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Research Article

Prevalence of Work-related Repetitive Stress Injuries with Reference to Working Posture among Sewing Machine Operators in a Nigerian Community

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ABSTRACT

The prevalence of work-related repetitive stress injury with reference to working posture of sewing machine operators in Mushin Local Government Area of Lagos State, Nigeria was investigated. A cross sectional descriptive survey was carried out among 105 (72 female and 33 male) sewing machine operators within Mushin Local Government Area of Lagos state, Nigeria using two standard questionnaires which captured information on WRSI and a Rapid Upper Limb Assessment (RULA) scale was used to assess the working posture of the participants. The 12-month prevalence of WRSI of the low back, neck, hand and shoulder of the participants in this study was observed to be 35.2%, 12.4%, 5.8% and 3.8%, respectively. There was a significant association between age (p=.008), gender (p=.0047) and low back WRSI. There was also a significant association ($p<0.05$) between WRSI and working posture of the participants. This study showed that low back pain was the most prevalent work-related repetitive stress injury among sewing machine operators in Mushin Local Government Area of Lagos State. Working posture was associated with WRSI.

Keywords: *Occupational health, Working Posture, Risk Factors, Sewing machine*

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INTRODUCTION

In Nigeria, studies on prevalence of work-related repetitive stress injuries among sewing machine operators are scarce, but a few have been done by Akanbi and Ikemefula, (2010), Akodu *et al*., (2013) and Maduagwu *et al*., (2014). A survey study on sewing machine operators in Ibadan Southwest Nigeria was conducted by Akanbi and Ikemefula, (2010). These authors assessed the sewing machine operators' workspace (i.e. sewing machine, chair and surrounding workplace). They also studied the most common risk factors among sewing machine operators, which are adaptations of awkward postures due to poorly designed seating devices that lack adjustable seat heights and back rests, and repetitive nature of sewing machine operators' tasks such as pedaling, and extreme flexion of the trunk and neck.

Akodu *et al*., (2013) conducted research on the prevalence pattern and impact of musculoskeletal disorders among Sewing machine operators in Lagos, south west, Nigeria. A prevalence rate of 92.0% was reported and the low-back (78.0%) was the most affected body part. Another study done by Maduagwu *et al* (2014) was designed to determine the prevalence of WMSDs in sewing machine operators in Maiduguri and it was reported that the most frequently affected body parts was the neck (31.4%).

The workplace found in clothing industries can expose workers to unfavourable working conditions due to the presence of physical hazards, ergonomic and mechanical, which can compromise the health of workers. (Dellerman, 2002). The tasks carried out as a sewing machine operator are usually performed in a sitting position throughout the day while working, with additional factors contributing to the development of these diseases such as repetitive motion, and high force requirement. The posture assumed by these professionals and the intensity of the workday, provide discomfort and pain, which can generate future pathologies in the neck, back and upper limbs (Dellerman, 2002). The seamstresses are responsible for organizing the workplace, preparing sewing machines and sewing clothes. They have to prepare parts for sewing and embroidery, using the templates

to sew the embroider pieces made accessories, and also check the quality of sewing and finishing of apparel pieces (Melo Junior, 2012). For the development of the task of sewing, many manual tasks are performed and these require a visual accompaniment to the inherent requirement of the task, this means that the torso and head are inclined forward. The neck and the back is subjected to strains maintained for long periods, which may cause pain, as well as the back, which is also subjected to stress, when it is necessary to rotate the body while the worker is on a fixed seat (Melo Junior, 2012) . In this activity, it is emphasized that the work in the clothing industry involves monotonous, highly repetitive tasks performed in a sitting posture with the upper back curved and the head directed to the sewing machine (Kaegaard and Andersen, 2000).

Studies by Akodu *et al*., 2013, Maduagwu *et al*., 2014 have assessed the prevalence of repetitive strain injuries among sewing machine operators in Nigeria but none have assessed the association between working posture and work-related repetitive stress injuries of this particular population. This study was hence designed to determine the prevalence of Work-related Repetitive Stress Injuries (WRSI) with reference to working postures of sewing machine operators in Mushin Local Government Area of Lagos state.

MATERIALS AND METHODS

Research design; A descriptive cross-sectional survey design was employed.

Participants: One hundred and five (105) sewing machine operators participated in this study. They were recruited from tailoring shops within Mushin Local Government Area of Lagos State, Nigeria. Included in this study were professional sewing machine operators with at least one year experience and who do no other kind of professional activity besides sewing. Excluded from this study were sewing machine operators who are no longer in practice,

Ethical approval: Prior to the commencement of the study ethical approval was sought and obtained from Health, Research and Ethics Committee of College of Medicine, Idi-Araba, Lagos (CMUL HREC) (approval number: CMUL/HREC/05/17/151) and informed written consent was obtained from the subjects prior to commencement of the study. Subjects were assured of confidentiality and anonymity of their data. Copies of the questionnaire were then distributed to the subjects by the researcher. The aims and objectives of the study were clearly explained to the subjects before administering the questionnaire. The questionnaires were then collected upon completion.

Methodology: The questionnaires titled Nordic musculoskeletal questionnaire (Kuorinka *et al* 1987) has been found to be valid and reliable and RULA employee assessment work sheet (McAtmney and Corlett, 1993) were used for data collection. The Nordic musculoskeletal questionnaire consisted of 40 forced –choice items divided into 3 sections:

Section 1: consist of physical and socio demographic data of the subjects, and this include; age, sex, marital status, years spent on job, weight, height, body mass index (BMI),
Section 2: collected data on the working condition of the participants.
Section 3: sought information on the work related repetitive stress injuries of neck, shoulder, hands, lower back of the subjects. Completion was aided by a body map to indicate the symptom sites. Respondents were asked if they had ever experienced any musculoskeletal trouble before and in the last 12 months which has prevented normal activity.

The RULA scoring system, a quick survey method for use in ergonomic investigations of workplaces where musculoskeletal disorders and repetitive stress injuries are reported indicates the level of intervention required to reduce musculoskeletal disease risks. It requires no special equipment and provides a quick assessment of the posture of neck, trunk, upper limbs and lower limbs (Yip *et al*, 2008), scores range from1-7. The researcher interviewed the sewing machine operators being evaluated to gain an understanding of the job tasks and demands, and then observed the worker's movements and postures during several work cycles. Selection of the postures evaluated were based on: 1) the most difficult postures and work tasks (based on worker interview and initial observation), 2) the posture sustained for the longest period of time, or 3) the posture where the highest force loads occur (Middlesworth, 2018).

A score of 1 or 2 indicates an acceptable posture with no risk of injury from the posture assumed while working; 3 or 4 indicates that further investigation is needed and changes may be required because the individual is working in a posture that could cause certain risk from their working posture, this score might be as a result of one part of the body in a awkward posture; 5 or 6 indicates a need for investigation and changes are required as soon as possible because the person is working in an awkward posture which might result into injury. A score of 7 indicates immediate investigation and changes are required immediately because the person is assuming a very bad posture while working (McAtmneyl and Corlett, 1993).
The RULA employee work sheet consists of 7 sections:
SECTION A: measures the position of the upper arm with score ranging from 1-6, SECTION B: measures the position of the lower arm with a maximum score of 3, SECTION C: measures the position of the wrist, with a maximum score of 6, SECTION D: measures the position of the neck, with a maximum score of 6, SECTION E: This section measures the position of the trunk with a maximum score of 6, SECTION F: measures the leg score; time spent on the machine at a stretch, with a maximum score ranging from l-2, SECTION G: This section measures the force/load score and hours spent on the machine per day. The RULA employ worksheet is divided into two body segment sections on the labeled A and B. Section A (left side) covers the arm and wrist. Section B (right side) covers the neck, trunk and legs. This segmenting of the worksheet ensures that any awkward or constrained postures of the neck, trunk or legs which might influence the postures of the arms and wrist are included in the assessment. The evaluator should score Group A (Arm & Wrist) postures first, then score Group B (Neck, Trunk & Legs) postures for left and right. For each region, there is a posture scoring scale

and additional adjustments outlined on the worksheet which need to be considered and accounted for in the score. For example, the score will be rated as 1, if the upper arm is in the range of 20° extension to 20° of flexion, whereas if the load or force is less than or equal to 2 kg and is held intermittently, the score is 0; the muscle score is 1 if an individual repeats an action for more than 4 times per minute (Van *et al*, 2016).

Summations of these scores give the RULA score. This was assessed in the subjects by the researcher through observation and scoring the positions of neck, upper limbs trunk, and lower limbs while the subjects were working with the sewing machine. A high score indicates immediate investigation for musculoskeletal risk, while a low score indicates acceptable posture to assume.

Statistical methods

The data were analyzed using Statistical Package for Social Science (SPSS) version 21 and summarized using descriptive statistics of mean, standard deviation, frequency, percentages, and pie charts. Inferential statistics of chi-square test was used to find the association between variables. The level of significance was set at $P<0.05$.

RESULTS

A total of 120 structured questionnaires were distributed to assess prevalence of neck and upper extremity repetitive stress injuries with reference to working posture among sewing machine operators in Mushin Local Government, Lagos State. 108(90.0%) of the questionnaires were returned but 105 were found adequate for analysis giving a response rate of 87.5%.

Table 1 shows that majority 26(24.8%) of the respondents were within the age range of 21-25years followed by 18(17.1%) of the respondents who were within 15-20years of age. Only 8(7.6%) of the respondents were above the age of 50years. The mean age of the respondents was 32±12.2years. 72(68.65%) of the respondents were females, while only 33(31.4%) were males. 30 (28.6%) of the respondents' weight were within 56-60kg, 22(21.0%) of the respondents had weight that is greater than 70kg while only 8(7.6%) had less than 50kg. Majority of the respondents 82(78.1%) have a normal Body Mass Index (BMI) range of between 18-24.5 while 8(7.6%) were underweight and none of the respondents had BMI that is greater than 30. 48(45.7%) of the respondents had spent between 1-5 years in their job, 12(11.45%) had spent 16-20 years while only 3(22.9%) had spent between 26-30 years and above 30 years respectively (Table 1).

Prevalence of work-related repetitive stress injury: Table 2 shows the lifetime prevalence of WRSI of the participants. Low back 61(58%) complaints were most prevalent among the respondents followed by neck pain 36(34.3%), hand pain 24(22.9%), and lastly, shoulder pain 19(18.1%).

The 12-month prevalence of low back, neck, hand and shoulder complaints of the respondents was 37(35.2%), 13(12.4%), 6(5.8%) and 4(3.8%), respectively.

Working Hours of The Respondents: Table 3 shows that on the average most 56(53.3%) of the respondents said they work 5-10hours per day, followed by 38(36.2%) of the respondents who work 11-15hours per day. Majority i.e. 75(71.4%) of the respondents work 6 times in a week while only 2(1.9%) work 4 times in a week. Eighty three (79.0%) of the respondents said they take a break while 29(27.6%) out of the 83 said the break lasts for 30minutes**.**

Table 1:
Socio-demographic characteristics of the respondents.

Variables	Frequency (n)	Percentage (%)
Age (years)		
15-20	18	17.10
21-25	26	24.80
26-30	17	16.20
31-35	8	7.60
36-40	13	12.40
41-45	4	3.80
46-50	11	10.50
>50	8	7.60
Total	**105**	**100.00**
Mean age: 32±12.2		
Sex		
Male	33	31.40
Female	72	68.60
Total	**105**	**100.00**
Weight (Kg)		
<50	8	7.60
50-55	16	15.20
56-60	30	28.60
61-65	19	18.10
66-70	9	8.60
>70	22	21.00
No response	1	1.00
Total	**105**	**100.00**
Mean weight: 62.9±10.1		
Height (m)		
1.50-1.55	1	1.00
1.56-1.60	5.70	
1.61-1.65	43	41.00
1.66-1.70	37	35.20
>1.70	17	16.20
No response	1	1.00
Total	**105**	**100.00**
Mean height: 65.8±7.0		
Body Mass Index (kgm^2)		
<18	8	7.60
18-24.5	82	78.10
25-29.5	14	13.30
30 and above	0	00
No response	1	1.00
Total	**105**	**100.00**
Mean BMI: 22.2±2.8		
How many years have you spent on the job?		
1-5	48	45.70
6-10 19		18.10
11-15 13		12.40
16-20 12		11.40
21-25 7		6.70
26-30 3		2.90
>30 3		2.90
Total 105		**100.00**
Mean years: 10.2±9.0		

Table 2:
12-month prevalence of neck, low back, shoulder and hand complaints of the respondents

Variables	Frequency (n)	Percentage (%)
Have you ever had any neck complaint?		
Yes	36	34.30
No	69	65.70
Total	**105**	**100**
In the past 12 months have you had neck complaints?		
Yes	13	12.40
No	22	21.00
No response	70	66.70
Total	**105**	**100.00**
Have you ever had low back complaints?		
Yes	61	58.00
No	43	41.00
No response	1	1.00
Total	**105**	**100.0**
In the past 12 months have you had low back pain complaints?		
Yes	37	35.20
No	20	19.00
No response	48	45.80
Total	**105**	**100.0**
Have you ever had any shoulder complaints?		
Yes	19	18.10
No	86	81.90
Total	**105**	**100.0**
In the past 12 months have you had shoulder complaints?		
Yes	4	3.8
No	12	11.4
No response	89	84.80
Total	**105**	**100.0**
Have you ever had any hand complaints?		
Yes	24	
No	81	
Total	**105**	**100**
In the past 12 months have you had hand complaints?		
Yes	6	5.70
No	18	17.20
No response	81	77.10
Total	**105**	**100**

RULA Score
Figure 1 shows that 17(16.2%) of the respondents have acceptable posture with a RULA score between '1-2' while 39(37.1%) of the respondents need further investigation. Twelve (11.4%) of the respondents have a RULA score of '7' which is significantly poor.

Association between RSI and Age, Gender, Years of experience and 12-month prevalence of WRSI.
There is no significant association between respondents age (p=.668), gender (p=.103) and years of experience (p=.114) with the 12month prevalence of neck WRSI.

Table 3:
Working hours of the respondents

Variables	Frequency (n)	Percentage (%)
On the average, how long do you work per day?		
5-10 hours	56	53.30
11-16 hours	38	36.20
16-20 hours	7	6.70
21-24 hours	4	3.80
Total	**105**	**100**
How many days do you work in a week?		
4	2	1.90
5	15	14.30
6	75	71.40
7	12	11.40
No response	1	1.00
Total	**105**	**100**
Do you take breaks/rest during work?		
Yes	83	
No	21	
No response	1	
Total	**105**	**100**
If yes, how often?		
10 minutes	11	10.50
20 minutes	10	9.50
30 minutes	29	27.60
60 minutes	23	21.90
120 minutes	8	7.60
240 minutes	1	1.00
No response	23	21.90
Total	**105**	**100**

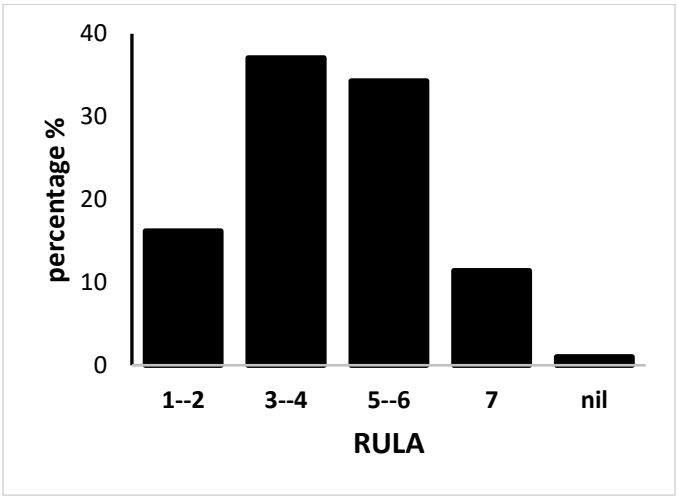

Figure 1:
RULA employee assessment score of the respondents
Key: 1-2 = acceptable posture, 3-4 = further investigation, change may be needed, 5-6 = further investigation, change soon, 7 = investigate and implement change.
RULA-Rapid Upper Limb Assessment.

There is no significant association between respondents age (p=.932), gender (p=.596) and years of experience (p=.748) with the 12-month prevalence of shoulder WRSI.

There is no significant association between respondents age (p=.693), gender (p=.223) and years of experience (p=.241) with the 12month prevalence of hand WRSI.

There is a significant association between respondents age (p=.008) and gender (p=.047) with the 12 months prevalence of low back WRSI but no significant association with their years of experience (p=.27) and prevalence of low back WRSI.

Table 4 shows that there is a significant association between neck complaints (p=.000), shoulder complaints (p=.007), hand complaints (p=.002), low back complaints (p=.000) and working posture of the respondents.

Table 4:
Association between WRSI of neck, shoulder, hand, low back and working posture of the respondents.

Variables	RULA scores						p-value
	1-2	3-4	5-6	7	Total	X^2	
Neck complaints							
Yes	1	5	20	10	36		
No	16	34	16	2	68	**33.95**	**.000***
Total	**17**	**39**	**36**	**12**	104		
Shoulder complaints							
Yes	0	6	7	6	19		
No	17	33	29	6	85		
Total	**17**	**39**	**36**	**12**	**104**	**12.14**	**.007***
Hand complaints							
Yes	1	5	11	7	24		
No	16	34	25	5	80		
Total	**17**	**39**	**36**	**11**	**104**	**14.68**	**.002***
Low back complaints							
Yes	2	15	32	11	60		
No	14	24	4	1	43		
Total	**16**	**39**	**36**	**12**	**103**	**39.46**	**.000***

DISCUSSION

The aim of this study was to determine the prevalence of work related repetitive stress injuries with reference to working posture among sewing machine operators in Mushin Local Government Area of Lagos State, Nigeria.

In this study the lifetime prevalence of low back, neck, hand and shoulder work- related repetitive stress injury was observed to be 58.0%, 34.35%, 22.9% and 18.1% respectively making the low back the most frequent area of discomfort among the participants. While the 12-month prevalence of work-related repetitive stress injury for low back, neck, hand, and shoulder was observed to be 35.2%, 12.4%, 5.8% and 3.8%. This might be as a result of awkward postures adopted by the sewing machine operators while working and also the poor working environment they are exposed to. This result is consistent with the findings of the study by Dianat *et al*., (2015) on sewing machine operators in Iran, who reported the prevalence of WRSI in the low back, neck, hands/wrist and shoulder, to be 58.9%,54.1%,40.2% and 27.8% respectively. This result also corroborate with the finding of a similar study conducted among Nigerian secretaries by Akodu *et al*., (2015) and reported that the major WRSI among Secretaries in Lagos State Civil Service Secretariat, Ikeja, include low back (71.3%), Neck (59.3%), shoulder (48.0%) and hand (28.0%). Maduagwu *et al*., (2015) reported the prevalence of major WRSI in the Low back and neck among sewing machine operators in Maiduguri to be 41.7% and 34.7%. The result also agrees with the report of the study by Ozturk and Esin, (2011) who investigated musculoskeletal symptoms and ergonomic risk factors among female sewing machine operators in Turkey, but did not agree with report of the study by Dianat and Karimi (2016) and Van *et al* (2016) who reported the prevalence of RSI to be highest in the neck region.

It was observed from this study that the prevalence of work related repetitive stress injury was higher among female than the male participants; therefore females are more at risk of work related repetitive strain injury. This inference is in agreement with the studies done by Lacerda *et al*, (2005) and Akrouf *et al* (2010), which reported that WRSI prevalence is higher among females than males. This may possibly be as a result of hormonal differences, not to mention psycho-social factors, e.g. poverty, home-life (i.e. taking care of children), living in a patriarchal society and the pressures and inequalities. It may also be as result of other activities carried out by the males and females asides operating the sewing machine or by other biomechanical differences such as elbow carrying angles and lean body mass as well as psychosocial and cultural phenomena (Hart *et al*, 1998).

The findings of this study also showed that on the average most, (56.3%) of the sewing machine operators' work 5hours per day, followed by 36.2% who work 11-15 hours per day. This might predispose the sewing machine operators to WRSI due to long hours of working in an awkward posture without break. Previous studies by Wang *et al*., (2007); Johnson *et al*., (2008); Dianat and Salimi, (2014), Dianat and Karimi, (2016) have shown that the long duration of sitting at work without a break may influence the risk of WRSI among different occupational groups.

The sewing task includes simultaneous hand and arm movements, and the continuous operation of foot pedals. Poor posture of the trunk, neck and upper extremities, and the monotonous repetitive movements result in a high prevalence of musculoskeletal complaints affecting the back, neck, upper and lower extremities among sewing machine operators (Gahlot *et al*, 2016).

In a study by Wang *et al*, (2007); Sealetsa and Thatcher, (2011), they attributed WRSI of sewing machine operator to be as a result of poor working postures. Typically sewing machine operators perform piece work activities and assembling. The fragmentation of work in this way means that the tasks are often highly repetitive and complex involving coordination of both hands usually performed in a seated working posture for a long time. The posture requires the operator to lean forward with a forward inclined posture of head and trunk to focus their attention and have a better visual control of their task. In many ways the operator has to adapt this posture and viewing angle so they can conduct this form of precision work (Kroemer, 2009) and this can lead to the development of WRSI, particularly in the neck, back and upper limbs (Sealetsa and Thatcher, 2011).

In this study it was shown that there was no significant association between age, gender, year of experience and Work Related Repetitive stress injury (WRSI) of neck, shoulder and hand of the participants. Although there was a significant association between age, gender and WRSI of low back of the participants, but none with their years of experience. This may be due the fact that prevalence of work-related RSI disorders increases as people enter their working years, that is by the age of 35 years, most people have experienced their first episode of back pain (Guo *et al*., 1995). This result is also similar to the findings of Ferreira and Saldiva, (2002), who reported a significant association between years of experience and WRSI among operators engaged in computer-telephone interactive tasks. The result is also consistent with the study of Akodu *et al*, (2014) who revealed a significant association between age and gender of the filling station attendants and prevalence of low back pain. Two other studies also reported a significant association between age and low back symptoms among workers involved in sewing activities (Ozturk and Esin, 201l; Dianat and Salami, 2014). This result is contrary to the findings of the study by Dianat *et al*, (2015) who revealed that there is a significant association between the number of years worked as a sewing machine operator and presence of symptoms in the neck and shoulders. In another study by Akodu *et al*, (2013) on prevalence, pattern and impact of musculoskeletal disorders in sewing machine operators, it was reported that age, frequency of sewing and years of sewing experience on sitting to sew, standing to cut and ironing were significantly associated with prevalence of musculoskeletal disorders among sewing machine operators.

The result of this study revealed that 16.2% of the sewing machine operators in Mushin Local Government Area of Lagos state had an acceptable posture, with a RULA score of 1-2, just over one-third, (37.1%) of the sewing machine operators' postures need further investigation while 11.4% of them had significantly poor postures with a RULA score of 7 which needs to be investigated and change implemented. This still confirms that the sewing machine operators adopt awkward posture when working on the sewing machine. A significant association was seen between work related repetitive stress injuries (low back, neck, hand, shoulder) and working posture of the participants in this study. These results are consistent with the reports by Ozturk and Esin, (2011) of poor working postures assessed by RULA method among sewing machine operators in Turkey as well as Shuval and Dunchin, (2005) among workers of Hitech company in Isreal. There was also an association between working posture and musculoskeletal disorders among garment and sewing machine operators in Cambodia in a study by Van *et al*, (2016). This result also agrees with the report of a RULA assessment study done by Akodu *et al*., (2015) among secretaries who showed that participants with musculoskeletal disorders had a RULA score of 3 or 4 and above. This, according to the RULA guideline implies that posture assumed by participants is poor. This could be as a result of section G of the RULA sheet which measures the hours spent on the machine per day. This study was limited in the aspect of region covered. Confidently a study by Choobineh *et al*., (2004) found that workstation intervention could reduce the prevalence of WRSI and improve the RULA scores of participants with poor working posture.

In conclusion, there was a high prevalence of work related repetitive stress injury, particularly in the low back, neck, hand and shoulder among sewing machine operators that participated in this study. The significant association between WRSI and working posture suggests a poor sewing workstation and suggests that sewing machine operators at their work stations have to be investigated and some changes recommended. It is therefore recommended that work place design modifications and ergonomics should be emphasized among sewing machine operators. By limiting the number of uninterrupted hours of work and allowing adequate rest breaks could lower the frequency and severity of musculoskeletal complaints.

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