

Risk Factors for Developing Work-Related Musculoskeletal Disorders during Dairy Farming

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Abstract

Background: Dairy farming work involves frequent use of poor postures. These postures may increase the risk of developing musculoskeletal disorders among dairy workers.

Objective: To assess postural load during performance of various tasks related to dairy farming.

Methods: This cross-sectional study was conducted on a dairy farm in Iran. In order to assess postural load, tasks related to dairy farming were divided into 3 categories: feeding, milking, and manure disposal. Each task was then divided into its constituent work subdivisions (tasks). Finally, the working posture for each work subdivision was evaluated using Rapid Entire Body Assessment (REBA).

Results: Based on the results from the REBA score, the poorest risk scores (risk level 4) were associated with the following tasks: (1) manure disposal, (2) filling feed bags, and (3) pouring milk into a bucket. Other tasks such as filling corn containers, pouring corn into the milling machine, preparing the feed, pouring food into mangers, attaching the milking machine, and pouring milk from a bucket into a tank imposed high risk (risk level 3). The risk for the tasks of washing and disinfecting the udders were assessed as medium risks.

Conclusion: The risk levels associated with most of the tasks on the studied farm were unacceptably high. Therefore, it is essential to implement ergonomic interventions to reduce risk levels of the tasks.

Keywords: Human Engineering; Risk factors; Occupational injuries; Musculoskeletal diseases; Dairy products

Introduction

Agriculture is one of the most dangerous jobs in both developing and developed countries.¹ Workers engaged in this sector are exposed to different work-related diseases and hazards. Work-related musculoskeletal disorders (WMSDs) have been described as one of

the main work-related diseases among agriculture sector workers.^{2,3} These diseases are usually initiated with feelings of fatigue and discomfort or pain that can develop into restricted movements and impaired muscle strength.^{4,5}

Poor and awkward posture is one of the major risk factors for developing WMSDs.^{2,6,7} The type and nature of tasks and

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work subdivisions in the agricultural sector often require workers to adopt awkward postures. These working postures include bending forward, kneeling, crawling, bending to one side, twisting, and repetitive actions, which can lead to traumatic stress and physical harm. Stiernström, *et al*, conducted a study of farmers and non-farmers in nine rural districts and concluded that the prevalence of WMSDs among farm workers was higher compared to the other occupational groups.⁸ In another study, Holmberg, *et al*, reported that the risk of musculoskeletal problems among farmers was 51% higher than that in workers from other sectors.⁹ Moreover, studies of agricultural workers from Finland yielded similar results of increased risk of developing WMSDs among workers from the agricultural sectors compared to other workers.^{10,11}

Dairy farming is one of the most important agricultural sectors where workers are forced to adopt and apply awkward and poor postures to complete tasks. These workers are thus, likely candidates for developing WMSDs.^{2,6} Nevertheless, very limited ergonomic intervention research has been done to reduce ergonomic risk factors for developing WMSDs among them.¹² There is a need to identify and assess the posture loads required for tasks to design effective and targeted ergonomic interventions.^{13,14} Our review of previous literature indicated that the majority of ergonomic risk assessments of postural load

in the dairy farming sector has focused on milking tasks^{12,15-17} and other dairy farming tasks such as feeding and manure disposal have been less considered.

According to the data from the Iranian Statistic Center, nearly 20% of Iranian workforce are engaged in the agricultural sector, especially in dairy farming.¹⁸ Despite the development of technologies and introduction of mechanization in the agricultural sector in Iran, still a large number of tasks in dairy farming are done manually and with poor postures. To the best of our knowledge, no study has so far been conducted to evaluate ergonomic risk factors among dairy farming workers in Iran. We therefore conducted this study to evaluate the working postural loads of different tasks on a dairy farm in Yasuj city, southwestern Iran.

Materials and Methods

Study Design and Workplace

This cross-sectional study was conducted in a dairy farm in Yasuj, southwestern Iran. Our field observations showed that most of the city's dairy farms were semi-industrial and that the tasks and work subdivisions performed in all farms were similar. Except milking, almost all other work subdivisions were done manually in dairy farms.

The Ethics Committee of Yasuj University of Medical Sciences reviewed and approved the ethical standards of this study. Having explained the purpose of the study to a manager of a farm and with his guidance and assistance, we identified the main tasks of workers in the dairy farm. All the tasks were categorized into three categories: feeding, milking, and cleaning. Finally, each task was subdivided into its constituent work subdivisions. The feeding task was subdivided into five subdivisions including (a) filling corn containers,

Table 1: REBA score and action levels

REBA score	Action level	Risk level	Action (including further assessment)
1	0	Negligible	None necessary
2–3	1	Low	May be necessary
4–7	2	Medium	Medium necessary
8–10	3	High	Necessary soon
11–15	4	Very high	Necessary now

Table 2: Postural load risk assessment of feeding task

Work subdivisions	REBA score	Risk level	Action
1. Filling corn containers	8	High	Necessary soon
2. Pouring corn into the milling machine	10	High	Necessary soon
3. Preparing food	9	High	Necessary soon
4. Filling the food bags	11	Very high	Necessary now
5. Pouring food into mangers	10	High	Necessary soon

(b) pouring corn into the milling machine, (c) preparing food, (d) filling the feeding bags, and (e) pouring food into mangers. Milking was also subdivided into five subdivisions including (a) washing udders, (b) attaching the milking machine, (c) disinfecting the udders, (d) pouring milk into buckets, and (e) pouring milk from a bucket into a tank. The task of manure disposal was represented by collecting and removal of manure.

Ergonomic Risk Factors Assessment

In order to evaluate the ergonomic risk factors during a working day, the working posture of different work subdivisions were photographed. In the next step, the photos illustrating the most frequent and worst working postures were selected. Finally, the selected postures for each work subdivision were assessed in accordance with the Rapid Entire Body Assessment (REBA) instructions. The action level for each work subdivision was determined. REBA is a useful and valid assessment method for postural analysis and correcting awkward work postures. REBA was designed and developed by Mac Atamney and Higent¹⁹. This method is based on a systematic process for evaluating body posture, forceful exertion, type of movement or action, repetition, and coupling. Based on the REBA worksheet, body parts are divided into two body segment sections of A and B. Section A includes neck, trunk, and legs, which forms a total of 60 posture

combinations. Section B includes upper arms, lower arms, and wrists, and makes up a total of 36 posture combinations.¹⁹ Load/force score is also assigned to the postures to evaluate the imposed load and exerted force on/by a person while taking a specific posture. The method also separately considers the static and dynamic postures and repetitive movements during the work that affects different body parts. By selecting each of these scores, and the use of tables from the REBA worksheet, the final REBA score is obtained. The final obtained REBA score is then scored according to Table 1, and the risk levels and required action levels are determined.

Results

In terms of feeding, for filling the corn container the highest final REBA postural scores were related to legs, trunks, and arms. For pouring corn into the milling machine, the highest scores were assigned to arms and wrists. The results also indicated that preparing food and filling the feeding bag mostly affected trunks and arms, as they were assigned with the highest scores. For the subdivision of pouring food into mangers, the highest scores were associated with upper and lower arms. The results of the postural load risk assessment of feeding are shown in Table 2. All the subdivisions in this task have either a “high risk” level (level 3) or a “very high risk” level (level 4).





Table 3: Postural load risk assessment of milking task

Work subdivisions	REBA score	Risk level	Action
1. Washing udders	6	Medium	Medium necessary
2. Attaching the milking machine	8	High	Necessary soon
3. Disinfecting udders	6	Medium	Medium necessary
4. Pouring milk into a bucket	11	Very high	Necessary now
5. Pouring milk from a bucket into a tank	8	High	Necessary soon

Considering the milking task, for washing and disinfection of the udder the highest postural scores were related to upper and lower arms. Attaching the milking machine and pouring milk into a bucket mostly affected the trunk and arms, as they were assigned with the highest scores. The highest postural score for pouring milk from a bucket into a tank was related to the upper arms. The results of the postural load risk assessment for milking are shown in Table 3. Comparable to the work subdivision of feeding, most of the work subdivisions had high (level 3) or a very high (level 4) risk levels, as well. Among the various work subdivisions, pouring milk into a bucket was associated with the highest level of risk. For manure disposal, the highest scores were related to the trunk and upper arms. The results of the postural risk assessment for this task are shown in Table 4.

Discussion

Given such levels of risk, rapid intervention to eliminate such postures, particularly in collecting and removal of manure, filling food bags, and pouring milk into a bucket, is needed.

In accordance with the REBA scores, actions must be quickly taken to correct the working posture of these tasks.

This study aimed at evaluating the ergonomic risk factors for musculoskeletal disorders among workers in a dairy farm

in southwestern Iran. Due to the poor economic situation of dairy farms in Iran, the owners of such farms are not willing to make use of modern and advanced technologies. Furthermore, since most of dairy farms have a limited number of cows (an average herd size of <100 cows per farm), purchase of advanced technologies is not economically feasible. Consequently, most of the workers in these farms have to perform their tasks manually using poor or awkward postures. This will lead to a considerable increase in the risk of developing WMSDs.

The results from the REBA analysis showed that most of the work subdivisions in milking were done in poor or awkward working postures. Results from previous studies also indicate that there is a high prevalence of musculoskeletal disorders among milkers, particularly in their shoulders, hands, wrists, lower back, and knees.^{12,15,20,21} Patil, *et al*, reported that the prevalence of carpal tunnel syndrome among dairy farm workers who performed milking tasks was nearly 17%.²² During milking, workers usually have to work fast and perform repetitive and stressful actions accompanied by awkward postures of the hands, wrists, forearms, arms, and shoulders.²³ In this regard, the results from this study showed that the highest final REBA scores for attaching the milking machine, and washing and disinfecting the udder were related to the working postures of arms, wrists, and trunks. Workers

Table 4: Postural load risk assessment of manure disposal

Work subdivisions	REBA score	Risk level	Action
1. Collecting and removal of manure	12	Very high	Necessary now

1. Collecting and removal of manure



Manure disposal

usually have to extend and stretch their arms and hands and bend to one side (side flexion) to have access to the udder. One of the ergonomic interventions to modify and minimize the risk of such awkward postures would be reducing the distance between the worker and the cow's udder.

Two work subdivisions, pouring milk from a barrel into a bucket and pouring milk into a tank with a bucket, attained REBA scores of 11 and 8, respectively. During performing these work subdivisions, workers had to work taking awkward postures of the upper trunk and the lower back. In line with these results, Groborz, *et al*, reported that pouring milk from a barrel into a milk container would impose a huge burden on the workers' upper limbs and lower backs, putting these body regions at risk of developing WMSDs.¹⁷ In their study, workers had to lift milk barrels of 25 kg with a relatively straight back and pour it into the milk container. Whereas in our study, the workers were required to lift milk barrels of 40 kg with a bent back posture. In addition, the workers had to pour a bucket of milk into a tank whose opening was above shoulder level and thus made him work with a poor and awkward posture of the upper trunk. In order to correct such working postures, as an ergonomic intervention, the level of the container openings should be modified in a way that makes it level with the height of workers' elbows. It is also recommended that a step ladder be located near the milk tank to fulfil this purpose. Additionally, in order to eliminate all the awkward postures related to pouring milk from a barrel into a bucket and pouring milk into a milk tank, a system of direct milk transfer pipelines between the milking machine and the milk

tank could be employed.

The results from the REBA showed that for feeding, the work subdivision of filling food bags imposed an unacceptable level of musculoskeletal risk to the workers. Such high risk was mostly related to the nature of the work subdivision where workers usually had to work with their backs bent and their knees in an awkward posture. One proposed solution to reduce these awkward working postures is the use of a holding device for the bag, which enables the workers to stand upright and fill bags with a shovel. Such a solution (working in a proper standing posture) can also be encouraged and adopted to correct the working postures during filling corn containers. Pouring corn into the milling machine was associated with a high risk posture load on workers' shoulders, arms, forearms, and wrists. During this work subdivision workers had to repeatedly empty a 10-kg container of corn into the opening of the corn milling machine. A proposed solution to eliminate the awkward postures during this work subdivisions and minimizing the physical load imposed on the worker could be the use of a material conveying vacuum

TAKE-HOME MESSAGE

- The most dangerous jobs in both developing and developed countries is agriculture, where workers are exposed to different work-related diseases and hazards.
- In most dairy farms, workers carry high risk of developing work-related musculoskeletal disorders. Therefore, taking corrective measures and implementing ergonomic interventions are essential in this agricultural sector.
- Interventions should be more focused on the modification and elimination of the poor postures of body regions.

pump to transfer corn from the ground to the opening of the milling machine.

The results of this study indicated that among the work subdivisions studied, the highest risk score was associated with manure disposal. In this work subdivision, the highest risk scores for developing awkward postures were related to the trunk, legs, and arms. One of the main reasons for adopting such awkward postures was probably the use of shovels of inappropriate size. Therefore, one ergonomic solution to reduce the harmful effects of this awkward posture is to use shovels with longer handles, more appropriate to the anthropometric characteristics of workers.

The main limitation of this study was its cross-sectional nature. For a more detailed and precise assessment, the combined use of observational methods with electromyography is recommended. This study was conducted in only one dairy farm, although our field observations showed that the tasks and work subdivisions performed in other farms were almost the same. However, generalizing these results to all farms, particularly in the case of Iranian industrial dairy farms, should be performed with caution.

In conclusion, taking into account the results of the present study and considering the fact that the tasks studied were almost identical in most dairy farms in Yasuj, Iran, it could be inferred that workers in dairy farms are exposed to high risk of developing WMSDs, and that taking corrective measures and implementing ergonomic interventions are essential in this agricultural sector. The assessment of the posture scores related to different body regions indicated that for most of the work subdivisions, trunks and arms were in awkward postures. Therefore, we suggest that interventions should be more focused on the modification and elimination of the poor postures of these body regions.

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Conflicts of Interest: None declared.

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