



*Original Research*

## Risk Assessment of Musculoskeletal Disorders of Farm Women during Livestock Activities – A Comparison of RULA and REBA Tools

Surabhi Singh

ASPEE College of Home Science & Nutrition, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, INDIA

\*Corresponding author: [surabhi1882@sdau.edu.in](mailto:surabhi1882@sdau.edu.in)

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### Abstract

Women play a major role in the livestock production activities in India. The female share in the agricultural labor force in case of India is about 30 per cent. Involvement of women in livestock activities can improve gender equity also. Most of the livestock activities like fodder cutting, milking the animals, maintenance of animal sheds and its allied functions have been performed by rural women. While performing these livestock activities, there may be many physical hazards such as lifting and carrying heavy loads; work with the trunk frequently flexed, twisted wrist and repetitive motion. This may lead to chronic or acute musculoskeletal diseases. Hence, it would be useful to assess the risk for musculoskeletal disorders involved with each activity for adopting measures. The present study was conducted in randomly selected ten villages of Deesa Taluka. From each selected village, fifteen farm women were selected by random sampling, who was actively involved in performing livestock activities. The study is focused on analyzing risk for musculoskeletal disorders while performing various livestock activities. Most of the livestock activities were rated as high risky and change was required immediately.

**Key words:** Livestock Activities, Musculoskeletal Disorders, Rapid Entire Body Assessment, Rapid Upper Limb Assessment

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### Introduction

Women play a major role in the livestock production activities in India. The female share in the agricultural labor force in case of India is about 30% (Sofa and Doss, 2011). Involvement of women in livestock activities can improve gender equity also. Women meet three fourth of the labor requirement in livestock production (Planning Commission, 2012). Most of the livestock activities like fodder cutting, milking the animals, maintenance of animal sheds and its allied functions have been performed by rural women.



While performing these livestock activities, there may be many physical hazards such as lifting and carrying heavy loads; work with the trunk frequently flexed, twisted wrist and repetitive motion. Tripathi et al (2017) found in their study that physical hazards ranked first followed by biological, psychological and chemical hazards during performing livestock activities. Kolstrup (2012) reported that repetitive and monotonous work in dairy houses were the work factors most frequently reported as causing physical discomfort among farmers, followed by lifting heavy objects. Singh (2017) affirmed in a study that maximum farm women were having back pain followed by shoulder pain and neck pain as symptoms of musculoskeletal disorders and they felt discomfort also in different body parts while performing livestock activities.

The physical circumstances of their occupation render rural women potentially vulnerable to musculoskeletal disorders (MSDs). Assessment of exposure levels to MSD risk factors can be an appropriate base for planning and implementing interventional ergonomic programs in the workplace. Thus, corrective measures should be adopted to improve the efficiency of the rural women and to avoid the musculoskeletal disorders. The present study is focused on risk analysis of the musculoskeletal disorders related to livestock activities among rural women.

### Materials and Methods

The present study was conducted in randomly selected ten villages of Deesa Taluka. From each selected village, fifteen farm women were selected by random sampling, who were actively involved in performing livestock activities. The selected women were non pregnant, bereft of serious ailments and chronic health problems. An interview schedule was used for collecting baseline data. BMI was measured by Body Fat Analyzer. RULA (Rapid Upper Limb Assessment) and REBA (Rapid Entire Body Assessment) tools were used for risk assessment of musculoskeletal disorders during performing various livestock activities. RULA (Appendix 1) and REBA sheet (Appendix 2) were used for collecting data. The respondents were observed while doing task and the scores of their postures were recorded in the sheet. Final scores were calculated and interpretation were drawn.

### Results and Discussion

**Table 1:** Distribution of farm women according to their age

S. No.	Age	N	%
1	Adolescents (12-18 yrs)	6	4
2	Young Adult (18-40 yrs)	105	70
3	Adult (40-65 yrs)	34	22.7
4	Old Age (> 65 yrs)	5	3.3
5	Total	150	100

**RULA Employee Assessment Worksheet**

Task Name: \_\_\_\_\_ Date: \_\_\_\_\_

**A. Arm and Wrist Analysis**

**Step 1: Locate Upper Arm Position**

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

**Step 2: Locate Lower Arm Position**

Step 2a: Adjust:  
 If wrist axis is backing across midline or out to side of body: Add +1

**Step 3: Locate Wrist Posture**

Step 3a: Adjust:  
 If wrist is bent from midline: Add +1

**Step 4: Wrist Twist**

Step 4a: Adjust:  
 If wrist is twisted in midrange: +1  
 If wrist is at or near end of range: +2

**Step 5: Look-up Posture Score in Table A:**  
 Using values from steps 1-4 above, locate score in Table A.

**Step 6: Add Muscle Use Score**  
 If posture mainly static (i.e. hand/foot restrained, or if action/repetition occurs 5X per minute): 0

**Step 7: Add Force/Load Score**  
 If load = 4.4 lbs. (biweighting): 0  
 If load 4.4 to 22 lbs. (static or repeated): +1  
 If more than 22 lbs. or repeated or static: +2

**Step 8: Find Row in Table C**  
 Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in Table C.

**Table A: Wrist Score**

Upper Arm	Lower Arm	Wrist Twst	Wrist Twst	Wrist Twst	Wrist Twst
1	1	1	2	3	4
2	2	2	3	4	5
3	3	3	4	5	6
4	4	4	5	6	7
5	5	5	6	7	8
6	6	6	7	8	9

**Table B: Neck, Trunk and Leg Score**

Step 9: Adjust:  
 If neck is twisted: +1  
 If neck is side bending: +1

Step 10: Adjust:  
 If trunk is twisted: +1  
 If trunk is side bending: +1

Step 11: Adjust:  
 If knee and foot are supported: +1  
 If not: +2

**Table C: Neck, Trunk, Leg Score**

Neck	Trunk	Leg	Score
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

**Table D: Final RULA Score**

Wrist / Arm Score	Neck, Trunk, Leg Score	Final RULA Score
1-2	1-2	1-2
3-4	3-4	3-4
5-6	5-6	5-6
7-8	7-8	7-8
9-10	9-10	9-10

**Scoring (Final score from Table C):**  
 1,2 = acceptable posture  
 3,4 = further investigation, change may be needed  
 5-8 = further investigation, change soon  
 9-10 = investigate and implement change

**Final RULA Score**

**Appendix 1**

Majority of the farm women belonged to young adult age group, while a few adolescents and old age farm women were also performing livestock activities. It can be stated that all the age group of farm women were performing livestock activities. Table 2 revealed that less than half of the farmwomen were low weight whereas almost one-fourth of the respondents were overweight and obese as per their BMI. Only 27 per cent farmwomen were falling under the normal category according to their BMI.

**Table 2: BMI (Kg/m<sup>2</sup>) of farm women**

BMI (Kg/m <sup>2</sup> ) of Farm Women	N	%
Low weight( < 20.0)	64	42.7
Normal (20.0-23.0)	41	27.3
Overweight (23.0-30.0)	36	24
Obesity (30.0-35.0)	9	6
Total	150	100

Majority of the farmwomen involved in all livestock related activities adopt awkward posture and work in unsuitable working condition. REBA and RULA tools were used to assess MSD risk associated with various livestock operations performed by women in rural areas.

**A. Neck, Trunk and Leg Analysis**

**Step 1: Locate Neck Position**  
 10-20° +1    20°+ +2    In extension +2

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

Neck Score

**Step 2: Locate Trunk Position**  
 0° +1    0-20° +2    20-60° +3    60°+ +4

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

Trunk Score

**Step 3: Legs**  
 Adjust: 30-60° +1    >60° +2

Leg Score

**Step 4: Look-up Posture Score in Table A**  
 Using values from steps 1-3 above, locate score in Table 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

**Scoring**  
 1 = Negligible Risk  
 2-3 = Low Risk. Change may be needed.  
 4-7 = Medium Risk. Further Investigate. Change Soon.  
 8-10 = High Risk. Investigate and Implement Change  
 11+ = Very High Risk. Implement Change

**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
Force Score		2	2	3	4	5	3	4	5	6	4	5	6
		3	2	4	5	6	4	5	6	7	5	6	7
		4	3	5	6	7	5	6	7	8	6	7	8
		5	4	6	7	8	6	7	8	9	7	8	9
		6	7	8	9	8	7	8	9	7	8	9	9

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

Table C		Score B											
Score A		1	2	3	4	5	6	7	8	9	10	11	12
1		1	1	1	2	3	3	4	5	6	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	10	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 = REBA Score

**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:**

Wrist Score

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

**Step 10: Look-up Posture Score in Table B**  
 Using values from steps 7-9 above, locate score in Table 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

Original Worksheet Developed by Dr. Alan Hedge. Based on Technical note: Rapid Entire Body Assessment (REBA). Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

**Appendix 2**

**REBA (Rapid Entire Body Assessment) Scores of Livestock Related Activities**

This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risk associated with job tasks. It is used to evaluate selected body posture, forceful exertions, type of movement or action, repetition and coupling. After assessment, a single score REBA represents following levels of MSD risk:

**Table 3: REBA scores and their interpretation**

Score	Level of MSD Risk
1	Negligible risk, no action required
3-Feb	Low risk, change may be needed
7-Apr	Medium risk, further investigation, change soon
10-Aug	High risk, investigate and implement change
11+	Very high risk, implement change

**Table 4:** REBA scores during performing different livestock activities

	<b>Fodder Collection</b> Neck Position=>20 <sup>0</sup> Trunk position= > 60 <sup>0</sup> Upper arm position = 20-45 <sup>0</sup> Repeated small range actions <b>REBA Score=9</b> High risk, Investigate and implement change
	<b>Cleaning &amp; care of animals</b> Neck Position=10-20 <sup>0</sup> Trunk position= 0-20 <sup>0</sup> Upper arm position = >90 <sup>0</sup> Repeated small range actions <b>REBA Score=6</b> Medium risk, Further investigate and change soon
	<b>Cleaning animal shed</b> Neck Position=> 20 <sup>0</sup> Trunk position= >60 <sup>0</sup> Upper arm position = >90 <sup>0</sup> Action causes rapid large range changes in postures <b>REBA Score=10</b> High risk, Investigate and implement change
	<b>Dung Collection</b> Neck Position=> 20 <sup>0</sup> Trunk position= 20-60 <sup>0</sup> Upper arm position = 45-90 <sup>0</sup> Action causes rapid large range changes in postures <b>REBA Score=8</b> High risk, Investigate and implement change
	<b>Disposing of animal dung</b> Neck Position=10- 20 <sup>0</sup> Trunk position= 0 <sup>0</sup> Upper arm position = >90 <sup>0</sup> Action causes rapid large range changes in postures <b>REBA Score=9</b> High risk, Investigate and implement change



**Milking**

Neck Position=10- 20°

Trunk position= 0-20°

Upper arm position = 45-90°

(shoulder is raised)

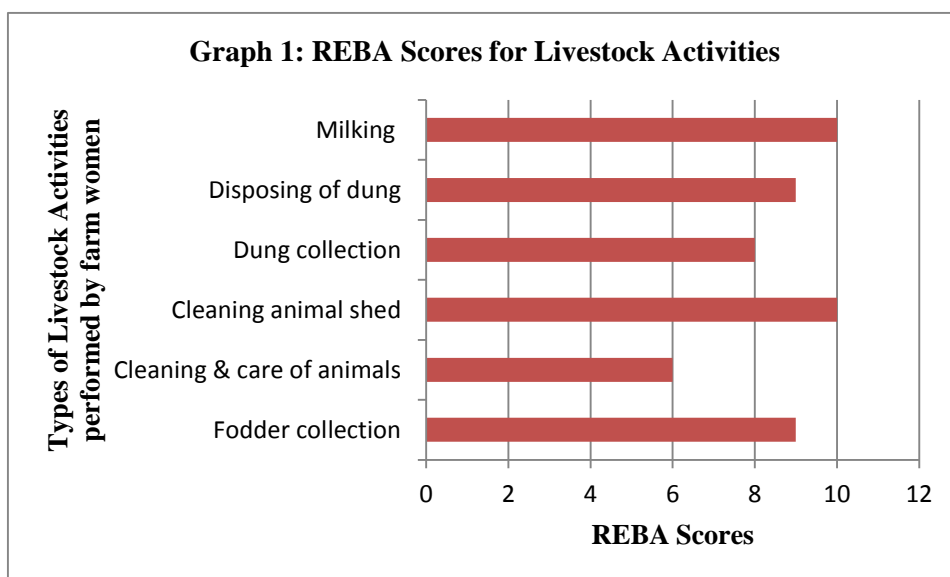
Wrist is twisted from midline

Action causes rapid large range changes in postures

**REBA Score=10**

High risk, Investigate and implement change

During fodder collection, the position of the neck, trunk and upper arm was extensively deviated from the normal posture. So, the posture was categorized under high risk. While cleaning of animals, the woman was in standing position but the upper arm position is at more than 90° angle; neck and trunk were also not in the middle plane. It was categorized under medium risk. Cleaning animal shed is again a tiresome job, in which woman was working in extremely awkward posture and this posture had been repeated in short duration. After collection waste from the shed in bending posture, woman carried load on her head and threw it at a distance. The posture which was analyzed is rated as high risk due to the position of neck, trunk and upper arm. Dung collection was performed in bending posture with deviated neck, trunk and upper arm position from the middle plane. Further, disposing of dung was also rated as high risk activity due to upper arm position and load carrying. Milking activity was also scored as high risk. It was performed in squatting posture with raised upper arm and twisted wrist. Here, on the basis of REBA scores, all the livestock activities performed by rural women were found under high risk of musculoskeletal disorders except cleaning and care of animals.



It can be inferred from the Graph that highest risk for MSD was associated with the activity of cleaning animal shed followed by fodder collection and disposing of dung. Thses activities may cause severe MSD's if no change will be done in the posture of farm women.

### RULA (Rapid Upper Limb Assessment) Scores of Livestock Related Activities


RULA was developed to evaluate the exposure of individual workers to ergonomic risk factors associated with upper extremity MSD. The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk and upper extremities. After assessment, final RULA scores represent the level of risk as given below-





**Table 5:** RULA scores and their interpretation

Score	Level of MSD Risk
2-Jan	Negligible risk, no action required
4-Mar	Low risk, change may be needed
6-May	Medium risk, further investigation, change soon
6+	Very high risk, implement change now

RULA scores for fodder collection shows very high risk as the farm woman in this posture was working outside the body with twisted wrist. Trunk was also bended. As far as cleaning and care of animals is concerned, it was rated as low risk activity for MSD. Cleaning animal shed scored as medium risk activity. Likewise disposing of animal dung and milking were also rated as medium risk activity for MSD among the workers.

**Table 6:** RULA scores during performing different livestock activities

	<b>Fodder Collection</b> Wrist & Arm Score = 6 Upper arm – 20-45° Lower arm working outside the body Wrist twisted Neck, Trunk and Leg Score- 6 <b>RULA Score -7</b> <b>Very high risk, implement change now</b>
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	<p><b>Cleaning &amp; care of animals</b> Wrist &amp; Arm Score = 3 Upper arm – 20-45° Lower arm working outside the body Wrist twisted Neck, Trunk and Leg Score- 5 <b>RULA Score -4</b> <b>Low risk, Change may be needed</b></p>
	<p><b>Cleaning animal shed</b> Wrist &amp; arm Score = 4 Upper arm – 45-90° (Person is leaning) Lower arm – &gt;100° Wrist extend from midline Neck, Trunk, Leg score-5 <b>RULA Score- 5</b> <b>Medium risk, Further investigation, change soon</b></p>
	<p><b>Dung Collection</b> Wrist &amp; arm Score = 3 Upper arm – 20-45° Lower arm – 50-100° Wrist bent from midline and twisted in midrange Neck- &gt;20° , Trunk-&gt;60° Neck, Trunk, Leg score-6 <b>RULA Score- 5</b> <b>Medium risk, Further investigation, change soon</b></p>
	<p><b>Disposing of animal dung</b> Wrist &amp; arm Score = 6 Upper arm – &gt; 90° Lower arm - &gt;100° Wrist bent from midline and twisted in midrange Neck, Trunk and Leg Score- 3 <b>RULA Score- 5</b> <b>Medium risk, Further investigation, change soon</b></p>



**Milking**

Wrist & arm Score = 5

Upper arm – 45-90°

Lower arm - 100°

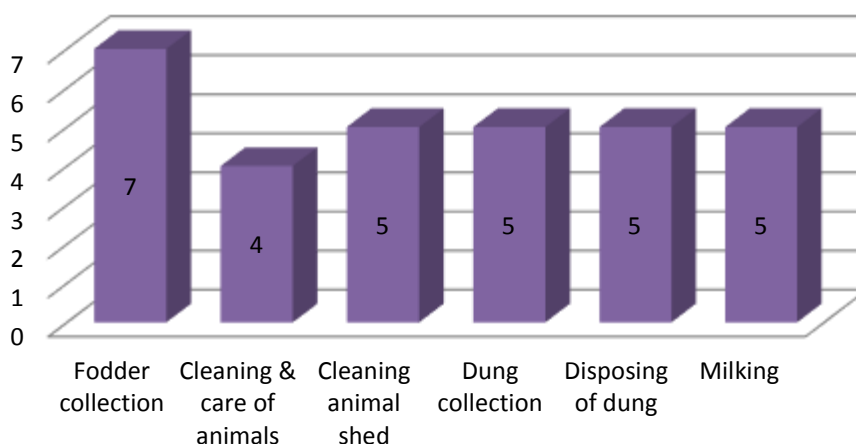
Wrist bent from midline and twisted

Neck, Trunk and Leg Score- 4

**RULA Score- 5**

**Medium risk, Further investigation, change soon**

**Graph : 2 RULA Scores for Livestock activities**



The graphical representation of RULA scores of livestock activities indicates that each of the activity has risks for musculoskeletal disorders. All the activities need changes though fodder collection was the activity which had the highest risks for upper limb musculoskeletal disorders. Changes in the posture are highly required. On comparing the results found by using REBA and RULA tools, disparity amongst level of MSD risk for different livestock activities was analyzed. Cleaning and care of animals was scored as medium risk for MSD's under REBA while it was scored as low risk for MSD's under RULA tools. Likewise, other activities such as cleaning animal shed, dung collection, disposing of animal dung and milking were scored as high risk for MSD's under REBA while they were scored as medium risk for MSD's under RULA tool. Though fodder collection was scored at the level of high risk under both the tools.

**Table 7:** Comparison of RULA and REBA postural assessment tools for livestock activities

Livestock activities	REBA Score	Action Level	RULA Score	Action Level
Fodder collection	9	High risk, Investigate and implement change	7	Very high risk, implement change now
Cleaning and care of animals	6	Medium risk, Further investigate and change soon	4	Low risk, change may be needed
Cleaning animal shed	10	High risk, Investigate and implement change	5	Medium risk, further investigation, change soon
Dung collection	8	High risk, Investigate and implement change	5	Medium risk, further investigation, change soon
Disposing of animal dung	9	High risk, Investigate and implement change	5	Medium risk, further investigation, change soon
Milking	10	High risk, Investigate and implement change	5	Medium risk, further investigation, change soon

RULA tool includes the details of upper limb while assessing risk while REBA tool includes the details of whole body during operation. **Table 8** depicts that fodder collection (2.8) and dung collection (2.8) were perceived as heavy activities by farm women according to mean scores followed by milking (2.7) and cleaning & care of animals (2.5) and disposing of dung (2.6). Results are in tune with the results assessed by REBA tool as all activities except cleaning & care of animals were assessed high risk activities for musculoskeletal disorders. Hence, REBA was found more suitable tool for assessing risk of musculoskeletal disorders while performing livestock activities.

**Table 8:** Workload perceived by farm women regarding various livestock activities

Perception of Farmwomen Regarding Workload of Activity	Mean score
Fodder collection	2.8
Cleaning & care of animals	2.5
Cleaning animal shed	2.6
Dung collection	2.8
Disposing of dung	2.6
Milking	2.7

RULA tool will not show the absolute picture of risk which may occur during performing livestock activities. It is suitable for those operations in which, upper body parts are more involved and lower limbs are at rest.

### Conclusion

It can be concluded from the study that majority of farm women were not having normal BMI and majority of them were performing all type of livestock activities. Risk for having musculoskeletal disorders was analyzed using REBA and RULA tools. Further, results obtained from REBA and RULA were also compared. It was found that REBA tool is comparatively more suitable for analyzing the posture during



performing livestock activities as the entire body is considered. While in RULA tool, only upper limbs are assessed. All the activities except cleaning & care of animals were assessed as having high risk for MSDs. Farm women also reported all these activities heavy to perform. Hence, changes are required and ergonomic interventions may be adopted to lower the risk for MSD by designing long handled tools, lifting equipment and imparting training to farm women for working in safe condition.

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