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Performance of protective hand gloves for vegetable plucking

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Abstract

Agriculture workers perform strenuous tasks and are exposed to a wide variety of occupational risks and hazards. Low socio-economic status and poor access to health care also contribute to existing health problems among the farm women. Farm workers face severe health hazards during vegetable plucking such as cuts and wounds in hands, hardness of skin, itching, blisters and abrasions. These work related hazards are ignored by the farmwomen, yet constantly affect their health as well as work efficacy. Hence user friendly hand gloves designed for vegetable plucking and assessed for functional and performance parameters. The Weighted Mean Scores depicted that the denim hand gloves were suitable with respect to weather condition and comfortable for fingers movement and increasing the work efficiency as opined by farm women. Whereas farm men expressed that knitted hand gloves were more comfortable with respect to size and fingers movement. Further there is a need to create awareness among the agricultural workers for usage and benefits of protective hand gloves.

Keywords: Farm women, health hazards, hand gloves, harvesting, protective clothing, vegetable

Introduction

Occupational health is concerned with the health and safety issues at work. The hazardous exposure of setting can adversely affect the human health. The general health of the people is related with occupation in which they are engaged. The work environment may influence the person's health either positively/negatively and productivity is in turn influenced by the worker's state of physical and mental well-being.

When work is associated with health hazards, it may cause occupational disease; which is one of the multiple causes for other diseases or may aggravate existing ill health of non-occupational origin. In developing countries, where work is becoming increasingly mechanized, a number of work processes have been developed that treat workers as tools in production, putting their health and lives at risk.

Women are extensively involved in various farm operations like transplanting, weeding, harvesting, processing, marketing and selling of food grains, fruits and vegetables etc., these tasks not only demand considerable time and energy but also lead to drudgery (Dahiya & Yadav 2017) [6]. Ergonomic risk factors are found in jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying heavy objects; and prolonged awkward postures. Bhattacharya and Chakarbarti, (2010) [4] reported high prevalence of musculoskeletal disorder among tea leaf pluckers. Shoulders, back, neck and fingers were the most affected organs. Musculoskeletal disorders (MSDs) were mostly related to the work habit *i.e.* awkward posture, repetitiveness and duration. Hence, urgent need was felt to design a plucking device to lower down the possibilities of MSDs among workers. Lot of ignorance especially by farming community is observed in agricultural activities. Use of local alternative techniques to cover their hands and body is less functional in turn affect their work output to a greater extent.

Protective clothing is a generic term that includes all such types of clothing/ assemblies that are specifically engineered to deliver a pre-defined performance or functionality to the user over and above its normal functions. Such clothing would normally be made from a mix of innovative materials and functionality in this case would imply the added value or function that a garment is expected to perform (Babel *et al.*, 2014) [3]. Such assemblies are ergonomically designed so as to have a minimum inhibit effect on movement and provide maximum comfort and performance to the user.

The critical design requirement here is to protect the body from exposure to extreme elements at the same time facilitating the transport of metabolic heat and moisture from the body (Bhavani *et al.*, 2019) [5].

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The functionality of clothing is to allow people to work in and around hostile environments, improve the quality of life and prevent or reduce injuries. In hazardous environmental, functional clothing is desired against extreme heat/cold, fire, rain, snow, dust, wind and UV protection. Therefore an effort was made to design low cost hand gloves and assess the suitability, comfort ability, functionality and acceptability of designed hand gloves among the agricultural labourers involved in vegetable plucking.

Material and Methods

I. Anthropometric measurements of hand

In the present study a survey was carried out to record the standard anthropometric measurements of hands of men and women involved in vegetable plucking operations.

Anthropometry is the study and measurement of human body dimensions of bone, muscle and adipose tissue. Anthropometry can be used to accurately describe the human body's shape, size and capability (i.e. reach, strength and work envelope). Specifically, sizing and size structure can be generated from anthropometric databases. The human hand has a large amount of variation in size, shape and strength between and within the individuals. Accurate and standard hand sizes within a specific population would be a valuable contribution to glove manufacturers. Currently, the hand sizes used in the manufacturing industry are based on the

measurements of hand length, breadth and circumference.

Anthropometry requires the use of many different measuring devices as well as techniques to obtain measurements of height, breadth, depth, distance, circumference and curvature. The primary tools used are anthropometers with straight or curved branches, spreading calipers and a sliding compass (McLain, 2010). Measuring tapes can also be used to measure circumferences and curvatures.

The anthropometric dimensions measured for hand are palm length (distance from the base of the palm to the middle finger), palm circumference (just below the knuckles, not including thumb), wrist length (distance from wrist to the middle finger) and wrist circumference. In total hand measurements of 60 respondents (30 women & 30 men) were recorded using measuring tape. Mean & standard deviation were calculated and the mean values were considered for designing the hand gloves.

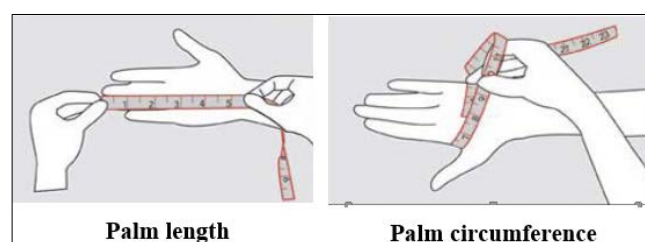


Table 1: Anthropometric measurements of hand (women) for hand gloves N = 30

Sl. No.	Palm length(inches)	Palm circumference(inches)	Wrist length(inches)	Wrist circumference(inches)
1	9	7	9	7
2	8	8	8	6
3	8	8.5	8	7
4	7	8	8	6
5	7.5	8	9	7
6	8	8	8.5	7
7	7.5	7	9	8
8	8	8	8	6
9	8	8.5	7	7
10	9	8	8	6
11	7.5	8	8	6
12	9	8	8.5	7
13	8	7	7	8
14	7	8	8	6
15	9	8.5	9	7
16	7	8	8	6
17	7.5	8	8	6
18	8	8	8.5	7
19	8	7	7	8
20	7	8	8	6
21	8	8.5	9	7
22	7	8	8	6
23	8	8	9	6
24	8	8	8.5	7
25	7.5	7	7	8
26	9	8	8	6
27	8	8.5	7	7
28	8	8	8	7
29	7.5	8	8	6
30	8	8	7.5	7
Total	237	237.5	242.5	201
Mean	7.9	7.91	8.08	6.7
SD	0.621	0.456	0.644	0.702

Table 2: Anthropometric measurements of hand (Men) for hand gloves N = 30

Sl. No.	Palm length (inches)	Palm circumference (inches)	Wrist length (inches)	Wrist circumference (inches)
1	8	10	9	8
2	8.5	9	8.5	9
3	8.5	9.5	9	8.5
4	8	9	10	8
5	8	10	9	9
6	9	9	9	9
7	8.5	9	9	9
8	8	10	9	8
9	8.5	9	8.5	9
10	8.5	9	9	8.5
11	8	9.5	10	8
12	8	10	9	9
13	9	9	8.5	9
14	8.5	10	9	8.5
15	8	10	9	8
16	8.5	9	9	9
17	8	9	9	9
18	8	9	10	8
19	8	10	9	9
20	9	9	9	9
21	8.5	9	9	8.5
22	8	10	9	8
23	8.5	9	8.5	9
24	8	9.5	9	9
25	8	9	10	8
26	8	10	9	9
27	9	9	10	9
28	8	10	9	8
29	8	9	10	9
30	9	9	10	9
Total	249.5	281.5	275	259
Mean	8.31	9.83	9.16	8.63
SD	0.382	0.467	0.497	0.453

II. Designing specification of hand gloves

1. Fabric Information

The details /specifications of the fabric selected for the present study is as mentioned below:

Table 3: Fabric information

Sl. No.	Type of fabric	Yarn count (s)		Cloth count (threads /inch)		Cloth thickness (mm)
		Warp	Weft	Warp	Weft	
1	Denim	8	14	71	44	0.69

Denim fabric was selected for designing the hand gloves for workers involved in vegetable plucking. the weft yarn count (14) of the denim fabric was higher, whereas the cloth count was found to be maximum in warp (71) direction indicating that the warp yarns were finer compared to weft yarns. the thickness of the denim fabric recorded was 0.69mm.

Constructional details of the hand gloves

Table 4: Specification of hand gloves

Sl. No.	Particulars	Details
Fabric details		
1.	Fabric	Stretchable jeans
2.	Fibre content	Cotton
3.	Weave type	Twill
4.	Fabric colour	Blue
Garment details		
5.	Length	34cms
6.	Width	29cms
7.	Seam type	Plain
8.	Fastener	Belt at wrist with Velcro
9.	Functional features	Dart on the palm, for proper fit and added protection

Design features

Denim i.e. stretchable jeans material was used for construction of hand gloves for both men (large size) and women (medium size) considering the standard hand measurements. Plain seams type was adopted in order to provide ample space for easy movement of fingers and palms. Further, a dart on the inner side of the gloves (palm) was inserted for comfort of the wearer provided with Velcro and belt to fasten at the wrist.

The detailed specifications of the hand gloves i.e. standard measurement used, constructional details and drafting instructions as given below.

Table 5: Standard measurements of hand gloves

Sl. No.	Specification	Measurements (cms)	
1	Total length	34	
2	Palm maximum circumference	26	
3	Wrist circumference	26	
4	Hem circumference	29	
Finger length & breadth		Length	Breadth
5	Thumb	7	5
6	Forefinger	11	4.5
7	Middle finger	11	4.5
8	Ring finger	9	4.5
9	Small finger	7	4.5

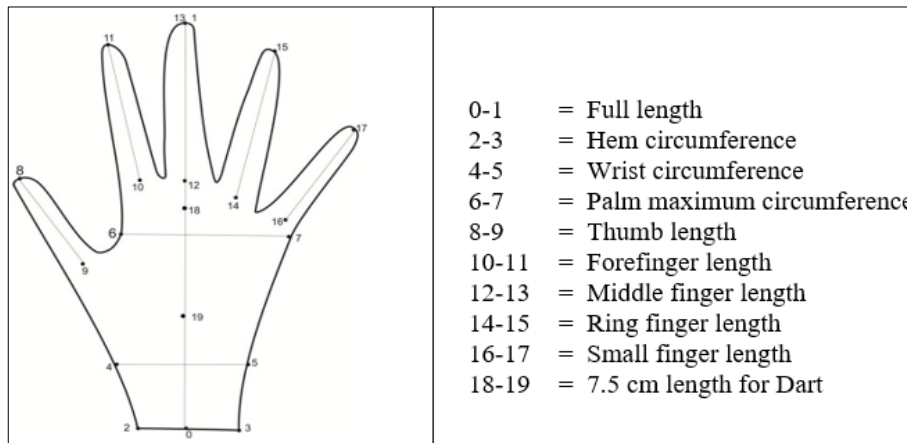


Fig 1: Drafting Instructions of hand gloves

III. Field trials of developed protective hand gloves and assessment of their suitability, comfort ability and acceptability

Locale of the study

Wear trails of the designed hand gloves was conducted at four villages viz., Narendra, Mulamuttala, Yadawad and B. Gudihal villages of Dharwad taluk.

Sample size and sampling technique

The sample size comprised of sixty respondents (30 men & 30women) was selected randomly to elicit information on suitability, comfort ability and acceptability of designed hand gloves (denim) in comparison to the knitted hand gloves of Hyderabad Centre.

Collection and analysis of data

Tools used

Self-structured questionnaire with three point scale was used to collect data on functionality and acceptability of refined hand gloves through personal interview method.

Statistical tools

The collected data was analyzed by Weighted Mean Score (WMS) that was calculated using the following expression

$$\text{Weighted Mean Score} = \frac{S_1 F_1}{N}$$

Where,

S₁ - Scores derived by the respondents answer using 3 point scale

F₁ - Frequency

N - Sample size

Scores given: Poor - 1 Moderate - 2 Good - 3

Results and Discussion

1. Health problems faced by the farm workers

Data presented in Table 1 reveals about problem faced by the farm workers during vegetable harvesting. It was noticed that 66.66 per cent farm men had itching /irritation in hands, followed by cuts in hands/palm and difficulty in consuming food (each 33.33%) and hardness of skin. Whereas cent percent of farm women faced cuts in hands/palms and difficulty in performing household activities followed by hardness of skin (86.66%) and itching /irritation in hands (80.00%).

Majority of ber fruit farm workers encountered the problems

viz, cuts and wounds on hands/arms and legs due to thorns and splinters leading to large lesions and infections as reported by Bains *et al.*, 2017 [2]. Greatest number of women opined that they suffer from pain in hands, fingers and in back while performing the harvest and post-harvest activities.

Similarly farm women involved in harvesting activities of bhendi and cluster beans also face severe health hazards viz, cuts and wounds in hands, hardness of skin, blisters and abrasions. Moreover, skin allergies due to chemical sprays are common problems of labourers involved in *Bhindi* cultivation (Gandhi *et al.*, 2014 &15) [7-8]. Women involved in harvesting and threshing activities of crops like sorghum, wheat and chickpea expressed that they faced problems viz, cuts /wounds and itching in hands and palms (Vastrad *et al.*, 2014) [10]. Farmwomen involved in chickpea harvesting faced rashes, cuts, allergies etc., on hands due to the presence of mallic acid in the plant (Vanishree S. *et al.*, 2016) [9]. The major problems encountered by the okra pluckers were deep cuts in hands, hindered, paining and severe finger wounds, with these problems farm women are not able to attend to their house hold chore (V. Daivashiromani *et al.*, 2020) [11].

2. Performance and acceptance of designed hand gloves

Table 2 represents data on suitability, comfort ability and acceptability of hand gloves. Weighted mean scores revealed that jeans hand gloves were more suitable with respect to weather condition (2.60) than knitted hand gloves (2.53). on the other hand knitted hand gloves were suitable with respect to activity (2.73). Farm men opined that knitted hand gloves were comfortable with respect to fit (2.93), ease in performing activities (2.60) and wear time compared to jeans hand gloves and existing practice. Similarly knitted hand gloves were comfortable for finger movement (2.42) and provided adequate aeration compared to jeans and rubber hand gloves. Knitted hand gloves were over all accepted (2.53) by farm men followed by jeans hand gloves (2.43). The respondents were highly satisfied with all the features of the protective gloves and also opined that gloves did not hinder the activities and increase the productivity of vegetable plucking.

Bains *et al.*, 2011 [1] developed protective gloves for okra pluckers, using single and double layers of denim, thick woven fabric and knitted fabrics. Acceptability of the type of the fabric was evaluated through field trials based on restriction in movement, adverse effect on productivity and the time taken for plucking. It was observed that full arm length protective gloves with double layer on the inner side made from knitted fabric were the most accepted design. The

respondents were highly satisfied with all the attributes of the protective gloves which increased the productivity of okra plucking.

It is observed from Table 3 that, jeans hand gloves were exhibited higher weighted mean scores for suitability with respect to activity (2.67) and weather condition (2.40) than knitted hand gloves. Jeans hand gloves were more comfortable with respect to fit (2.47), fabric properties (2.40) and activity (2.60) compared to knitted hand gloves and existing practice. The jeans hand gloves were comfortable for finger movement (2.40) and have adequate aeration (2.30) than knitted and rubber gloves. Farm women overall accepted the jeans hand gloves (2.87) than knitted hand gloves (2.13). The farm women were highly satisfied with all the features of the jeans hand gloves and also opined that jeans gloves increases the productivity of vegetable plucking.

Gandhi *et al.*, 2014 [7] reported that farm women involved in

bhendi plucking used various mitigating measures like homemade mittens of cloth materials (40%), surgical gloves (30%), cotton (20%) and woolen gloves (10%). Performance evaluation of existing mitigation measures was studied in terms of durability, safety and comfort. It was found that mittens made of denim cloth were most preferred followed by cotton gloves, woolen gloves and surgical gloves. Use of protective hand gloves in *Bhindi* harvesting reduced the health hazards.

Similar results were observed in the study conducted by Vanishree *et al.*, 2016 [9] and the result revealed that protective gloves increased the efficiency in harvesting chickpea by reducing burning sensation, rashes on skin and efficient hand weeding operation. The qualitative data revealed that wearing hand gloves increased the cleanliness of hands which enhance smooth and healthy intake of food.

Table 1: Problems faced by the farm workers during vegetable harvesting N = 60

Sl. No.	Health hazards	Men (n = 30)		Women (n = 30)	
		No.	%	No.	%
1	Hardness of skin	08	26.6	26	86.66
2	Burning of hands	05	16.6	10	33.33
3	Rashes on hands	02	6.66	15	50.00
4	Cuts in hands/palms	10	33.33	30	100.00
5	Itching /irritation in hands	20	66.66	24	80.00
6	Difficulty in consuming food	10	33.33	22	73.3
7	Difficulty in performing household activities	05	16.6	30	100.00

Table 2: Suitability, comfort ability and acceptability of Hand gloves by Farm men N = 30

Sl. No.	Parameters	Existing practice		Jeans hand gloves
		Without hand gloves (n= 26)	Rubber hand gloves (n=4)	
I.				
1	Suitable with respect to the activity	1.07	0.20	2.40
2	Suitable with respect to the weather condition	1.00	0.17	2.60
II.				
1	With respect to fit	0.97	0.20	2.07
2	With respect to fabric properties	1.00	0.13	2.20
3	Comfortable while performing the activity	0.93	0.20	2.27
4	Time period			
	1hrs	0.70	-	-
	2hrs	0.53	0.13	0.40
	3hrs	-	0.13	0.86
	More than 3hrs usage	-	-	1.03
5	Comfortable for finger movement	-	0.12	2.25
6	Adequate aeration	-	0.10	2.10
III	Overall acceptability	0.87	0.27	2.43

Table 3: Suitability, comfort ability and acceptability of Hand gloves by Farm women N = 30

Sl. No.	Parameters	Existing practice		Jeans hand gloves
		Without hand gloves (n= 20)	Rubber hand gloves (n=10)	
I.				
1	Suitable with respect to the activity	0.83	0.46	2.67
2	Suitable with respect to the weather condition	0.87	0.46	2.40
II.				
1	With respect to fit	0.77	0.40	2.47
2	With respect to fabric properties	0.67	0.46	2.40
3	Comfortable while performing the activity	0.80	0.40	2.60
4	Time period			
	1hrs	0.53	-	-
	2hrs	0.46	0.33	0.60
	3hrs	-	0.13	1.40
	More than 3hrs usage	-	-	0.60
5	Comfortable for finger movement	-	0.30	2.40
6	Adequate aeration	-	0.32	2.30
III	Overall acceptability	0.77	0.33	2.87



Fig 1: farm women engaged in bhedi plucking



Fig 2: farm men engaged in bhedi plucking

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Conclusion

Agriculture workers perform strenuous tasks and are exposed to a wide variety of occupational risks and hazards. Low socio-economic status and poor access to health care also contribute to existing health problems in this population. Farm workers faced severe health hazards in vegetable plucking in terms of cuts and wounds in hands, hardness of skin, itching, blisters and abrasions. In order to overcome this protective hand gloves were designed and developed. The Weighted Mean Scores depicted that the denim hand gloves were suitable with respect to weather condition. Handgloves were comfortable with respect to performance of activity & fingers movement which increased the output thereby, increasing the efficiency of work as opined by farm women. Further there is a need to create awareness among the agricultural workers for usage and benefits of protective hand gloves and popularization of these protective measures in agricultural operations.

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