

Original Research Article

Prevalence of work-related musculoskeletal disorders and analysis of working posture using rapid entire body assessment tool amongst the sewing machine operators in a garment industry: a cross sectional study

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ABSTRACT

Background: Work-related musculoskeletal disorders (WMSDs) are emerging problems and it occurs when there is a mismatch between the physical requirements of the job and the physical capacity of the human body. Study aimed to find out the prevalence of WMSDs, the influence of varied working posture and level of physical activity (PA) for the development of WMSDs amongst the sewing machine operators.

Methods: This is a cross-sectional study and conducted in a garment industry at Vapi, Gujarat. By purposive sampling technique, 100 sewing machine operators having minimum one year of experience, in the age group of 18-60 years were recruited with their consent. Örebro Musculoskeletal pain questionnaire (ÖMPQ), Rapid Entire Body Assessment tool (REBA), Quick Exposure Check tool (QEC) and International Physical Activity Questionnaire (IPAQ) was administered to all the participants. Data was analyzed using SPSS 24 software. Descriptive statistics applied for categorical variables, Spearman Rank correlation coefficient (r) was calculated for the relationship between PA and WMSDs.

Results: This study revealed the prevalence of WMSDs as 70% and low back pain was the commonest complaint. REBA demonstrated that 55% of participants were at high musculoskeletal risk and 44% were at very high risk. QEC identified that neck region had very high exposure risk for the development of WMSDs. The level of PA shows no association with WMSDs ($r = 0.040$, $p=0.62$).

Conclusions: Sewing machine operators of this study adopted a poor working posture which corresponds to the development of high musculoskeletal risk and an increased prevalence of WMSDs.

Keywords: Musculoskeletal disorders, REBA, Sewing machine operators

INTRODUCTION

Occupational health hazards are not uncommon in working places and the prevalence of Work-related musculoskeletal disorders (WMSDs) is on the rise. WMSDs occur when there is a mismatch between the physical requirements of the job and the physical capacity

of the body of worker.¹ World Health Organization (WHO) had identified multi-factorial risk factors like physical and psychosocial factors particularly in those involved in sedentary and repetitive activities for the development of WMSDs.² WMSDs has a vast impact on the health, productivity, and careers among the working population.

Textile industry is one of the oldest industries in India, and millions of people are employed with it.³ The work of sewing machine operators requires high precision, coordination, speed and repetitive movements, thus identified to have high ergonomic risks.^{4,5} Literature has identified poorly designed workstation such as non-adjustable seat heights and back rests, quality of machine, height of table, vibrations and noise made from machine and adaptation of prolonged awkward posture as risk factors for the development of WMSDs amongst them.^{3,6}

Various studies revealed that prevalence of low back pain, neck pain hands/wrists pain as common WMSDs and few have cited for hearing discomfort, visual discomfort, respiratory and skin problems among the sewing machine operators. However, these studies are limited to finding out the prevalence and lacked in associating with work related risk factors and/or individual factors.^{5,7-9} In order to mitigate the development of WMSDs it is often necessary to identify and evaluate the workplace risk, work practices of individual, working posture, functional capacity and anthropometric variability.

Awkward posture is one of the primary risk factors WMSDs. Since prevalence studies of WMSDs amongst sewing machine operators are very limited in India and lacked in assessing worker's varied postures, we lack awareness to what extend the varied awkward posture can influence development of WMSDs in sewing machine operators in garment industry?

Additionally, limited studies have identified that decrease in Physical activity (PA) increase the risk of depression, anxiety disorders having an impact on the health increasing the risk of WMSDs.^{11,12}

Thus, the primary objectives of this study were to find out the prevalence of WMSDs, to evaluate working posture, to identify the most vulnerable body part which is exposed to risk factors and to evaluate PA in workers of various occupation.

METHODS

This cross-sectional study was conducted from May 2019 to December 2019 at private garment industry located at Valsad district, Gujrat. Prior to conduct this study, Institutional ethics review committee approval was obtained. The study was registered under clinical trial registry India: CTRI/2019/05/018892.

Sewing department consists of five different motorized sewing machines units with a particular task. Single needle lock stitch machine for general sewing. Bartack machine unit, used for dense stitches. Welt pocket machines unit for stitching pockets. Overlock machine unit, used as safety stitches on fabric edges. Feed of the arm machine unit, used for side and inseams stitching of shirts and trousers.

sewing machine operators using electric pedal sewing machine, between the age group of 18-60 years of both genders, having minimum of one year experience, working for 8-10 hours per day and who primarily involved in stitching garments by sitting on the chair were included in this study. Participants having, musculoskeletal pain prior to entering this profession, recent history of spinal/lower limb/upper limb surgeries, inflammatory joint diseases and the pregnant tailors were carefully excluded. To recruit the study participants purposive sampling technique was used. The participants allowed to withdraw if they wish to, at any point of the study period.

Data source/measurement

Demographic details of the participants including hand dominance, years of working, hours of working/day were recorded. To estimate the point prevalence of the musculoskeletal disorders, the workers were interviewed using reliable and valid Örebro musculoskeletal pain questionnaire (ÖMPQ).¹³ To analyse body postural risks during the task, REBA a reliable, sensitive ergonomic assessment tool was used.^{14,15} Camera was used to record the lateral view video and anterior view pictures, in accordance with Helen Hayes protocol.¹⁷ These were analyzed using a free 2D motion analysis Kinovea software to find out the angle of body parts used in REBA worksheet.^{16,18} To calculate the exposure risk for the development of WMSDs of body segments, QEC tool was used. QEC additionally is used to determine the action levels for ergonomic changes.¹⁹

To measure the level of physical activity (PA), International Physical Activity questionnaire (IPAQ) was used. Based on the score levels of physical activity were classified as low, moderate and vigorous level.²⁰

Sample size was calculated by epi info software, considering 55% as prevalence rate of WMSDs in garment manufacture unit, as reported by Mehta R in 2012, at 90% confidence level, sample size arrived at 67, considering 10% rejection rate, sample size was rounded off to total 100.⁸ Permission was procured from the concerned garment industry. Purpose of study was explained to all the participants and written consent was obtained.

Statistical analysis

Data was collected, coded, tabulated and analysed using SPSS 24 software. On Application of Shapiro-Wilk test, all the continuous variable showed freely distributed data therefore non-parametric test was adopted. Descriptive statistics such as frequency distribution and percentage were calculated for all categorical variables. Whereas mean and standard deviation for continuous variables. To find out association of WMSDs with age group, sitting hours, gender and BMI cross tabulation chi-square was applied. To find out relationship between level of PA and

its influence on OMPQ disability risk, Spearman Rank correlation coefficient (r) was calculated.

RESULTS

A total of 100 sewing machine operators were participated in this study and their recruitment strategy is shown using STROBE flow diagram in Figure 1. Their age ranged from 19-59 years and mean age of 33.06±8. Other demographic details of the participants are presented in Table 1.

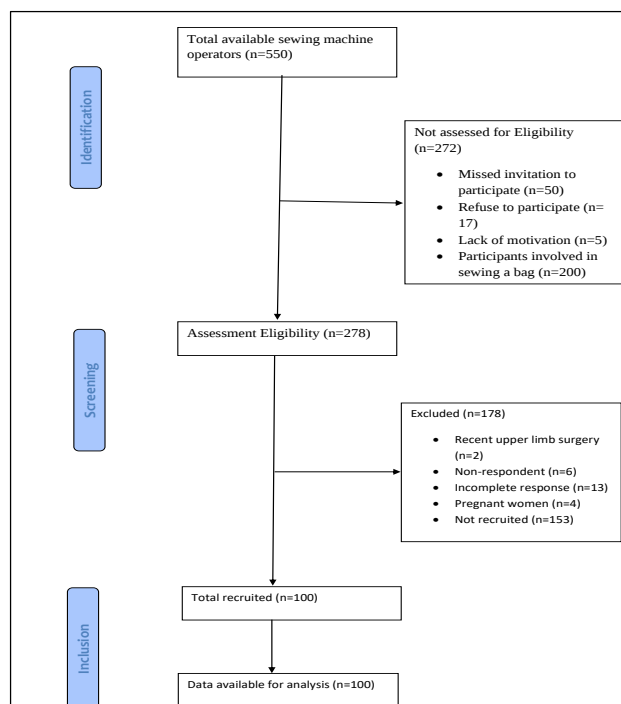


Figure 1: Participant's recruitment strategy.

The prevalence of musculoskeletal symptoms amongst the participants was found to be 70%, in which 40% were females and 60% were males. Based on the possible multiple response, low back pain was found in 60% of respondent. Pain in different body parts, perceived by the participants are shown in Figure 2. In addition to that 24.29% also reported to have a discomfort in the eyes.

The intensity of the pain was measured using numerical rating scale (NRS). Based on the NRS score, pain was categorised as no, mild, moderate and severe pain. It was observed that during the past 1 week 8.6% participants had No pain, 34.3% had mild pain, 41.4% had moderate pain and 15.7% had severe pain. And during past 3 months, 3% participants had No pain, 45.3 % had mild pain, 25.8% had moderate pain and 25.8% had severe pain.

Considering pain episode for past three months, 97.1% participants experienced pain episode, in which 28.6% always had musculoskeletal discomforts. With various adopted coping strategies to deal with pain, 50% of the

participants were able to decrease the pain intensity to zero, 12.9% could bring it to mild intensity of pain, 20.1% to moderate and 17.1% remained in high intensity of pain. Participant's duration of the current pain is shown in Figure 3.

Table 1: Demographic details of study participants.

Variables	Frequency in percentage
Gender	
Male	62
Female	38
Age distribution in decade	
2 nd	2
3 rd	38
4 th	35
5 th	25
Types of sewing machine operators	
Single needle lock stitch machine	76
Bartack machine	5
Welt pocket machine	2
Overlock machine	15
Feed of arm machine	2
Years of experience	
Range	1 to 28 years
Mean and SD	8.94±6.58 years
Working hours/day	
8	86
9	1
10	6
12	7
Mean and SD	8.41±1.10hrs
Working days/week	6
BMI	
Range	15 to 41 kg/m ²
Mean	21.92±3.84 kg/m ²

SD: Standard deviation

Based on the score obtained in OMPQ from each participant, various disability risk group were formed. Figure 4 demonstrates gender wise frequency of the categorized disability risks; here no pain means no disability risk.

Among the participants who had pain, 42.9% had different levels of anxiety and 51.4% felt depressed to varied extent in past one week. Moreover, 61.4% feared that the pain may become persistent, 15.7% felt that they might have to switch their job due to pain and 81.4% stated that they were satisfied with their job. Level of trouble faced by the participant's in performing various daily activities, due to pain, are demonstrated in Table 2.

Table 3 gives the details of the percentage of participants with each REBA score. Participants are categorized into various postural risk groups according to their score, which is demonstrated in Figure 5.

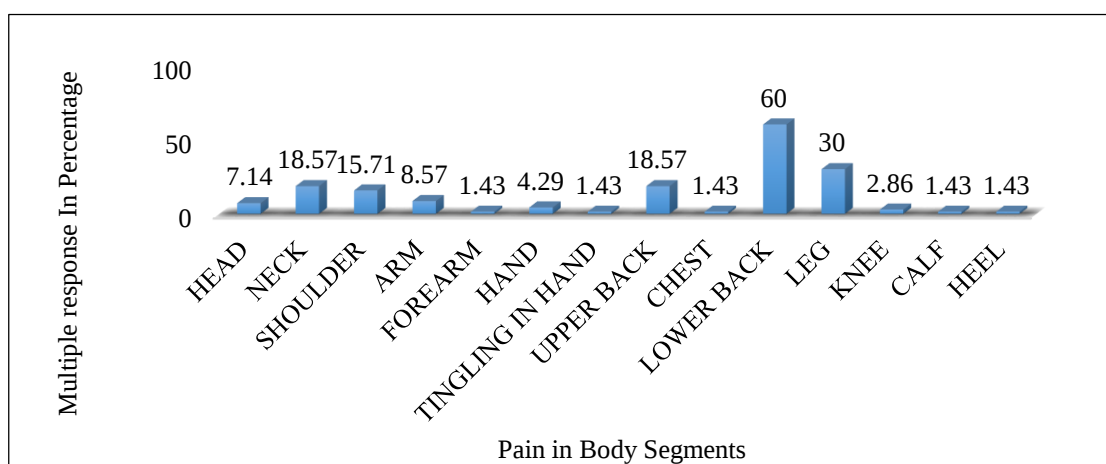


Figure 2: Prevalence of WMSDs in sewing machine operators.

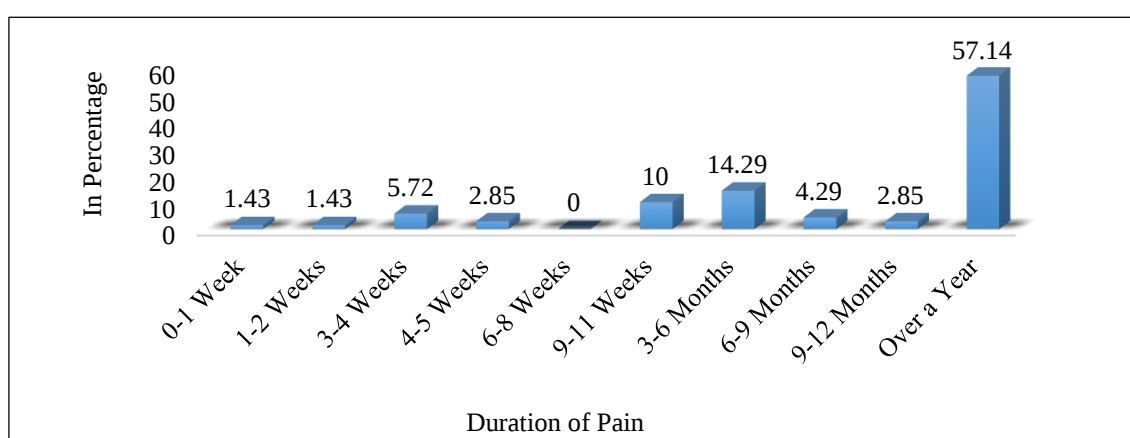


Figure 3: Participant's duration of current pain.

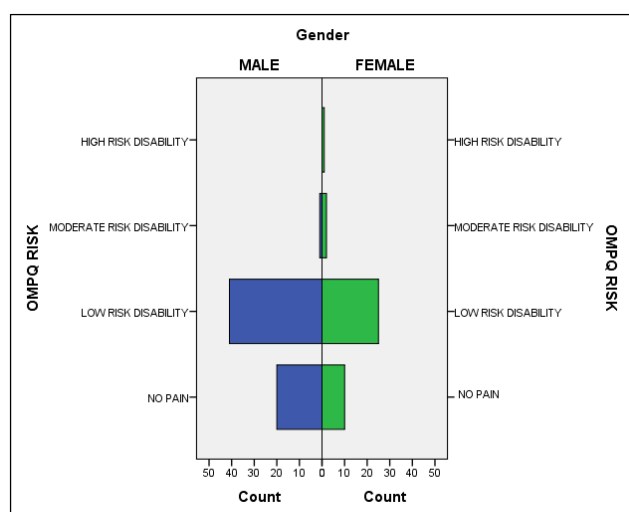


Figure 4: Participant's disability risk.

Based on the assessed physical exposure to musculoskeletal risk by QEC, their categorized risk score is shown in Table 4.

Table 2: Level of trouble in performing daily activities.

Activities	No or minimal trouble (%)	Moderate trouble (%)	Maximum trouble (%)
Light work for an hour	78.57	17.14	4.29
Walk for an hour	88.57	10	1.43
Ordinary household chores	80	14.29	5.71
Weekly shopping	80	18.57	1.43
Sleep at night	88.57	8	0

Table 5 shows the participant percentage for the action levels for the ergonomic changes to be done based on their score.

According to IPAQ, 57% of participants had high PA, 36% had medium and 7% had low PA. IPAQ identified the mean sitting hours/day as 7.81 ± 1.538 hrs. Three strata

were made for average sitting hours/day/week, which are <6hours, 6-8 hours, >8 hours. It was identified that 64% participants had 6-8 hours sitting, 35% had more than 8

hours of sitting. Thus, only 1% of participants had an active lifestyle rest all had sedentary lifestyle.

Table 3: Distribution of REBA scores for each study participant (n=100).

	Participants in percentage													
REBA score	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Neck	-	1	56	43			-	-	-	-	-	-	-	-
Trunk	0	0	17	62	21	0	-	-	-	-	-	-	-	-
Leg	-	0	1	99	0	-	-	-	-	-	-	-	-	-
Load	100	0	0	0	-	-	-	-	-	-	-	-	-	-
Upper arm		6	12	50	29	2	0	-	-	-	-	-	-	-
Lower arm	-	52	48	-	-	-	-	-	-	-	-	-	-	-
Wrist	-	0	0	100	-	-	-	-	-	-	-	-	-	-
Couple score	0	0	0	100	-	-	-	-	-	-	-	-	-	-
Table A	-	0	0	0	1	11	44	29	14	1	-	-	-	-
Score B	-	0	0	0	0	1	12	5	68	0	13	1	0	-
Table C	-	0	0	0	0	0	1	6	9	40	37	7	0	-
Activity score	-	100	0	0	-	-	-	-	-				-	-
Total REBA score	-	0	0	0	0	0	0	1	6	9	40	37	7	0

Table 4: Participant percentage distribution based on exposure level in QEC.

Row- body part exposure/ column participant percentage	Low exposure	Moderate exposure	High exposure	Very high exposure
Back	0	14	84	2
Shoulder/arm	0	17	83	0
Wrist/hand	0	1	99	0
Neck	0	0	0	100

Table 5: Summary of action levels.

Action levels	Scores	Participant percentage	Remarks
1	<40	0	Acceptable
2	40-49	0	Investigation further
3	50-69	98	Investigation further and change soon
4	>=70	2	Investigation further and change immediately

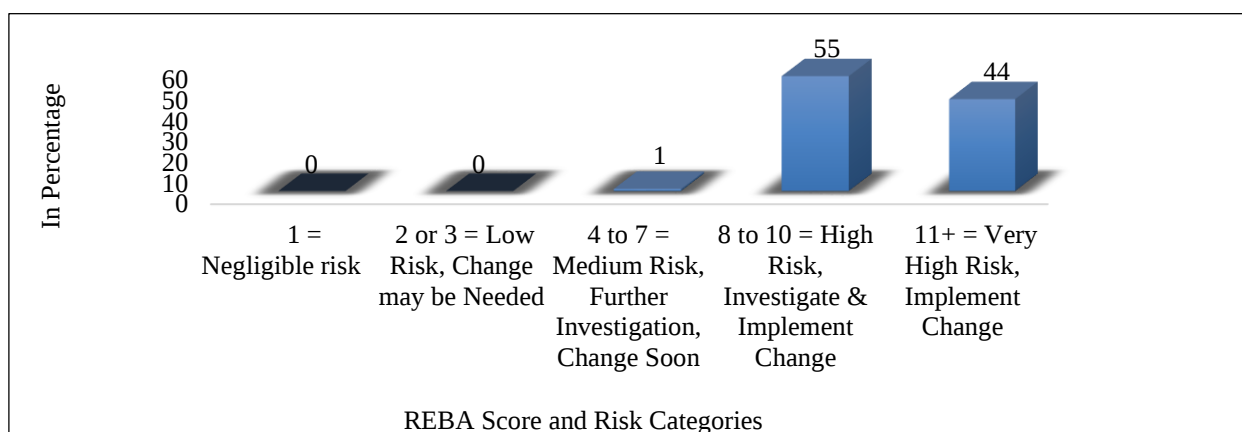


Figure 5: Sewing machine operators REBA score and risk categories.

The correlation coefficient of $r = 0.040$, $p=0.62$ was obtained between PA with OMPQ risk, indicates that

there is no correlation of the level of physical activity performed by and the disability risk of the participants.

To find out association of pain with age, gender, BMI, sitting hours variables Chi-Square test was used, p values were calculated with $\alpha = 0.05$. The association p values were 0.616, 0.527, 0.113, 0.595 respectively, concluding no association.

DISCUSSION

Sewing machine operators job requires prolonged sitting hours, large degree of shoulder and elbow movements with hand manipulations and high visual demand. The workers were supervised, hence worked continuously at a high pace without a rest period.

The high prevalence of 70% WMSDs with low back reported common site of pain in this study is similar to many other studies.^{7,10,27,29,30} However, findings of our study are in contrast with other researchers which identified neck pain as common prevalence in these workers.^{21,23}

The participants used chairs without lumbar support, hard and flat seat leading to poor pressure distribution and posterior pelvic tilt, compromising lumbar lordosis increasing the biomechanical disadvantage of the lumbar spine causing overwork of the back extensors in flexed posture, altering the blood supply to the muscles and electrolyte imbalance, triggering fatigue, eventually leading muscle spasm, soft tissue strains, micro tears and finally reduced strength and endurance leading to mechanical pain.^{27,25} Furthermore, repetitive activity does not allow the soft tissues to get enough rest to recover from the damage thus postural homeostasis is compromised.^{24,26}

The tables were at an ideal height to perform precision work, thus reducing the subconscious lifting of shoulder keeping the elevators relaxed, reducing strain over the shoulders and eventually neck troubles. This could be the reason that we had low prevalence of shoulder and neck WMSDs unlike the other studies mentioned earlier.

This study revealed that 24.29% had eyestrain which is similar to study by Van et al.²¹ As the distance between eye and the object being viewed reduces below 610-930mm, the ocular muscles work continuously for accommodation of the visual field leading to fatigue of the ocular muscles thus results in eyestrain.²⁴

In spite of suffering from pain, 80% percent of the workers did not take leave and continued their job, this explains why more than half of the participants had a persisting pain over a year. Job security, monetary needs were the other factor that motivated the worker to continue work. The unattended repetitive micro injuries and inability to cope up with pace and stress, workers often plan to retire early or change their jobs. In our study, 15.7% were thinking about changing their current job due to unresolved pain and similar findings were

observed in study performed in Sri Lanka by Lombardo et al.²²

High-risk posture identified in REBA, contributed the development of WMSDs thus it demands a priority in implementing changes in their workstation which is consistent with Upasana et al and explains inappropriate posture and the WMSDs go hand in hand, indicating lack of ergonomic awareness about workstation.²⁸

Very high-risk exposure of neck identified in this study; however the study prevalence of neck pain was less. This could be due to healthy worker effect.^{23,30} Constant bent and twisted neck while working along with high visual demand explains why neck was at very high-risk exposure among all.

Manipulating the cloth causes compression from grasping edges of the fabric concentrating force on small areas of the fingers. Repetitive task and high pace manipulations, with inadequate rest, recovery time and vibration of the table are the reasons for high exposure risk for development of WMSDs at wrist and hand.³¹ Additionally, Stress causes non-postural, involuntary muscle activity, which prevents relaxation leading to exhaustion and ultimately muscle and tissue damage.²⁹

Literature has shown that reduced PA is associated with development musculoskeletal pain.³² This study observed little or no correlation of PA with OMPQ disability risk as most of our participants had PA mainly in house domain. Continual exposure without adequate rest period for repair of structural damage leads to repetitive stress disorder.²⁶ Additionally, physical activity in our study considered the entire week MET usage of the participants and not the physical conditioning activities that have positive effect on muscular strength and endurance. Future study should identify the perceived exertion and nutritional levels of the participants.

Almost 99% of the participants in this study found to be spending 6 or more hours in sitting. Hadgraft et al reported increased health risk for that those adults having sitting occupation spending around 7 hrs of sitting in a day.³³ Thus, this study warrants further to explore how a structured physical activity amongst the sewing machine operators helps in reducing the risk of WMSDs.

The study had limitations in recruiting an unequal number of participants on different machines and not identifying old and new machines, which could have influenced the results.

CONCLUSION

The study concluded a high prevalence of WMSDs amongst the sewing machine operators and lower back is found to be the most affected region. Posture analysis by REBA revealed poor working postures among the participants, which may contribute to the development of

musculoskeletal discomforts at workplace thus draws attention to make ergonomic changes in the workstation. Moreover, neck region has been identified as very high exposure risk by QEC tool and there was little or no correlation between level of PA and WMSDs.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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