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Gender differentials on muscular stress of male and female dairy workers during preparing food for cattle

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Abstract

Dairy farming is physically arduous occupation and exposes the dairy workers to various risks factors that have been associated with musculo-skeletal disorders. Further age and sex of dairy workers are the additional contributing risks factors responsible for muscular stress during preparing food for cattle. Hence in present study an attempt has been made to find out the risks factors involved in causing muscular stress during preparing food for cattle as well as to find out impact of age and sex of dairy workers on muscular stress caused during preparing food for cattle. Twenty two females and thirty males of lower age group (30-40 yrs.) and ten males and eight females of higher age group (40-50yrs.) were selected on the basis of their physical fitness. Physical fitness of the respondents was assessed through BMI index, blood temperature, blood pressure and heart rate. Study was conducted in three villages of Kalayanpur block (Hirdypur, Ishwarigang and Dharpur) of Kanpur Nagar (U.P.). India. Overall analysis of four stages of preparing food for cattle i.e. onward journey(stage-1), fodder cutting(stage-2), preparing and carrying bundle (stage-3) and chaffing (stage-4) performed by female and male dairy workers of lower and higher age group, elicits that except onward journey, each stage of preparing food for cattle caused considerable muscular stress among dairy workers. Moreover maximum muscular stress was observed during chaffing. It may be because during chaffing a number of risk factors are prevailing as forceful body movements, whole body vibration, sustained bending posture, mechanical stress caused due to handling of chaff machine. Further, during stage – I (fodder cutting), percentage increase in grip strength whereas in rest of stages, percentage decrease in the grip strength was observed. Percentage increase in grip strength during fodder cutting indicates warm up period of the grip muscle, due to short duration of work whereas percentage decrease in grip strength during preparing and carrying bundle of fodder, chaffing and during complete cycle. Signifies fatigue of grip muscle due to longer period of work initiating anaerobic oxidation results in accumulation of lactic acid and CO₂. Percentage increase in grip muscles strength was maximum in males of lower age group and percentage decrease in grip muscles was maximum in females of higher age group. Because age and sex have significant impact on grip muscles of dairy workers thus these are the personal risk factors on for the part of dairy worker engaged in preparing food for cattle leaving them vulnerable to various musculoskeletal disorders.

Keywords: Age, sex, muscular stress, preparing food for cattle

1. Introduction

In dairy sector, dairy workers and cattle are two main factors responsible for milk production. The entire responsibility of successful dairy business in dairy farming goes to dairy workers. Various dairy development programmes have been run by Government and non-government organizations for the development of dairy industry. However, all the attempts made in India, were totally related to development of cattle breeding, cattle feeding, cattle health and hygiene, cattle vaccination and other cattle management practices. Unfortunately, worker who is integral part of more milk production is ignored. Dairy farming is physically arduous occupation and exposes the dairy workers to various risk factors that have been associated with musculo-skeletal disorders. Work related musculo-skeletal disorders (wises) are one of the greatest occupational health concerns today. In India, unlike developed country, dairy farming requires manual material handling with heavy lifting, pushing and pulling. All these have been recognized as risks factors for occupational health by NIOSH. More than 1 million workers annually sustain injuries severe enough to result in lost time from work due to overexertion or repetitive motion (Anonymous, 1999) ^[1]. There is a clear relationship between back disorders and physical load with the main physical risks factors being manual material handling (MMH), load moment, frequent bending and twisting during work awkward postures of stooping, squatting and kneeling (Anonymous, 2001) ^[2].

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Manual material handling (MMH) has been recognized as a major cause of industrial accident, acute overexertion injury and chronic repetitive strain injury. Osteoarthritis of hip and upper limb complaints and hand arm syndrome are the occupational disease and hazards associated with work related risks factors prevalent in dairy farming activities. Further, work force of dairy sector in India is heterogeneous i.e. females and males of various age group are engaged in dairy sector. In dairy sector there is an estimated seventy five million women as compared to fifteen million men (Padmanabhan, 2001) [7]. Data on gender division of labour in livestock rearing show that the total mean working hours of women was significantly higher than that of men (Upadhyay, 2003) [9]. Women who work in dairy farming may be at special risk for occupational injury because women have anatomical and physiological differences with men that may place them at risk for work related injuries (Engberg, 1993) [3]. On an average upper body strength is 40.75 per cent less in females than in males while lower body strength is 5.30 per cent less in females (Falkel *et al.*, 1986) [4]. As we know that males and females have different body capacity to perform the work and as the age of workers increases. Various physiological changes take place in human body which reduce worker's working capacity. Thus age and sex of dairy workers are contributing factors in developing occupational diseases. Preparing food for cattle is a very common practice performed by dairy workers. In present study. An attempts has been made to find out muscular stress among males and females of lower and higher age groups during milking and to find out impact of age and sex on muscular stress caused during milking. Findings of the study will be useful in improving the working conditions of the dairy sector and enhancing work and health status of the workers through developing appropriate tools and techniques for milking operations while keeping age and sex factors of the workers in consideration.

2. Materials and Methods

2.1 Research design

Experimental research design was planned for the study. In experimental research design researcher tests the hypothesis of casual relationship between variables. Experimental research designs require procedures that will not only reduce bias and increase reliability but will permit drawing inferences about casualty.

2.2 Sampling design

Multistage random cum purposive sampling design was used to select the study area and respondents. Following stages were included for selection of locale, block, villages and respondents.

2.2.1 Selection of locale

District Kanpur (U.P.) was selected purposively for the present study with the assumption that the rural population of district were intensively engaged in dairy farming activities.

2.2.2 Selection of block

District Kanpur was covered by 10 developmental blocks. Out of 10 blocks, Kalyanpur was selected randomly. The total population of Kalyanpur block was 1, 40, 285 lakh comprised of 75,666 lakh males and 64,619 lakh females.

2.2.3 Selection villages

Three villages namely Hirdayapur, Ishwariganj and Dharampur were selected randomly from the list of villages of

Kalyanpur block (Lottery or chit system).

2.2.4 Selection of respondents

Forty male and thirty female respondents of two age group (30-40 years and 40-50 years) were selected purposively on the basis of physical fitness. Thirty male and twenty two female respondents of 30-40 years and ten male and eight female respondents of 40-50 years were found physically fit from the selected samples of phase - I. Physical fitness was assessed through body mass index, body temperature, body pressure and heart rate.

The subjects who met the following conditions were selected for the experiments

Physical fitness: BMI index

Body temperature: Not above 99°F

Blood pressure: 12/80⁺-10

Heart rate: 70-90 beats/min.

2.3 Method of data collection

Muscular stress among dairy workers was assessed by measuring grip strength of both arm with the help of grip dynamometer. Readings or observations were taken in both split up cycle and complete cycle of selected dairy activities. The subject was asked to pull the handle before and after the work with both left and right hand and the reading given on the dial in kgs was recorded for both the hands. The per cent reduction in grip-muscular strength (muscular fatigue) was calculated from the following formula:

$$\% \text{ reduction in grip Strength} = \frac{W_r - S_w}{S_r} \times 100$$

Where

S_r = Strength of muscles during rest (kg)

S_w = Strength of muscles during work (kgs)

All the observations were taken on only experimental group by standardizing working conditions of preparing food for cattle.

2.4 Analysis of data

The collected data were tabulated and analyzed with the help of tabulation, subjective frequency, arithmetic mean, standard deviation, paired 't' test one way classification. ANOVA. Adjusted ANOVA (Snedecor, G.W. and Cochran, W.G.1967) [8]. Before analyzing data related to angle of body deviation were transformed on the basis of their size and unit given by Federor, W.T. (1955) [5].

3. Results and Discussion

From the table1, it is evident that F values for the group means of percentage change of left and right arms was highly significant at 0.01 percent level of significance for male and female dairy workers of lower and higher age groups in all the split-up stages and complete cycle of preparing food for cattle.

From the table 2. It is clear that maximum percentage increase in grip strength of both left and right arms was observed among male dairy workers of the lower age group (A₁B₂) and minimum among female dairy workers of higher age group (A₂B₁) at stage-II (fodder cutting) whereas in rest of the split-

up stages (stage-III and stage-IV) as well as in complete cycle of work, percentage decrease in grip strength of the both left and right arms in all the dairy workers (A₁B₁, A₁B₂, A₂B₁ and A₂B₂) was observed and it was maximum among females of higher age group (A₂B₁) and minimum among males of lower age group (A₁B₂). Among all the split-up stages of preparing food for cattle, percentage decrease in grip strength of both left and right arms was maximum in stage-IV (chaffing) whereas impact of whole activity (comprised of all split stages) on the percentage change in grip strength was higher in complete cycle as compared to each split-up stage.

From the data contained in Table 3, it is obvious that means of all the four groups of dairy workers for percentage change in grip strength of both left and right arms were significantly differ from each other (taken two groups of dairy workers at a time) in all the split-up stages and complete cycle of preparing food for cattle.

It is elicited from the table4 that main effect of age (A) and sex (B) of the dairy workers on percentage change in grip strength of left and right arms was significant along with their a interaction effect (A×B) in all split-up stages and complete cycle of preparing food for cattle. Significant interaction effect implies that effect of age of dairy workers has varied along with sex of dairy workers.

Table 5 depicts that mean values of percentage increase in grip strength of the left and right arm was maximum in males (B₂) and minimum in females (B₁) in stage-II (fodder cutting) whereas percentage decrease in grip strength of left and right arms was maximum in females (B₁) and minimum in males (B₂) in rest of split-up stages (stage-III, stage-IV) and in complete cycle of preparing food for cattle.

Table-6 implies that in stage-II adjusted mean values of percentage increase in grip strength of right and left arms was significantly higher in lower age group (A₁) as compared to female dairy workers of higher age group (A₂).

It was also significantly higher in male dairy workers as compared to female dairy workers in stage-II (fodder cutting). On the other hand, adjusted mean values of percentage decrease in grip strength of left and right arms was significantly higher in females (B₁) and males (B₂) in stage-III (preparing and carrying bundle of fodder), stage-IV (chaffing) and complete cycle of preparing food for cattle.

Overall analysis of different stages of preparing food for cattle performed by female and male dairy workers of lower and higher age group. Elicits that except onward journey. Each stage of preparing food for cattle exert considerable high muscular stress in grip strength among dairy workers. More over maximum muscular stress was observed during chaffing. It may be because a number of risk factors are prevailing in stage-IV (chaffing), as forceful body movements. Whole body vibration, sustained bending posture, mechanical stress caused due to handling of chaff machine. Further, during stage-II (Fodder cutting), percentage increase in grip strength while in remaining stage, percentage decrease in the grip strength of both arms (left and right arms) was observed. Percentage increase in grip strength during fodder cutting indicates warm – up period of the grip muscles due to short duration of work whereas percentage decrease in grip strength signifies fatigue of grip muscles due to longer period of work initiating anaerobic oxidation (Glycolysis) results in accumulation of lactic acid and CO₂. Moreover, percentage increase grip strength was maximum in males of lower age group and percentage decrease in grip muscles was maximum in females of higher age group. The reason for this. May be same as discussed in case of milking and cleaning of cattle shed. Because age and sex have significant impact on grip muscles of dairy workers thus these are the personal risk factors on the part of dairy workers engaged in preparing food for cattle leaving them vulnerable to various WMSDs.

Table 1: ANOVA for the group means of percentage change in grip strength in left and right arm of the dairy workers in different stages of preparing food for cattle

		Percentage change in grip strength of left and right arms (Preparing food for cattle)															
		Spl. Split-up stages												Complete cycle			
Sources	D.F.	Stage II				Stage III				Stage IV				Left		Right	
		Left		Right		Left		Right		Left		Right		Left		Right	
		M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F	M.S.	F
Group	3	0.250	76.48**	0.916	239.9***	0.455	48.763***	0.203	99.55***	0.256	87.78***	99.55***	0.150	0.321	73.00***	0.150	76.62***
Error	66	0.003		0.004		0.009		0.003		0.003		0.002		0.004		0.002	

Stage I = Onward journey, Stage II = Fodder cutting, Stage III = Preparing and carrying bundle of fodder. Stage IV = Chaffing

Table 2: Mean values of percentage change in grip strength in left and right arm among group of dairy workers in different stages of preparing food for cattle

Stages (Preparing food for cattle)	Percentage change in grip strength of left and right arms (Mean values)							
	A ₁ B ₁ =G ₁ (n=22)		A ₁ B ₂ =G ₂ (n=30)		A ₂ B ₁ =G ₃ (n=8)		A ₂ B ₂ = G ₄ (n=10)	
	Left	Right	Left	Right	Left	Right	Left	Right
Split up Stages								
Stage I	-	-	-	-	-	-	-	-
Stage II	+8.941 (+9.820)	+9.269 (+21.06)	+9.109 (+10.01)	+9.407 (+26.03)	+8.873 (+8.120)	+9.2850 (+15.20)	+9.1280 (+12.20)	+9.209 (+20.47)
Stage III	-9.076 (-10.60)	-9.407 (-14.80)	-8.873 (-12.00)	-9.140 (-11.00)	-9.2780 (-16.50)	-9.425 (-21.00)	-8.407 (-7.890)	-9.269 (-12.00)
Stage IV	-9.275 (-16.20)	-9.311 (-22.40)	-9.089 (-11.46)	-9.285 (-15.69)	-9.407 (-20.3)	-9.511 (-24.62)	-9.269 (-15.53)	-9.441 (-20.96)
Complete Cycle	-9.341 (-17.70)	9.445 (-23.40)	-9.126 (-12.30)	-9.318 (-17.06)	-9.433 (-21.37)	-9.514 (-24.50)	-9.326 (-17.50)	-9.422 (-21.96)

A₁B₁ = Females of lower age group (G₁), A₁B₂ = Male of lower age group (G₂)

A₂B₁ = Female of higher age group (G₃), A₂B₂ = Male of the higher age group (G₄)

Stage I=Onward journey, Stage II=Fodder cutting, Stage III=Preparing and carrying bundle of fodder. Stage IV=Chaffing

(1. At stage-1 (Onward journey) no change in grip strength was observed.

2. Positive sign indicates percentage increase in grip strength. 3. Negative sign indicates percentage decrease in grip strength)

Table 3: Comparison of groups of dairy workers on the basic of percentage change in left and right arm in different stages of preparing food for cattle

Source	Percentage change in left and right arms (Preparing food for cattle)															
	Split-up stages												Complete cycle			
	Stage II				Stage III				Stage IV				Left		Right	
	Left		Right		Left		Right		Left		Right		Left		Right	
	S.Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S.Ed	't' ₆₆	S.Ed	't' ₆₆	S.Ed	't' ₆₆	S.Ed	't' ₆₆
G ₁ VsG ₂	0.016	9.984***	0.0173	-7.619***	0.027	7.473***	0.016	-5.796***	0.015	7.938***	0.0127	12.20***	0.0186	11.522*	0.0124	10.758***
G ₁ VsG ₃	0.024	-5.873***	0.026	19.78***	0.0399	-5.070***	0.024	20.89***	0.022	-8.82***	0.0187	-4.769***	0.027	-3.485***	0.0183	-3.603***
G ₁ VsG ₄	0.022	-4.7502***	0.023	6.345***	0.0368	-2.425*	0.022	8.554***	0.021	-3.222***	0.0173	-2.0107*	0.025	-3.593***	0.0169	-2.303*
G ₂ VsG ₃	0.023	-13.14***	0.025	25.90***	0.038	-10.53***	0.023	25.76***	0.022	-14.82***	0.0180	-13.55***	0.026	-11.64***	0.0176	-11.33***
G ₂ VsG ₄	0.021	-8.458***	0.023	12.48***	0.035	-7.233***	0.021	-13.39***	0.020	-9.467***	0.0167	-11.48***	0.024	-8.237***	0.0162	-10.67***
G ₃ VsG ₄	0.027	4-.509***	0.029	-12.11***	0.045	3.268**	0.028	-11.31***	0.026	5.410***	0.022	2.534*	0.031	3.423*	0.0210	2.827*

G₁ = A₁B₁ (Females of lower age group), G₂ = A₁B₂ (Males of lower age group), G₃ = A₂B₁ (Females of higher age group), G₄ = A₂B₂ (Males of higher age group)

Stage-I=Onward journey, Stage II=Fodder cutting, Stage III=Preparing& carrying bundle of fodder. Stage IV=Chaffing

Table 4: Adjusted ANOVA for age(A) and sex (B) of dairy workers and their interaction effect (A x B) on adjusted means of percentage change in grip strength of left and right arm of dairy workers during different stages of preparing food for cattle

Source	D.F.	Percentage change in left and right arms (Preparing food for cattle)															
		Split -Up stages												Complete cycle			
		Stage II				Stage III				Stage IV				Left		Right	
		M.S.		F		M.S.		F		M.S.		F		M.S.		Fs	
A	1		1047***	1.928	503.9***	0.717	76.89***	1.913	569.4***	0.490	168.2***	0.284	138.3***	0.311	7068***	0.211	107.4***
B	1	0.385	118.3***	0.617	161.6***	0.611	65.48***	0.387	115.3***	0.259	88.80***	0.284	138.30***	0.596	735.58***	0.191	97.68***
A x B	1	0.005	3.449***	0.163	42.83***	0.009	-	0.154	45.94***	0.000	3.145***	0.033	16.26***	0.037	8.533***	0.038	19.13*
Error	66	0.003		0.004		0.009		0.003		0.003		0.002		0.004		0.002	

Stage-I=Onward journey, Stage II=Fodder cutting, Stage III=Preparing& carrying bundle of fodder. Stage IV=Chaffing

(At stage-I(Onward journey) no change in grip strength was observed)

Table 5: Adjusted means of percentage change in grip strength of left and right arm for the groups of dairy workers during different stages of preparing food for cattle

Stages (Preparing food for cattle)	Percentage change in left and right arms (Adjusted means)									
	Groups of dairy workers									
	A ₁		A ₂		B ₁		B ₂			
	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
A) split up stages										
Stage-I	-	-	-	-	-	-	-	-	-	-
Stage-II	+9.137 (+12.06)	+9.261 (+15.41)	+9.159 (+12.50)	+9.341 (+17.98)	+9.154 (+12.49)	+9.345 (+18.12)	+9.205 (+13.83)	+8.772 (+18.56)		
Stage-III	-9.311 (-17.09)	-9.105 (-11.31)	-8.939 (-18.00)	-9.149 (-12.36)	-8.973 (-18.60)	-9.178 (-13.09)	-9.185 (-13.35)	-9.128 (-11.84)		
Stage-IV	-9.349 (-18.25)	-9.305 (-16.178)	-9.448 (-21.89)	-9.348 (-18.21)	-9.491 (-23.64)	-9.376 (-19.21)	-9.319 (-17.24)	-9.231 (-14.55)		
Complete cycle	-9.462 (-22.46)	-9.356 (-18.50)	9.484 (-22.47)	-9.384 (-19.49)	-9.502 (-24.10)	-9.365 (-23.35)	-9.462 (-18.80)	-9.351 (-18.34)		

Stage-I=Onward journey, Stage II=Fodder cutting, Stage III=Preparing& carrying bundle of fodder. Stage IV=Chaffing

A₁= Lower age group (30-40), A₂=Higher age group (40-50), B₁=Females. B₂= Males

(1. At stage-1 (Onward journey) no change in grip strength was observed.

2. Positive sign indicates percentage increase in grip strength. 3. Negative sign indicates percentage decrease in grip strength)

Table 6: Comparison of groups of dairy workers on the basis of adjusted means of percentage change in grip strength of left and right arm in different stages of preparing food for cattle

Groups	Percentage change in left and right arms (Preparing food for cattle)															
	Split Up stages												Complete cycle			
	Stage II				Stage III				Stage IV				Left		Right	
	Left		Right		Left		Right		Left		Right		Left		Right	
	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆	S. Ed	't' ₆₆
A ₁ VsA ₂	0.015	-10.23***	0.017	22.45***	0.026	-8.778***	0.016	23.87***	0.015	-12.98***	0.012	-11.76***	0.018	-8.413***	0.012	-10.38***
B ₁ VsB ₂	0.014	10.89***	0.015	-12.73***	0.023	8.096***	0.014	-10.75***	0.013	9.450***	0.011	11.79***	0.016	11.66***	0.011	9.912***

Stage-1 = Onward journey, Stage II = Fodder cutting, Stage III = preparing & carrying bundle of fodder. Stage IV = chaffing

(At stage-I(Onward journey) no change in grip strength was observed)

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