

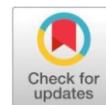
Original Research Article

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Workload and Rating of Perceived Exertion of the female laborers in cutting of sorghum crop

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ABSTRACT

Women constitute almost half of the workforce engaged in agriculture. The rural women participate in a broad range of agricultural activities involve a lot of physical strain which create serious health problems in the long run. Keeping this in view a study was conducted in four villages of Dharwad taluka were randomly selected for the study thus a total sample comprised of 160 women. With respect to the tools for harvest and post harvest activities of sorghum crop i.e., two improved sickle from dev Agro Tools Bangalore and one from CIAE Bhopal. The results revealed that mean working heart rate and energy expenditure was higher during cutting stalks with CIAE Bhopal sickle i.e., 141.40 beats/min and 13.76kj/min respectively when compared to traditional sickle. Based on the mean working heart rate, cutting stalks of sorghum crop was classified as very heavy for CIAE Bhopal sickle and as heavy for traditional, I-108 and I-104 sickles. With respect to the musculoskeletal disorder, the female laborers expressed very severe pain by the use of CIAE Bhopal sickle compared to other sickle and less score was observed with I-104 sickle for upper and lower parts of the body. Challenges in this study included the physical strain experienced by the women during the use of various sickles, which could affect the accuracy and consistency of the data on health impacts. Additionally, assessing musculoskeletal disorders and energy expenditure in real-world settings posed logistical difficulties, as individual variations in technique and body type may have influenced the results. Despite these challenges, the study contributed valuable insights into the differences in health impacts between traditional and improved sickles, highlighting the importance of ergonomic tools for reducing physical strain in agricultural tasks. The findings emphasize the need for better tool design to prevent musculoskeletal disorders and optimize energy expenditure for female agricultural workers.

Keywords: Workload, Sorghum crop, Muscular-skeletal problems and female laborers, Energy expenditure, Health impacts and Ergonomic tools

Introduction

Women constitute almost half of the workforce engaged in agriculture. Rural women participate in a broad range of agricultural activities such as production, processing preservation and utilization of food. They play a key role in the entire food system starting from the selection of seeds, sowing, manuring, drying, stacking, storing and feeding the family from the harvested produce. Further, they play a major role in the decision-making process at household level. It is imperative to understand that they appear to influence the decisions regarding the choice of farm enterprise as well as the desirable production features of a particular commodity or crop. It has been shown whether it is shifting cultivation, subsistence and low or high input in agriculture. Women work longer and harder than men though they paid less. They also work on more tasks than men. In spite of their enormous contributions to farming, the women have largely remained invisible as active farmers. Most people have failed to recognize the work that women's involvement in agriculture is enormous.

Drudgery is generally conceived as physical and mental strain, fatigue, monotony and hardships experienced while doing a job.

It is certain, that if appropriate and drudgery-reducing farmstead implements are made available to the rural women, these would contribute to reduction in drudgery, increase capability, productivity and consequently the greater workload thereby improving efficiency.

Sorghum is one of the four major grains of the world. It follows wheat, rice and maize in area and production. Sorghum is grown in the tropics and subtropics under a variety of names viz, jowar, jaur, cholam or jola in India. In India, sorghum ranks third in area and production after rice and wheat. The crop accounts for nearly 52 percent of the area and 63 per cent of production under millets with an area of 15.1 million tones (Hosamani and Chhitapur, 1997). The area under sorghum cultivation in the country has remained more or less stable in the last two decades. Hence, it is indeed obvious that women are actively involved in the harvest and post harvest activities related to sorghum. Very limited studies are available to ease the drudgery perceived and physiological cost during the above-mentioned activities and hence the proposal of research entitled.

Materials and Methods

The present study entitled Workload and Rating of Perceived Exertion of the Female Laborers in cutting of Sorghum Crop was carried out in Dharwad taluka of Karnataka State India. Explorative research design was used to elicit the required information from the respondents. The population of the study comprised of agricultural female laborers who performed harvest and post-harvest activities of sorghum crop regularly.

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A total of 160 women respondents were selected from the four villages namely Yettingudda, Narendra, Amminbhavi and Lokur. Thus the sample comprises of 40 female laborers in each of the four villages who performed the harvest activity regularly and suitable statistical tools were used compute the data.

Results and discussion

The socio-economic profile of the female laborers is documented in Table-1. The perusal of the table indicates that, the larger percentage of female laborers belonged to the nuclear family (61.90%) followed by joint (23.80%) and extended family (21.5%) systems. This trend was more or less similar among all the female households of selected villages except Lokur village (52.50%) where more respondents were from joint family.

Regarding the caste profile of the respondents, it is clearly seen that majority of the respondents belonged to other backward castes (46.27%) followed by upper caste and scheduled caste, recorded the equal percentage (16.25%) and the least was lower caste (7.5%).

As per the findings, majority of respondents were landless while 36.9 percent of the respondents possessed dry land. Further among the landholders 15.6 percent had small land holding i.e., (2.5-5.0 acres) followed by 13.8 percent marginal (0.0-2.5 acres) and 7.5 percent possessed medium size land (5.0-10.0 acres). The results are in line with results of Agarwal *et al* 2004.

With respect to the personal profile of the respondents, equal percentage (35 each) was of the age group of 34 years and 34-41 years. Only 30 percent of the sample was from more than 41 year of age group.

The most equal percentage of the respondents were illiterate (43.10% each) while 41.3 percent of the respondents were educated up to primary and secondary level (15%). However, education up to the primary level was comparatively more among Lokur (50%) and Narendra (45%) villages. The results are in line with the results of Kavita and Reddi 2002.

Thirty six percent of the respondents from marginal and medium land holding of dry land were self-cultivators and rest were landless. The observed percentage of self-cultivators was more or less equal among the respondents of different selected villages.

Table 2 indicates the heart rate, energy expenditure and rating of perceived exertion of the female laborers in performing the activity using the selected sickles. The observed mean for working heart rate of the female laborers while cutting stalks with various sickles was found to be varied. The mean working heart rate of the female labourers while using I-104 sickle was found to be least (123.22 beats/min) when compared to other sickles. However, change in the working heart rate of the female labourers was observed with traditional (130.72 beats/min) and I-108 sickle (130.43 beats/min). The mean heart rate of the female laborers was 141.40 beats/min while using the sickle of CIAE-Bhopal was found to be revealing high working heart rate. The mean peak heart rate recorded during the work was also of similar trend for the selected different models of sickles (Figure-8a). Thus based on the above findings the sickles I-104 was found to be superior when compared with traditional and other improved sickles for the fact that the mean heart rate of the female laborers was lower. The results are contradictory with the results of Borah and Kalita (2004)

Based on the heart rate, the energy expenditure for the above-mentioned sickles during the cutting of stalk was estimated by using the formula mentioned under the methodology chapter.

Thus energy expenditure of the female laborers for the activity by using I-104 was found to be least (11.51kj/min) as compared to traditional (12.06kj/min), I-108 (12.02kj/min) and CIAE Bhopal (13.76kj/min) sickles.

Further, the data on total cardiac cost of work, which indicates stress on heart during the activity, revealed that the mean physiological cost of work was found to be higher for CIAE Bhopal sickle (35.69 beats/min) when compared with traditional (29.14beats/min) and other improved sickles, I-108 (28.46beat/min), I-104 (23.01beat/min). So, it can be concluded that cutting stalks of sorghum crop with I-104, while being one of the modified sickles caused less stress as compared to other sickles. Similar trend was observed for total cardiac cost of work during cutting stalks for traditional sickle (1165.72beats/min) and other improved sickles, viz., CIAE Bhopal (1427.75beats/min), I-108 (1138.58beats/min), I-104 (920.33beats/min).

Further rating of perceived exertion as expressed by the selected female laborers, cutting stalks of sorghum crop by I-104 was less exerting (3.80) when compared to other improved sickles, viz., I-108 (4.13), CIAE Bhopal (4.55) and traditional sickle (3.98). Thus based on the above findings, next to sickle I-104, traditional sickle, I-108 and CIAE Bhopal were found to better with regard to their efficiency. The results are in line with results of Chauhan and Saha (2004)

It is observed from the table-3 that, the mean working heart rate and energy expenditure was higher during cutting stalks with CIAE Bhopal sickle i.e., 141.40 beat/min and 13.76kj/min respectively, when compared with traditional and other improved sickles. Based on the mean working heart rate, cutting stalks of sorghum crop was classified as very heavy for CIAE Bhopal sickle and as heavy for traditional, I-108 and I-104 sickles.

Further, it is evident from the results that, the perceived exertion rated by the female laborers during the cutting stalks with the different sickles and for threshing as very heavy. Majority of the female laborers (90.00%) expressed their exertion towards cutting stalks with CIAE Bhopal sickle as very heavy followed by I-108 (80.00%), I-104 (53.33%) where as the traditional sickle was perceived as heavy (73.33%) by the majority of the laborers. The results are on far from the results of Hasalkar *et al* (2007)

Table 4 indicates that the weighted mean score of the pains experienced with different types of sickle for cutting stalks of sorghum crop. The pain felt with CIAE Bhopal was found to be higher followed by traditional and I-108sickle. The less score of pain was observed with I-104 sickle for upper and lower parts of the body.

As per the mean score, the pains experienced by the female laborers were higher with CIAE Bhopal in upper parts of the body followed by traditional sickle.

Acknowledgment

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Conclusion

The study conducted in Dharwad taluka sheds light on the significant physical strain experienced by female agricultural laborers, particularly during the harvesting of sorghum crops. Findings suggest that the use of the CIAE Bhopal sickle resulted in higher mean working heart rates and energy expenditure compared to traditional sickles, indicating increased exertion levels and potential health risks. Furthermore, musculoskeletal disorders were more pronounced among laborers using the CIAE Bhopal sickle, highlighting the need for ergonomic improvements in agricultural tools to mitigate health issues. These insights underscore the urgency for interventions aimed at reducing the physical burden on female agricultural workers, promoting their well-being, and enhancing productivity. Implementing ergonomic tools and providing appropriate training could alleviate the adverse health effects associated with agricultural activities, ensuring a safer and more sustainable work environment for rural women.

Conflict of Interest

The authors declare that there are no conflicts of interest concerning the publication of this research. The study was conducted with academic integrity, and the findings are unbiased.

Future Scope of the Study

- This study provides critical insights into the physiological workload and health implications for female laborers in agriculture, specifically in sorghum harvesting.
- Future research could explore the impact of ergonomic interventions, such as modified sickles and other labor-saving devices, on reducing physical strain and musculoskeletal disorders.
- Further studies could also examine the long-term health outcomes of these laborers over multiple harvest seasons. Expanding the sample size to include more regions and crop types could provide a broader understanding of agricultural labor conditions across different socio-economic contexts.
- Additionally, the implementation of training programs on proper body mechanics and the use of ergonomic tools could be investigated to assess improvements in labor efficiency and well-being.

Table:1 Socio-economic profile of the female laborers

Profile of the Respondents	Lokur n=40	Narendra n=40	Yettingudda n=40	Amminbhavi n=40	Total N=160
Personal profile of the respondents					
Family Type					
Nuclear	11(27.50)	30(75)	30(75)	28(70)	99(61.9)
Joint	21(52.5)	5(12.5)	7(17.5)	5(12.5)	38(23.8)
Extended	8(20)	5(12.5)	3(7.5)	7(17.5)	20(12.5)
Caste					
Upper Caste	-	6(15)	12(30)	8(20)	26(16.25)
Lower Caste	-	5(12.5)	6(15)	1(2.5)	12(7.5)
OBC	11(27.5)	20(50)	16(40)	27(67.5)	74(46.27)
Schedule Caste	12(30)	5(12.5)	3(7.5)	2(5)	22(13.75)
Schedule Tribe	17(42.5)	4(10)	3(7.5)	2(5)	26(16.25)
Type of land					
Dry	16(40)	15(37.5)	13(32.5)	15(37.5)	59(36.9)
Irrigated	-	-	-	-	-
Land holding category (acres)					
Landless (0.0-0.0)	24(60)	25(62.5)	27(67.5)	25(62.5)	101(63.1)
Marginal (0.0-2.50)	5(12.5)	7(17.5)	4(10)	6(15)	22(13.8)
Small (2.50-10.00)	6(15)	6(15)	7(17.5)	6(15)	25 (15.6)
Medium (5.00-10.00)	5(12.5)	2(5)	2(5)	3(7.5)	12(7.5)
Large (above 10.00)	-	-	-	-	-
Personnel profile of the respondents					
Age (Years)					
Up to 34	-	24(60)	16(40)	16(40)	56(35)
34-41	22(55)	12(30)	9(22.5)	13(32.5)	56(35)
41-59	18(45)	4(10)	15(37.5)	11(27.5)	48(30)
Educational level					
Illiterate	18(45)	14(35)	18(45)	19(47.5)	69(43.1)
Primary	20(50)	18(45)	15(37.5)	13(32.5)	66(41.3)
Secondary	5(5.0)	8(20)	6(15)	8(20)	24(15)
Total family income Rs/ month					
Less than 2749	12(30)	14(35)	13(32.5)	22(55)	61(38.12)
2749-3511	12(30)	11(27.5)	10(25)	08(20)	41(25.62)
More than 3511	16(40)	15(37.5)	17(42.5)	10(25)	58(36.26)

Table 2: The physiological parameters and rating of perceived exertion of the female labourers in cutting stalks of sorghum crop with selected sickle

Mode of sickles	Physiological Parameters						
	Mean working Heart rate (beats/min)	Mean Peak Heart rate (beats/min)	Mean energy expenditure (Kj/min)	Mean peak energy expenditure (Kj/min)	Mean TCCW (beats)	Mean PCW (beats/min)	Mean RPE
Traditional	130.72 + 10.25	134.95 + 17.66	12.06 + 1.60	12.62 + 3.02	1165.72 +340.86	29.14 +8.52	3.98 +0.55
Improved I-104 I-108 CIAE Bhopal	123.22 +2.98	129.50 +11.50	1151 +1.09	11.91 +2.18	920 +190.78	23.01 +4.77	3.80 +0.34
	130.43 +9.18	133.51 +12.39	12.02 +1.43	12.50 +1.99	1138.58 +362.85	28.46 +9.07	4.13 +0.41
	141.40 +6.08	146.13 +10.56	13.76 +0.95	14.51 +1.68	1427 +251.69	35.69 +6.29	4.55 +0.36

Note: TCCW: Total Cardiac Cost of Work

PCW: Physiological Cost of Work

RPE: Rating of Perceived Exertion

Table 3: Work load and Rating of perceived exertion of the female labourers in cutting sorghum crop

Models of sickles (n=30)	Mean Heart rate (beats/min)	Mean energy expenditure (Kj/min)	Work load	perceived exertion as rated by the female laborers		Mean score of RPE
				Heavy	Very Heavy	
Traditional	130.72	10.25	Heavy	22(73.33)	8(26.67)	4.27
Improved I-104	123.22	11.51	Heavy	14(46.67)	16(53.33)	4.53
I-108	130.43	12.02	Heavy	6(20.00)	24(80.00)	4.80
CIAE Bhopal	141.40	13.76	Very Heavy	3(10.00)	27(90.00)	4.90

Note: Figures in parentheses indicate percentages

Table 4: Mean Score of musculoskeletal problems of female labourers during cutting stalks of sorghum crop

Body parts	Mean score of musculoskeletal problems of female laborers with sickles			
Upper body parts	Traditional mean score	Improved sickles mean score		
		I-104	I-108	CIAE Bhopal
Eye	3.43	3.53	3.97	3.93
Neck	3.50	3.67	3.93	3.97
Shoulder joint	3.97	2.93	3.63	4.07
Upper arm	4.07	2.83	3.17	4.23
Elbows	3.87	3.87	4.07	4.10
Wrist/hands	4.53	2.50	3.17	4.30
Lower body parts 2.60				
Low arm	3.60	2.60	2.60	3.83
Low arm	3.20	4.47	4.0	4.23
Upper thing	3.60	3.37	3.90	4.20
Knees	2.97	3.20	3.17	3.80
Calf muscles	3.57	3.40	3.60	4.10
Ankles	3.57	3.57	3.63	3.67
Feet	3.87	3.80	3.30	3.73

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