Applied Ergonomics 51 (2015) 180–188

Contents lists available at ScienceDirect

Applied Ergonomics

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

Association of individual and work-related risk factors with musculoskeletal symptoms among Iranian sewing machine operators

Iman Dianat [a, *], Madeh Kord [b, 1], Parvin Yahyazade [b, 1], Mohammad Ali Karimi [c, 2], Alex W. Stedmon [d, 3]

[a] Department of Occupational Health, Faculty of Health, Tabriz University of Medical Sciences, Tabriz, Iran
[b] Student Research Committee, Tabriz University of Medical Sciences, Tabriz, Iran
[c] Islamic Azad University, Bushehr Branch, Bushehr, Iran
[d] Human Systems Integration Group, Faculty of Engineering & Computing, Coventry University, UK

ARTICLE INFO

Article history:
Received 5 February 2014
Accepted 27 April 2015
Available online 28 May 2015

Keywords:
Sewing operation
MSDs
RULA

ABSTRACT

This cross-sectional study evaluated working conditions and the occurrence of self-reported musculoskeletal symptoms among 251 Iranian sewing machine operators. A questionnaire and direct observations of working postures using the rapid upper limb assessment (RULA) method were used. A high prevalence of musculoskeletal symptoms, particularly in the neck/shoulders, back and hands/wrists were found. The mean RULA grand score of 5.7 highlighted a poor sewing workstation design and indicated that most operators (with posture assessed at action level 3) needed an investigation and changes in their working habits soon. Work-related factors (including number of years worked as an operator, prolonged working hours per shift, long duration of sitting work without a break, feeling pressure due to work and working postures) and individual factors (including age, gender, BMI and regular sport/physical activities) were associated with musculoskeletal symptoms in multiple logistic regression models. The findings add to the understanding of working conditions of those jobs involving sewing activities and emphasise the need for ergonomic interventions to reduce musculoskeletal symptoms in the future.

1. Introduction

Musculoskeletal disorders (MSDs) are a major health problem in both industrialized and industrially developing countries (Buckle and Devereux, 2002; Colombini and Occhipinti, 2006; Öztürk and Esin, 2011; Nazari et al., 2012; Widanarko et al., 2014). MSDs have considerable impact on both individuals and countries worldwide (Coury et al., 2000) and, more specifically, work-related MSDs have been recognised as a significant problem within the European Union in terms of individual ill health and economic factors such as impact on production and revenues (Buckle and Devereux, 2002). This also seems to be the case in other parts of the world such as the United States and Asia (Lewis et al., 2002; Oh et al., 2011). A number of risk factors including physical, psychosocial, organizational and socio-demographic aspects have been identified as being associated with the development of MSDs among different occupational groups, particularly in those involved in sedentary and repetitive activities (McLean et al., 2001; Buckle and Devereux, 2002; Fogleman and Lewis, 2002; Johnston et al., 2008; Dianat and Salimi, 2014). Prevention of MSDs is, therefore, one of the most important factors that can have a major impact on productivity enhancement and on promotion of health and safety at work (Kogi et al., 2003).

With specific reference to sewing machine operators, this is an occupational group that may experience a high prevalence of MSDs (Wang et al., 2007; Öztürk and Esin, 2011; Sealetsa and Thatcher, 2011) that is often attributable to poor working postures that have to be maintained during the whole working period as well as to repetitive hand and arm movements that characterise this kind of work (Li et al., 1995). Typically, sewing machinists perform piece–work activities, assembling component parts of a final garment or product. The fragmentation of work in this way means that the task are often highly repetitive, potentially dangerous and

* Corresponding author. Tel.: +98 41 33357580; fax: +98 41 33340634.
E-mail addresses: dianati@tbzmed.ac.ir (I. Dianat), madeh.kord@yahoo.com (M. Kord), pyzade@yahoo.com (P. Yahyazade), karimi_a@live.com (M.A. Karimi), alex.stedmon@coventry.ac.uk (A.W. Stedmon).
[1] Tel.: +98 33357581; fax: +98 41 33340634.
[2] Tel.: +98 9177742003; fax: +98 771 5559858.
[3] Tel.: +44 (0) 2477 657 390.

http://dx.doi.org/10.1016/j.apergo.2015.04.017
0003-6870/

complex task involving the coordination of both hands, usually performed in a seated working posture for a long period of time. The operation usually requires the operator to lean forward (with a forward inclined posture of both head and trunk) to focus their attention and have better visual control of the task. In many ways, given the fixed nature of the sewing machine, the machinists has to adapt their posture and viewing angle so that they can conduct this form of 'precision work' (Kroemer, 2009) and this can lead to the development of MSDs, particularly in the back, neck and upper limbs (Serratos-Perez and Mendiola-Anda, 1993; Öztürk and Esin, 2011; Sealetsa and Thatcher, 2011).

The textile industry in Iran is one of the oldest and largest industries, which employs more than 10% of all workers in Iran's manufacturing sector, and accounts for approximately 6% of the total industrial production of the country (Iranian Statistics Centre, 2002). The textile industry, which is dominated by small and medium enterprises (SMEs), is regarded as a very labour-intensive industry. While the occupational health and safety programmes in developing countries have mainly focused on large-scale industries, SMEs in these countries are a major and very much neglected sector in occupational health research (McCann, 1996). A better understanding of the occupational hazards and their control measures in this sector has the potential for a notable impact on national productivity and workers' quality of life. Currently, there is limited research on the occurrence of MSDs and the associated risk factors among the Iranian sewing machine operators. The findings from research in this area will help to better understand the working conditions of those jobs involving sewing operation and to assist in introducing preventative measures and developing guidelines in this regard. It also has the potential to inform work practises in other developing nations with similar industrial sectors (e.g. the Far East).

1.1. Rationale

Having provided an overview of the textile industry in Iran and the potential of this work to lead to MSDs research was conducted to investigate the following factors:

- evaluate the MSD risk levels associated with typical sewing machinist operating postures,
- evaluate the frequency and severity of musculoskeletal symptoms among sewing machine operators,
- evaluate the association between musculoskeletal symptoms and contributing individual and work-related factors.

2. Materials and methods

2.1. Study design and procedure

A cross-sectional, descriptive-analytical study was conducted over a five-month period between July and November, 2012. The study setting was in three provinces of western Iran (e.g. East Azerbaijan, Kermanshah and Kordestan). Data on the number of sewing machine operators in the study area was obtained from the Iranian Ministry of Industries and Mines. There were a total of approximately 5000 operators involved in sewing machine operating tasks in the study region who worked at approximately 470 different workshops. Sampling was done by a multi-stage random selection process. The first stage was to select workshops (n = 60) using probability proportion to size sampling method. The number of operators in each of these selected workshops ranged from 6 to 15, with a total of 525. Using the same procedure, 251 participants (151 males and 100 females) were then selected from these workshops. Each participant was familiarised with the study procedure and any questions were answered by the investigator. A written informed consent form was signed by each operator before participation in the study. The participation was strictly on a voluntary basis and the operators were under no obligation to complete the study. The data collection was performed using a questionnaire and direct observation of the operators during their work. The operators were not paid for their participation. The study protocol was reviewed and approved by the ethical review committee of Tabriz University of Medical Sciences.

2.2. Data collection

Data for demographic, work-related and musculoskeletal symptoms were recorded using a questionnaire. Demographic details included: age, gender, height, weight, body mass index (BMI as weight/height^2), educational level (illiterate, primary school, secondary school and diploma), marital status (single or married) as well as individual habits such as being involved in regular sport and physical activities each week and smoking habits of the respondents. The questions regarding the work-related items were based on the relevant literature (Westgaard and Jansen, 1992; Li et al., 1995; Herbert et al., 2001; Öztürk and Esin, 2011; Dianat and Salimi, 2014) and included: number of years worked as an operator, number of hours worked per day and week, job satisfaction based on the survey question: "How much are you satisfied with your job? low, moderate and high", perceived speed of work: "Does your work require you to work very fast? yes/no", duration of continuous work without a break (>10 min): "How many hours do you usually work without breaks (breaks > 10 min)?", and perceived pressure due to work: "Do you feel pressure due to work? yes/no". There were also questions regarding the workstation design including the use of adjustable chairs (yes/no) and operators' satisfaction with the design of sewing machines and tables (with response alternatives: low, moderate and high).

The frequency of musculoskeletal symptoms in different body regions was measured using the standardised Nordic Musculoskeletal Disorders Questionnaire (Kuorinka et al., 1987). This questionnaire was translated and revised into Farsi and has an established validity and reliability (Dianat et al., 2013, 2014; Dianat and Karimi, 2014). The respondents were asked to indicate if they had experienced any ache, pain, discomfort or numbness in the last 12 months for different body regions using a body map. Those operators who reported musculoskeletal symptoms in any of the body regions were also asked to indicate the severity of these in each of the different body areas, using a scale of 0 – no pain to 5 – very high pain. The questionnaire was administered by one of the authors interviewing the operators and took approximately 15 min to complete.

The questionnaire was tested through a pilot study on a sample of 30 participants and minor word modifications were made on some items of the questionnaire. The test-retest reliability (stability) of the items of the questionnaire was evaluated with Kappa coefficients. The kappa coefficients ranged from 0.82 to 0.99, indicating a good reliability of the measure.

In addition to these data, Rapid Upper Limb Assessment (RULA) (McAtamney and Corlett, 1993) was used to evaluate the working postures of operators at their workstations. RULA, as a reliable and validated observational method, can be used for assessment of biomechanical and postural loading on the musculoskeletal system which is known to contribute to MSDs. This method was designed for assessing the severity of postural loading and is particularly applicable to sedentary jobs (Li and Buckle, 1999) similar to the sewing tasks in the present study. In this method, work postures are selected in relation to their perceived severity, frequency of occurrence or other such criteria and a score is calculated for