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Musculoskeletal Problems among Handloom Workers

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Abstract

A cross sectional descriptive study was conducted in the industry with the objectives of determination of MSDs symptoms prevalence in different anatomical location of body region; identification of major factors and socio-demographic characteristics associated with MSDs symptoms in handloom occupation. First, musculoskeletal problems were surveyed by questionnaire among 450 weavers selected conveniently. The results of this part revealed that symptoms from the musculoskeletal system occurred in high rate among weavers with the prevalence significantly higher. All body region were affected by musculoskeletal problems, among them high prevalence found in neck (69.72%) and shoulder (69.17%) region and lowest in ankle (23.89%) region in last 7 days. Most of the sick leave found for neck, knee, and shoulder and hips pain. Statistical analysis indicated that age of the handloom workers influence musculoskeletal problems was significantly higher in lower back and ankle region ($p<0.05$). Personal income and family income was a factor to aggravate musculoskeletal problem but it was not statistically significant ($p\geq0.05$). Family size was a strong factor to influence musculoskeletal problems in upper back, lower back and knee region ($p<0.05$). Job experience was a key factor to aggravate musculoskeletal problems in all body region was statistically significant ($p<0.05$). Among all body region, highest musculoskeletal problems was found in lower back region ($p<0.05$). Working hour was significant only in elbow region ($p<0.05$). Working days per week was significantly severe in ankle region ($p<0.05$). General working condition score was 2, 3, 4 among 13. General working condition score were significantly higher in some body region, among them knee ($p<0.05$) region was significantly higher. Ankle pain was statistically significant with working posture of handloom workers ($p<0.05$). Musculoskeletal problems were positively associated with age, individual and family income, family size, job experience, working hour per day, working days per week, general working condition and working posture. Long hours of static work with awkward posture at traditionally designed looms can lead high prevalence of musculoskeletal problems among handloom weavers.

Keywords: *Musculoskeletal Problems, Handloom Workers.*

Introduction

Handloom industry is the biggest handicraft industry in Bangladesh. It is the second largest source of rural employment after agriculture. This industry is an increasingly essential element of economic, social development and it has become one of the largest economic industries in Bangladesh **[1].** It is to be noted that the Dhaka division, which has the leading share of looms, also has a higher usage – Rajshahi and Dhaka divisions have usages of about 67% and 63% respectively, whereas Chittagong is third with 58% and Khulna has 50% (Bangladesh, 1982). Handlooms are traditionally household units. Handloom industry in Tangail has a glorious history of its own. The “Tangail Sharee” of Bangladesh has a great popularity and reputation within and outside the country and this traditional Sharee is only produced in Tangail district and has been named after the name of the district. Each year, this industry produces significant number of Sharri and supplies all over the world. Each week Bangladeshi government exports around 50,000 piece Sharri to our neighbouring country India where the product is very demandable and

popular. The international patent of Tangail Sharee bears the handloom industry of Tangail. The soft silk Sharee, cotton silk Sharee, Jamdani Sharee, Benarosee Sharee have brought revolutionary change in handloom industry of Bangladesh. They are widely recognized and reputed worldwide. Although the Tangail Sharee has a great competition with the India Sharee but still it is unique due to its original making process and from the ancient period the workers of Tagail handloom industry learns it traditionally. Historically, the Basak community of Patrail union of Tangail is the oldest one who bears the original making process of Tangail Sharee. Tangail Sharee (Cotton sharee, Half Silk, Soft Silk, Cotton Jamdani, Gas-mercerised twisted cotton sharee, Dangoo sharee, Balucherri) are mainly made in the handloom industries of Patrail union, Tangail Sadar, Delduar and Kalihati, Nagorpur, Basail of Tangail District **[2].** The making process of Tangail Sharee needs sophisticated capacity of the workers and huge attention for its design. The weavers sell the Sharee in the nearest "haat" of Bazitpur and Korotia twice in every week. The consumers of this "haat" are mainly retailers who buy products from the weavers and supplies in all over the country. The biggest haat of Tangail Sharee of the country sits in Korotia union of Tangail sadar in every Wednesday afternoon and continues upto Thursday evening. Handloom sector in Bangladesh consists of more than 0.183 million handloom units with 0.505 million handlooms and about 1 million handloom weavers of which about 50% are female worker. Production of these handloom fabrics is diffused in numerous production centers all over the country which are linked up by a network of primary, secondary and central markets. Handloom industry is the biggest handicraft industry in our country; it is the second largest source of rural employment after agriculture. This industry is an increasingly essential element of economic, social development and it has become one of the largest economic industries in Bangladesh. About 80 percent people of our country live in rural country sides. It is an underdeveloped and agro-based country. Handloom weaving is one of the most important non-agricultural sources of income in Bangladesh. It is the second largest source of rural employment after agriculture. role in generating local employment and linking with other sectors. It is the second largest source of rural employment after agriculture **[3].** The present study focuses on identification of different dimensions of work and works risk factors among the weavers in handloom and explores its association with the MSDs among male and female **[4].** Handloom sector in Bangladesh consists of more than 0.183 million handloom units with 0.505 million handlooms and about 1 million handloom weavers of which about 50% are female worker. A manpower of about one million weavers, dyers, hand spinners, embroiderers and allied artisans have been using their creative skills into more than 0.30 million active looms to produce around 687 million meters of fabrics annually. Production of these handloom fabrics is diffused in numerous production centers all over the country which are linked up by a network of primary, secondary and central markets. Handloom industry is the biggest handicraft industry in our country; it is the second largest source of rural employment after agriculture. The knowledge and skills needed for this sector transformed from their forefathers **[3].** This industry is an increasingly essential element of economic, social development and it has become one of the largest economic industries in Bangladesh. About 80 percent people of our country live in rural country sides. It is an underdeveloped and agro-based country. Most of the small and cottage industry of this country is built up on the basis of the supply of agro-products. During their economic transformation from an agricultural to an industrial society, most of the developing countries take different necessary steps for the rural development. Handloom weaving is one of the most important nonagricultural sources of income in Bangladesh. It plays an important role in generating local employment and linking with other sectors. It is the second largest source of rural employment after agriculture. Work-related musculoskeletal disorders (WMSDs) have emerged as major health problem among handloom workers in both industrialized and industrially developing countries. The purpose of this study was to determination of MSDs symptoms prevalence in different anatomical location of body region; identification of major factors and socio-demographic characteristics associated with MSDs symptoms in handloom occupation.

Background

Handloom is a machine or device, which is made of wood and of iron (some portion) and used to produce woven fabric. Handloom is generally run without any electrical motor; it is run by man's hand and foot combination. The manufactures of this industry as 'Muslins' was highly acclaimed thought the world because of its singular beauty and high qualified variety. The muslin of Dacca was favorite cloths to the aristocracy including kings, queens, and emperors. As late as 1972 Henry Patllo remarked that the demand for "Bengal's textile manufacturers could never reduce because no other nation on the globe could either equal or rival their quality''. However, from 1793 the exports of Bengal cotton-goods started to decline. This gradual decline of the demand for Bengal cotton - goods, resulted in the decline of the industry. The most important reason for the decline of the handloom industries was Industrial Revolution in England. The Bengal handicrafts could not withstand the foreign competition, which derived its strength from large machinery, large-scale production, complex division of labor etc. Thus, the main challenge came from the impact of Industrial Revolution. During the Pakistan period, the Pakistan Government allowed import of yarn on open general license and abolished sales tax on handloom products, which led to a tremendous growth of the industry in the early 1950s. After independence, Bangladesh Government set up a new Handloom Board in 1978, which took over the development of the handloom industry from the Small, and Cottage Industries Corporation. Since, its formation, the Handloom Board has taken some policy measures to develop the industry **[1].** There are two types of looms namely; handloom and power loom according to operational practice. A loom may be operated manually or mechanically. Normally handlooms are those, which are manually operated, and as such, these are distinct from power looms, which are operated by power. The Bangladesh Handloom Board (BHB) ordinance, 1977 defines 'handloom' as a 'weaving device operated manually for production of fabrics other than hundred percent silk or art silk'. There are several types of handloom in Bangladesh. Such as: a. Pitl loom, b. Power loom, c. Chattarranjan Loom, d. Benarosy and Jamdani Loom, e. Kamer / Waist Loom Among all types of loom Benarosylooms are concentrated in Mirpur area, Dhaka, the Jamdani looms are specially operated in Rupgang (Taraboo) area of Narayangang District and Kamer / Waist loom is found in the Hill Tracts of Chittagong. According to the Handloom Census, handloom consumes about 71 percent of medium quality yarn, and about 15 and 7 percent of coarser and fine qualities respectively. It also appears that Dhaka, Chittagong and Khulna divisions mainly specialize in medium quality fabric, while Rajshahi (in North Bengal) produces finer quality fabric. Although handloom weaving is carried on throughout the country, it is traditionally concentrated in a few districts--mainly Dhaka, Pabna, Comilla and Tangail -- in which there are about 70% of the installed looms and more than 79% of the total operated looms. Dhaka accounts for about 33% of the total operational capacity and about 35% of total employment. The next two important centres are Pabna and Comilla accounting for 22% and 16% of the operational capacity respectively. Dhaka has long been established as an important centre for handloom industry because of its skilled craftsmen and specialized products and continues to play a leading role **[5].** Handloom industry in Bangladesh is having glorious past, questionable present and blurry future due to a lot of internal and external factors that are acting behind the scene **[6].** About 80% people of this country are directly or indirectly depend on agricultural. The loom industry is the ancient, the biggest and the most important cottage industry of Bangladesh. As it is the biggest handicraft industry in our country, it is the second largest source of rural employment after agriculture **[1].** Though the employment opportunity in this sector has been squeezed in the last 15 years, this sector is still offering employment to nearly 0.9 million weavers in rural area **[2**]. This industry has lots of future prospects as well as glorious past. Handloom products have shown decisive upward trend in the export market since 1972 and Bangladeshi handloom products with their distinctive design and superior quality have created a niche for themselves in overseas markets **[7].** This ancient and most important cottage industry of Bangladesh is now on the way of extinction because of various problems and barriers adjacent to this industry. Weavers in our country don't get quality raw materials at right time and at right price **[1].** Besides, Weavers are suffering from inadequate contemporary technology and

scarcity of working capital which are mandatory to maintain the smooth flow of production **[2].** The entire improvement, growth and structural adjustment have been achieved near - total absence of public policies and programs [**8**]. At the time of independence over a thousand weavers societies were existed and now almost all of which are dormant due to lack of strategic vision from government to protect and promote this sector **[9].** Weavers in our country don't get quality raw materials at right time and at right price **[1].** Although, the technical skill of the weavers of Bangladesh is second to none in the handloom-producing world they are lagging behind in capturing the modern technology due to lack of infrastructural support from the government **[7].** Moreover, most of the weavers are Hindu in religion. There are afraid about the religious conflict. After independence, most of the Hindu weaver migrated from Bangladesh to India due to religious conflicts, robbering, lack of securities etc. The process of this type of migration is continued till to date. Thus it is an urgent need to mark the existing problem and future expectations of loom industry in Bangladesh. In our study we find out some problems of loom industry in Bangladesh like poor advertising, shortage of raw materials, inadequate capital, insufficient governmental facilities etc. Our broad objective is to find out the barriers and problems of the loom industry of Bangladesh, to provide a solution to these problems and to identify the potentiality of this sector.

Methods

Study design and sample

The study was conducted for a period of one year extending from January 2015 to December 2015 in Pathrail union (Delduar Thana) in Tangail district. The target population of this research was handloom workers. Both male and female workers who are working more than 6 months and severity of pain in past 6 months were eligible for the study. Non cooperative, mentally ill workers and working experience less than 6 months were excluded from the study. The ultimate sample size for the study was 450 which were selected by convenient sampling. Each sample was collected from every workshop. A semi-structured questionnaire, which consisted of 4 parts as follows:

Part 1: Socio-demographic questionnaire consists of age, gender, marital status, religion, educational qualification, individual income, family income and family size of handloom workers.

Part 2: Job related questionnaire it included type of work, job experience, working hours per day, working days per week, over time/extra time, night work, physical or mental stress during work, break during work, job beside handloom, type of work beside handloom, duration of work beside handloom, job before handloom.

Part 3: Standardized Nordic questionnaire: This questionnaire records the prevalence of MSDs in terms of musculoskeletal symptoms (ache, pain, discomfort etc.,) in the preceding 12 months and prevented them attending job in the preceding 12 months and the prevalence of musculoskeletal pain in last 7 days.

Part 4: Ergonomic checklist: It included issues of general working conditions (GWC), workstation design and adjustability (WD), working posture (WP) and hand tools (HT) have been the criteria of particular importance for evaluation. All items of the checklist are observed at workstations.

Ergonomics index action category ergonomic category

0-25 4 Worse
26-50 3 Bad
51-75 2 Fair
76-100 1 Good

Goniometer: Goniometry, "the use of instruments for measuring the range of motion of joints of the body," The purposes of this descriptive study were to 1) assess the relative importance of three potential sources of goniometric error at the elbow by sequentially disclosing variability associated with alignment of goniometer arms, identification of bony landmarks, and application of external forces. The purposes of this descriptive study were to at first stabilize the stationary portion of the body. This is the part of the

body that is proximal to the joint you are testing. It is important that the respondents don't move his body while moving the joint. This step isolates the joint for a more accurate measurement. Look at the reading of goniometer before removing it from the respondent's body. Ensure that you take an appropriate reading of the degree of motion on the goniometer. A traditional is a protector with extending arms. To use a goniometer

1. Align the fulcrum of the device with the fulcrum or joint to be measured.
2. Align the stationary arm of the device with the limb being measured.
3. Hold the arm of the goniometer in place while the joint is moved through its range of motion.

Before going to the process of data collection, pretesting was carried out on 10 handloom workers in Narayangonj district to finalize to procedure and to evaluate the effectiveness of the research instrument. Modifications were made as necessary and the research instrument was finalized. Data was collected by direct face to face interviewing the handloom workers who fulfilled the selection criteria. The interview was taken by researcher himself at the place of study without disturbing their routine work. The data were collected by a prepared pre-tested questionnaire. The analysis were include description of the study population by their socio-demographic characteristics at first instance using certain descriptive statistics, frequency distribution tables on frequencies, percentages, mean, median & SD. In order to find out association between two or more variables Chi-Square test and Fisher's exact test were performed to see the statistical significance. Graphical software was used for creation of charts by using Microsoft Excel.

Analysis

Collected data were checked-rechecked, edited, coded and recorded for quality management. For analysis purpose data were grouped as follows: Age were grouped as <30years, 30-45years and ≥46 years; Educational qualification was categorized as illiterate, primary, secondary, SSC, HSC and graduate; Marital status was categorized as married and currently single; Individual income were grouped as tk.<6000, tk. 6000-7999 and tk. ≥8000; Family income were grouped as tk.<6000, tk. 6000-7999 and tk. ≥8000; Family size were grouped as ≤3, 4-6, >6 family member; Job experience was categorized as ≤12 years, 13-25 years, ≥26 years; Daily working hours were grouped as ≤8 hours and >8 hours; Working hour per day was categorized as ≤6 days and >6 days; General working condition score was categorized as 2,3 and 4. Working posture score was categorized as 2, 3 and 4; Ergonomic categories were grouped as good, fair, bad and worse. Data were analyzed with SPSS 22. To assess or measure the objectives, for descriptive statistics-frequency, percentage, mean, median, standard deviation (SD) were used for socio-demographic factors, job related factors and standard Nordic questionnaire. For test of significance, Chi-square test was done to see the relation between musculoskeletal problems (dependent variable) and associated factors (independent variable). For all statistical test used in this study, statistically significant level set as $p \leq .05$.

Result

This cross sectional study was carried out on 450 handloom workers in some rural area of Tangail district. The main purpose of the study was to identify and analyze musculoskeletal problems among handloom workers of Bangladesh. Participation of this study who were selected purposively and each participant was provided with a consent form. The standard Nordic Musculoskeletal Questionnaire, a validated instrument for the musculoskeletal problems was used for this study. After completion of data analysis, the results were organized in the tabular form and figures as necessary respectively. The tables and figures are described below. The findings of the study are presented in the subsequent pages. All the respondent was male. The job type of the handloom workers was full time. They did not do work at night. All of the respondents were involve in over time/extra time and they were stressed during work time. They often took break during work schedule.

A. Socio-demographic Characteristic of the respondents

Table-1 shows the distribution of handloom workers by age. The age of the respondents were between 23 to 62 years and their mean age was 39.48± (7.78) years. Among the 450 respondents most (68.9%)

were 30-46 years of age, another 15.8% below 30 years of age and 15.33% were 46 years of age or older. Among all respondent 93% were married and 7% were currently single**.** Among them 35% were Muslim and 65% were Hindu. Among all respondents 51% had primary education. Whereas, 48% were illiterate and only 1% had secondary educational qualification. The personal income of the respondents was between 5000 to 10000 taka. The mean personal income was 7131.11 (±1102) taka. Among the 450 respondents most (54.2%) personal income was 6000-7999 taka and another 38.9% belongs to 8000 taka or above and a few 6.9% was less than 6000 taka. The monthly family income of the respondents were between 5000 to 18000 taka. The mean monthly family income was 7908.89 (±2351.73) taka. Among the all respondents most (48.2%) family income was 6001-7999 taka, 45.3% were 8000 taka or above and a few 6.4% families monthly income was less than 6000 taka. The respondents were found families having 2 to 18 members. Minimum family size 2 and maximum 18 was found. The mean family size was 5.35 (±1.69). Among all handloom workers most 345(76.7%) were 4-6 family size. Another 78(17.6%) found family members were more than 6 and a few 27(6%) found family members were 3 or less than 3.

Table 1. Socio-demographic characteristics of the respondents

Characteristics	**Frequency**	**Percent % n= 450**
Age (Years)		
<30	71	15.8
30-45	310	68.9
≥46	69	15.3
Minimum age 23 years, Maximum age 62 years and Mean age 39.48 (±7.78) years.		
Marital Status		
Married	419	93.0
Currently Single	31	7.0
Religion		
Muslim	158	35.0
Hindu	292	65.0
Level of Education		
Illiterate	216	48.0
Primary	230	51.0
Secondary	4	1.0
Personal Income		
<6000	31	6.9
6000-7999	244	54.2
≥8000	175	38.9
Minimum income- Tk. 5000, Maximum income- Tk. 10000 taka and Mean personal income-Tk. 7131.11 (±1102)		
Monthly family Income		
<6000	29	6.4
6000-7999	217	48.2
≥8000	204	45.3
Minimum income- Tk. 5000, Maximum income- Tk. 18000 and Mean family income- Tk. 7908.89 (±2351.73)		
Family Size in group		
≤3	27	6.0
4-6	345	76.7
>6	78	17.3

Minimum family size- 2, Maximum- 18 and Mean Family size was- 5.35 (±1.69) in no.

B. Distribution of handloom workers by their job experience, daily working hours, working days per week: n= 450

This table 2 shows distribution of handloom workers by their job experience, daily working hours, working days per week. The job experiences of the respondents were found between 6 to 42 and the mean job experience was 19.68(±7.35) years. Among all respondent most (62.4%) were 13-25 years of job experience, another 22.4% were found to ≤12 years and 15.3% were ≥26 years of job experience. The daily working hours of the respondents were between 6 to 12 hours and the mean hours was 11.21(±1.125). Among all respondent most (97.3%) daily working hours was more than 8 hours and a few 2.7% was ≤8 working hour. The working days per week of the respondents were between 5 to 7 days and mean days was 6.09(±0.29) days. Most of the handloom workers 409 (90.4%) did their work ≤6 days and only a few attended their work above 6 days.

Table 2. Distribution of handloom workers by their job experience, daily working hours, working days per week

Characteristics	**Frequency**	**Percent (%) n=450**
Job Experience		
≤12	86	19.1
13-25	281	62.4
≥26	83	18.4
≤12	86	19.1
Minimum experience- 6 years, Maximum- 42 years and Mean experience was- 19.68 (±7.35) years.		
Daily working hours		
≤8	12	2.7
>8	438	97.3
Minimum daily working hours- 6 hours, Maximum- 12 hours and Mean working hours was- 11.21(±1.125) hours.		
Working days per week		
≤6 days	409	90.9
>6 days	41	9.1
Minimum days- 5, Maximum days- 7 and Mean days- 6.09(±0.29)		

C. Distribution of musculoskeletal problems among handloom workers in their body region in last 12 month and last 7 days: n=450

Table 3 shows distribution of musculoskeletal problems among handloom workers in their body region in last 12 month according to percentage. Among all respondent musculoskeletal problems had present in neck 75%, in shoulder 75%, in elbow 54%, in wrist 54%, in upper back 63%, in lower back 66%, in hips 78%, in knees 42% and in ankle 59%. Among all respondent mostly found in neck (69.72%) and shoulder (69.17%) region was currently suffered from musculoskeletal problem. Hips was the second highest 53.06%, elbow (40.28%), wrist (38.06%), upper back (34.72%), lower back (37.5%), knees (34.44%), ankle (23.89%) was currently suffer in musculoskeletal problem (Table-3).

Table 3. Distribution of musculoskeletal problems among handloom workers in their body region in last 12 month and last 7 days

Body region	Musculoskeletal problems in last 12 month			Musculoskeletal problems in last 7 days		
	Yes	No	Total	No	Yes	Total
Neck	335(75%)	115	450	109	251(69.72%)	360
Shoulder	338(75%)	112	450	111	249(69.17%)	360
Elbow	244(54%)	206	450	215	145(40.28%)	360
Wrist	242(54%)	208	450	223	137(38.06%)	360
Upper back	284(63%)	166	450	235	125(34.72%)	360
Lower back	299(66%)	151	450	225	135(37.5%)	360
Hips	351(78%)	99	450	169	191(53.06%)	360
Knees	189(42%)	261	450	236	124(34.44%)	360
Ankle	264(59%)	186	450	274	86(23.89%)	360

D. Distribution of the respondents by age, working hour per day and musculoskeletal problems in last 7 days: n= 450

The table 4 shows the relationship between respondent's age and musculoskeletal problems in different body region in last 7 days. Within last 1 week neck and shoulder pain was highest (68.1%) among those belonged ≥46 years of age. As well as increase their age neck pain and shoulder pain became increase with their age subsequently. But shoulder pain was statistically significant ($p<0.05$). Highest elbow and wrist pain (44.9%) were found in ≥46 years of age. Elbow pain 33.8% and 29.0% found who had <30 and 30-45 years of age. 29.6% and 27.4% wrist pain belongs to <30 and 30-45 years of age. Severe upper back pain 43.5% was on ≥46 years of age and pain was increased with their age. Highest lower back pain 47.8% belongs to ≥46 years of age. Another 21.1% and 27.4% pain found on <30 and 30-45 years of age. Hips/Thigh pain was high (52.2%) ≥46 years of age and 38.0% and 41.3% pain who were<30 and 30-45 years of age. But it was not statistically significant ($p\geq0.05$). Severe knee pain (42.0%) found who had ≥46 years of age and another 26.8% and 24.5% pain belongs to <30 and 30-45 years of age. Ankle pain was severe (31.9%) on ≥46 years of age and 16.9% pain were <30 and 30-45 years of age group. Above discussion revealed that musculoskeletal pain in all body region was statistically significant ($p<0.05$) except neck and hips/Thigh region ($p\geq0.05$). Table 4 shows the relationship between respondent's working hour per day and musculoskeletal problem in last 7 days. Most of the respondents (438) worked more than 8 hours per day. Neck and shoulder pain was very common in both working group. The severity of pain was more than (55.0%) in both working schedule. But it was not statistically significant ($p\geq0.05$). Elbow pain was highest (75.0%) who work 8 hour or less than 8 hours per day and lowest (31.1%) found who worked more than 8 hours per day. It was statistically significant ($p<0.05$). Wrist and upper back pain was highest (≥33.3%) in ≤8 hour group and 29.9% and 27.6% found in more than 8 hours group. But it was not statistically significant ($p\geq0.05$). Lower back and hips pain was common in both working schedule and the pain was found (≥29.5%) but it was not statistically significant ($p\geq0.05$). Knee pain was highest (50.0%) was found who worked ≤8 hour per day and 26.9% found who worked more than 8 hours per day. But it was not statistically significant ($p\geq0.05$). Ankle pain was severe (41.7%) found who worked ≤8 hour per day and 18.5% found who worked more than 8 hours per day. But it was not statistically significant ($p\geq0.05$).

Table 4. Distribution of the respondents by age, working hour per day and musculoskeletal problems in last 7 days: *Statistically significant (p<0.05)

Body region	Age			Test of significance	Working hour		Test of significance
	<30 (n=71)	30-45 (n=310)	≥46 (n=69)		≤8 (n=12)	>8 (n=438)	
	F (%)	F (%)	F (%)		F (%)	F (%)	
Neck	35 (49.3)	161 (54.5)	47 (68.1)	χ^2= 5.66, df 2, p=0.05	9 (75.0)	242 (55.3)	χ^2= 1.84, df 1, p=0.174
Shoulder	34 (47.9)	168 (54.2)	47 (68.1)	χ^2= 6.31, df 2, p=0.04*	8 (66.7)	241 (55.0)	χ^2= 0.64, df 1, p=0.423
Elbow	24 (33.8)	90 (29.0)	31 (44.9)	χ^2= 6.62, df 2, p=0.03*	9 (75.0)	136 (31.1)	χ^2= 10.33,df 1, p=0.001*
Wrist	21 (29.6)	85 (27.4)	31 (44.9)	χ^2= 8.2, df 2, p=0.01*	6 (50.0)	131 (29.9)	χ^2= 2.22, df 1, p=0.136
Upper back	14 (19.7)	81 (26.1)	30 (43.5)	χ^2=11.19, df 2, p=0.004*	4 (33.3)	121 (27.6)	χ^2= 0.19, df 1, p=0.663
Lower back	15 (21.1)	87 (28.1)	33 (47.8)	χ^2=13.65, df 2, p=.001*	6 (50.0)	129 (29.5)	χ^2= 2.34, df 1, p=0.125
Hips/Thigh	27 (38.0)	128 (41.3)	36 (52.2)	χ^2= 3.41, df 2, p=0.18	8 (66.7)	183 (41.8)	χ^2= 2.96, df 1, p=0.08
Knees	19 (26.8)	76 (24.5)	29 (42.0)	χ^2= 8.69, df 2, p=0.01*	6 (50.0)	118 (26.9)	χ^2= 3.11, df 1, p=0.07
Ankle	12 (16.9)	52 (16.9)	22 (31.9)	χ^2=13.90, df 2, p=0.008*	5 (41.7)	81 (18.5)	χ^2= 4.07, df 1, p=0.13

E. Distribution of the respondents by their general working condition score, working posture score and musculoskeletal problems in last 7 days: n=450

Table 5 shows the relationship between respondent's general working condition score and musculoskeletal problem in last 7 days. General working condition was a part of observational ergonomic checklist. It was made by 13 questions which related with handloom workers. All items of the checklist are observed at workstations. An item is assessed to be either provided (yes) or not provided (no). An item is scored 1 if it is provided (yes) and 0 if it is not provided (no). If the score increases it means good working condition. After data analyses 2 score got 44 respondents, 3 score got 220 respondents and 186 respondents got 4 score. Neck pain was highest (72.7%) those respondents got 2 score and 50.9% and 57.5% found who were got 3 and 4 score. It was statistically significant (p<0.05). Similar with neck pain was severe 68.2% whose score was 2 but it was not statistically significant (p≥0.05). Elbow and wrist pain decreased when the score was increased but it was not statistically significant (p≥0.05). Upper back, lower back, hips and knees pain decreased when the score became increase and that pain was statistically significant (p<0.05). But ankle pain was highest 28.2% those were got 3 score and 22.7% and 8.1% found pain whose score was 2 and 4. But it was statistically significant (p<0.05). Table 5 shows the relationship between respondent's working posture score and musculoskeletal problem in last 7 days. Working posture was a part of observational ergonomic checklist. It was made by 9 questions which related with handloom workers. All items of the checklist are observed at workstations. An item is assessed to be either provided (yes) or not provided (no). An item is scored 1 if it is provided (yes) and 0 if it is not provided (no). If the score increases it means good working posture. Among all body regions, ankle pain was statistically significant with working posture of handloom workers (p<0.05).

Table 5. Distribution of the respondents by their general working condition score, working posture score and musculoskeletal problems in last 7 days: *Statistically significant ($p<0.05$)

Body region	General working condition score			Test of significance	Working posture score			Test of significance
	2 (n=44)	3 (n=220)	4 (n=186)		2 (n=113)	3 (n=258)	4 (n=79)	
	F (%)	F (%)	F (%)		F (%)	F (%)	F (%)	
Neck	32 (72.7)	112 (50.9)	107 (57.50	χ^2=7.47, df 2, p=0.024*	63 (55.8)	144 (55.8)	44 (55.7)	χ^2=0.01, df 1, p=1.00
Shoulder	30 (68.2)	113 (51.4)	105 (57.0)	χ^2=4.55, df 2, p=0.10	62 (55.9)	142 (55.0)	45 (57.0)	χ^2=0.10, df 1, p=0.94
Elbow	21 (47.7)	68 (30.9)	56 (30.1)	χ^2=4.39, df 2, p=0.06	35 (31.0)	80 (31.0)	30 (38.0)	χ^2=1.45, df 1, p=0.48
Wrist	20 (45.5)	63 (28.6)	54 (29.0)	χ^2=5.19, df 2, p=0.07	34 (30.1)	74 (28.7)	29 (36.7)	χ^2=1.84, df 1, p=0.39
Upper back	19 (43.2)	74 (33.6)	32 (17.2)	χ^2=19.33,df 2, p=0.001*	35 (31.0)	65 (25.2)	25 (31.6)	χ^2=2.02, df 1, p=0.36
Lower back	21 (47.7)	82 (37.3)	32 (17.2)	χ^2=26.62,df 2, p= 0.001*	37 (32.7)	72 (27.9)	26 (32.9)	χ^2=1.26, df 1, p=0.53
Hips/Thigh	23 (52.3)	109 (49.5)	59 (31.7)	χ^2=15.03,df 2, p=0.001*	57 (50.4)	105 (40.7)	29 (36.7)	χ^2=4.34, df 1, p=0.11
Knees	17 (38.6)	81 (36.8)	26 (14.0)	χ^2=29.33,df 2, p=0.001*	40 (35.4)	64 (24.8)	20 (25.3)	χ^2=4.65, df 1, p=0.09
Ankle	10 (22.7)	62 (28.2)	15 (8.10)	χ^2=26.51,df 2, p=0.001*	33 (29.2)	40 (15.5)	14 (17.3)	χ^2=9.61, df 1, p=0.008*

F. Distribution of the respondents by ergonomic categories and musculoskeletal problems in last 7 days

Table 6 shows the relationship between respondent's ergonomic categories and musculoskeletal problem in last 7 days. Based on the result there were no workshops found under good and fair ergonomic category. About 97.6% of the workshops fall in ergonomic category 3. This means that corrective measures are required and working conditions should be improved. As the results indicate, improvements should focus on general working condition and the working posture. Another 2.4% workshop fall in ergonomic category 4. This means further investigation is needed. Corrective measures are required soon. Musculoskeletal problem in last 7 days become increases in worse category than bad category in all body region. But it was not statistically significant ($p\geq0.05$).

Table 6. Distribution of the respondents by ergonomic categories and musculoskeletal problems in last 7 days

Body region	Ergonomic categories		Test of significance
	Bad (26-50) (n=439)	Worse (0-25) (n=11)	
	F (%)	F (%)	
Neck	242 (55.1)	9 (81.8)	χ^2=3.1, df 1, p=0.07
Shoulder	240 (54.7)	9 (81.8)	χ^2=3.2, df 1, p=0.07
Elbow	140 (31.9)	5 (45.5)	χ^2=0.9, df 1, p=0.34
Wrist	132 (30.1)	5 (45.5)	χ^2=1.2, df 1, p=0.27
Upper back	120 (27.3)	5 (45.5)	χ^2=1.7, df 1, p=0.18

Lower back	130 (29.6)	5 (45.5)	χ^2=1.3, df 1, p=0.24
Hips/Thigh	185 (42.1)	6 (54.5)	χ^2=0.67, df 1, p=0.41
Knees	131 (27.6)	3 (27.6)	χ^2=0, df 1, p= 0.98
Ankle	84 (19.1)	3 (27.3)	χ^2=0, df 1, p=0.50

G. Ergonomic assessment of weaving workshop with the ergonomic checklist

Table 7 shows ergonomic assessment of weaving workshop with the ergonomic checklist. It shows the workstation design and hand tools are the major source of problem in workshop; the means of workstation design and hand tools indices are 33.3% respectively. Another source of problem general working condition was 25.5% and working posture was 32.5%.

Table 7. Ergonomic assessment of weaving workshop with the ergonomic checklist n= 450

Index	Mean	Std. deviation	Min-Max
General working condition	25.5	4.9	7.7-30.8
Workstation design	33.3	.0002	33.3-33.3
Working posture	32.5	7.2	22.2-44.4
Hand tools	33.3	.000	33.3-33.3
Ergonomic	30.4	2.5	24.3-35.1

H. Socio-demographic and job related factors with the strongest influence on musculoskeletal problems in different body regions of handloom weavers

Table 8 shows socio-demographic and job related factors with the strongest influence on musculoskeletal problems in different body regions of handloom weavers. Statistical analyses showed that musculoskeletal symptoms in different body regions (neck, shoulders, legs, etc.) were significantly associated with age, working posture, daily working time, as well as, age, monthly income, general working condition and job experience. In the following, the major ergonomic factors identified to be associated with musculoskeletal problems are discussed with the ultimate goal of developing guidelines for weaving workstation design to improve working posture and to reduce postural stress.

Table 8. Relationship between age, total work time per week and self- reported health problems

Body region	Individual factors	OR	95% CI	p-value
Neck	Age	.61	.36-.99	.048*
Shoulder	Age	.59	.35-.98	.039*
Elbow	Age Working hour per day	.56 6.66	.34-.92 1.77-24.99	.023* .001*
Wrist	Age Job experience	.51 .63	.31-.84 .42-.94	.007* .027*
Upper back	Age Monthly income Job experience	.46 7.69 .49	.28-.76 1.02-58.13 .32-.75	.002* .020* .001*
Lower back	Age Monthly income Job experience	.43 8.6 .47	.26-.71 1.14-64.91 .31-.70	.001* .013* .001*
Hips/Thigh	Age	.59	.36-.76	.034*

Knees	Age Monthly income Job experience	.45 7.6 .66	.27-.75 1-57.48 .44-1.01	.002***** .021***** .057
Ankle	Age Job experience Working hour per day	.43 .56 3.10	.25-.74 .35-.90 .96-10.01	.002***** .017***** .047*****

*Statistically significant ($p<0.05$). n= 450

Discussion

The aim of the present study was to investigate the musculoskeletal problems among handloom weavers in relation to socio-demographic characteristics, work related factors and working conditions. The age of the respondents of this current study was 39.48 (±7.78) years. Almost a similar study was conducted by A NAG et al.2009 **[4]** in India included respondents having a mean age was 40.5(±11.5) years. Job experience of the respondents of this current study was 19.68 (±7.35) years. A NAG et al.2009 **[4**] in India included respondents having a mean job experience was 22(±11.5) years. Working hour per day of the respondents of this current study was 11.21(±1.125) hours. A NAG et al.2009 **[4]** in India included respondents having a mean working hour per day was 9.7(±2.3) hours. In this current study respondent was 52% has educational qualification. A NAG et al.2009 **[4**] in India included respondents having educational qualification was 79%. The major finding of the study was that the prevalence of musculoskeletal problems was considerably high in almost all of the body regions of the handloom weavers, with the most reported symptoms were in the neck, lower back, ankles/feet, wrists/hands, upper back, shoulders and knees, respectively. Almost the entire handloom weavers participated in this study experienced some type of musculoskeletal symptom in at least of their body regions in the last 12 months. Almost 100% weavers reported musculoskeletal symptoms in the last 12 months, needed to take days off due to such symptoms. These findings may not be surprising as most of the participants reported that they were not satisfied with their work station design, tools or environmental condition of the workshops. The results also showed significant relationship between the reported symptoms in the neck, shoulder, elbow, wrist, upper back, lower back, hips, knee and ankle area and age, job experience, working hours per day within last 7 days. The results showed a high prevalence of currently musculoskeletal symptoms among weavers. The prevalence of reported symptoms in the neck and shoulder area was about 68.1%. Prevalence of musculoskeletal problems in elbow, wrist, upper back and lower back was more than 43%. The result of this study showed that the average of musculoskeletal symptoms in different body regions was 80% in last 7 days. Hips and knee pain was found 52.2% and 42% respectively. Among all body region the least complaints among weavers in ankle area 32.9% respectively. Sangeeta Pandit, Prakash Kumar, Debkumar Chakrabarti, 2013 [**10**] in India included severity of pain in neck 88%. Shoulder 76%, wrist 46% elbow 60%, lower back 86%, hips 78%, knee 42% and ankle 58%. Alireza Choobineh, Mohammadali Lahmi, Houshang Shahnavaz, Reza Khani Jazani, Mostafa Hosseini, 2006 **[11**] in Iran showed that prevalence of MSD symptoms in different body regions of weavers during the last 12 months were neck (35.2%), shoulders (47.8%), wrists (38.2%), upper back (37.7%), lower back (45.2%), and knees (34.6%).81% of the weavers had experienced some kind of symptoms and pain from the musculoskeletal system felt at some time in the last 12 months. Regarding the environmental condition of workshops, as shown by the results of this study, more than 90% participants were not satisfied with the environmental condition of their workshops such as working posture, thermal condition, noise level and cleanliness of the air. The results also indicated that weavers' satisfaction with ergonomic checklist of the workshops were associated with musculoskeletal symptoms, suggesting that the environmental and ergonomic conditions of the work place should be taken into account in risk assessments for musculoskeletal problems. In addition, about almost all of weavers were somewhat to completely dissatisfied with workshop lighting condition which has shown inadequate lighting in all weaving

workshops. With respect to the work station design and tools, most of the participants in this study expressed dissatisfaction with their seat (a plank of wood). The results indicated that the weavers' satisfaction with general working condition was associated with upper back, lower back, hips, knees and ankle symptoms. In addition, weavers' dissatisfaction with working posture was associated with ankle complaints. These findings suggest that the worker's satisfaction can be regarded as an important indicator of the musculoskeletal problems working population. Therefore, to reduce the prevalence of musculoskeletal complaints, a well-designed working posture, working environment, workstation and hand tools that increases comfort level while weaving is suggested. Almost all weavers were also dissatisfied with their hand tools shape and weaving height. The results of the present study indicated that poor working conditions and workstation design may increase the rate of musculoskeletal problems and complaints among weavers. Alireza Choobineh, Mostafa Hosseini, Mohammadali Lahmi, (2006) [**11**] showed in their article insufficient lighting results in awkward posture, for weavers incline their heads, necks and backs to be able to look closer at their work. Lack of cooling and heating systems in weaving workshops, which have low income, results in improper thermal conditions. As seen, nearly 50% of weavers perceived the thermal condition as very warm, warm and slightly warm in summer time and about 47% of them perceived the thermal condition as very cold, cold and slightly cold during winter time. Improper climate will have adverse effects on the well-being of the weavers and consequently on their performance. They showed that workstations and working postures are the major sources of problems in workshops: the means of workstation and working posture indices are 29.1% and 30%. Based on the results, working conditions in 2% of the workshops are acceptable (action category 1). Working conditions in 60% of the workshops fall in action category 2. So, the interpretation is that in these workshops further investigation is needed and corrective measures may be required for the improvement of working conditions. In 38% of the workshops visited working conditions are worse so that they fall within action category 3. This means that corrective measures are required and working conditions should be improved. As the results indicate, improvements should focus on workstation design and the working posture. Accordingly, significant relationships were found between job factors and reported musculoskeletal symptoms in some body areas. There is a significant relationship between elbow symptoms and daily working hour. Also, upper back, lower back and hips/thigh symptoms were found to be related to family size of handloom workers. There were significant relationship between job experience and musculoskeletal problems in different body region. Ankle pain was significant with working days per week. The results of the present study indicated that poor general working conditions increases the musculoskeletal problems in neck, upper back, lower back, hips, knees and ankle. Among all body regions, ankle pain was significant with working posture score. Most health problems in this sector originate from ergonomic risk factors. Any improvement program in this industry should, therefore, focus on the ergonomic aspects of hand-weaving operation. Alireza Choobineh, Mohammadali Lahmi, Houshang Shahnavaz, Reza Khani Jazani, Mostafa Hosseini, 2006 **[11]** in Iran showed that musculoskeletal symptoms in different body regions (neck, shoulders, legs, etc.) were significantly associated with loom type, working posture, daily working time, seat type and type of knots (so-called ergonomic factors), as well as, age, gender, marital status and job tenure (so-called individual factors), significant factors associated with musculoskeletal problems for each body region. The checklist and ergonomics index presented in this paper can be applied to assess working conditions in weaving workshops as the first step in identifying major ergonomic problems and setting priorities and corrective measures. Literature has shown that predisposing factors for musculoskeletal problems are multi-factorial and may be attributed to posture, repetitive movement, physical load, psychological stress and other ergonomic factors. There are several limitations that need to be taken into account when applying the findings of the study. First, the study was cross-sectional in design, which prevents an evaluation of the relationship between cause and effect. Another limitation is that there are possible limitations associated with the reliability and accuracy of self-reported data on musculoskeletal problems. In addition, a further empirical investigation into detailed discomfort areas in relation to general working condition and

working postures may benefit the industry to prevent workers from suffering work related musculoskeletal disorders. In this workstation, loom is vertical. Seat, loom and weaving heights are not adjustable. There is not enough leg space under the loom. It is believed that the recommended workstation improves working posture and results in reduced postural stress on weavers' bodies and, consequently, reduced prevalence of MSDs symptoms. To conclude, a high prevalence of musculoskeletal problems exist among handloom workers which affects the daily practice of more than two third of them. Further studies are needed to identify the specific risk factors for musculoskeletal problems so as to introduce effective remedial measures.

Conclusion

On the basis of this cross sectional descriptive study following conclusion may be drawn. The descriptive study showed that poor working conditions and musculoskeletal problems in handloom workers occurred in high rate. More than 75% of the weavers were currently suffered from musculoskeletal pain. Thus, improvement of working conditions and control of MSDs risk factors seemed essential. Since the majority of ergonomics factors for developing musculoskeletal symptoms among weavers were attributable to poor-designed weaving workstation, it was concluded that any ergonomics interventional program had to concentrate on designing ergonomics-oriented weaving workstation. Musculoskeletal problems were positively associated with age, individual and family income, family size, job experience, working hour per day, working days per week, general working condition and working posture.

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