Analysis of Posture of Rickshaw Pullers Using REBA and Suggestion for Change in Design

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ABSTRACT

Rickshaw is a very common, effective and easily available method of transport. The rickshaw pullers carry a load of 50-70 kilograms on average. This study specifically aimed to [1] Assess the posture of rickshaw pullers while at work; [2] Analyze their working conditions; [3] Determine possible existence of hazards in the workplace; [4] Possible changes in the design of rickshaw to make it more ergonomic 2 rickshaw pullers from Jadavpur Station Road in Kolkata participated in this study. The pictures of those rickshaw pullers were taken during their work time. Rapid entire body assessment (REBA) was carried out to assess musculoskeletal loads on rickshaw pullers, due to their postures, repetition, and force. The amount of back strains, shoulder strains, work related MSD (Musculoskeletal Disorder) risk was found to be very high and demands changes in the structure of rickshaw. REBA score was calculated and was found to be 9 (8-11: high).So it indicated high risk of suffering from injuries. REBA tool is a useful and an applicable tool for assessing risk factors producing entire body disorder in rickshaw pullers. So this research is pertinent in providing awareness and this may serve as a basis of recommendation to improve the design of rickshaws.

Key words: Rickshaw, REBA

INTRODUCTION

Rapid Entire Body Assessment was proposed by Hignett and McAtamney as a means to assess posture for risk of work related musculoskeletal disorders (WRMSDs). REBA is a postural targeting method for estimating the risks of work-related entire body disorders. A REBA assessment gives a quick and systematic assessment of the complete body postural risks to a worker. It is a better tool for the whole body, for static dynamic and rapidly changing postures.

The word 'rickshaw' was originated in Asia where they were mainly used as a means of transportation for the social elite. Rickshaws are a mode of human-powered transport and it was first seen in Japan around 1868. A cycle rickshaw, also known as a pedicab, is often hailed as environment-friendly and an inexpensive mode of transportation. Since it is considered as Indian traditional ride they are almost used in each and every part of India which includes villages, small towns, metros, heritage sites etc. In metros these are used inside institutional areas, market places and also in narrow and crowded lanes where there is accessibility problem for vehicles. The cycle rickshaw is a modified tricycle, which is used extensively as a mode of transport for carrying passengers and luggage. All over India, about 8.5 lakh persons earn

their livelihood by pulling cycle rickshaw. The cycle rickshaw pullers undergo heavy physical work during carrying passengers. Besides, the pullers have to work in hot summer and rainy season. A rickshaw puller carries a load of 70 kg, on an average, in every trip he makes. In this study REBA analysis was applied on a rickshaw puller. The study was conducted at Jadavpur Station Road, Kolkata. The aim of this study was to analyze the level of risk at which the rickshaw pullers are subjected to. Also the possible remedies in the design of the rickshaw are analyzed.

METHODS

Subjects: 5 rickshaw pullers were selected as a subject for the purpose. Their postures were analyzed using REBA.

Fig 1: Photograph of a Subject

Methodology:

Calculation of REBA Score: In this method the assessor assigns scores to postures and body alignment based on body part diagram. Load, Force and coupling scores are added to calculation for the body and then final score for both groups are summated to form the final action score. The REBA analysis sheet is given below.

According to Hignett and McAtamney the development of REBA was aimed to:

Develop a postural analysis system sensitive to musculoskeletal risks in a variety of tasks.

[1] Divide the body into segments to be coded individually, with reference to movement planes.

[2] Provide a scoring system for muscle activity caused by static, dynamic, rapid changing, or unstable postures.

[3] Reflect that coupling is important in the handling of loads but may not always be via the hands.

Give an action level with an indication of urgency.

The observed posture range numbers are selected for the Trunk, Neck and Legs and were recorded in the boxes labeled A in the score sheet. Using scores of trunk, leg and neck, score from Table A were located and load/force score were added. Similar procedure was followed for Scoring the Upper Arms, Lower Arms, and Wrists. Table B score and the Coupling score for each hand involved were entered in the scores in the B boxes.

Data Collection Procedure: 1.Several rickshaws were first observed to get familiar with the working condition of the rickshaw pullers 2. The postures and forces were scored on the diagrams of the REBA worksheet for each body part in chosen postures. 3. Scores are put into a table by following the instruction on the score sheet.4. Intervention, action levels, or the types of investigation needed will be determined by the final score.

Analysis of Problem: The problem arises when the rickshaw puller bends in forward direction for reaching the handle of the rickshaw through which he changes the direction. Under this condition his body experiences flexion and extension in between 20 degrees and 60 degrees and more than 20 degrees respectively. This adds +3 to the REBA score, thus increasing the risk of the concerned design. Furthermore the structure of rickshaw experiences a load of more than 10 kg, thus adding +2 to the REBA score.

RESULT:

Table A:

		TRUNK				
		1	2	3	4	5
NECK=1	LEGS					
	1	1	2	2	3	4
	2	2	3	4	5	6
	3	3	4	5	6	7
	4	4	5	6	7	8
NECK=2	LEGS					
	1	1	3	4	5	6
	2	2	4	5	6	7
	3	3	5	6	7	8
	4	4	6	7	8	9
NECK=3	LEGS					
	1	3	4	5	6	7
	2	3	5	6	7	8
	3	5	6	7	8	9
	4	6	7	8	9	9

Table B:

		UPPER ARM					
		1	2	3	4	5	6
LOWER ARM=1	WRIST						
	1	1	1	3	4	6	7
	2	2	2	4	5	7	8
	3	2	3	5	5	8	8
LOWER ARM=2	WRIST						
	1	1	2	4	5	7	8
	2	2	3	5	6	8	9
	3	4	4	5	7	8	9

Table C:

		SCOREA											
		1	2	3	4	5	6	7	8	9	10	11	
SCORE B	1	1	1	2	3	4	6	7	8	9	10	11	12
	2	1	2	3	4	4	6	7	8	9	10	11	12
	3	1	2	3	4	4	6	7	8	9	10	11	12
	4	2	3	3	4	5	7	8	9	10	11	11	12
	5	3	4	4	5	6	8	9	10	10	11	12	12
	6	3	4	5	6	7	8	9	10	10	11	12	12
	7	4	5	6	7	8	9	9	10	11	11	12	12
	8	5	6	7	8	8	9	10	10	11	12	12	12
	9	6	6	7	8	9	10	10	10	11	12	12	12
	10	7	7	8	9	9	10	11	11	12	12	12	12
	11	7	7	8	9	9	10	11	11	12	12	12	12
	12	7	8	8	9	9	10	11	11	12	12	12	12

The shaded areas in the table denotes the selected portion (score)

A .Neck, Trunk and Leg Analysis:

STEP 1(LOCATION OF NECK POSITION):

From the picture of the subject taken, it is seen that the neck has a flexion of greater than 20 degrees in forward direction. So the trunk score is taken as +2.The nick is not twisted to either side, so no question of adding 1 occurs under this scenario.

STEP 2(LOCATION OF TRUNK POSITION):

Again referring to the picture we can see that the trunk is under flexion between 20 degrees to 60 degrees. So we take the trunk score as +3. In this case also there is no question of adding +1 since the back is not twisted or tilted to side.

STEP 3(ANALYSING THE LEG POSITION):

Again referring to the picture we get that the knee flexion is greater than 60 degrees. So the score for the leg is given as +2.

STEP 4(EVALUATING THE SCORE OF THE TABLE A):

Using the step 1-3 we evaluate the score in table A

STEP 5(ADDING THE LOAD SCORE):

Since the subject is always subjected to load more than 22 lb (10kg) so the load score is taken as +2. Then this score is added to the score of Table A.

5 (Score of table A) + 2(load score) =7(Score A)

STEP 6 (FINDING SCORE A):

The column with score A equal to 7 is marked

B. Arm and Wrist Analysis:

STEP 7 (LOCATION OF THE UPPER ARM POSTION):

Again considering the picture of the subject taken we can say that the upper arm is under flexion between 20 degree to 45 degrees .The arm is not supported .so there is no question of subtracting 1 from the given result. So the Upper arm score is taken as +2.

STEP 8 (LOCATION OF THE LOWER ARM POSITION):

The lower arm position is under flexion greater than 100 degrees. So the lower arm Score is taken as +2.

STEP 9(LOCATION OF THE WRIST POSITION):

The wrist is under extension greater than 15 degrees. So we take the wrist score as +2. There is no appreciable bending of the wrist from midline. So there is no question of adding 1 to the result.

STEP 10(DETERMINING THE SCORE OF TABLE B):

The score of table B is determined and its value is seen to be +3

STEP 11(ADDING THE COUPLING SCORE):

Since the handle is acceptable but not ideal so the coupling score is taken as +1 which is considered as fair. Next the coupling score is added with the posture score of table B

1(coupling score) + 3(posture score of table B) =4(Score B)

STEP12 (FINDING THE COLUMN IN TABLEC):

The column in the Table C is found and matched with the score of Table A, which was determined in the step 6 .Thus we can reveal the score C which comes to be +8

STEP13 (DETERMINING THE ACTIVITY SCORE):

Driving the rickshaw consist of actions in which rapid large range changes in posture occurs. So the activity score is taken to be +1

FINAL REBA SCORE= SCORE OF TABLE C+ACTIVITY SCORE = 8+1=9

So final Reba score comes to be +9 which is quite high. So we have to investigate the design and implement changes in it.

Changes in Design:

1. The distance between the seat of the rickshaw puller and the handle through which it controls the direction is too large. So the entire body is under extension in forward direction .Hence this distance is to be adjusted according to the height and length of the arm of the rickshaw puller to reduce the posture hazard.

2. Pair of legs are integral part in drawing a rickshaw. The legs should be kept in an upright condition so that no bending occurs at the hinge joint of the legs. To do this the sprocket chain needs to be at an optimum distance from the seat of the puller

3. To reduce the activity score we can run the sprocket chain with mechanized means like motors

4. The structure is quite heavy and consists of wood and metal nearly about 120 kgs. Choosing the material for the rickshaw design must be performed meticulously .Various selection tools like TOPSIS , MOORA needed to be applied in order to ensure that chassis becomes light without compromising on its MTTF(Mean time to Failure).As we reduce the load we can lessen the REBA score to a certain extent.

5. A support behind the seat of the puller can be incorporated so as to keep the posture upright.

STATEMENT OF RELEVANCE

Rickshaw is one of the most important medium of transport in Kolkata. So it's a high time to test the posture problems related in driving a rickshaw and suggest some remedial measure related to the problem.

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SCOPE OF FURTHER RESEARCH

We have taken 5 subjects as our experiment. The investigation can be done for more subjects and the REBA score can be verified. In our case all the score came around 9. Further we have identified few areas of problem. By further investigation more areas of problem can be cited. Also much more remedial measures can be put into light by further research. Selecting the suitable material for the designing of rickshaw chassis can also be a field of further research.

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