Reliability of the Demand-Control Questionnaire for sewing machine operators

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The Demand-Control Questionnaire (DCQ), a 20-item scale that measures psychological work demands, job control and workplace social support, has frequently been used to assess occupational stress. The purpose of this study was to determine the test-retest reliability and internal consistency of the DCQ with sewing machine operators. Forty-six sewing machine operators completed the DCQ on two occasions with an 11-week time interval. A repeated measures analysis of variance model and subsequent application of generalizability theory were used to calculate the test-retest reliability of the subjects’ ratings on the DCQ. Cronbach’s alpha was used to determine the internal consistency of the scale. The test-retest reliability was 0.33 (95% confidence interval = 0.05–0.61), indicating fair reliability. Good internal consistency (Cronbach’s alpha = 0.70) was found. The DCQ appears to be a reliable measure for assessing occupational stress in sewing machine operators. Workplaces need to place greater emphasis on the role of occupational stress in the prevention and treatment of musculoskeletal injuries among sewing machine operators.

Keywords: Occupational musculoskeletal injuries, reliability, occupational stress, sewing machine operators

1. Introduction

The incidence of musculoskeletal disorders has increased rapidly during the past 20 years [8,9,11,23,33]. Some investigators [10,24] have suggested that physical factors such as sustained static load, repetitiveness and heavy lifting may be risk factors for developing neck, shoulder and back disorders. Others have indicated that the psychosocial work environment and workplace organization such as high psychological demands (e.g., how hard and fast the worker must perform the work tasks), low job control (e.g., complexity of work) and low workplace social support (e.g., job satisfaction) have been shown to influence the occurrence of musculoskeletal disorders [4,5,12,14,17,21].

Numerous studies have identified sewing machine operators as a high risk group for developing musculoskeletal disorders [1,2,25,32]. These studies have focused on risk factors such as static postures, repetitive arm movements, lack of sufficient rest during work tasks and time pressure as contributing to the occurrence of these disorders [1,2,9,25,32]. Andersen and Gaardboe [1,2] also showed that the risk of developing persistent neck and shoulder complaints increased with the number of years of working as a sewing machine operator.

The Demand-Control Questionnaire (DCQ), developed by Karasek and Theorell [15], has frequently been used in the literature to measure workplace psychosocial factors or occupational stress. The DCQ is based on the Demand-Control (DC) model [15]. The DC model comprises three basic dimensions – psychological demands (e.g., a fast pace and high level of expectations), job control or decision latitude (e.g., control the worker has over the use of his or her abilities and the way in which the work is accomplished) and social support (e.g., support from coworkers and supervisors). The DCQ model has been used to predict a broad range of health and behavioral consequences of the work environment [3,7,26,28]. In the DC model, “job strain” is defined as those jobs characterized by a combination of high psychological workload demands,
low job control and low social support. According to Karasek and Theorell [15], sewing machine workers can be classified as being in a high strain occupation.

The DCQ is a 20-item scale consisting of 3 subscales—demand (5 items), control (9 items) and social support (6 items). The scaling for each item consists of a 4-point Likert response scale ranging from 1 = disagree, 2 = strongly disagree, 3 = agree and 4 = strongly agree. It takes about 5 to 10 minutes to complete the scale. The DCQ is found in the Appendix.

While several studies have used the DCQ to measure occupational stress in working populations [3,7,21,26,28], few studies have examined its psychometric properties. The DCQ was originally developed and validated for comparisons among occupations [15]. Muntaner and Schoenbach [19] examined the construct validity of the DCQ by using confirmatory factor analysis to investigate the demand, control and support dimensions of the scale. These investigators used two different models to determine whether social support should be included in the work environment. They concluded that social support is an important component of the psychosocial work environment. Using data from the United States national surveys of working conditions (Quality of Employment Surveys for 1969, 1972 and 1977), Schwartz et al. [27] examined the internal consistency of the DCQ. They reported pooled Cronbach’s alpha coefficients of 0.61 for the demand subscale and 0.85 for the control subscale. The purpose of the present study was to determine the test-retest reliability and internal consistency of the DCQ with sewing machine operators.

2. Method

2.1. Subjects

Forty-six workers (4 males and 42 females), whose mean age was 36.3 years ($SD = 5.8$; range = 23 to 52) participated in the study. Their mean years of employment as a sewing machine operator was 9.3 ($SD = 4.8$; range = 1.25 to 20). The sewing machine operators completed the 20-item DCQ [15] on two occasions with an 11-week time interval.

2.2. Statistical analysis

A repeated measures analysis of variance (ANOVA) model and subsequent application of generalizability theory were used to generate the variance components for the factors of subject, time and item in the DCQ [31]. Cronbach’s alpha was used to examine the internal consistency of the 20-item DCQ items as well as the internal consistency of the 3 subscales—demand, control and social support. If a scale is internally consistent, each item should correlate with all other items [31]. A coefficient alpha of 0.70 and higher is acceptable [30]. Since it was felt that factors such as education level, years of employment as a sewing machine operator and whether English was the worker’s first or second language may influence the ability to understand the DCQ items, a repeated measures analysis of covariance (ANCOVA) was conducted [20].

The readability, or ease of reading and understanding, of the DCQ was examined using the readability formula by Flesch-Kincaid—a widely used formula that calculates the grade level required for a reader to understand the text [13]. The Flesch-Kincaid formula is readily available in “Grammatik” in the Corel WordPerfect 8 software package [6]. The Flesch-Kincaid formula evaluates readability as the average number of words per sentence and the average number of syllables per word, from which a grade level score is assigned [6]. The formula for calculation is: 0.39 times the average number words per sentence + 11.8 times the average number of syllables per word minus 15.59 equals the Flesch-Kincaid grade level [22].

3. Results

The repeated measures ANOVA revealed that the test-retest reliability coefficient was 0.33 (95% confidence interval (CI) = 0.05–0.61). Cronbach’s alpha for the total DCQ was 0.70 (95% CI = 0.49–0.91). Cronbach’s alphas for the demand, control and social support subscales were 0.51 (95% CI = 0.26–0.76), 0.68 (95% CI = 0.46–0.9) and 0.71 (95% CI = 0.5–0.92), respectively. The repeated measures ANCOVA demonstrated that there were no statistically significant differences in the DCQ scores for the factors of education, years employed as a sewing machine operator and English as a second language. The readability analysis indicated that the DCQ items and instructions were at a 4.27 grade level.

4. Discussion

This study showed that the test-retest reliability of the DCQ with sewing machine operators was 0.33 (95%
Cronbach’s alpha for the DCQ was 0.70 (95% CI = 0.49–0.91) indicating good internal consistency. In our study Cronbach’s alphas for the demand and control subscales were 0.51 and 0.68, respectively. It is difficult to compare our values to those reported by Schwartz et al. [27]. In their study, they found pooled Cronbach’s alphas of 0.61 and 0.85 for the demand and control subscales, respectively. Schwartz et al. used census data from three years allowing them to base their findings on large sample sizes in comparison to the 46 subjects in our sample. Their sample consisted of census data for all occupations in comparison to our sample of only sewing machine workers at one workplace. In addition, they used 18 items (for the demand and control subscales) versus our 14 items (for the demand and control subscales) which may have allowed them to achieve a higher Cronbach’s alpha [31].

The readability analysis of the DCQ showed that the readability level was at a 4.27 grade level. A grade 4 readability level is considered to be an adequate reading level because in both Canada and the United States, the average reading level is grade 8 or grade 9 [18,29].

When selecting outcome measures, clinicians need to consider not only available psychometric evidence such as reliability, validity and sensitivity to change, but also clinical sensibility and practicality of administration. Such measures should be brief, easy to explain and interpret, suitable for repeated administration at various time intervals and easy to score. The self-administered DCQ adheres to these requirements as it is relatively short (consisting of only 20 items), takes about 5 to 10 minutes to complete, the items are meaningful to both workers and clinicians and the scale is easy to score. The findings of this study support the use of the DCQ as a reliable and clinically relevant instrument that can be used to assess the occupational stress or psychosocial factors of the client’s work environment and to make recommendations for job modifications and redesign of the work station.

A limitation of this study may be the length of the test-retest time interval of 11 weeks. Streiner and Norman [31] suggested a test-retest interval of 2 to 14 days to examine the temporal stability of both the phenomenon (in the absence of an intervention) and its measurement (affects of mood or test-taking fatigue). We felt that the 11-week time interval was appropriate as the sewing machine workers were reasonably stable with regards to performing the same work tasks during this time frame and no new interventions, organizational changes, or production demands had been introduced.

5. Conclusion

The DCQ is a reliable instrument that provides an integrative conceptual framework, consisting of 3 subscales of demand, control and social support, for the evaluation of occupational stress. Future research is necessary to further examine the psychometric properties (i.e., reliability, validity and sensitivity to change) of the DCQ with both sewing machine operators and other working populations. Further intervention studies that evaluate the effects of reducing occupational stress in sewing machine operators also are necessary. Workplaces need to place greater emphasis on the role of occupational stress in the prevention and treatment of musculoskeletal injuries among sewing machine operators.

References


Appendix

Demand-Control Questionnaire [15]

Please answer each question by checking off the one answer that best fits your situation. Sometimes none of the answers fit exactly. Please check the answer that comes closest.

<table>
<thead>
<tr>
<th>Demand-Control Questionnaire</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My job requires that I learn new things. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>2. My job involves a lot of repetitive work. (C)*</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>3. My job requires me to be creative. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>4. My job allows me to make a lot of decisions on my own. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>5. My job requires a high level of skill. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>6. On my job, I have little freedom to decide how to do my work. (C)*</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>7. I get to do a variety of different things on my job. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>8. I have a lot of say about what happens on my job. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>9. I have an opportunity to develop my own special skills. (C)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>10. My job requires working very fast. (D)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>11. My job requires working very hard. (D)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>12. I am not asked to do an excessive amount of work. (D)*</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>13. I have enough time to get the job done. (D)*</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>14. I am free from conflicting demands that others make. (D)*</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>15. My supervisor is concerned about the welfare of those under him. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>16. My supervisor pays attention to what I am saying. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>17. People I work with are competent in doing their jobs. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>18. People I work with take a personal interest in me. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>19. People I work with are friendly. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>20. People I work with are helpful in getting the job done. (S)</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

D = Demand item; C = Control item; S = Social support item.
*Reverse scored.