

Ergonomics Risk Assessment of Musculoskeletal Disorder on Construction Site

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Abstract—The common problem in construction industry in recent years is the safety and health of construction workers. The construction activities lead to work related musculoskeletal disorder. The aim of research studying Ergonomic Risk Factors (ERFs) in building construction sites so as to recommend suggestions which mitigate ergonomics injuries. The ergonomics risk assessment are studied to achieve this aim. Data is collected through questionnaire checklist, REBA and QEC ergonomic risk assessment tool. The results shows that most workers were at higher risks and at moderate risks. Risk rank order is determined by RII (relative importance index). Based on the analysis and findings the task need to reassessed and redesigned to safely carry out.

1. INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are a major occupation problem worldwide. In construction sites workers perform activities daily for very long time that leads to musculoskeletal injury at different parts of body.

Construction workers are exposed to various factors at work which include awkward posture, heavy lifting, repetitive motion, vibration and forceful exertion which leads to musculoskeletal injuries at construction site.

MSDs inherent the productivity of the workers in construction site. Construction workers are the human capital of construction industry. The aim of occupational ergonomics is to decrease injuries at site.

2. RESEARCH AIM

The main objective of the study was ergonomics risk assessment of construction activities performed at construction site using ergonomics assessment tool. This assessment recommends suggestions which mitigates ergonomics injuries.

3. METHODOLOGY

This research study was conducted at residential building construction sites. The methods used for ergonomics risk assessment are questionnaire checklist from 20 construction sites, REBA (rapid entire body assessment) and QEC (quick

exposure check) as ergonomics assessment tool. The video recording of the posture movements of the workers are recorded.

3.1 REBA WORKSHEET

The study was done at building construction site. A video of posture analysis is cropped to get snapshots of posture of the workers. This were used to fill the scores in the REBA worksheet based on the observation. From this we get the risk score of the particular activity. Various activities were observed like brick masonry, reinforcement steel bending, concrete levelling, hammering, shutter removal, scaffold removal.

3.2 QEC WORKSHEET

Using QEC worksheet the exposure check was done at construction site. In this observers assessment and worker assessment was done for the activities like brick masonry, reinforcement steel bending, concrete leveling, hammering, shutter removal, scaffold removal.

3.3 CHECKLIST (QUESTIONNAIRE)

A questionnaire based survey was conducted at 20 construction sites for ergonomics design and analysis of some jobs like material handling, machinery work, brick masonry, shuttering, scaffolding on construction site. Data collected through survey are required for identifying ergonomics risk factor, discomforts in various body parts. The ranking of the factors in terms of criticality by response was found by Relative Importance Index (RII) :

$$RII = \frac{\sum W}{A \times N} \quad (0 \leq RII \leq 1)$$

where, W = Weight given to each factor by respondents

A = highest weight

N = Total no. of respondents

4. RESULT AND DISCUSSION

4.1 REBA WORKSHEET

The assessment using REBA worksheet is presented in appendix. Table 1 represent the different risk level obtained after posture analysis through videography.

Table 1: Reba Level

REBA Level	0	1	2	3
REBA score	1	2-3	4-7	8-10
Risk level	Negligible	Low	Medium	High
Required action	acceptable	Change may be needed	Further invest. & change soon	Invest. & change soon
% of workers	0	17	45	38

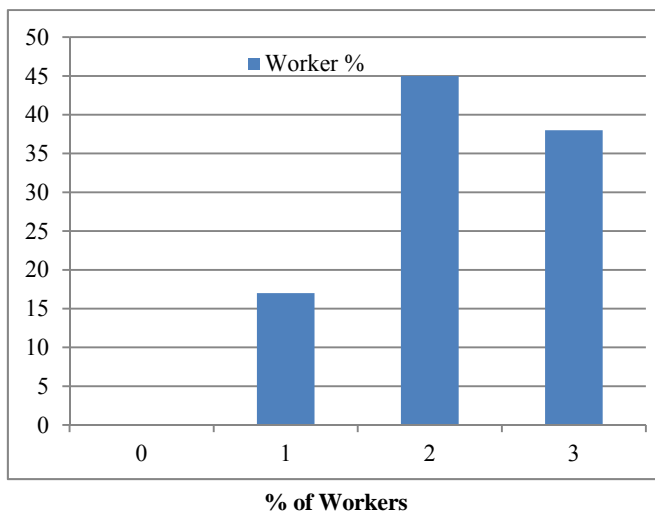


Fig showed that near about 38% workers are at high risk need investigation and implement change, where as near about 45% workers are at medium risk and needs further investigation and change soon. Around 17% workers are at low risk. The table also shows that no workers at negligible risk.

4.2 QEC WORKSHEET

The assessment using QEC work sheet is presented in appendix. The exposure score varied for all activities. QEC shows the exposure score of back, shoulder/arm, wrist/hand & neck.

Score	Exposure level			
	Back	Sholder/arm	Neck	Wrist/hand
Concrete leveling	34 (VH)	26(M)	14(H)	36(H)
Steel bar bending	26 (H)	30(H)	14(H)	36(H)
Brick masonry	3(VH)	30(H)	12(H)	34(H)

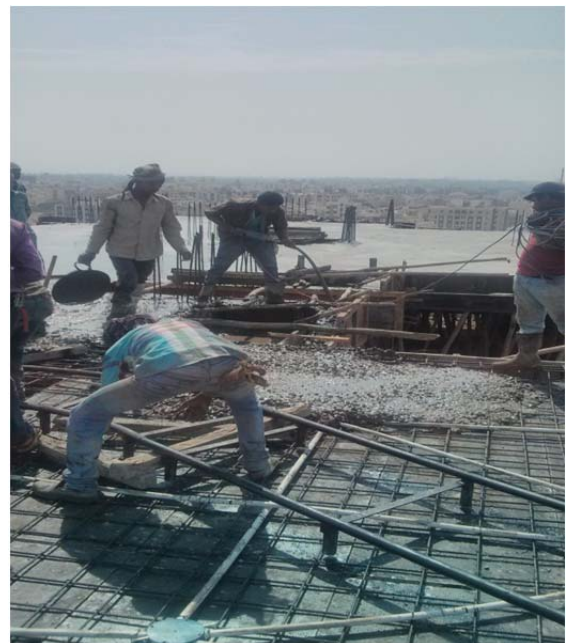
Steel cutting	34 (VH)	30(H)	12(H)	40(H)
Brick lifting	38 (VH)	32(H)	14(H)	38(H)

Where L=LOW

M= MODERATE

H = HIGH

VH= VERY HIGH



4.3 CHECKLIST (QUESTIONNAIRE)

Based on the survey conducted on musculoskeletal injuries on construction site among 50 workers at construction site. The survey was conducted on discomfort on various body parts

and activity factors of activities performed by skilled unskilled labor, manual works etc. Relative Importance Index and ranks are discussed below:

Table: RII and Ranking (level of discomfort in body parts)

Discomfort in body parts	Concrete leveling RII (rank)	Scaffolding removal RII(rank)	Bricks lifting RII (rank)	Brick Masnry RII (rank)	Steel bending RII (rank)
Neck	0.43(9)	0.54(9)	0.6 (7)	0.5 (9)	0.45 (8)
Elbows	0.83(4)	0.76(7)	0.8 (6)	0.8 (6)	1(2)
Knees	0.75(7)	0.8(5)	0.9 (5)	1(2)	0.4 (9)
Shoulder	0.96(2)	1(1)	1(1)	0.9 (5)	1(1)
Back	0.98(1)	0.9(4)	1(2)	1(3)	0.8 (5)
Hands	0.91(3)	1(2)	1(3)	0.9 (4)	1(3)
Forearm	0.78(6)	1(3)	0.9 (4)	1(1)	1(4)
Ankle/Feet	0.79(5)	0.78(6)	0.5 (8)	0.7 (7)	0.6 (6)
Thighs	0.71(8)	0.75(8)	0.4 (9)	0.6 (8)	0.5 (7)

Table: RII and Ranking (Physical factors)

Physical factors	Concrete leveling RII (rank)	Scaffolding removal RII(rank)	Bricks lifting RII (rank)	Brick Masnry RII (rank)	Steel bending RII (rank)
Awkward posture	1(1)	1(1)	1 (1)	0.9 (2)	0.7 (5)
Static posture	0.8(4)	0.7(5)	0.8 (4)	0.9 (3)	1(2)
Work load	0.7(5)	0.9(3)	0.9 (3)	0.7 (5)	0.9 (3)
Strenuous activity	0.9(2)	0.95(2)	0.8 (5)	0.8 (4)	0.9 (4)
Repetitive work	0.9(3)	0.8(4)	0.9 (2)	1 (1)	1 (1)

RII was calculated for all ergonomics factors and discomforts in body parts and from there ranks were given accordingly. From the above results we can identify most critical factor for the activities and from them proper steps can be taken to avoid musculoskeletal injuries

5. CONCLUSION

On the basis of analysis of results and score obtained by ergonomics assessment tool REBA the workers are at higher risk & working in bad postures nearly 40% of workers are at

higher risk of musculoskeletal disorders (MSDs) so immediate change is required. There is lack of ergonomics in the construction site at smaller level. By QEC worksheet it was found that high risk score for various body parts and through checklist it was found that there is higher risk of MSDs. Poor job condition are observed which leads to MSDs.

6. RECOMMENDATIONS

- Ergonomics interventions must be implemented on the construction sites.
- There should be proper knowledge & awareness among workers about ergonomics.
- Workers should take some time to rest in between activities.
- Possible equipments should be redesigned, discover new equipments so that workers are at good working conditions.
- Proper safety equipments must be provided.

Ergonomics programs and seminar should be arranged at construction site.

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APPENDIX

REBA Employee Assessment Worksheet

Based on Technical Note: Rapid Upper Body Assessment (REBA), Adapted: Workday, Applied Ergonomics P/2000 3/11/05

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

Step 2: Locate Trunk Position

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

Step 3: Legs

Step 3a. Adjust...
If feet are not flat: +1
If feet are not shoulder-width apart: +1

Step 4: Look-up Posture Score in Table A

Step 5: Add Forward Lean Score

Step 6: Score A, Find Row in Table C

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:

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

Step 8: Locate Lower Arm Position:

Step 8a. Adjust...
If wrist is bent from midline or twisted: Add +1

Step 9: Locate Wrist Position:

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

Step 10: Look-up Posture Score in Table B

Step 11: Add Coupling Score

Step 12: Score B, Find Column in Table C

Step 13: Activity Score

Task name: _____ Reviewer: _____ Date: _____

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA. © 2000, Workday Inc. rebaworkday.com (313) 444-1807

Exposure Scores Worker's name _____ Date _____

Back

Back Posture (A) & Weight (H)

A1	A2	A3	
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 1

Shoulder/Arm

Height (C) & Weight (H)

C1	C2	C3	
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 1

Wrist/Hand

Repeated Motion (F) & Force (G)

F1	F2	F3	
G1	2	4	6
G2	4	6	8
G3	6	8	10

Score 1

Neck

Neck Posture (C) & Duration (L)

C1	C2	C3	
L1	2	4	6
L2	4	6	8
L3	6	8	10

Score 1

Now do **ONLY** 4 if static **OR** 5 and 6 if manual handling

Static Posture (E) & Duration (J)

E1	E2	
J1	2	4
J2	4	6
J3	6	8

Score 4

Frequency (D) & Weight (H)

D1	D2	D3	
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 4

Wrist Posture (E) & Force (G)

E1	E2		
G1	2	4	6
G2	4	6	8
G3	6	8	10

Score 4

Frequency (D) & Duration (L)

D1	D2	D3	
L1	2	4	6
L2	4	6	8
L3	6	8	10

Score 5

Total score for Back
Sum of scores 1 to 4 **OR** 5 and 6 if manual handling

Total score for Shoulder/Arm
Sum of Scores 1 to 5

Total score for Wrist/Hand
Sum of Scores 1 to 5

Total for Neck
Sum of Scores 1 to 2

Driving
M1 M2 M3
1 4 9

Total for Driving

Vibration
N1 N2 N3
1 4 9

Total for Vibration

Work pace
P1 P2 P3
1 4 9

Total for Work pace

Stress
Q1 Q2 Q3 Q4
1 4 9 16

Total for Stress

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:

1/1/1/1/1

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 6 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 (select worse case situation)?

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.