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Musculoskeletal Health Problems and their Association with Risk Factors among Manual Dairy Farm Workers

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Abstract: Work related musculoskeletal problems are very common in industries operating their routine activities manually. These problems are the outcome of various strenuous tasks in awkward postures. A study in similar contrast was carried out for manual Indian dairy farm workers to investigate the prevalence of musculoskeletal problems and associated postural risk in this occupation. For this purpose a modified Nordic questionnaire was administered among 125 manual dairy farm workers. Binary logistic regression was applied to determine the association of postural risk factors and prevalence of musculoskeletal problems. As per the results, lower back pain was found to be the most common health issue (50.52%) mostly affecting workers engaged in fodder cutting (64.29%) and working in cowshed (63.16%). The age was significantly associated with musculoskeletal disorders in shoulders (OR=1.122, p=0.038), lower back area (OR=1.145, p=0.027) and also knees (OR=1.457, p=0.001). The workers with a balanced BMI ratio (20.1-25) were associated with very less neck disorders (OR=0.01, p=0.035) as compared to those who are underweight or overweight. The most strenuous task in dairy work is miking of cattle which was significantly associated with neck disorders (OR=5.731, , p=0.045) compared to other tasks. The height of an individual is also associated with heavy disorders in neck area of workers. With a proper ergonomic intervention, quality training of workers, use of proper hand tools and aids as well as modification in workstation design are needed to provide the more comfortable work life to dairy farm workers.

Keywords: Musculoskeletal disorders, MSDs, Dairy farming, Logistics regression, Risk factors

1. Introduction

Musculoskeletal disorders (MSDs) are one of the crucial occupational health issues and the major reason for absence from work thereby affecting the productivity and efficiency of an organization. With a momentum towards industry 4.0, occupational health problems are gradually controlled; but still MSD issues are rising among the manual workers. MSDs are major occupational health issues which also cause monetary losses to the countries. The primary factor for prevalence of musculoskeletal disorder is poor working postures. Industry has always focused on health of workers to improve the efficiency and effectiveness of work on individual and organizational level irrespective of the type of industry on continuous basis[26-27].With the rising globalization and developing a competitive edge within every sector, occupational health and safety is always a matter of concern for every segment, may be related to agriculture, food industry, machinery, construction, packaging, healthcare etc[28].

Over a span of time the researchers have studied and developed and experimented on many ergonomic tools like NIOSH lifting equation, REBA, RULA, OWAS, Job Strain Index, ROSA, WISHA etc. Apart from these standard operating tools certain tools have been customized by researchers depending on the case study and the level of investigation like the application of Jack, Humantech Brief Survey, ERGO Job Analyser, GM-UAW Checklist, Snook & Ciriello Tables, Arm (Segmental) Vibration TLV's, HAL (Hand Activity Level), Garg Model and LMM-Lumbar Motion Monitor System[1].

The authors studied the open source human pose estimation technology for analysing joint angles with recordings of 10 participants and compare that with studies made through Kinect system. Open pose method

gave better and accurate results compared to Kinectic software, as open-pose appeared to be promising even in non-ideal conditions[2]. The authors Li et. al analyzed intelligent REBA quick capture system which was convolutional pose machine (CPM) compared to motion capture machine with real time on site assessment. The CPM proved to be more accurate compared to old REBA motion capture system based on correlation scores to define musculoskeletal disorders with better precision[3].

SSI (Small Scale industries) in India are affected by well being of workers in terms of productivity and cost benefits[29]. The author derived an association amongst task performed by the worker and the type of musculoskeletal disorder developed in an individual using REBA, RULA and logistic regression analysis[30]. A similar study was performed by Umesh et. al using the concept of NIOSH equation technique for calculation of recommended weight limit (RWL) and lifting index (Li) for a worker based on farm activity done by him. Both RWL and Li define the limits of weight to be lifted and the risk index for a particular task[31]. An observational study made by authors in Sumul dairy, Surat using standard Nordic questionnaire over 50 participants revealed the prevalence of work related musculoskeletal disorders with pain in lower back (32%), upper back (18%), knee (18%) and 4% each in neck and wrist. Low back pain is mostly prominent in age group of 28-35 years[3]. The authors Eka et. al studied the postural analysis for agro farm workers in Indonesia and how the traditional tools used in farms can cause severe pain disorders and injuries to workers[4]. Ahmad et. al studied application of Monte-Carlo simulation to joint angles of body parts depending on the type of work performed by workers and the different working conditions. The investigation of workstation design and making required improvements can lead to reduction of work related musculoskeletal disorders[5]. D. Kee worked on the quantification of musculoskeletal loads in industry by using chi-square test and logistic regression analysis over 209 cases which showed that the consistent values for logistic model for RULA score were 52.4%. and REBA were 44.8%, thereby justifying RULA as better system for postural load analysis[6]. D. Kee at. al studied to calculate the maximum holding times (MHTs) for different body postures using OWAS, REBA and RULA assessments using free variables including the height of hand, hand distance, rotation angle of trunk and external load. The results were that RULA assessed postures were tested more stressfully and generated more sensitive grand scores compared to OWAS and REBA[7]. Yarandi et. al studied the occurrence of work related musculoskeletal disorders in workers of a power plant industry in Iran using NERPA, RULA and REBA assessments on 295 subjects. The correlation values between the levels of MSDs and risk levels in RULA, NERPA and REBA were 0.764, 0.723 and 0.689 with $p<0.05$, thereby making RULA best for examination[8]. Mgbemena et. al concluded that timely and systematic ergonomic intervention using digital human models (DHMs) in any industry through software tools can lead to improved productivity, reduced cost and better working conditions for employees[9]. A similar study by Kulkarni et. al shows risk assessment of load lifting tasks in construction industry with intervention of ergonomics to suggest corrective measures and reduce the severity of discomfort[10]. An observation made by Wibowo and Mawadati on RULA and REBA assessments taking in account different joint angles including neck, back, legs, wrist, forearm for load lifting tasks resulted in grand score 7 for RULA and 11 for REBA which are under high risk zone and need immediate improvement in work posture[11]. A research on male mango harvesting farmers in Thailand used REBA and RULA analysis to assess MSDs associated with four different tasks performed by them in farms. Both REBA and RULA resulted in detecting the prevalence of pain in right shoulder; right upper arm and lower back[32]. Another such research in Brazil focused to develop a correlation between SI (strain index) and RULA to obtain a new version of assessment technique which was more reliable and had better interpretation of ergonomics for farmers[33]. A cross sectional study by D. Kee made a systematic comparison of OWAS, RULA and REBA to select the best assessment technique. RULA being the most widely used had certain limitations in regard to REBA and OWAS[34].

2. Material & Methods

2.1 Experimental Set-Up and Sampling

A cross sectional survey was carried out in dairy farms situated in Jaipur and Sikar districts of Rajasthan (India)for workers in the age group of 18-60 years. The study involved 132 number of workers from dairy farming sector as participants for analysis of musculoskeletal disorders. A prior permission was availed from the owners of dairy farms to ensure an enthusiastic and dedicated involvement of workers during entire assessment process. Out of 132 workers who were approached, few of them did not give consent to be a part of this study, few declined to appear for Nordic questionnaire and finally 97 participants were actually the part of final assessment process. The duration of study was May 2021 to July 2022. As the weather during August to March remains pleasant in Jaipur and nearby areas it is convenient for researchers to observe and interact with dairy workers even during afternoon time when all of their dairy activities are conducted sequentially in a structured way.

2.2 Data Collection Tools & Procedure

The study tends to focus on musculoskeletal disorder issues in various body parts like lower back, upper back, wrist, shoulders, fingers and neck with reference to

certain characteristics studied individually and in groups. The Nordic Musculoskeletal Questionnaire (NMQ) was modified, validated and accepted by the team to collect the data of dairy farm workers with respect to certain characteristics. The characteristics considered for assessment are age, gender, education, BMI, experience of work, smoking habits, working hours per day and breaks[12]. The experimental set up engaged 97 participants for the current study and postural assessments for achieving best results. All the participants were engaged in dairy farming activities directly on daily basis. These activities could be green and dry fodder cutting, fodder mixing, cleaning cowshed, fodder circulation, milk processing, milk packaging, milk delivery. The farm activities also include harvesting, pruning, digging, peeling, sorting, weeding and above all load carrying, material handling tasks on daily basis as detailed by author Gurnani et. al[26]. Apart from Nordic questionnaire few details were collected through face to face interview and observations while performing the dairy farming activities.

2.3 Ethics Consideration

The guidelines raised by International Ergonomics Association and HSE (Human Safety and Ergonomics) gateway were followed strictly due the entire study and no animals were harmed during the entire research. The WMA declaration of Helsinki with ethical principles and international code of medical conduct was followed to ensure no contradictions with proper legal and regulatory guidelines on human subjects[13].

2.4 Analysis

Out of 132 participants who were approached for postural assessment study, 97 workers (response rate 73.5%) willing confirmed their presence and shared the relevant data and personal characteristics with the research team for an accurate study. The study revealed that only 9.28% of workers reported no taskwise occurrence of musculoskeletal disorders and the remaining confirmed at least one or more disorders in their body. Few of the workers were randomly picked for REBA and RULA study and since these techniques do not engage any expensive efforts, they are frequently acknowledged by worldwide researchers for calculation of risk scores at many instances. IBM SPSS Software (version 26) was used to analyse over all demographic characteristics like age, experience, gender, weight, height, BMI, working hours and tasks performed which helped to make a comparative study and to tabulate the major factors effecting the prevalence of MSDs. Based on the questionnaire survey data the prevalence of MSDs for dairy workers were observed in neck, shoulder, lower arm, upper arm, lower back, upper back, wrist, finger and knees. These parts were considered as independent variable and the binary logistic regression with significance level $p<0.05$, odd ratio OR and confidence interval CI was used to determine the relation between demographic characteristics and these independent variables. Based on the calculations from logistic regression we could find a significant association of most of demographic factors with the MSDs in different body parts.

3. Results

3.1 Characteristics of participants

With respect to the data collected and analysed for 97 active participants, only 1.03% of workers were below 20 years of age while the majority were in age group of 21-40 years. Considering the BMI index of workers 90.72% of workers were with normal weight, 7.22% underweight and only 2.06% overweight. 3/4th of the total survey participant workers were male. Only 18.56% of workers were there with less than 5 years of experience in dairy industry and most of them (45.36%) had already worked in dairy farm for more than 5 years.

3.2 Musculoskeletal issues amongst workers

The majority of workers reported occurrence of lower back pain (50.52%) and also frequent pain in knee (34.02%) and neck (35.05%). The lower back pain was common to all dairy workers more prominent in workers engaged in fodder cutting and circulation (64.29%) and working in cowshed area (63.16%). The knee joint pain is also prominent for those engaged in fodder cutting and circulation (64.29%) and working in cowshed (42.11%) and milk processing (27.59%).

Fig 1. Frequent bending, kneeling while cleaning cowshed area increases stress on lower back and knees

The reason for all three might be frequent kneeling and bending in both the activities which creates a stress in knee joint. The occurrence of MSDs is neck area is

more common for workers employed in milking of cows (48.28%) and working in cowshed (36.84%). The workstation design and body height adjustments during both the activities which involve more of kneeling, bending and sitting may create this level of discomfort for the workers. The cow milking process done manually requires a rigorous fingers and wrist movements thereby increasing the stress and MSDs within fingers upto 55.17% and wrist to a level of 37.93%. Moreover, daily activities like milk packaging and delivery involves frequent load lifting and carrying milk filled drums to a certain distance which have an average weight of 40 Kgs, thereby making MSDs prominent in lower back (37.5%) and shoulder area (31.25%).

The prevalence of lower back pain is most dominating one for most of the dairy farm activities. Chokprasit et. al investigated the prevalence of MSDs in lower back area through a survey on 317 participants involved in harvesting of rubber in farms. 71.2% of total workers with more of experience in farms and without proper training are risk predators of lower back pain[14].

The occurrence of other MSDs like pain in neck, shoulders, arms, knee, wrist, fingers are dependent on the kind of activity performed by the workers.

Table 1. Characteristics of workers in Dairy Farm (N=97)

Characteristics	Category	No of workers	%
Age	upto 20	1	1.03
	21-30	29	29.90
	31-40	29	29.90
	41-50	23	23.71
	More than 50	15	15.46
Weight	upto 50	5	5.15
	51-60	17	17.53
	60-70	41	42.27
	70-80	31	31.96
	more than 80	3	3.09
Height	less than 1.6	19	19.59
	1.60-1.70	51	52.58
	1.71-1.80	17	17.53
	more than 1.8	10	10.31
BMI Index	upto 20	7	7.22
	20.1-25	52	53.61
	25.1-30	36	37.11
	more than 30	2	2.06
Gender	Male	75	77.32
	Female	22	22.68
Education Status	Illiterate	7	7.22
	Literate only	58	59.79
	Secondary	17	17.53
	Sr. Secondary	13	13.40
	Graduate	2	2.06
Smoking habit	Yes	30	30.93
	No	67	69.07

Work Experience	less than 5 years	18	18.56
	5-10 years	44	45.36
	more than 10 years	35	36.08
Task	Fodder Cutting & circulation	14	14.43
	Work in cowshed	38	39.18
	Milking Cows / milk processing	29	29.90
	Milk Packaging & Delivery	16	16.49

Table 2. Taskwise occurrence of musculoskeletal disorders

Body parts having discomfort	**N=97**		**Percentage of workers facing discomfort while performing dairy farm activities**			
	No. of workers suffering	**% of workers suffering**	**Fodder Cutting & circulation (n=14)**	**Work in cowshed (n=38)**	**Milking Cows /milk processing (n=29)**	**Milk Packaging & Delivery (n=16)**
Neck	34	35.05	21.43	36.84	48.28	18.75
Shoulder	23	23.71	28.57	18.42	24.14	31.25
Upper Arm	6	6.19	0.00	7.89	10.34	0.00
Lower Arm	19	19.59	14.29	31.58	6.90	18.75
Lower Back	49	50.52	64.29	63.16	34.48	37.50
Upper Back	21	21.65	14.29	26.32	31.03	0.00
Knee	33	34.02	64.29	42.11	27.59	0.00
Wrist	23	23.71	14.29	18.42	37.93	25.00
Fingers	21	21.65	0.00	13.16	55.17	0.00
No problem with body parts	9	9.28	14.29	7.89	0.00	25.00

Fig 2. Frequent load lifting in farms involves increasing stress on neck, lower back, shoulders and knees

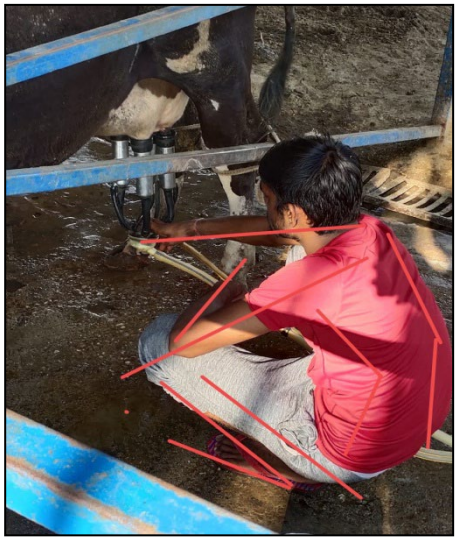

Fig 3. Prolonged working postures while milking process causes stress in knees, wrist and fingers

3.3 Association of Musculoskeletal issues with demographic characteristics

The binary logistic regression applied to the given factors resulted in an intersting association between individual characterstiscs and musculoskeletal pain in different body parts. This association is shown in Table No. 2.

The results of binomial regression analysis show that the increase in age was associated with increasing disorders in shoulders (OR=1.122, 95% CI: 1.006-1.25, p=0.038), lower back area (OR=1.145, 95% CI: 1.016-1.291, p=0.027) and also knees (OR=1.457, 95% CI: 1.167-1.864, p=0.001). Table 3 4 and 5 will give an accurate analsysis of the association of charaterstics with different muscuskeletal disorders. The workers with more height are very likely to have neck related disorders (OR=463526658, 95% CI: 214-1002340360429840, p=0.007) compared to those with an less or average height. The increase in weight of workers is associated with bit less of disorders in neck area (OR=0.804, 95% CI: 0.655-0.987, p=0.037). The workers with a balanced BMI value falling in range of 20.1 to 25 are associated very less disorders (OR=0.01, 95% CI: 0-0.72, p=0.035) in neck area compared to those who are underweight with BMI < 20 or overweight with BMI > 20.

The task(3) which engaged the worker in frequent sitting, and kneeling while miking of cattle is associated with high level of neck disorders (OR=5.731, 95% CI: 1.039-31.608, p=0.045) compared to other tasks. The task(2) which engaged workers in frequent bending, kneeling and load carrying while cleaning the cowshed area is associated with frequent pain in shoulders (OR=0.085, 95% CI: 0.011-0.694, p=0.021). The gender is significant contributor in MSDs as males are highly prone to wrist pain (OR=68.731, 95% CI: 2.829-98.251, p=0.009) compared to females. Dairy workers who were more experienced are less prone to knee disorders (OR=0.699, 95% CI: 0.527-0.997, p=0.013) compared to disorders in other parts of body. Considering few of the cases with significance value (0.99) with respect to BMI in different ranges the occurence of musculoskeletal disorders is common in shoulder, lower back, knee and wrist. The two major tasks of dairy farming task(2) and task(3) which involves cleaning of cowshed and milking of cattles has more rigorous body movements and awkward bending, kneeling postures are associated with MSDs in upper arm, back knee and fingers with significance value>0.9 and very high odd ratios.

4. Discussions

MSDs is common in manufacturing, agriculture, construction, health care, office work, process industries, etc. As agreed with the authors MSDs occur due to continuous exposure to ergonomic risk factors creating ill effects to worker's health. Work related MSDs in agriculture or dairy farming are occur due to bending, squatting, kneeling in awkward postures and continuous load lifting for prolonged duration. To reduce the risk of WMSDs, systematic quantification and analysis of risk factors are necessary[15]. Depending on the task or activities perfromed in dairy famring the level of risk and MSDs vary similar to that being observed by author in case of mechanized wood loading. The posture alteration is important to recover muscles to original pose and reduce fatigue and improve operators' comfort and health[16].

Table 3. Association between risk factors and musculoskeletal disorders in neck, shoulder and upper arm area

Characteristics	Neck				Shoulder				Upper Arm			
	Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.	
			Lower	Upper			Lower	Upper			Lower	Upper
Age	0.58	1.03	0.93	1.14	0.04	1.12	1.01	1.25	0.65	0.90	0.57	1.43
Height	0.01	463526658	214.36	1002340360429840	0.95	1.72	0.00	48827448	0.12	0.00	0.00	5581.05
Weight	0.04	0.80	0.66	0.99	0.78	0.97	0.78	1.21	0.71	0.90	0.51	1.59
BMI												
BMI (upto 20)	0.05	0.00	0.00	1.10	1.00	167728706	0.00	___	1.00	339099003826	0.00	___
BMI (20.1-25)	0.04	0.01	0.00	0.72	1.00	152398887	0.00	___	1.00	12621602535	0.00	___
BMI (25.1-30)	0.32	0.17	0.01	5.54	1.00	62638440	0.00	___	1.00	227997460	0.00	___
Exp	0.72	1.03	0.89	1.19	0.84	0.99	0.85	1.14	0.55	1.23	0.62	2.41
Gender (M)	0.45	0.36	0.03	5.19	0.94	0.90	0.06	14.10	0.15	0.00	0.00	11.96
Tasks												
Fodder cutting & circulation	0.70	0.66	0.08	5.28	0.07	0.12	0.01	1.20	1.00	1.71	0.00	2.87
Work in Cowshed	0.31	2.44	0.44	13.53	0.02	0.09	0.01	0.69	1.00	223058035	0.00	___
Miling Cows/ milk processing	0.05	5.73	1.04	31.61	0.08	0.20	0.03	1.22	1.00	273712632	0.00	___

Table 4. Association between risk factors and musculoskeletal disorders in lower arm, lower back and upper back

Characteristics	Lower Arm				Lower Back				Upper Back			
	Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.	
			Lower	Upper			Lower	Upper			Lower	Upper
Age	0.46	1.05	0.93	1.17	0.03	1.15	1.02	1.29	0.16	1.10	0.96	1.73
Height	0.18	0.00	0.00	631.09	0.19	25308.49	0.01	105421492666	0.67	42.39	0.00	87.62
Weight	0.22	1.18	0.91	1.53	0.37	0.91	0.74	1.12	0.24	0.87	0.69	1.47
BMI												
BMI (upto 20)	1.00	4899204216	0.00	___	1.00	14801899	0.00	___	0.81	0.47	0.00	0.76
BMI (20.1-25)	1.00	1228874226	0.00	___	1.00	27770173	0.00	___	0.27	0.07	0.00	0.16
BMI (25.1-30)	1.00	120532301	0.00	___	1.00	121739896	0.00	___	0.11	0.04	0.00	0.07
Exp	0.75	1.03	0.87	1.22	0.71	0.97	0.81	1.16	0.77	0.97	0.82	1.72
Gender (M)	0.95	0.90	0.03	25.25	0.64	1.87	0.14	25.45	0.11	0.08	0.00	0.15
Task												
Fodder cutting & circulation	0.22	0.20	0.02	2.53	0.65	0.64	0.09	4.63	1.00	109354831	0.00	___
Work in Cowshed	0.84	0.82	0.12	5.55	0.76	1.28	0.26	6.33	1.00	197125299	0.00	___
Miling Cows/ milk processing	0.07	0.12	0.01	1.19	0.36	0.46	0.09	2.39	1.00	334515549	0.00	___

Table 5 Association between risk factors and musculoskeletal disorders in knee, wrist and fingers

Characteristics	Knee				Wrist				Fingers			
	Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.		Sig. (p)	OR	95% C.I.	
			Lower	Upper			Lower	Upper			Lower	Upper
Age	0.001	1.457	1.167	1.864	505	0.965	0.868	1.627	0.398	0.924	0.77	1.109
Height	0.767	21.767	0	45.534	0.926	2.048	0	4.17	0.874	4.046	0	123383754
Weight	0.216	1.207	0.896	2.612	0.316	1.115	0.901	2.37	0.84	1.026	0.799	1.319
BMI												
BMI (upto 20)	1	2.55	0	4.61	1	0.652	0	1.384	0.613	0.193	0	111.844
BMI (20.1-25)	0.999	145964364	0	___	0.999	1007002562	0	___	0.929	0.807	0.007	93.706
BMI (25.1-30)	0.999	70270870	0	___	0.999	3319642361	0	___	0.462	4.072	0.097	171.674
Exp	0.013	0.699	0.527	0.997	0.601	1.043	0.89	1.94	0.499	1.104	0.829	1.468
Gender (M)	0.746	0.515	0.009	1.12	0.009	68.731	2.829	98.251	0.175	12.131	0.33	446.552
Task												
Fodder cutting & circulation	0.998	22435299695	0	___	0.307	0.307	0.032	0.69	1	1.318	0	3.87
Work in Cowshed	0.997	128043413081	0	___	0.436	0.491	0.082	0.917	0.998	254944386	0	___
Miling Cows/ milk processing	0.998	21021110163	0	___	0.343	2.192	0.432	4.59	0.998	3680596417	0	___

The outcomes of regression showed that males suffer with more MSDs ascompared to females. Age and type of task were found to be significantly associated with pain in back, fingers, wrists and forearms. Although the level of risk and MSDs (more than 50%) observed by Rahul et. al is more than the results in our study. The pauses and rest beaks during working hours effect the risk of MSDs[17]. The industries which focus on tradicional methods of working need emphasis on ergonomic intervention in workstation design. The other factors like designing of hand tools being used frequently and over a majorspan of time effects the work related MSDs for workers specially in wrist, fingers, hand and forearms. The ergonomic intervention in hand tool design effects the working capability and improves the overall efficiency of the system thereby reducing MSDs in above mentioned parts[18].

The data analysis shown in our research for workers affected from musculoskeletal disorders (especially in the lower back part, shoulders, knee, hand and neck) is analogous to those for potato cultivators, due to awkward twisting, stooping and squatting postures held for a long duration with a high level of repetitiveness[19)-20)]. Prevalence of Lower back disorders is the major concern for agro-farmers as analyzed by Osborne et. al which is much higher, i.e. 75% of total survey participants[21)] compared to our study which accounts to lower back pain in range of 60-65% for dairy workers[22)]. The author also recommends that future study on MSDs to be occupation or task specific for better understating of variance[25)]. Another study by Leerberk et. al for brick kiln workers comparable to the study made for dairy farm workers show that the mean age of the workers was 36 ± 14.5 years. 62% (n = 192) had normal body mass index whereas the same BMI for dairy was taken as 53.61% (n=97). The observation for dairy workers shows 50.52% suffering from chronic lower back ache whereas the same count for brick kiln workers on average was observed to be 59%[23)-24)].

5. Conclusion

The dairy farming occupation involves harvesting, fodder cutting and fodder circulation, cowshed cleaning, milking process, frequent load lifting and delivery of product to far off areas. Specific activites in dairy farm done repeatedly and frequently for a certain duration makes it a high risk occupation. In exploring MSDs for dairy farm workers the lower back and spinal area was maximum researched part. Lower back problems are common for majority of farmers involved in different tasks. The severity of MSDs in lower back and upper extremeties depends on the type of tasks being assigned to the worker. The survey sample size and other demographic characterstics also influence the final results of study thus making a certain variance on MSDs in lower back and other parts too. The neck, shoulders, arms, wrist, fingers and back are most common parts facing MSDs due to awkward bending, kneeling, squatting, stooping and twisting of mucles.The postural analysis shows that working in cowshed and the process of milking cows are those where workers are exposed to high risk. The binomial regression results show that the characterstics like age, height, gender, BMI are associated with MSDs in an individual in one or more body parts. The workers with a balanced BMI (20.1-25) are less prone to MSDs compared to those who are either overweight or underweight. The gender has a major significance as the prevalence of MSDs is more in females compared to that of .males.

The occupation based characterstics like type of task, number of years in dairy, working duration, rest pauses and smoking habits have a significant assocation with MSDs on workers. The study reveals that mojority of dairy workers are enduring from lower back disorders specially those engaged in cleaning of cowshed (63.16%) and fodder cutting and circulation (64.29%). Those employed in milking cows are engaged in rigorous work through wrist and fingers (55.17%) thereby generating more stress in them and making them more exposed to MSDs. Those who are working with an automated milking system in dairy are prone to less of these disorders. Any task in dairy farming which engages worker in load lifting or material handling over a certain distance, like milk drums lifting, packaging and delivery will generate musculoskeletal disoders in lower back (37.5%) and shoulders (31.25%).

It is recommended for workers to be trained with ergonomic safety and use tools wisely to reduce lower back pain. There can be minor modifications in work station set up by bringing some conveyor based automation to reduce the load carrying task for workers. The duration of work hours should be feasible and followed by routine breaks to avoid continuous and repetitive awkward postures. All activities or tasks should not be bound specifically to a particular individual and thus assigned on rotational basis to avoid bearing the risk of a specific task to a particular individual. A frequent postural analysis on remedial basis should be done for all workers to detect the possible injuries and make efforts to control them feasibly within a specified time. To conclude, the study reveals a significant association between risk factors and prevalence of disorders in particular body parts and therefore an intelligent ergonomic intervention can improve the health of dairy farm workers.

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