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Ergonomic Evaluation for Dung Collection and Transportation by Rural Women

Sudesh Gandhi
Dept of Family Resource Management,
College of Home Science,
CCS Haryana Agricultural University, Hisar

Mamta Dilbaghi
Dept of Family Resource Management,
College of Home Science,
CCS Haryana Agricultural University, Hisar

Manju Mehta
Dept of Family Resource Management,
College of Home Science,
CCS Haryana Agricultural University, Hisar

Abstract

In Haryana, a rural woman starts her day even before sun rises with cleaning of cattle-shed i.e. collecting and fetching of cattle dung. During the activity she adopts unnatural body postures that put undue stress on her body. Hence, the present study aimed at ergonomic evaluation of dung collection and fetching activity. Thirty rural women having average health status were selected from two villages of Hisar district of Haryana state. Rural households possessed 3-5 animals followed by 6-8 animals.

An average of 17 kg of dung was produced per animal in 24 hours. On an average they fetched one iron basket/animal as head load having its weight ranging from 18-25 kg. A woman spent 52 minutes in morning and 43 min in the evening for dung collection and transportation. Respondents used to dump the dung in open place away from their home. Physiological stress indicated that average heart rate increased to 127 bpm over the resting HR (84bpm). Squatting and bending posture was adopted during dung collection and then load was lifted from the ground with back bending at more than 90^{o} and fetched as head load to a distant place. The same activity was repeated in the evening too. Extreme postural deviation was observed while collecting dung and lifting dung as head load. A fetching trolley has been developed (Shraddha, 2005) for dung transportation which would be helpful for the worker to do the activity with lesser efforts. There is a need to educate the rural women to use drudgery reducing technology for dung collection and its transportation that would reduce the muscular stress and increase their efficiency.

Keywords: Biomechanical Stress, Musculo- Skeletal Discomfort, Overall Discomfort Score, Postural Variation

Introduction

Dung is acknowledged as a resource in rural scenario. Cattle dung has a significant place in everyday life in rural North India, thus is managed daily. Dung collection is considered as exclusively women's work. For women there are no developed countries. This statement implies undoubtedly to Haryana woman as she starts her day even before sun rises with cleaning of cattle-shed i.e. collecting and fetching of cattle dung and the same activity is done in the evening too where she spends a lot of time daily. Studies show that women spend 1-5 hours per day for collecting bio-fuels i.e. firewood, dung, agri waste etc (Mahadevia and Shukla 1997). Specifically, on an average a woman spends 89.42 min for collecting dung per day (Bose 1993). Moreover she has to travel a long distance for its disposal carrying heavier loads as head load. Longer treks and heavy head loads put undue strain on the woman's health.

Making dung-cakes can take up to two hours a day, depending on how much dung a woman has access to and the amount of cooking fuel required (Jeffery et al, 1989). As the work involved is for family use, women do not get any acknowledgement of the contribution this work makes to household production. This throws light on some neglected aspects of agrarian society on women's condition. During dung collection and transportation activity women adopt many unnatural postures adding to the drudgery of women. The situation gets much worse while lifting dung from

the ground particularly carrying dung load on head which is very harmful for their health. They perform activities in their own convenient postures without realizing the cost of energy and other physiological cost to the body in those particular postures. This in turn has implications for women's health perform this work

Dung-work receives little attention in the literature, despite the hard labour and considerable efforts put in by women without generating any additional entitlements. Keeping in view the above the present study was undertaken with the objectives: Studying the time and activity profile of women in dung collection and transportation activity, and assessing the physiological stresses and biomechanical stress of women involved in the activity.

Hypothesis

Dung collection and Transportation activity involved high Physiological and biomechanical stress.

Methodology

The study was carried out on 30 rural women belonging to two villages namely Burak and Gandhi Nagar of Hisar district of Haryana state. 15 female respondents were selected from each village for the present study. Time and activity profile and ergonomic evaluation of the respondents involved in dung fetching and transportation was carried out to found the drudgery of the women in the activity.

Procedure for measuring the various parameters

Time and Activity Profile

Time and activity profile comprised time spent on dung collection activity, tool used, place of dumping the dung ,no of animals and weight of the dung carried in the morning as well in the evening was studied. Stop watch was used for measuring the time used and padometer was used for measuring the distance travelled.

Ergonomic evaluation of the respondents involved in dung fetching and transportation:

Under ergonomic evaluation, physiological stress and biomechanical stress was calculated.

Physiological stress

Heart rate

Heart rate is an indicator of cardiac stress due to physical workload. Hence, HR was recorded using polar heart rate monitor firstly at rest & then after every 5 minute during the activity till the recovery of the subject. From the values of HR, energy expenditure, total cardiac cost of work (TCCW) and physiological cost of work (PCW) were calculated.

TCCW= Cardiac cost of work (CCW) + Cardiac cost of recovery (CCR)

CCW= (Avg. working HR – Avg. Resting HR) x Duration of activity

CCR= (Avg. Recovery HR – Avg. Resting HR) x **Duration of activity**

Physiological cost of work (PCW) = TCCW / Total **time of the activity**

Energy expenditure during work was also calculated by AHR by using the regression equation given by Varghese et al (1994)[3]:

Energy expenditure (kJ/min) = 0.159 x Avg Working HR (bpm) – 8.72

Biomechanical Stress

Biomechanical stress was measured by recording the muscular fatigue or discomfort in the muscles of the body by recording the subjective feeling of the subject regarding incidence of musculo-skeletal discomfort in the body after the task. along with overall discomfort score and postural variation.

Musculo- skeletal discomfort

A human body map was used to identify incidence of musculo- skeletal discomfort in different body parts resulting from postural discomfort (Corlette and Bishop, 1976)[2]. Five point scale ranging from very severe pain (5) to very mild pain (1) was used to quantify the stress on muscles used in work.

Overall discomfort score

For the assessment of overall discomfort rating, a psycho-physical rating scale at 10 point continuum, 0 being the lowest point showing no discomfort and 10 being the uppermost point showing extreme discomfort was used (Corlette and Bishop, 1976).

Postural variation

It includes number of times a woman adopted various postures viz. Bending ,squatting and sitting while performing the activity.

Results and Discussion

General Profile of the respondents

General profile of the respondents is presented in table 1**.** It is clear from the table that half of the respondents (50.0%) belonged to middle age group (30-45 years) followed by 18-30 yrs (26.7 %) and 45-60 yrs (23.3 %) of age respectively. One-third of the respondents were small farmers (33.3%) followed by landless laborers. Equal number of respondents were medium and large farmers (20.0 % each). Three-fifth of the families were of nuclear type (60.0%) followed by joint (40.0%). Maximum of the respondents had herd size of 3-5 animals followed by 1-2 animals.

Table1

General profile of the respondents N=30

Parameters	Frequency	Percentage
Age		
18-30 yrs	8	26.7
30-45 yrs	15	50.0
45-60 yrs	7	23.3
Land owning status		
Landless laborer	8	26.7
Small Farmer	10	33.3
Medium Farmer	6	20.0
Large Farmer	6	20.0
Family type		
Nuclear	18	60.0
Joint	12	40.0
Herd size		
1-2 animals	9	30.0
3-5 animals	14	46.7
6-8 animals	7	23.3
Place of keeping animals and dumping the dung*	Keep animals	Dump the dung
Home & its peripherry	19(63.3 %)	5(16.7%)
Naura/ Badaa	11(36.7%)	28(93.3%)

Field	2(6.7%)	2(6.7%)

*multiple response

Majority of the respondents kept their animals in home and its periphery (63.3%) and dump the dung in badaa (63.3%) an open place where they dump the dung and make the dung cakes and its storage.

Time and activity profile

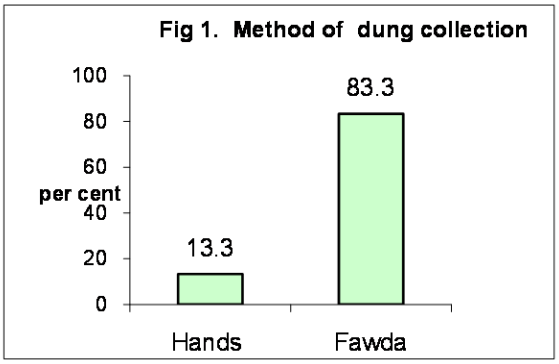
Table 2 indicates that on an average woman spent 52 minutes in morning for dung collection and transportation while in evening she spent 43 minutes for the same activity. The reason for spending more time in morning is that animal shed is dirty in morning so they have to work more for cleaning it.

Table 2

Time and activity profile of dung collection and transportation N=30

Activities		
Time spent (min)	**Morning**	**Evening**
Dung collection	22	18
Dung transportation	30	25
Total time spent	52	43
Average distance travelled/cycle(mt)	**Morning**	**Evening**
	830	660
No. of tasla/ basket carried	**Morning**	**Evening**
1-3	8(26.7)	6(20.0)
3-5	16(53.3)	10(33.3)
5-8	8(26.7)	7(23.3)
Av weight of tasla/basket (kg) with dung	**Morning**	**Evening**
	25	18

A woman travelled 830 mt in the morning and 660 mt in the evening for dumping the dung. Overall she travelled a distance of 1.490 km/cycle and 2.98 km/day for dung transportation. More than half (53.3%) of the respondents carried 3-5 *taslas of* dung in morning and 33.3% respondents carry 3-5 *taslas* in evening.. Nearly one-fifth of the respondents carried 5-8 *taslas* in the morning and 23.3 % respondents carried 5-8 *taslas* in the evening. Average weight of the *tasla* with dung was about 25 kg and 18 kg in the morning and evening respectively. Distance of dumping place was about between 100-170 mt of range. Regarding method of dung collection, it is clear from figure 1 that majority of the respondents used *Fawda* (83.3%) for dung collection. Only 13.3 per cent respondents used hands for dung collection (Fig 1).



Physiological stress

Table 3 depicts the working heart rate, energy expenditure and workload of respondents in dung collection and transportation activities.

Table3

Physiological stress of women collecting and transporting dung N=30

Activities	**AHR (bpm)**	**PHR (bpm)**	**EE (kj/min)**	**TCCW (beats)**	**PCW (beats)**
Dung collection	118	127	10.0	805	40.3
Dung lifting	127	131	11.5	226	113
Dung transportation	110	121	8.8	1318	27.4

It is clear from the table that among three sub activities, heart rate for dung lifting was highest (127 bpm) followed by dung collection (118bpm) and dung transportation (110 bpm). Physiological stress for dung lifting activity was highest due to sudden change in posture during the lifting of dung. Correspondingly, energy expenditure for these activities was 10.0 kj/min, 11.5 kj /min and 8.8 kj/min respectively. TCCW was highest for dung transportation activity because it was a longer duration activity and lowest for dung lifting as this activity was done for only 2-3 min. After calculating PCW, it is clear from the table that dung lifting is however a shorter duration activity but its physiological cost of work is highest depicting more drudgerious activity.

Biomechanical Stress

Biomechanical stress comprised musculo-skeletal discomfort, postural variation and overall discomfort score.

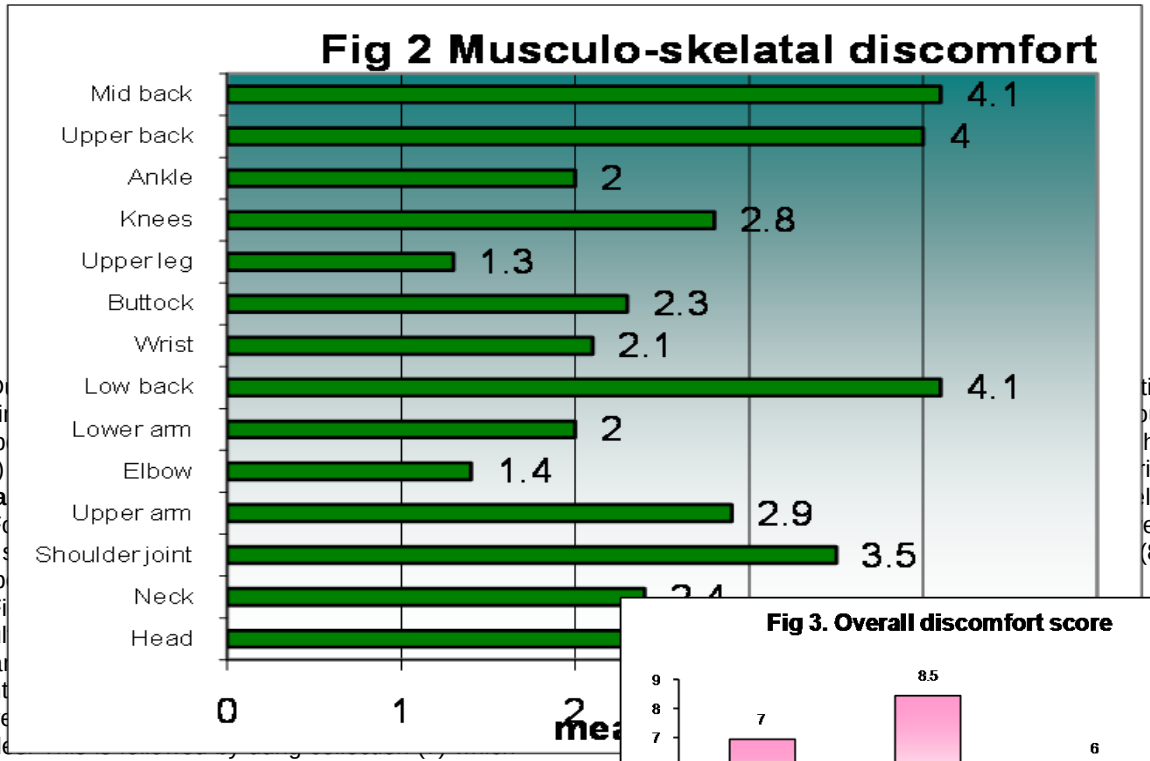
Musculoskeletal discomfort

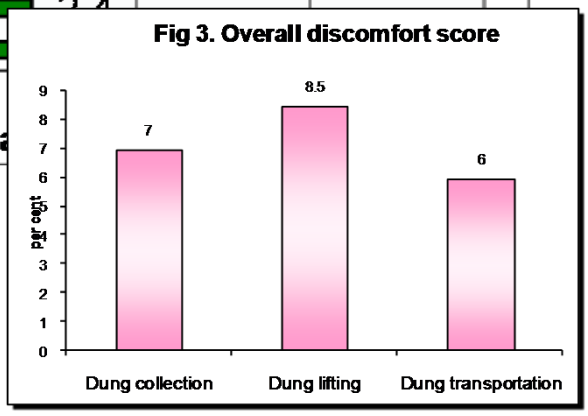
This section comprises musculoskeletal discomfort among women. Most important factor of musculoskeletal discomfort among women is adoption of awkward posture for longer duration and secondly, repetitive action of a muscle. Data in figure indicate the incidence of discomfort in dung collection and transportation. It is clear that magnitude of discomfort was severe in low back and mid back (4.1), followed by upper back (4.0). Respondents reported moderate discomfort in head (3.8) and shoulder joint (3.5). Mild discomfort was reported in upper arm (2.9), knees (2.8), and neck (2.4). Conclusively, musculoskeletal discomfort was highest in back. .

Table 4

Average postural variation while performing activity

Posture Adopted	**Dung Collectio**	**Dung Lifting**	**Dung Transportation**
Squatting	10	-	-
Bending	8	2	2
Stooping	6		-
Standing	3	1	2





is more tough activity than dung transportation (5). Women gave this response because they don't feel much fatigue in dung transportation. Although, they do this activity leisurely, yet the number of trips and time consumed make it drudgerious activity. They reported more discomfort during dung collection activity because they have to change postures very frequently which are hazardous and full of fatigue. There is a need to educate people about the right way to use body postures during work. There is need to develop workload reducing technologies.

A fetching trolley has been developed (Shraddha, 2005) for dung transportation which would be helpful for the worker to do the activity with lesser efforts. Use of trolley will avoid lots of weight to be carried on head, thus reducing drudgery of a woman.

Conclusively dung collection is a activity carried out in the morning and evening by the women only. She carries 25 kg and 18 kg weight of dung on head in the morning and evening respectively and travels a distance of 100-170 mt for dumping the dung. Dung collection is mainly done in stooping and bending

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