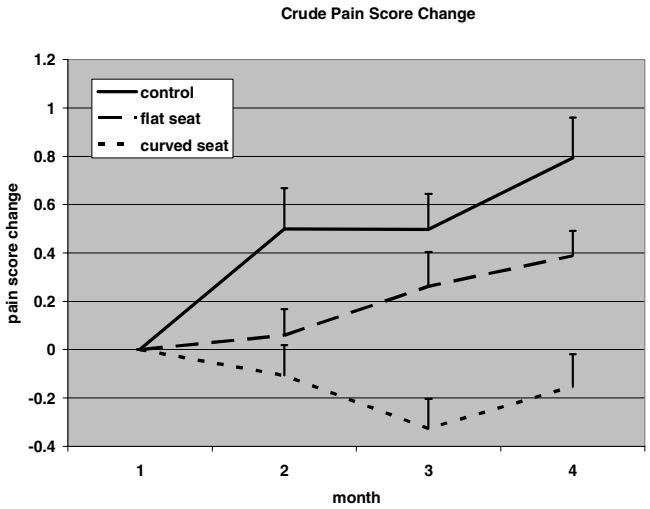

Figure 3. Crude pain score changes by month by treatment group.

The unadjusted change in neck/shoulder pain severity scores over time by treatment group are presented in Figure 3. In the repeat-measures linear regression model, the difference in the slope of pain score change was 0.14 (95% CI: 0.07 to 0.22) points (on a 0-5 scale) per month between the flat chair

intervention group and the control group, while the difference in the slope of pain score change was 0.34 (95% CI: 0.28 to 0.41) per month between the curved chair intervention group and the control group. Adjustment for 7 covariates (age, gender, ethnicity, education level, years in the US, BMI, shop) did not significantly change the findings from the crude analysis.

At the end of the study, when subjects were asked how they felt about the new workplace design compared to their old setup, almost all reported that it was better or much better (control group: 91.2%; flat seat group: 92.7%; curved seat group: 89.8%).

DISCUSSION

This study demonstrates that garment workers with neck/shoulder pain who are provided with an adjustable height, flat seat pan task chair will experience less neck/shoulder pain over a 4 month period compared to a control group. Garment workers provided with an adjustable height, curved seat pan task chair experience an even greater decline in neck/shoulder pain relative to the control group. The protective effect of the chairs persisted after adjustment for potential confounders.

The beneficial effect of an adjustable height chair has been demonstrated by others. Herbert et al. (19) reported that the introduction of chairs with adjustable height seat pans and back rests among 36 garment workers could reduce symptom severity in the neck, shoulder, elbow and forearm regions over a 6 month period. However, their study did not include a concurrent control group.

Potential limitations of our study include the small number of shops involved, the loss to follow-up, and the lack of blinding of subjects. The 13 shops studied were a sample of convenience, but the size of the shops and the ethnicity of their employees are representative of the garment shops in the Los Angeles area. Approximately 25% of subjects dropped out or were lost to follow-up during the course of the study. Most of this loss was due to subjects leaving the job. Strengths of the study were the high participation rate of subjects within shops, the large sample size, and the excellent compliance with use of the primary interventions (e.g., chairs). Another possible source of bias is that it was not possible to blind subjects to their intervention. However, the large number of miscellaneous items given to all study participants appears to have masked the items which were really being evaluated (e.g., chairs), as was intended. All three groups perceived their intervention equally positively.

In conclusion, the study demonstrates that garment workers may experience a decline in neck/shoulder pain if they are provided with adjustable height task chairs, especially if the chair has a forward curved seat pan. The findings may be generalizable to other seated jobs that are visually demanding and involve the repetitive manipulation of material or parts. Health care providers may consider recommending an adjustable height task chair with a curved seat pan for patients with neck or shoulder pain who are garment workers or who perform forward sitting tasks. Finally, owners of sewing companies should consider providing such a task chair for their employees as a way of reducing pain and loss of trained workers due to impaired health.

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