Research Article

RISK FOR MUSCULOSKELETAL DISORDERS AND DISCOMFORT AMONG FARM WOMEN–CASE STUDIES

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Abstract- Musculoskeletal disorders (MSDs) has been reported as major health problem amongst a large number of working population. As women are involved in many agricultural and allied activities, it leads to many health hazards mainly musculoskeletal disorders such sprain, strain, low back pain, pain in lower and upper extremities etc. Researchers need to focus on assessing risk for musculoskeletal disorders among farm women and recommend ergonomic interventions to improve their body posture and job design. This paper presents RULA case studies of farm women and reports their discomfort level while performing different agricultural and allied activities. It was found that none of the farm woman was working in an acceptable posture and it required changes. In exploring their discomfort level, lumber and lower limbs were found the most affected body parts due to poor posture and poor job design.

Keywords- RULA, Discomfort Scale, Farm Women, Body Posture.

Citation: Singh Surabhi, et al., (2017) Risk for Musculoskeletal Disorders and Discomfort among Farm Women–Case Studies. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 9, Issue 10, pp.-3980-3983.

Introduction

Agriculture ranks among the most hazardous industries. Farming is one of the few industries in which farmers are at risk for fatal and non-fatal injuries (NIOSH 2013) [1]. The physical demand of the farm work which range from moderate to heavy, often include standing, squatting, bending and reaching, carrying heavy loads and working for long hours, may cause certain hazards to the person. Long hours of work, heavy work, extreme postures, lack of rest, sometimes poor nutrition and health apparently indicate that the farm women are under serious physical stress. Thus, the health of agricultural worker is always at risk. Research has shown that many important risk factors can be successfully addressed in agricultural work using ergonomic approaches (Meyers and Miles, 1997) [2].

Musculoskeletal disorders (MSDs) are defined as a group of injuries that affect the musculoskeletal system including the nerves, tendons, muscles, and supporting structures such as intervertebral discs (NIOSH, 1997) [3]. A large number of working population suffer from a substantial health problem, i.e., musculoskeletal disorders. Women are the major work force in agricultural and allied sectors. They work in awkward and uncomfortable posture, it leads to many health hazards mainly musculoskeletal disorders like strain/sprain, neck pain, shoulder pain, back pain, accidents like cut/wounds, lacerations/scratches, injury leading to surgical treatment, fatal injuries, knee injuries and tendon disorders. In addition to causing pain, suffering, illness and injury, they can also result in reduced work ability and, consequently, reduced farm income (Whelan et al., 2009) [4]. Tripathy and Kwatra (2016) stated that vegetable production places farm workers at a risk of postural discomfort and musculoskeletal disorders [5].

Materials and Methods

RULA and discomfort scale were used to assess the risks for work related musculoskeletal disorders and discomfort felt by farm women. Farm women for case studies were selected randomly while they were performing agricultural and livestock activities.

RULA is a postural targeting method for estimating the risks of work-related upper limb disorders. A RULA assessment gives a quick and systematic assessment of the postural risks to a worker. The result of test is final RULA score. There are four action levels of RULA score.

The RULA action levels give the urgency about the need to change how a person is working as a function of the degree of injury risk.

1. Action level 1 – RULA score 1-2 means that the person is working in the best posture with no risk of injury from their work posture.

2. Action level 2 – RULA score 3-4 denotes that the person is working in a moderate risky posture and most probably one part of the body is in a deviated and awkward position, so this should be further investigated and corrected.

3. Action level 3 – RULA score 5-6 means that the person is working in a poor posture with a risk of injury from their work posture, and the reasons for this need to be investigated and changed in the near future to prevent an injury.

4. Action level 4 – RULA score 7-8 means that the person is working in the worst posture with an immediate risk of injury from their work posture, and the reasons for this need to be investigated and changed immediately to prevent an injury.

RULA scores for three activities were calculated by using ERGOMASTER SOFTWARE. The following three case studies gives an idea that farm women are working in a bad posture which has high degree of risk for having musculoskeletal
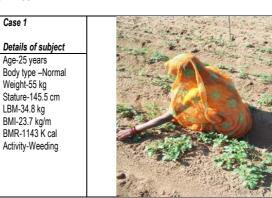
disorders.

A ten point discomfort scale was used to assess the discomfort level of farm women at different body parts while performing tasks. Body part discomfort survey is a vital part of the job analysis. From employee responses to the discomfort survey, an employer can identify body parts that may be experiencing elevated levels of discomfort. The responses can also assist for prioritizing control strategies by concentrating on the body parts affected by current job design.

Rapid Upper Limb Assessment

Case 1	
Details of subject	
Age-25 years Body type –Normal Weight-55 kg Stature-145.5 cm LBM-34.8 kg BMI-23.7 kg/m BMR-1143 K cal Activity-Weeding	

Step Score

Step		Score
1: Upper Arm Position	15° to 45°	2
2: Lower Arm Position	90° or less	1
3: Wrist Position -15° or less		3
4: Wrist Twist Wrist is twisted in mid-range		1
5: Calculate UE Posture Score		**3**
6: UE Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1
7: UE Force/Load Score		
Load is less than 2 kg (intermittent)		0
8: Calculate Final Wrist and Arm Score		**4**
9: Neck Position Flexed 0° to 10°		1
10: Trunk Position Flexed 0° to 20°		2
11: Leg Position Legs and feet supported and balanced		1
12: Calculate Trunk Posture Score		**1**
13: Trunk Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1
14: Trunk Force/Load Score		
15: Calculate Final Neck, Trunk & Leg Score		**3**
Final RULA Score		**3**

Required action	Acceptable	Investigate Further	Investigate Further and Change Soon	Investigate and Change Immediately
Final Score	1 or 2	3 or 4	5 or 6	7

The final RULA score for the subject is 3. Though it is not acceptable, it can be improved further. The subject is weeding in a squatting position but her trunk position is little flexed. Weeding with improved weeder in a standing posture can be a better alternative to reduce the risk of musculoskeletal disorders. Body composition parameters show that the farm woman fall under the normal category with normal BMI.

Case 2	
Details of subject	
Age-22 years Body type –low fat low weight Weight-46 kg Stature-145.4 cm LBM-28.4 kg BMI-16.3 kg/m BMR-1071 K cal	

Activity- *Potato seed making*	

Step Score

Step		Score
1: Upper Arm Position	15° to 45°	2
2: Lower Arm Position	90° or less	1
3: Wrist Position 0° to 15°		2
4: Wrist Twist Wrist is twisted in mid-range		1
5: Calculate UE Posture Score		**2**
6: UE Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1
7: UE Force/Load Score Load is less than 2 kg (intermittent)		0
8: Calculate Final Wrist and Arm Score		**3**
9: Neck Position Flexed 0° to 10°		1
10: Trunk Position Flexed 20° to 60°		3
11: Leg Position Legs and feet supported and balanced		1
12: Calculate Trunk Posture Score		**1**
13: Trunk Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1
14: Trunk Force/Load Score		0
15: Calculate Final Neck, Trunk & Leg Score		**4**
Final RULA Score		**4**

The final RULA score for the subject is 4 which is not acceptable and it can be investigated further for improvement. The subject is slicing potato for making seeds in a squatting position. Sitting position with trunk at 0^0 would be a better position.

The body composition parameters of farm women were also analyzed and it was found that the subject was underweight with low fat and low BMI. Underweight women may have poor physical stamina and a weak immune system, leaving them open to infection as well more prone for miscarriages. Underweight farm woman performing heavy work in an awkward posture may cause serious health hazards.

Case 3	
Details of subject	
Age-43 years Body type –low fat low weight Weight-41.7 kg Stature-157 cm LBM- 33.5 kg BMI-16.9 kg/m BMR-1147 K cal Activity- *Harvesting*	

Step Score

Step		Score
1: Upper Arm Position	45° to 90°	3
2: Lower Arm Position	90° or greater	2
3: Wrist Position 0° to 15°		2
4: Wrist Twist Wrist is twisted in mid-range		1
5: Calculate UE Posture Score		**3**
6: UE Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1
7: UE Force/Load Score		
Load is less than 2 kg (intermittent)		0
8: Calculate Final Wrist and Arm Score		**4**
9: Neck Position In Extension		4
10: Trunk Position		4
11: Leg Position Legs and feet supported and balanced		1
12: Calculate Trunk Posture Score		**1**
13: Trunk Muscle Use Score		
Posture is mainly static (i.e. held for longer than 10 minutes)		1

14: Trunk Force/Load Score	0
15: Calculate Final Neck, Trunk & Leg Score	**8**
Final RULA Score	**6**

The final score of RULA is 6 for the subject who is harvesting green fodder for animals. She is working with high risk level for musculoskeletal disorders in an awkward posture and it should be changed soon. She is harvesting with a traditional sickle in a bending posture. If she uses a tool which can harvest in a standing position then it would be a better posture. The subject was found underweight with low BMI and low fat. Continuous working with the present posture may cause permanent musculoskeletal disorders. Twisting or bending the trunk can result in an increased risk for the development of diseases at the lower back. If movements or postures with the hands below knee level or outstretched are performed over prolonged periods or recurrently, working conditions should be changed. The subject is harvesting green fodder below knee level, hence she is more prone to have musculoskeletal disease of low back.
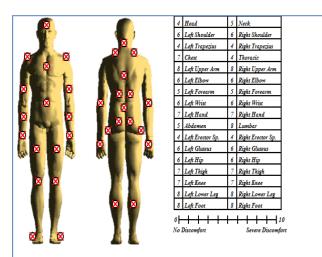
These results of RULA scores are eye opener as almost every task in agriculture is performed in an awkward or worst posture. These postures are risk factors for musculoskeletal disorders of neck, shoulder and back. Working in awkward or worst posture needs to be improved. It can be improved by designing women friendly tools and equipment. The tools or equipment should be designed using women anthropometry in such a manner so that it improves working posture of farm women.

Discomfort Level Assessment
Discomfort level of farm women was recorded at a ten point discomfort scale. Five cases were observed and analyzed performing different agricultural and livestock activities using discomfort scale. The relationship of pain and discomfort to work postures, forced static exertions, and frequency of motion is a widely accepted indicator of poor job design.

Case 1
Activity: Livestock activities
Age: 22 yrs
Stature: 145.4 cm
Weight: 46 kg
Body type: low fat low weight
Percent body fat: 17.7
LBM: 28.4 kg
BMI: 16.3 kg/m^2

4	Head		5	Neck
6	Left Shoulder		6	Right Shoulder
4	Left Trapezius		4	Right Trapezius
7	Chest		4	Thoracic
8	Left Upper Arm		8	Right Upper Arm
6	Left Elbow		6	Right Elbow
5	Left Forearm		5	Right Forearm
6	Left Wrist		6	Right Wrist
7	Left Hand		7	Right Hand
5	Abdomen		8	Lumbar
4	Left Erector Sp.		4	Right Erector Sp.
6	Left Gluteus		6	Right Gluteus
6	Left Hip		6	Right Hip
7	Left Thigh		7	Right Thigh
7	Left Knee		7	Right Knee
8	Left Lower Leg		8	Right Lower Leg
8	Left Foot		8	Right Foot

0 |—|—|—|—|—|—|—|—|—| 10
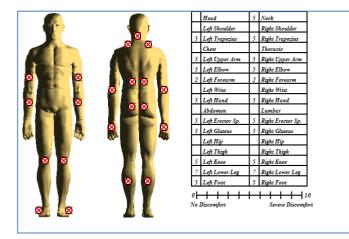No Discomfort   Severe Discomfort

The above analysis showed that the subject experienced severe discomfort in lower legs, feet, arms and lumbar. She also reported discomfort in many other parts of the body such as thigh, knee, hands and chest. The subject performed livestock activities in awkward posture for long working hours, which might cause discomfort. It is noted here that the subject was underweight with low fat. Hence,

working while she was not physically fit increased her discomfort level.
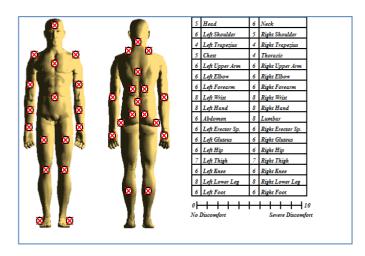
Case 2
Activity: Weeding
Age: 25 yrs
Body type: Standard
Weight: 51.6 kg
Stature: 154 cm
LBM: 36.6 kg
PBF: 29.7
BMI: 21.8 kg/m2
BMR: 1125 Kcal

	Head		5	Neck
	Left Shoulder			Right Shoulder
5	Left Trapezius		5	Right Trapezius
	Chest			Thoracic
5	Left Upper Arm		5	Right Upper Arm
5	Left Elbow		5	Right Elbow
2	Left Forearm		2	Right Forearm
	Left Wrist			Right Wrist
5	Left Hand		5	Right Hand
	Abdomen			Lumbar
5	Left Erector Sp.		5	Right Erector Sp.
5	Left Gluteus		5	Right Gluteus
	Left Hip			Right Hip
	Left Thigh			Right Thigh
5	Left Knee		5	Right Knee
5	Left Lower Leg		7	Right Lower Leg
5	Left Foot		5	Right Foot

0 |—|—|—|—|—|—|—|—|—| 10
No Discomfort   Severe Discomfort

This subject experienced heavy pain in left and right lower legs but moderate pain in other parts of the body which were used during performing weeding such as arms, elbows, hands and knees. This discomfort can be minimized by improving posture during working. Standing posture is better than bending and squatting postures. The subject was having standard body type.

Case 3
Activity: Harvesting
Age: 25 yrs
Body type: Over fat
Weight: 47.5 kg
Stature: 145 cm
LBM: 32.6 kg
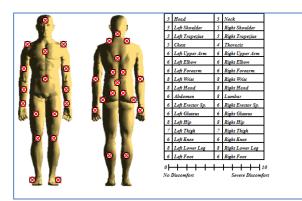PBF: 31.4
BMI: 22.6 kg/m^2
BMR: 1120 Kcal

5	Head		6	Neck
6	Left Shoulder		5	Right Shoulder
4	Left Trapezius		4	Right Trapezius
5	Chest		4	Thoracic
6	Left Upper Arm		6	Right Upper Arm
6	Left Elbow		6	Right Elbow
6	Left Forearm		6	Right Forearm
8	Left Wrist		8	Right Wrist
8	Left Hand		8	Right Hand
6	Abdomen		8	Lumbar
6	Left Erector Sp.		6	Right Erector Sp.
6	Left Gluteus		6	Right Gluteus
6	Left Hip		6	Right Hip
7	Left Thigh		7	Right Thigh
6	Left Knee		6	Right Knee
8	Left Lower Leg		6	Right Lower Leg
6	Left Foot		6	Right Foot

0 |—|—|—|—|—|—|—|—|—| 10
No Discomfort   Severe Discomfort

The subject reported severe pain in the hands, wrist, lumbar and legs. She

reported minor pain in upper parts of body such as head, trapezius, thoracic and so on. Working in bending position with extended forearms are the risk factors of musculoskeletal such as epicondylitis, hand and wrist disorders, low back pain and so on. Viester et al. (2013) found in their study on working population that the BMI was associated with musculoskeletal symptoms, in particular symptoms of the lower extremity. Hence, overweight subjects may report more discomfort in lower extremities as compared to standard weight farm women.

Case: 4
Activity: Harvesting
Age: 22 yrs
Body type: standard
Weight 45.1 kg
Stature: 144 cm
LBM 35.7 kg
PBF: 20.8
BMI 21.7 kg/m2
BMR 1159 Kcal

3	Head	5	Neck
3	Left Shoulder	5	Right Shoulder
3	Left Trapezius	3	Right Trapezius
5	Chest	4	Thoracic
6	Left Upper Arm	6	Right Upper Arm
6	Left Elbow	6	Right Elbow
6	Left Forearm	6	Right Forearm
8	Left Wrist	8	Right Wrist
8	Left Hand	8	Right Hand
6	Abdomen	8	Lumbar
6	Left Erector Sp.	6	Right Erector Sp.
6	Left Gluteus	6	Right Gluteus
6	Left Hip	6	Right Hip
7	Left Thigh	7	Right Thigh
6	Left Knee	6	Right Knee
8	Left Lower Leg	8	Right Lower Leg
6	Left Foot	6	Right Foot

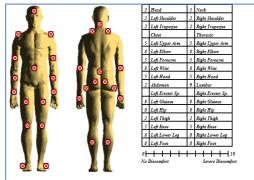0 —————————————— 10
No Discomfort   Severe Discomfort

Notes:
Subject experienced severe discomfort in the lower region of the spine, wrist and legs throughout this task. She experienced minor discomfort in the upper region of her body. It should be noted that poor body mechanics were demonstrated and subject is in less than "good" physical health. This analysis shows high risk for musculoskeletal disorders of low back disorders and wrist disorders. Osborne et al. (2012) found the spine was the most researched body region, followed by lower and upper extremity while exploring MSD's risk factors.

Case: 5
Activity: Livestock activities
Age: 24 yrs
Body type: Obese
Weight 51.4 kg
Stature: 144.9 cm
LBM 34 kg
PBF: 33.9
BMI: 24.4 kg/m2
BMR 1140 Kcal

3	Head	5	Neck
2	Left Shoulder	2	Right Shoulder
2	Left Trapezius	2	Right Trapezius
	Chest		Thoracic
5	Left Upper Arm	5	Right Upper Arm
8	Left Elbow	8	Right Elbow
5	Left Forearm	5	Right Forearm
8	Left Wrist	8	Right Wrist
5	Left Hand	5	Right Hand
2	Abdomen	9	Lumbar
	Left Erector Sp.		Right Erector Sp.
8	Left Gluteus	8	Right Gluteus
8	Left Hip	8	Right Hip
2	Left Thigh	2	Right Thigh
5	Left Knee	5	Right Knee
8	Left Lower Leg	8	Right Lower Leg
8	Left Foot	8	Right Foot

0 —————————————— 10
No Discomfort   Severe Discomfort

Farm women were performing various livestock activities such as milking, feeding animals and dung collection. This subject experienced severe discomfort in lower parts of the body such as lower legs, lumbar, left and right feet, gluteus, hips and wrists after performing these strenuous tasks. This discomfort may be felt due to working for long hours in awkward posture such as bending, squatting and stooping. Revolving peedha should be used in milking while a dung collector with long handle should be used for collecting dung.

Conclusion
Farm women were involved in various strenuous farming and livestock activities. Eight case studies were done for assessing RULA and discomfort score of farm women while performing different activities. It was found that farm women were working in uncomfortable and painful posture. Every activity was performed in awkward posture and needed to be changed. Involvement of farm women in such activities with same body posture for long may cause serious musculoskeletal disorders of spine and lower extremities. Further, discomfort scale was used to assess their discomfort level after performing various tasks. All the cases reported severe discomfort in their lower legs while performing weeding, harvesting and livestock activities. Lumbar and wrists were also severely affected body parts in theses activities. Thus, the workers need to change their posture while working which can be done through introducing women friendly tools and equipment; and improved work station.
This study recommends the immediate implementation of ergonomics interventions among farm women and health education on common postural change to take down morbidity due to musculoskeletal disorders.

Author Contributions: Authors helped in data collection, analysis and paper drafting.

Abbreviations:
LBM: Lean Body Mass
PBF: Percent Body Fat
BMI: Body Mass Index
BMR: Basal Metabolic Rate

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

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