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## Risk assessment of handloom weavers for musculoskeletal disorder in durrie unit

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### Abstract

Objective of this study is to assess risk of musculoskeletal disorder IN handloom weavers of Durrie unit. Eighty male handloom weavers were selected from durrie units of Sujatganj and Rail Bazar of Kanpur Nagar. Risk of musculoskeletal disorder was assessed by using REBA and QEC tool. To evaluate working posture by using REBA the working postures were captured by still photography and for Quick exposure checklist observer's and worker's assessment was taken on postural problems related to work in different body parts i.e. Back, Neck, Shoulder/arm and Hand/wrist. Data reveals that mean REBA score is 11 which indicate very high level of risk and mean QEC score for neck, back and wrist/hand was 17, 31 and 43 respectively was in very high risk category and shoulder/arm with mean score 37 in high risk category. REBA reported 56.25 percent weavers were at high risk level and 43.75 percent at very high risk level. QEC also report 61.25 percent weavers at high and 38.75 percent at very high risk category.

**Keywords:** Durrie unit, risk assessment, handloom weavers, REBA, QEC

### 1. Introduction

The handloom sector is the second largest employer in India, providing employment to about 65 lakh people. The sector represents the continuity of the age-old Indian heritage of hand weaving and reflects the socio-cultural tradition of the weaving communities. Carpet weaving is one of the most tedious professions, requiring long hours of static work and can be a high-risk occupation for developing MSDs as awkward posture, repetitive movements and contact stress are common (Choobineh *et al.*, 2004) <sup>[2]</sup>. The postures adopted by the workers in their working place depends upon the type of work, the design of work place, personal characteristics, the tools required to perform the particular work and also the duration and frequency of the work cycle. At work the weavers sometimes have to assume postures without giving consideration to their individual capability and limitations, which results in stress and trauma the workers experience. This eventually leads to a decline in productivity and quality of work. Poor posture results from certain muscles tightening up or shortening while others lengthen and become weak which often occurs as a result of one's daily activities. There are different factors which can impact on posture and they include occupational activities and biomechanical factors such as force and repetition. Risk factors for poor posture also include psychosocial factors such as job stress and strain. Workers who have higher job stress are more likely to develop neck and shoulder symptoms. In a study on carpet mending operation working conditions were very poor and awkward working postures were very common. They reported high rate of musculoskeletal problems in knees, back and shoulders of the carpet menders. Alireza Choobineh *et.al* (2004) <sup>[2]</sup> reported that Carpet weavers suffer from musculoskeletal problems mainly attributed to poor working postures. Their posture is mostly constrained by the design of workstations. Choobineh A. *et.al* (2007) <sup>[4]</sup> reported that long hours of static work with awkward posture at traditionally designed looms can cause high prevalence of musculoskeletal disorders (MSDs) among carpet weavers. Carpet industry occupies a pivotal position in the economic dynamism of various countries. The weavers in the carpet industry suffer from various types of health risk factors. The risk in the carpet industry is higher and the ability to control it is lower. The majority of the problems are due to poor ergonomics and work station design and long hours of static working condition in the carpet industry Khurshed Ahmad Wani and Y.K. Jaiswal (2011) <sup>[6]</sup>. Handloom weaving in India is an inherited art where weavers learn to weave from their ancestors and thus this craft is practiced widely in rural areas and is providing employment to a wide section of rural artisans. Despite of the fact that Indian handlooms have made a distinct place in globalised world, this sector has not attained proper awareness as far as weaving related health problems and perils

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are concerned. Several health hazards are associated with weaving and related activities which along with causing stress and strain to weavers pose certain health related risk factors to them Alka Goel & Isha Tyagi (2012) [3].

**2. Material and Method**

The present study was carried out to determine the postural stress among handloom weavers in durrie unit. Eighty male weavers engaged in durrie weaving were selected randomly from Sujatganj and Rail Bazar of Kanpur Nagar District. Posture for risk of work related musculoskeletal disorder among handloom weavers in Durrie unit was assessed by using REBA Scale developed by Hignett and McAtamney (2000) [5] and risk was assessed by using Quick Exposure Checklist (LI, G. and Buckle, P. (1998) [7].

**Procedure to assess REBA Scale**

1. Consider critical task of a job.
2. For each task, assess the posture factors by assigning a score to each region.
  - Group A (Trunk, Neck and Legs) postures
  - Group B (Upper Arms, Lower Arms, and Wrists)

3. For each region, there is a posture scoring scale plus adjustment notes for additional considerations.
4. Then score the Load / Force and Coupling factors.
5. Finally, score the Activity.
6. Find the scores from Table A for the Group A posture scores and from Table B for the Group B posture scores.
7. For each region, there is a posture scoring scale plus adjustment notes for additional considerations.
8. Then score the Load / Force and Coupling factors.
9. Finally, score the Activity.
10. For each region, there is a posture scoring scale plus adjustment notes for additional considerations.
11. Then score the Load / Force and Coupling factors.
12. Finally, score the Activity.
13. Find the scores from Table A for the Group A posture scores and from Table B for the Group B posture scores.
14. Score A is the sum of the Table A score and the Load / Force score. Score B is the sum of the Table B score and the Coupling score for each hand.
15. Get Score from Table C, by entering it with the Score A and the Score B. The REBA score is the sum of the Score C and the Activity score.
16. The degree of risk is found in the REBA Decision table.

**REBA Employee Assessment Worksheet**

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

### A. Neck, Trunk and Leg Analysis

**Step 1: Locate Neck Position**

Step 1a: Adjust...  
If neck is twisted: +1  
If neck is side bending: +1

Neck Score:

**Step 2: Locate Trunk Position**

Step 2a: Adjust...  
If trunk is twisted: +1  
If trunk is side bending: +1

Trunk Score:

**Step 3: Legs**

Leg Score:

**Step 4: Look-up Posture Score in Table A**

Using values from steps 1-3 above, locate score in Table A

Posture Score A:

**Step 5: Add Force/Load Score**

If load < 11 lbs: +0  
If load 11 to 22 lbs: +1  
If load > 22 lbs: +2  
Adjust: If shock or rapid build up of force: add +1

Force/Load Score:

**Step 6: Score A, Find Row in Table C**

Add values from steps 4 & 5 to obtain Score A. Find Row in Table C.

Score A:

### B. Arm and Wrist Analysis

**Step 7: Locate Upper Arm Position:**

Step 7a: Adjust...  
If shoulder is raised: +1  
If upper arm is abducted: +1  
If arm is supported or person is leaning: -1

Upper Arm Score:

**Step 8: Locate Lower Arm Position:**

Lower Arm Score:

**Step 9: Locate Wrist Position:**

Step 9a: Adjust...  
If wrist is bent from midline or twisted: Add +1

Wrist Score:

**Step 10: Look-up Posture Score in Table B**

Using values from steps 7-9 above, locate score in Table B

Posture Score B:

**Step 11: Add Coupling Score**

Well fitting Handle and mid rang power grip: good: +0  
Acceptable but not ideal hand hold or coupling acceptable with another body part: fair: +1  
Hand hold not acceptable but possible: poor: +2  
No handles, awkward, unsafe with any body part: Unacceptable: +3

Coupling Score:

**Step 12: Score B, Find Column in Table C**

Add values from steps 10 & 11 to obtain Score B. Find column in Table C and match with Score A in row from step 6 to obtain Table C Score.

Score B:

**Step 13: Activity Score**

+1 1 or more body parts are held for longer than 1 minute (static)  
+1 Repeated small range actions (more than 4x per minute)  
+1 Action causes rapid large range changes in postures or unstable base

Activity Score:

SCORES	
Table A	Neck
	1 2 3
Legs	1 2 3 4 1 2 3 4 1 2 3 4
Trunk Posture Score	1 2 3 4 1 2 3 4 3 3 5 6 2 2 3 4 5 3 4 5 6 4 5 6 7 3 2 4 5 6 4 5 6 7 8 6 7 8 9 4 3 5 6 7 5 6 7 8 6 7 8 9

  

Table B	
	1 2
Wrist	1 2 3 1 2 3
Upper Arm Score	1 1 2 2 1 2 3 2 1 2 3 3 3 4 4 5 5 4 5 5 4 4 5 5 5 6 7 5 6 7 8 7 8 8 8 9 9

  

Table C	
Score A (score from table A + load/force score)	Score B, (table B value coupling score)
	1 2 3 4 5 6 7 8 9 10 11 12
1	1 1 1 1 2 3 3 4 5 6 7 7 7 7
2	1 2 2 3 4 4 5 6 6 7 7 8
3	2 3 3 3 4 5 6 7 7 8 8 8
4	3 4 4 4 5 6 7 8 8 9 9 9
5	4 4 4 5 6 7 8 8 9 9 9 9
6	6 6 6 7 8 8 9 9 10 10 10 10
7	7 7 7 8 9 9 9 10 10 11 11 11
8	8 8 8 9 10 10 10 10 11 11 11 11
9	9 9 9 10 10 10 11 11 11 12 12 12
10	10 10 10 11 11 11 11 12 12 12 12 12
11	11 11 11 11 12 12 12 12 12 12 12 12
12	12 12 12 12 12 12 12 12 12 12 12 12

  

Table C Score

+

Activity Score

Final REBA Score

Task name: \_\_\_\_\_ Reviewer: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

This tool is provided without warranty. The author has provided this as a simple means for applying the concepts provided in REBA. © 2000 Hignett Consulting, Inc. provided by Practical Ergonomics rbarker@ergosmart.com (816) 444-1667

**Table 1: REBA Decision**

Reba Score	Risk Level
1	Negligible
2-3	Low
4-7	Medium
8-10	High
11-15	Very High

**Risk Risk assessment (Quick Exposure Checklist):**

1. An observational checklist on postures and other physical requirements aimed for rapid assessment of task with minimal training of observers.
2. Posture of back, shoulder/arm, wrist/hand and neck are observed and rated with two and three step scales using: fuzzy logic” (natural language without exact borders

3. The workers are asked to rate the weights handled, daily time in the observed task, level of hand force, visual demands, driving of vehicles, use of vibrating tools, and difficulties to keep up with the work as well as stress fullness of this work.
4. The ratings are weighted to scores added to summery scores for body parts and other items (driving, vibration, work pace and stress).
5. Based on these score, priority level for intervention has been proposed to provide a basis for decision- making and communication within organisations.
6. Workers perception and observers assessment was taken into account by QEC checklists.

**Table 2: Recommended QEC Percent score**

The action level from QEC		
Action level	Intervention recommended	Recommended QEC % Score
Acceptable risk	Acceptable posture	<40%
Moderate risk	Further investigation needed; Change may be required	40-49%
High risk	Investigation and changes may be needed soon	50-69%
Very high risk	Investigation and changes needed immediately	>70%

**Quick Exposure Checklist**

Worker's name \_\_\_\_\_ Date \_\_\_\_\_

**Observer's Assessment**

**Back**

**A When performing the task, is the back**  
(select worse case situation)

A1  Almost neutral?  
 A2  Moderately flexed or twisted or side bent?  
 A3  Excessively flexed or twisted or side bent?

**B Select ONLY ONE of the two following task options:**

**EITHER**  
 For seated or standing stationary tasks. Does the back remain in a static position most of the time?  
 B1  No  
 B2  Yes

**OR**  
 For lifting, pushing/pulling and carrying tasks (i.e. moving a load). Is the movement of the back  
 B3  Infrequent (around 3 times per minute or less)?  
 B4  Frequent (around 8 times per minute)?  
 B5  Very frequent (around 12 times per minute or more)?

**Shoulder/Arm**

**C When the task is performed, are the hands**  
(select worse case situation)

C1  At or below waist height?  
 C2  At about chest height?  
 C3  At or above shoulder height?

**D Is the shoulder/arm movement**

D1  Infrequent (some intermittent movement)?  
 D2  Frequent (regular movement with some pauses)?  
 D3  Very frequent (almost continuous movement)?

**Wrist/Hand**

**E Is the task performed with**  
(select worse case situation)

E1  An almost straight wrist?  
 E2  A deviated or bent wrist?

**F Are similar motion patterns repeated**

F1  10 times per minute or less?  
 F2  11 to 20 times per minute?  
 F3  More than 20 times per minute?

**Neck**

**G When performing the task, is the head/neck bent or twisted?**

G1  No  
 G2  Yes, occasionally  
 G3  Yes, continuously

\* Additional details for L, P and Q if appropriate

\* L  
 \* P  
 \* Q

**Worker's Assessment**

**Workers**

**H Is the maximum weight handled MANUALLY BY YOU in this task?**

H1  Light (5 kg or less)  
 H2  Moderate (6 to 10 kg)  
 H3  Heavy (11 to 20kg)  
 H4  Very heavy (more than 20 kg)

**J On average, how much time do you spend per day on this task?**

J1  Less than 2 hours  
 J2  2 to 4 hours  
 J3  More than 4 hours

**K When performing this task, is the maximum force level exerted by one hand?**

K1  Low (e.g. less than 1 kg)  
 K2  Medium (e.g. 1 to 4 kg)  
 K3  High (e.g. more than 4 kg)

**L Is the visual demand of this task**

L1  Low (almost no need to view fine details)?  
 \*L2  High (need to view some fine details)?  
 \* If High, please give details in the box below

**M At work do you drive a vehicle for**

M1  Less than one hour per day or Never?  
 M2  Between 1 and 4 hours per day?  
 M3  More than 4 hours per day?

**N At work do you use vibrating tools for**

N1  Less than one hour per day or Never?  
 N2  Between 1 and 4 hours per day?  
 N3  More than 4 hours per day?

**P Do you have difficulty keeping up with this work?**

P1  Never  
 P2  Sometimes  
 \*P3  Often  
 \* If Often, please give details in the box below

**Q In general, how do you find this job**

Q1  Not at all stressful?  
 Q2  Mildly stressful?  
 \*Q3  Moderately stressful?  
 \*Q4  Very stressful?  
 \* If Moderately or Very, please give details in the box below

### 3. Results and Discussion

The working postures of the respondents while durrie weaving through handloom was observed and score was assigned to each body parts by using the REBA score sheet. The position

of neck, trunk, leg as well as load/force, upper arm, lower arm and wrist used in carrying out activities were considered for analysis of postures.

**Table 3:** Distribution of the respondent according to REBA Employee Assessment Worksheet

S. No.	Body parts	MEAN	S.D	Maximum Score
1	Neck	2.40	0.4928	3
2	Trunk	4.60	0.4928	5
3	Leg	3.20	0.9859	4
4	Force/load score	1.00	0.0000	2
	Score A	6.60	0.4928	12
1	Upper arm	3.60	0.4928	6
2	Lower arm	1.00	0.0000	2
3	Wrist	2.00	0.0000	2
4	Coupling	2.00	0.0000	2
	Score B	7.60	0.4929	12
	Score C	9.60	0.48989	9
	Activity Score	1.00	0.0000	1
	REBA Score	10.6	0.48989	11

Analysis of data in table 3 regarding REBA score to different body parts of handloom weavers in durrie unit reveals that in score A maximum mean score 4.60 was for trunk and in score B maximum mean score 3.60 was for upper arm. Mean for score B which includes upper arm, lower arm, wrist and

coupling was higher (m s 7.60) as compare to score A (m s 6.60) which include neck, trunk, leg and force /load score. Mean for score C was 9.60 which after adding mean of activity score (m.s 1.00) turn to REBA mean score (m.s10.6.)

**Table 4:** Percentage distribution of the respondent on the basis of REBA score N =80

S. No.	Action category	Interpretation	Score	
			Frequency	Percentage
1	1-Negligible risk	No change is required	-	-
2	2-3 low risk change	Change may be needed	-	-
3	4-7 medium risk	Further investigate change soon	-	-
4	8-10 high risk	Investigate & implement change	45	56.25
5	11+ very high risk	Implement Change	35	43.75

REBA action category presented in table 4 reveals that maximum 56.25 percent weavers were in action category 4 which ranges between score 8-10 i.e. high risk which directs for investigation and implementation of change, whereas,

43.75 percent weavers were in action category 5 which scores above 11 i.e. very high risk and directs to implement change immediately.

**Table 5:** Comparison of QEC score of weavers with recommended priority scores N = 80

S. No	Body Area	QEC Score for weaving activity				Weaver's Score
		Low	Moderate	High	Very High	
1	Back (static)	8-14	16-22	24-28	30-40	31
2	Shoulder/ Arm	10-20	22-30	32-40	42-56	37
3	Wrist/ hand	10-20	22-30	32-40	42-56	43
4	Neck	4-6	8-10	12-14	16-18	17

Analysis of data in table 5 regarding assessment of risk factor in different body parts while weaving through Quick Exposure Checklist reveals that QEC mean score for Durrie weaving was 31 for back (static) which belongs to very high exposure to hazard in back, mean QEC score for shoulder was 37 which shows high exposure to hazard in shoulders, wrist / hand with mean QEC score 43 was exposed to very high health hazard

and neck with QEC mean score 17 is highly exposed to health hazard. Table clearly depicts that while weaving back, wrist/hand and neck were exposed to very high risk of health hazard and shoulder /arm only to high risk. This might be due to the improper design of work station, hand tools or long working hour.

**Table 6:** Percentage distribution of weavers on the basis of recommended action level in QEC N = 80

S. NO.	Action level	Intervention recommended	Recommended QEC % Score	Frequency	Percentage
1	Acceptable risk	Acceptable posture	<40%	-	-
2	Moderate risk	Further investigation needed; Change may be required	40-49%	-	-
3	High risk	Investigation and changes may be needed soon	50-69%	49	61.25
4	Very high risk	Investigation and changes needed immediately	>70%	31	38.75

Analysis of weaving operation using QEC gives exposure score to specific body parts including the back, shoulder/ arm, wrist / hand, and neck. The percentage of total QEC score for weaving operation of each individual was calculated. Data presented in table 6 shows that out of total weavers 61.25 percent were in 50-69percent range which mean they are exposed to high risk so investigation and changes may be needed soon, whereas, 38.75 percent weavers who were above 70 percent QEC score were exposed to very high risk so for them investigation and change is needed immediately.

#### 4. Conclusion

Indian hand woven fabrics have been known since time immemorial. Though it employs the largest number of people, the handloom sector is considered a sunset industry, and there is an air of inevitability given the relentless march of mechanisation, modernisation and sophistication. Still, there are many advocates of handloom for reasons including ideology, philosophy, sheer love for handloom products and economic arguments. Many policies and programmes were prepared by government to increase the production, productivity and GDP through this sector but no attention has been paid on human component of this sector. Worker an integral part of this sector suffers from many health related hazard due to nature of this work. Handloom weaving requires long hours of work in static and awkward posture which gradually leads to risk of work related musculoskeletal disorder. Study conducted through REBA and QEC reports high risk to 56.25 and 61.25 percent weaver's respectively and very high risk to 43.75 and 38.75 percent weavers. Hence their work station and work environment need to be reviewed and redesigned so that productivity can be enhanced without creating strenuous condition for weavers.

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