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Investigation of musculoskeletal symptoms and ergonomic risk factors among female sewing machine operators in Turkey

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ABSTRACT

This cross-sectional study aimed to identify the prevalence of musculoskeletal symptoms and ergonomic risks in female sewing machine operators at a textile company. The study sample comprised all female sewing machine operators in the company. The sample included 283 sewing machine operators. Data were collected through the use of the adapted Nordic Musculoskeletal Questionnaire and by direct observations via the rapid upper limb assessment (RULA) to determine ergonomic risks. RULA is a validated tool for assessment of ergonomic risks. The mean age of the women was 30.2 (SD: 8.4) and the mean number of years of employment was 13.4 (SD: 5.5). The highest prevalence rates for the women's musculoskeletal symptoms were in the trunk (62.5%), neck (50.5%), and shoulder (50.2%). Of the women, 65% had experienced musculoskeletal pain or discomfort over the last 6 months. Pain intensity of these symptoms was assessed with a visual analogue scale. The average pain intensity of the women was found to be 3.5 (SD: 2.8). Results of the RULA scores were found to be quite high. There were no employees who received RULA scores of 1–2, which indicates acceptable postures (all scores >5). The final RULA scores of 6.9 indicate that the participants' postures at their work stations need to be investigated immediately.
Relevance to industry: This study based on the RULA method allowed to perform a rapid and quite correct evaluation tolls for SMOs. For this research population, the research findings provided fundamental data on the prevalence of musculoskeletal symptoms and ergonomic risks among Turkish female SMOs.

1. Introduction

Musculoskeletal disorders (MSDs) are a major cause of work-related disabilities and injuries in the developed and industrially developing countries (Andersen and Gaardboe, 1993; Choobineh et al., 2004; Kaergaard and Andersen, 2000). MSDs, particularly those of the upper body, are increasingly prevalent in western societies (Strazdins and Bammer, 2004). According to findings in some studies, the prevalence of MSDs is 10%; it is as high as 80% in others (Eerd et al., 2003). Musculoskeletal disorders are more common among women than among men (Dahlberg et al., 2004). Although men and women may have the same job title, they still do not perform the same type of work tasks (Yun et al., 2001). Today, women are probably more often exposed to monotonous repetitive, and heavy work tasks than men, e.g. Health care personnel, cashiers, cleaners, and sewing machine operators (SMOs) (Brisson et al., 1989; Dahlberg et al., 2004).

Sewing machine operation includes jobs that involve operating power sewing machines to sew, alter or repair wearing apparel, linens, blankets, and other fabric articles. This includes operation of automatic sewing machines when the operator must know how to thread the machine, wind bobbins, adjust tension, and oil parts. Sewing machine operators use hands to handle, control, or feel objects, and tools; sit for long periods of time, and repeat the same motions (Kaergaard and Andersen, 2000; Wang et al., 2007). For this reason, a high prevalence of musculoskeletal symptoms of neck, shoulder, back, hand/fingers and lower extremities have been found in studies of female SMOs (Kaergaard and Andersen, 2000; Brisson et al., 1989; Kilroy and Dockrell, 2000; Vihma, 1982).

Turkey, in which this study was conducted, is a developing country with a population of 68 million. Half of Turkey's population is composed of women, 19% of these women (5.7 million) are illiterate (Esin and Öztürk, 2005; Ministry of labour and social security, 2005). While the participation of women in the labour force was 28% in 1988, this percentage decreased to 24.5% in 2004. Of the working women, 77% are family workers without pay and 14% are employed as industrial workers (Esin and Öztürk, 2005). Working women in Turkey have a lot of problems concerning wages, employment, working conditions and social benefits. The vast majority of women working in industry are employed in textiles. Being the most developed sector in Turkey, the textile

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industry has a key role in its economy. There are approximately 4–5 million registered employees in the textiles industry in Turkey. However, the actual number is estimated to be 7–8 million, together with the unregistered workers. Of these employees, 10.9% are women and most of these women work as SMOs. Some studies place, MSD prevalence between 32% and 60% for all employees. It is predicted that this percentage is higher among female employees (Açık et al., 2004; Bilgütay et al., 2004; Çivitci et al., 2004; Tüzün et al., 2004). However, research with working women is not sufficient. In particular, there is almost no information about MSD prevalence in working women. Also, there are insufficient studies which have used reliable ergonomic risk assessment methods of risk prevention. The findings from the studies to be conducted into this issue will make it possible for those providing occupational health services such as occupational health nurses and occupational physicians to learn about ergonomic risk assessment methods. The study was conducted on female SMOs, who are assumed to display higher MSD prevalence. The aim of this cross-sectional study was:

1) To determine MSD prevalence among female SMOs in Turkey using a modified version of Nordic Musculoskeletal Questionnaire (NMQ),
2) To examine the level of ergonomic workplace risk factors by using the Rapid Upper Limb Assessment (RULA),
3) To investigate the relationship between MSDs and demographic factors, work characteristics, and RULA scores.

2. Method

2.1. The workplace

This cross-sectional study was conducted in a textile company that manufactures clothes. The company is located in Istanbul, in north-western Turkey, the most developed city of Turkey in terms of population and economy. A total of 670 employees work in the six different departments of the company. There are 307 employees in the sewing department, where the study was conducted. Of these, 8% are male and 92% are female. The work tasks performed within this department are forming patterns, sewing, ironing, and final inspection. Fabrics come into the pattern department in rolls, are cut in the desired patterns, and then sent to SMOs to be sewn. Each SMO sews the ready-to-sew pieces coming from the pattern department. Then, mid-ironers iron the pieces sewn. Finally, final products (pants, jacket, shirt, etc.) are delivered to final ironers to be pressed and made ready for sale after inspection by final inspectors. When the work environment was evaluated, an awkward work station design was observed. In the extended work area, there are non-adjustable chairs, poor machine design, and unorganized work surfaces. The manufacturing continues on a 24-h/7-day basis with a shift system.

2.2. Participants

The study samples are paid according to their years of employment, an average of 500 USD per month. SMOs perform their tasks sitting. There are two work tasks. The first one is the "sewing" task. The female worker sits on a chair, leans forward at an angle of 45°, and moves her hands backward and forward and to the left and right to move the fabric (45–100 times per minute). The arms are positioned over the machine at an angle between 45° and 90° to the trunk. The head is positioned forward at an angle between 10° and 20°. One of the legs moves the pedal of the sewing machine but the other is static. During the second work task, the female worker bends down to the right at an angle of 45° in order to get the pieces such as zippers and the like (30–50 times per minute).

2.3. Data collection

In this study, the data were obtained with a questionnaire and by direct observation. The questionnaire was prepared based on the Nordic Musculoskeletal Questionnaire (Kourinka et al., 1987). The questionnaire has three sections. On the first section are items to determine musculoskeletal symptoms frequency of pain, and intensity of pain. The subjects were asked questions about the musculoskeletal symptoms (pain, discomfort) they had had over the last 6 months and were asked to mark them on the body discomfort chart. Symptoms of pain or discomfort were recorded as presence of pain. They were also asked "How often do you feel pressured because of your work?" to determine feelings of participants about their work. They were asked to select from one of the following choices: "I have never had", "I have often had", "I have very often had", or "I always have had". The participants were also asked to mark on a Visual Analogue Scale (VAS) for self-reported pain intensity where they thought their pain was. The VAS is a horizontal line, 100 mm in length with the left end of the line representing no pain and right end of the line representing the worst pain. Subjects were asked to mark on the line where they thought their pain was. The VAS score is determined by measuring in millimetres the distance from the left hand end of the line to the point that the subject marked.

In the second section of the questionnaire, information was collected about age, education, and marital status, number of living with children, health-related factors (i.e., body mass index [BMI]), non-work-related physical activity, smoking behaviour, and chronic illnesses. On the third section of the questionnaire, there were items about their work/work-place characteristics: number of hours worked per day and week, total years of employment, and items for evaluation of work station design, type of chair used, machine design, and work surface.

Ergonomic risk factors were assessed through direct observation of women's postures at their work stations by means of the Rapid Upper Limb Assessment (RULA) tool (Mc Atamney and Corlett, 1993, 1996). RULA is a validated tool that assesses biomechanical and postural loading on the work-related upper limb disorders. It provides a method of screening a working population quickly for exposure to a likely risk of work-related upper limb disorders. RULA was developed without the need for special equipment, which provides the opportunity for a number of investigators to be trained in doing the assessment without additional equipment expenditure as, the investigator only requires a clipboard and pen this way.

In the RULA assessment method, a score is calculated for the posture of each body part. A score of 1 indicates the ''best'' or most neutral posture, e.g. arms by the sides, elbows in approximately 90° flexion, wrists in neutral position, forearms mid-way between pronation and supination, neck in 10° flexion, trunk and legs sitting and well supported. A score of 4 indicates the "worst" position, e.g. shoulder flexion above 90° or flexion between 45° and 90° and abduction. The combined individual scores for shoulder, elbow and wrist are called score "A" and those for neck, trunk and legs give score "B". Muscle use and force exerted in each working position are attributed a score of 1 and 0 respectively, because they are static postures without loading. These scores are added to scores A and B to obtain scores "C" and "D". Based on the design of the RULA method, each combination of scores C and D is called a "grand score" and reflects the musculoskeletal loading associated with the worker's posture. Low grand scores (of 1 or 2)