

Full Length Research Paper

Ergonomic evaluation and the predictors of occupation related musculoskeletal disorders among tailors in Enugu Metropolis

Echezona Nelson Dominic Ekechukwu^{1,2,3*}, Nwanneka Cynthia Okolo¹ and Blessing Chiagozikam Atueyi⁴

¹Department of Medical Rehabilitation, Faculty of Health Sciences and Technology, College of Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

²Occupational and Environmental Health Unit, Institute of Public Health, College of Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

³LANCET Physiotherapy, Wellness and Research Centre, Enugu, Nigeria.

⁴Department of Medical Rehabilitation, College of Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

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Tailoring task is usually fostered with the adoption of constrained postures, repetitive movements, and prolonged static loading which have been identified as major ergonomic risk factors of occupation related musculoskeletal disorders (OMSD). This study was undertaken to ergonomically evaluate the work set up and determine the prevalence and predictors of OMSD among tailors in Enugu Metropolis. This exploratory cross-sectional study sampled 270 tailors in Enugu metropolis. The Nordic musculoskeletal questionnaire was used to assess OMSD, while a self-structured proforma was used to obtain their demographic details, work related variables and the ergonomic assessment of their workstation. Data obtained was analyzed descriptively and inferentially using Chi-square and logistic regression. The level of significance set at 0.05. Majority of the participants were females (73.0%) and married (72.6%). Most of the participants used seats made of wood (58.1%) and plastic (39.6%) that were neither padded (61.1%) nor had back rest (67.8%). Most of the participants (83.3%) used manual sewing machines. The prevalence of OMSD in this population was 67.0% and was more common around the upper back (43.0%), low back (36.3%) and knees (23.3%). There was a significant association between OMSD and each of age ($\chi^2 = 16.98$, $p = 0.002$), and fatigue ($\chi^2 = 6.198$, $p = 0.013$). However, fatigue was the only significant predictor of OMSD ($\beta = 0.858$, $p = 0.024$). There is a high prevalence of OMSD among tailors in Enugu metropolis, associated with age and fatigue. Work should be terminated at the early onset of fatigue.

Key words: Ergonomics, predictors, occupation related musculoskeletal disorders (OMSD), tailors, Enugu metropolis.

INTRODUCTION

Almost everyone experiences musculoskeletal pain at some point in their lives. This pain which could vary from

*Corresponding author. E-mail: nelson.ekechukwu@unn.edu.ng.

mild to severe and acute to chronic is a major characteristic of occupation related musculoskeletal disorders (OMSDs). OSDs can be defined as impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves or the localized blood circulation system that are caused or aggravated primarily by the performance of work and by the effects of the immediate environment in which work is carried out (Jang et al., 2014). An OSD is well recognized as having a multi-factorial etiology (Odole et al., 2019). Back pain as an example of OSDs could be associated with several causes such as physical stress which could stem from improper techniques while lifting of heavy loads, poor posture, forceful or repetitive movements involving the back (Vieira and Costa, 2010); psychosocial stress from high perceived workload and time pressure, low control and lack of social support at work (Soares et al., 2019); and personal characteristics such as age and tobacco use and physical characteristics such as obesity and height (Ezeukwu et al., 2015). Physical stress majorly caused by restricted posture is associated with some job tasks such as tailoring.

Tailoring is one of the small and medium scale enterprises (SME) in Nigeria (Oni, 2012). It is a major source of revenue especially among the middle and lower classes of the population that constitute the major percentage of the country's population (Schwartz, 2012). A typical tailoring task in this environment is characterized with the adoption of constrained postures, repetitive movements, and prolonged static loading which have been identified as major ergonomic risk factors of OSDs. Tailors sit often and in order to have a good view of their work piece, they usually sit with their backs unsupported, with a forward flexion of their spine especially at the upper and lower lumbar spine. A poor posture could lead to disc injury, as is the case of tailors who spend most of the day sitting. This condition could result in micro-trauma to the outer fibrous ring that may, if ignored, result in disc rupture, protrusion or herniation. The muscles of the low-back and neck are consequently loaded (static loading) by the weights of the back and head, respectively for quite some time. A longer duration of this static loading could be precipitated by work pressure depending on the season of the year with the festive season being the most demanding times for tailors. Cervicalgia among workers could be due to the myofascial pain syndrome or muscle tension in the neck, eventually spreading to the shoulders, a condition characterized by severe pain (Almeida et al., 2012). The tailoring job may therefore expose the workers to this cumulative overuse syndrome (OSD) if these factors are not identified and most possibly nipped in the bud.

Some studies (Tawiah et al., 2015; Lugay and Martias, 2015; Vieira and Costa, 2010) have assessed the musculoskeletal disorders of manual material handlers such as carpenters, miners, drivers, typist, etc. However, there appear to be a dearth of published literatures on the ergonomic evaluation of tailor's workstation, as well as

the prevalence and predictors OSDs of these cohorts in our environment. This study therefore evaluated tailors workstations using ergonomics principles and determined the predictors of OSDs among tailors in Enugu metropolis.

MATERIALS AND METHODS

Participants

This exploratory cross sectional study purposively sampled 270 tailors in Enugu metropolis. All the participants gave a written informed consent. Only adult tailors with at least two years full-time work experience were included while those that presented with possible cofounders such as musculoskeletal abnormality like trauma, fracture and neurological cases such as stroke that were excluded. A minimum sample size of 242 participants was calculated using the expression of effect formula: $N = n (Z_1 - Z_2) / ES^2$, where N = minimum sample size, n = number of groups = 1, Z_1 = α -confidence interval at 0.05 = 1.96, Z_2 = β -confidence interval at 0.01 = 0.84, and ES = effect size = 0.16.

Nordic musculoskeletal questionnaire

The questionnaire consists of structured, forced, binary scale which can be used as self-administered questionnaire or in interview. It was used for the assessment of OSD symptoms. The first section contains demographic variables, anthropometric variables and work-related variables. The second section contains the musculoskeletal discomfort form which specifically focuses of specific body parts. It has been reported to have a test-retest reliability and validity of 23% and 0.8, respectively (Kuorinka et al., 1987). Its sensitivity and specificity ranges are 66-92% and 71-88%, respectively (Ohlsson et al., 1994).

Ergonomic workstation assessment form

This was used to evaluate the workstations of the participants. The form has three sections (A, B, and C). Section A assessed participants' demographic details, this section had 6 items. The second section assessed their job related variables and had 8 items while section C had 6 items and was used to assess the ergonomic details in their workstations. Thus the form had a total of 20 items (such as work duration, work frequency, work volume, job tasks, seat assessment, work surface assessment, reaches, types of sewing machine, rest breaks, etc.) and a categorical scaling (Ekechukwu et al., 2018).

Weighing scale (Hanson, Ireland)

This was used to measure the weight of the participants in kilogram (kg) as described by Ekwuonwu et al. (2016).

Inelastic tape measure (Butterfly, USA)

This was used to measure the hip and waist circumferences of the participants in centimeters (cm) as reported by Ekechukwu and Okoh (2020).

Stadiometer (Harrison, China)

It was used to measure the heights of the participants in meters. It

consists of a long, calibrated, wooden ruler attached to a flat wooden base on which the subject climbed barefooted as reported by Ezeukwu et al. (2015).

Procedures

Ethical approval was obtained from the Health Research Ethics Committee of UNTH; Ituku-Ozala was expedited or exempted. An informed consent form was obtained from the participant before involving them in the study. Participants were told to withdraw from the study if they wish. Information about the participant was kept confidential and every procedure in the questionnaire was explained to the participant before filling the questionnaire.

The participants were approached in their various workstations, and the research objectives explained to the eligible. The NMQ was self-administered; it presented a figure of the human body with nine anatomical regions to assist the participants in marking the corresponding regions of their body on which they had OMSD symptoms (aches, pains, discomfort or numbness) in the last 7 days and the last 12 months. The participants were usually given enough time to fill this questionnaire and submit immediately by hand or at designated collection points. Few cases where the participant was unable to fill the questionnaire immediately, they were allowed to retain the questionnaire, but were asked to fill and turn-in same within a period of two weeks. On the other hand, the Ergonomic Workstation Assessment Form was researcher administered. Items were checked-off when found or seen around the workstation.

Data analysis

Data obtained was analyzed using SPSS version 20 (2014). Descriptive statistics of frequency, percentage, mean and standard deviation was used to summarize participants' variables such as their demographic, OMSDs, and workstation related details. Chi square test was used to evaluate the association between OMSD and each of the demographic details (e.g. age, sex, level of education etc), and work related variables (e.g. work surface, seat features, work fatigue etc). Binomial logistic regression was used to create a model for predicting musculoskeletal disorders. The level of significance was set at $\alpha = 0.05$.

RESULTS

Summary of the demographic characteristics of the participants

A total of 270 subject participated in the study, they all submitted their filled questionnaire. Majority of the participants were females (73.0%), between the ages of 35-44years (40%), married (72.6%), and had only primary/secondary school education (74.4%). Also, most of the participants were self-employed (80.0%), worked between 8 and 10 h per day (78.1%) for 6 days in a week (84.1%) and had common job task of sewing (84.8%) as also shown in Table 1.

The mean height, weight and BMI of the participant in the study were 1.56 ± 0.07 m., 72 ± 12 kg and 29.6 ± 4.3 kg/m², respectively. Also, the mean year of service, volume of work (normal days) and volume of work (festive period) were 11.60 ± 8.70 years, 3.49 ± 8.8 clothes and 6.30 ± 13.9 clothes, respectively.

Assessment of the furniture revealed that the mean seat height, work surface height and work surface width were 0.48 ± 0.03 , 0.76 ± 0.31 and 0.47 ± 0.66 m, respectively shown in Table 2.

Summary of the ergonomic workstation assessment

Most of the participants involved in the study (95.6%) reported that the height of their seat was ideal (suitable) for their usage. However, few (38.9%) of the seats used by these participant were padded. Most of the participant used seats made of wood (58.1%) or plastic (39.6%). Most of the participants had seats with no back support (67.8%) and none of the seats were adjustable (100.0%). Majority of the participants used the leg operated sewing machine (86.77%), and reported being fatigued after their days work (95.6%) shown in Table 3.

Prevalence of OMSDs among the participants

Sixty-seven percent of the participants in this study had an OMSD mostly around the upper back (43.0%), lower back (36.3%) and knees (23.3%). However, only few of the participants reported having their MSDs preventing them from doing their work (5.9%) or troubled by the disorder (1.5%) shown in Table 4.

Association between OMSD and selected variable of the participants

There was a significant association between OMSD and each of age ($\chi^2 = 16.979$, $p = 0.002$), level of education ($\chi^2 = 12.583$, $p = 0.28$), the non-use of seats with back rest ($\chi^2 = 4.524$, $p = 0.33$) and work fatigue ($\chi^2 = 6.198$, $p = 0.013$) of the participants. However, there was a non-significant association between OMSD and the rest of the variables ($p > 0.05$) shown in Table 5.

Summary of the regression model for predisposing OMSD among the participants

A binomial logistic regression model was performed to ascertain the effects of age, level of education, use of seats with back support and fatigue on the likelihood that the participants have OMSD at 12-month. The logistic regression model was statistically significant ($\chi^2 = 30.06$, $p < 0.0001$). The model explained 14.7% of the variance in MSD and correctly classified 71.9% of cases. Fatigue was the only significant predictor ($\beta = 0.858$, $p = 0.024$) of OMSD among the participants as shown in Table 6.

DISCUSSION

This study revealed a high prevalence of OMSD among

Table 1. Summary of socio-demographics of the participants (N = 270).

Socio-demographic details	Category	Frequency	Percentage
Sex	Male	73	27.0
	Female	197	73.0
Age (years)	20-24	22	8.1
	25-34	51	18.9
	35-44	108	40.0
	45-49	54	20.0
	≥50	35	13.0
Marital status	Married	196	72.6
	Single	72	26.7
	Divorced	1	0.4
	Widowed	1	0.4
Level of education	Primary/secondary	201	74.4
	NCE	24	8.9
	OND	20	7.4
	HND	7	2.6
	BSc	9	3.3
	Others	9	3.3
Employment status	Employer	216	80
	Employee	54	20
Active Work duration (h/day)	< 5	19	7.0
	5 - 7	40	14.8
	> 8	211	78.2
Work frequency (days/week)	3	1	0.4
	4	1	0.4
	5	29	10.7
	6	227	84.1
	7	12	4.4
Job task	Cloth cutting	2	0.7
	Sewing	229	84.8
	Brooding	4	1.5
	Weaving	10	3.7
	Multiple tasks	25	9.3

tailors. This finding is similar to the reports of Kaegaard and Andersen (2000) who conducted a case study on OMSD of the neck and shoulders among female sewing machine operators. Similarly, the study by Lugay and Martias (2015) in Philippine on the predictive models of OMSDs among Sewing Machine Operators in the Garments Industry also had similar report. The impact of OMSDs cannot be overemphasized. It ranges from the direct and indirect economic cost such as absenteeism and reduced productivity, health cost. It has also been

linked to heightened presenteeism, early retirement, economic inactivity that usually culminates into reduced quality of work life and general quality of life (Ekechukwu et al., 2017). Tailoring in this environment could be described as a job characterized by high demand, with low control. These are ergonomic concepts that have been found to aggravate OMSDs.

Most of the tailors who participated in this study used leg operated sewing machine. This biomechanics of this task involves constrained posture of the knee joint that

Table 2. Mean distribution of participation variables (N=300).

Variable	Minimum	Maximum	Mean	SD
Height (m)	1.37	1.76	1.56	0.07
Weight (kg)	47	119	72.07	12.06
Body mass index (kg/m ²)	18.01	43.88	29.63	4.29
Year of service	1	45	11.60	8.71
Volume of work (normal)	1	100	3.49	8.79
Volume of work(festivity)	1	150	6.30	13.99
Seat height (m)	0.39	0.59	0.48	0.03
Work surface height (m)	0.45	1.13	0.76	0.31
Work surface width (m)	0.33	1.53	0.47	0.66
Work surface length (m)	0.10	1.20	0.87	0.13
Sites	0	9	1.29	1.25

Table 3. Frequency table showing the ergonomic workstation assessment (N=270).

Variable	Category	Frequency	Percentage
Seat height ideal	Yes	258	95.6
	No	12	4.4
Seat padded	Yes	105	38.9
	No	165	61.1
Seat material	Wood	157	58.1
	Plastic	107	39.6
	Metal	6	2.2
Seat with a back rest	Yes	87	32.2
	No	183	67.8
Seat with arm rest	Yes	61	22.6
	No	209	77.4
Seat adjustability	Yes	0	0.0
	No	270	100.0
Reaches	Yes	266	98.5
	No	4	1.5
Reach frequency	Rare	45	16.7
	Often	156	57.8
	Much	69	25.6
Work surface ideal	Yes	269	99.6
	No	1	.4
Type of sewing machine	Hand operated	2	.7
	Leg operated	234	86.7
	Electronic	34	12.6
Work Fatigue	Present	225	83.3
	Absent	45	16.7

Table 3. Contd.

Job satisfaction	Good	258	95.6
	Poor	12	4.4
Sleep duration/day	<5 h	10	3.7
	5-6 h	145	53.7
	7-10 h	112	41.5
	>10 h	3	1.1
Rest breaks	None	100	37.0
	<2 min/h	8	3.0
	2-5 min/h	23	8.5
	>5 min/h	139	51.5

Table 4. Prevalence of general and regional OMSD among the participants (N=270).

Variable	Category	Frequency	Percentage
General OMSD	-	181	67.0
Regional OMSD	Neck	18	6.7
	Shoulder	33	12.2
	Elbow	2	0.7
	Wrist/Hand	6	2.2
	Upper back	116	43.0
	Low back	98	36.3
	Hip/Thigh	12	4.4
	Knees	36	23.3
Work prevention	Ankles/Foot	22	8.1
	Yes	16	5.9
Trouble	No	254	94.1
	Yes	4	1.5
	No	266	98.5

OMSD: Occupation related musculoskeletal disorder.

will enhance a repetitive movement of dorsiflexion and plantarflexion of the ankle joints. This constrained posture and repetitive motion may probably be responsible for the higher prevalence of knee and ankle OMSDs (23.3 and 8.1%) when compared with those of domestic gas workers of similar demographics with the tailors in this study (8.0 and 2.0%) as reported by Oluka et al. (2020). Also, majority of the tailors in the study worked actively over 8 h per day, in awkward and constrained postures with minimal rest breaks. These are unhealthy recipes for precipitating OMSDs. This finding has been similarly reported by some studies (Bodhare et al., 2011; Lugay and Martias, 2015) which revealed that heavy workload, fixed body positions, non-neutral posture and high work pace as significant risk factors of OMSDs. Volume of

work is best described by the work duration, frequency and intensity which were reported in this study to be high. An important ergonomic control for job tasks characterized by high work load is intermittent breaks such as stretch breaks, rest breaks as well as adequate work pace. These controls give room for the healing of tissue micro-trauma which if neglected may result in cumulative trauma disorders (OMSDs).

There was a significant association between OMSD and each of the age group and fatigue. However, only fatigue was a significant predictor of OMSDs. Although OMSDs are problem amongst both the young and old, it however tends to be more severe in the elderly, this implies that as one ages, they become more predisposed to physiological and degenerative changes that increase

Table 5. Association between MSDs and selected variable of the participants (N=270).

Variable	Categories	n(N)	Percentage (%)	χ^2	p-value
Age(years)	20-24	12 (22)	54.55	16.979	0.002*
	25-34	24 (51)	47.06		
	35-44	75 (108)	69.44		
	45-49	44 (54)	81.48		
	≥50 years	26 (35)	74.29		
Sex	Male	50 (73)	68	0.10	0.756
	Female	131 (197)	66		
Marital status	Married	138 (196)	70	5.31	0.150
	Single	41 (72)	57		
Level of education	Primary/secondary school	146 (201)	72.63	12.538	0.028*
	NCE	10 (24)	41.67		
	OND	11 (20)	55.0		
	HND	4 (7)	57.14		
	B.Sc.	5 (9)	55.56		
	Others	5 (9)	55.56		
Back rest	Yes	46 (87)	55.17	4.524	0.033*
	No	135 (183)	73.77		
Seat material	Wood	104 (157)	66	0.11	0.945
	Plastic	73 (107)	68		
	Metal	4 (6)	67		
Work fatigue	Present	158 (225)	70.22	6.198	0.013*
	Absent	23 (45)	51.11		
Work status	Employer	147 (216)	68	0.51	0.476
	Employee	34 (54)	63		

their odds of developing OMSDs. It is also possible that unhealthy work practices such as poor postures, excessive mental workload, repetitive movements and other behavioural abnormalities in early adulthood may become manifest as one ages. It is therefore pertinent that tailors and workers in other industries adhere to healthy work regulation in line with the common ergonomic slogan of “work to walk”. A common social malady often seen among these cohorts is the insistence to continue working in the face of over work termination criteria such as fatigue. This unhealthy work behaviour that circumvents natural physiologic reflexes may be due the present pervading economic crunch. This is however obtrusive to the cliché that health is wealth. This finding is in consonance with the work by Guo et al. (2004) that reported age as a significant outcome of musculoskeletal disorder. Conversely, the studies by Holmstrom and Engholm (2005), Pransky et al. (2005) and Ekechukwu et

al. (2018) implicated age and fatigue as factors associated with OMSD, respectively.

Poor educational exposure was significantly associated with OMSD. The World Health Organisation recognises level of education as one of the 10 social determinants of health capable of influencing health inequality (WHO, 2021) as well as competence (Adeniyi et al., 2013). A person’s level of education can influence his/her approach to pain as well as health-seeking-behaviour. It is therefore possible that the educationally disadvantaged participants with OMSD may not take the episode seriously as a result of ignorance of the possible consequences such as disability and reduced functions. Also, given that people tend to have spouses with similar educational exposure (Chiappori et al., 2016), and also that, level of education is a core determinant of socioeconomic status; it is therefore possible that the participants with lower educational status may have less

Table 6. Regression model of musculoskeletal disorder among participant (N=270).

Variable	Category	Model Summary		OR	P-value
		χ^2 (e)	R ² (C)		
Age (years)	20-24			1	-
	25-34			0.555	0.377
	35-44			0.893	0.094
	45-49			0.355	0.468
	≥50 years			-0.160	0.775
Level of education	Primary/Secondary School Cert.			1	-
	NCE			-0.635	0.397
	OND	30.064 (<0.001)	0.147 (71.9%)	0.551	0.525
	HND			-0.001	0.999
	B.Sc			0.273	0.803
	Others			-0.188	0.856
Back rest	Yes			1	-
	No			-0.491	0.135
Fatigue	Yes			0.858	0.024*
	No			1	-

income alternatives and so may have a greater urge to increase his/her work volume with less control which may result in OMSDs. A similar relationship has been reported by Lal (2008) and Lacey et al. (2018) in Norway and United Kingdom, respectively.

In addition, there was a significant association between OMSD and working with seats without back support. The task of dress making sometimes inevitably requires the tailor to adopt some constrained and awkward postures. This involves forward flexion of the spine in order to position the head in order to have a good view of the work piece, and the positioning of the limb girdles so as to give the limb extremities a greater degree of freedom require for precise manipulation of the work piece for the hands and repetitive movements for the feet. The tailor maintains (constrains him/herself in) this posture as the stitching progresses. At the end of each run of stitching, he/she inspects what has been done and may rest the spine musculature before proceeding to the next run of stitches or sewing tasks. It is at this point that the backrest is crucial. The backrest serves as a support for the back muscle thereby relieving it of the strain and creates room for the healing or recovery from the micro-trauma that may have occurred. This is a little act that is capable of breaking and setting off the vicious cycle of a cumulative trauma disorders (CTDs) such as OMSDs. It is therefore advised that tailors should work with seats that have firm and cushioning back support as well as take rest breaks at work intervals. Similar result was also found by Ekechukwu et al. (2020) among architecture undergraduates.

Finally, the findings of this study should be interpreted with caution. The use of a non-probability sampling technique and recruitment of only participants from a section of the country may influence its external validity. A multi-centre, multi-regional comparative study is therefore recommended.

Conclusion

There is a high prevalence of OMSD among tailors in Enugu metropolis and this is the most common around upper back, low back and knee regions. There is a significant association between OMSD and each of age, level of education, use of seat without a back support and fatigue among tailors in Enugu metropolis. Fatigue is a significant predictor of OMSD in this population. It was recommended that every tailor use seats with comfortable back rests and that tailors should discontinue their work tasks as soon as they start to experience fatigue.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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