CARDIOVASCULAR LOAD AND STRAIN ON DAIRY WORKERS INVOLVED IN MILKING

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ABSTRACT

In the present study, an attempt was made to find out cordiac load or strain on dairy workers during milking by estimating energy expenditure. On the basis of physical fitness of respondents, 30 male and 22 female respondents of 30-40 yrs. And 10 male and 8 female respondents of 40-50 yrs. were selected for experiments. Findings showed that energy expenditure was higher among female respondents as compared to make respondents of higher age group as compared to female and male respondents of lower age group.

Key words : Cardiac laod, Energy expenditure, Heart rate, Milking, Respondents.

Milking is physically arduous occupation and exposes the diary workers is various risk factors that have been associated with musculo-skeletal disorders (MSDs). In a Swedish study, it was observed that female milkers had a greater risk of developing hand and wrist MSDs as compared to agriculture workers (non-milkers) Stal, *et al*. (1996). In the same study, symptoms of numbness and white finger related to vibration exposure were also reported. During any physical activity, there is an increase in blood circulation which increases the rate of transportation of oxygen, CO_2 and the metabolites formed during muscular contraction. The increase in blood flow is met through the combination of two factors viz., an increase in pulse rate and increase in blood volume output from the heart per beat (stroke volume). If the volume ejected per beat remains constant and the heart rate increases, cordiac output also increases. In the light of above facts an attempt was made to assess the cordiac load and strain on dairy workers performing milking operation.

METHODOLOGY

Present study was conducted in 3 villages of Kalyanpur block of Kanpur Nagar (U.P.) namely-Hirdayapur, Ishwarigunj and Dharmpur which were randomly selected from the list of villages of Kalyanpur. On the basis of physical fritness index suggested by Garrow (1981), forty male and thirty female respondents of two age-group 30-40 yrs. and 40-50 yrs. were selected purposively. Thirty male and twenty-two female respondents of 30-40 yrs. and ten male and eight female respondents of 40-50 yrs. were found physically fit from the selected samples of phase-I. Physical fitness was assessed through body mass index, body temperature, blood pressure and heart rate.

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

Physical fitness : BMI index
Body temperature : Not above 99^0F
Blood Pressure : $120/80\pm10$
Heart rate : 70-90 beats/min

Cardiac load and strain was made by calculating energy expenditure in split-up stages and complete cycle of selected dairy farming activities through formula proposed by Varghese *et al*. (1994).

Energy expenditure (kg/min) = 0.159 x average heart rate (beats/kin) – 8.72

Heart rate of dairy workers was measured with the help of polar heart rate monitor before, during and after each split-up stages and complete cycle.

Split-up stages of milking was as below :

Stage- I : Onward journey from home to cattle-shed with carrying bucket containing small quantity of water.

Stage – II : Milking operation

Stage – III : Backward journey from cattle-shed to home.

ANOVA, adjusted analysis of variance (Snedecar

and Cocharan, 1967) was used for analysis of data.

RESULTS AND DISCUSSION

Average heart rate (A.H.R.) of female and male dairy workers of lower and higher age-group during selected dairy farming activities :

The energy expenditure which has also been extensively used in occupational work load is estimated from the regression equation derived from the values of heart rate from laboratory experiments for Indian housewives (Varghese et al., 1995).

Table 1 highlights that maximum mean value of average heart rate (A.H.R.) was found among dairy workers of A_2B_1 group i.e. female of higher age-group whereas minimum among dairy workers of A_1B_2 group i.e. males of lower age-group in all split-up stages and complete cycle of milking. Further, it is also apparent from the Table 1 that in all split-up stages, the effect of stage-II (milking) was recorded maximum on the A.H.R. of all dairy workers of four group (A_1B_1, A_1B_2, A_2B_1, A_2B_2). Except it, cumulative effect (complete cycle) of all the split-up stages on average heart rate was higher as compared to distinct effect of each stage of split-up cycle of milking.

Energy expenditure among male and female dairy workers of lower and higher age group performing milking :

Human energy measurements for various activities provide a rational basis for recommendations of improvements in equipment design for more output and safety. Results pertaining to energy expenditure during milking are presented in different heads and sub-heads. Where A = Age, B = Sex.

A_1B_1 = Females of lower age group (30-40 yrs.)
A_1B_2 = Males of lower age group (30-40 yrs.)
A_2B_1 = Females of higher age group (40-50 yrs.)
A_2B_2 = Males of higher age group (40-50 yrs.)
(Applicable for Table 1 and 2)

It is obvious from Table 2 that maximum mean value of energy expenditure (E.E.) was among females of higher age-group (A_2B_1) in all split-up stages and complete cycle of cleaning of cattle-shed. Except it, among all split-up stages, the mean value of energy expenditure (E.E.) was maximum in stage-II (milking) as compared to other split-up stages (Stage-I and Stage-II) of milking. Comulative effect of all the split-up stages of milking was higher in complete cycle than the distinct effect of each split-up

Table 1: Mean values of average heart rate (A.H.R.) among dairy workers during different stages of milking.

Groups	A_1B_1	A_1B_2	A_2B_1	A_2B_2	F
Symbols	G_1	G_2	G_3	G_4	Df = 66
Size	n=22	n=30	n=8	n=10	
Split-up Stages					
Stage-I	4.833	3.554	5.171	4.048	41.51*
	(22.86)	(12.13)	(26.24)	(15.89)	
Stage-II	5.911	5.050	6.284	5.448	26.19***
	(34.44)	(25.00)	(38.99)	(29.18)	
Stage-III	5.710	4.734	5.787	4.834	143.3***
	(32.10)	(21.91)	(28.99)	(22.87)	
Complete cycle	6.212	5.322	6.312	5.641	6.30***
	(38.09)	(27.82)	(47.28)	(31.32)	

Table 2: Mean values of average heart rate (A.H.R.) among dairy workers during different stages of milking.

Groups	A_1B_1	A_1B_2	A_2B_1	A_2B_2	F
Symbols	G_1	G_2	G_3	G_4	Df = 66
Size	n=22	n=30	n=8	n=10	
A. Split-up Stages					
(1) Stage-I	5.500	4.533	9.000	6.000	44.82***
(2) Stage-II	9.182	6.767	11.00	8.900	46.93***
(3) Stage-III	6.000	5.067	10.00	5.773	34.95***
B. Complete cycle	9.200	7.033	12.38	9.046	53.22***

stages of milking on energy expenditure (E.E.) in dairy workers of the all the four groups.

Further, F-values for energy expenditure (E.E.) were highly significant for group means in all split-up stages and complete cycle of cleaning of cattle-shed i.e. the mean values of energy expenditure for each group or dairy workers were significantly different from one another.

Table 3 indicates that mean values of energy expenditure (EE) of dairy workers of all the four groups were significantly different from each other while two groups were taken at time at the split-up stages and complete cycle of work.

The main effect of age (A) and sex (B) of dairy workers on energy expenditure (E.E.) was significant at 0.1% level of significance whereas their interaction effect was non-significant in all split-up stages and complete cycle of milking. Non-significant interaction effect of (A x B) implies that mean value (adjusted) of energy expenditure in dairy workers of two different sex was not varied along with age in all the split-up stages and complete cycle of milking (Table 4).

Among dairy workers of higher age-group, maximum mean value (adjusted) of energy expenditure was recorded whereas minimum energy expenditure was measured among male dairy workers in all split-up stage and complete cycle of milking (Table 5).

Table 6 implies that adjusted mean value of energy expenditure (E.E.) was significantly higher among dairy

Table3: Comparison of groups of dairy workers on the basis of energy expenditure (E.E.) during different stages of milking (Kcal/min).

Groups	Split-up Stages						Complete cycle	
	Stage-I		Stage-II		Stage-III			
	$S.E_D$	't' 66	$S.E_D$	't' 66	$S.E_D$	't' 66	$S.E_D$	't' 66
G_1 Vs G_2	0.274	3.526***	0.289	7.886***	0.342	2.067*	0.311	6.909***
G_1 Vs G_3	0.404	-8.679***	0.425	-4.600***	0.502	-8.414***	0.457	-6.980***
G_1 Vs G_4	0.373	-1.342***	0.393	-2.394*	0.464	-2.490*	0.423	2.667**
G_2 Vs G_3	0.389	-11.49***	0.410	-10.34***	0.484	-10.19***	0.441	-12.12***
G_2 Vs G_4	0.357	-4.112***	0.376	-6.474***	0.444	-2.100*	0.405	-4.614***
G_3 Vs G_4	0.463	6.475***	0.488	3.687***	0.577	6.930***	0.525	6.612

Table 4:Adjusted ANONA for age (A) and sex (B) of dairy workers and their interaction effect (AxB) on adjusted means of energy expenditure during different stage of milking (Kcal/min).

Source	d.f.	Split-up Stages						Complete cycle	
		Stage-I		Stage-II		Stage-III			
		M.S.	F	M.S.	F	M.S.	F	M.S.	F
A	1	74.39	77.97***	66.07	63.36	75.65	51.09***	80.16	65.30***
B	1	38.25	40.09***	79.55	75.09	41.72	28.18***	106.5	0.673***
AxB	1	13.61	3.06***	0.755	0.712	35.72	2.419	5.792	2.719
Error	66	0.954		0.71		1.481		1.227	

Table 5 : Adjusted mean of energy expenditure (E.E.) among groups of dairy workers during different stages of milking (Kcal/min).

Stages	Group of dairy workers (adjusted mean)			
Symbols	A_1	A_2	B_1	B_2
A. Split-up Stages				
(1) Stage-I	5.057	6.408	7.416	4.914
(2) Stage-II	7.897	9.552	10.12	7.398
(3) Stage-III	5.485	6.869	7.864	5.309
B. Complete cycle	8.134	10.58	10.01	7.517

Table6: Comparison of the adjusted means of energy expenditure (E.E.) among groups of dairy workers during different stages of milking (Kcal/min).

Groups	Split-up Stages						Complete cycle	
	Stage-I		Stage-II		Stage-III			
	$S.E_D$	't' 66	$S.E_D$	't' 66	$S.E_D$	't' 66	$S.E_D$	't' 66
A_1 Vs A_2	0.267	-8.830***	0.282	-7.897***	0.33	-7.148***	0.303	-8.08***
B_1 Vs B_2	0.235	6.332***	0.249	8.666***	0.294	5.038***	0.268	9.313**

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workers of higher age-group in comparison to lower age group. Furthermore, mean value of energy expenditure was significantly higher among female dairy workers as compared to male dairy workers.
Where:
* shows significant level at 5%
** shows significant level at 1%
*** shows significant level at 0.1%
} Applicable to all the tables

Above discussion suggests that state-II was the most stressful stage having maximum mean value of energy expenditure among dairy workers of all the four groups. It may be because milking required squatting posture, wrist deviation from its normal position and induced whole body vibration and mechanical stress caused due to forceful movements involved in handling under of cattle during the operation. All these factors are the work related factors and may be responsible in onset of various musculo-skeletal disorders among females and males engaged in milking operation. Further, age and sex are the personal risk factors on the part of dairy workers in developing various musculo-skeletal disorders because ageing of dairy workers has equally increased the energy expenditure of male and female dairy workers during the work. Futhermore, females were required more energy for performing milking as compared to males. Hence, females will be more easily affected by all the work related risk factors of milking. Thus, there is great need for mechanization of milking operation. Further, tools and techniques should match the physical capabilities of both male and female dairy workers of lower and higher age groups.

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