

HAND ANTHROPOMETRY AND GRIP STRENGTH OF WOMEN WEAVERS IN HANDLOOM INDUSTRY OF LAKHIMPUR DISTRICT, ASSAM

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ABSTRACT

For designing the man-machine interface in an industry, it is essential to ensure the compatibility of man and machine to safeguard his health, safety, comfort and efficiency. Handloom weaving is dependent on manual labor; by and large the major contribution comes from women. The present study was conducted on women workers, who perform the activities in the handloom industry of Lakhimpur district of Assam. The objective of the study was to measure the hand anthropometry and the grip strength of women weavers while performing weaving activities on handloom. Various parameters observed were weight, height, time, body mass index (BMI), and hand anthropometry and grip strength. A sample of 40 women workers of Lakhimpur district Assam was selected for the study through multistage random sampling. Statistical analyses of the data are employed through frequency, percentage, mean, standard deviation, and critical difference and co-efficient of correlation. Mean values of anthropometric measurements for different hand dimensions did not show a wide variation within the range except hand circumference and hand depth. The present study was found to significantly differ from the reference value except some measurements as hand length and length of finger to crotch level. Maximum decrease in grip strength was found to be 10.46kg for right hand grip and 10.07kg for left hand grip while drawing the reed to and fro, and 6.62kg for both hands for throwing the shuttle where as minimum decrease in grip strength was found to 6.02kg for left hand, 5.32kg for right hand and 3.7kg for both hands while been getting.

KEYWORDS: Grip Strength, Hand Anthropometry, Handloom, Women workers

INTRODUCTION

Handloom industry is one of the important cottage industries in Assam and plays a vital role in the socio-cultural and economic life of the people. Assam accounts for the highest concentration of handloom industry {census of handloom in India (2009-10) NCAER, New Delhi. The handloom industry of Assam engages about 12 lakhs person as full time and part time weavers (Das 1982). Ninety percent of these weavers are women and most of the weavers entering the early stage show the utter necessity of assuming family responsibilities. Ergonomics is the study of the relationship between man, machine and the environment in which the work takes place. To measure the capabilities of human beings and then to modify or arrange the environment to fit such capabilities, it attempts to "Fit the job to the man rather than fit the man to the job" (Osborne). Static muscular effort and incorrect body postures damage the Intertribal disc (Grand jean, 1973). While at work the weavers sometimes have to assume postures without giving consideration to their individual capability and limitations, which results in stress and trauma the workers experience. The women who are forced to frequently use cutters, strippers and other tools, which are not optimally designed to their hand dimensions and strength, range, might have higher prevalence of clinical symptoms and disorders of the hand (Nag et al, 2003). The ability to predict strength

was most accurate for the single repetition and then declined with the increase duration of the experiments. The dominant hand was significantly stronger than the opposite hand, but also fatigue more rapidly (Nicolay and Walker, 2005). There were significant co-relation between hand grip strength and anthropometry measures stated (Shahida and Zawich, 2015). Sadhu et al, (1989) found that the significant lowest decrease of muscular strength of the right hand while grinding in sitting posture (on Pihari) induced less fatigue (9.6%) than that (28.15%) produced in squatting position. The health status and the workforce in every country have an immediate and direct impact on national and world economies. Next to agriculture handloom industry plays a predominant place in the rural economy of the state and women are the main working force in the handloom industry. Recognizing the pivotal significance of the handloom industry in the state of Assam which provides livelihood to the majority of the population through entrepreneurial development a need is felt to explore the interactions between human and their components in this industry with the following objectives.

- To measure the hand anthropometry of the women weavers working in handloom industry.
- To measure the grip strength of women respondents, while performing the weaving activities on handloom.

MATERIALS AND METHODOLOGY

Descriptive cum experimental research design was used in the present study and tool employed for the data collection was interview schedule. A sample of 40 women workers of Lakhimpur district, Assam was selected for the study through multistage random sampling. For experimental data various parameters were used i.e. Weight, height and time were recorded by weighing balance, anthropometric rods, grip dynamometer and stopwatch. Statistical analysis of the data was employed through frequency, percentage, mean, standard deviation, Critical difference while inferential statistics employed were coefficient of correlation.

Grip strength-Grip strength of the women workers was measured before the performance of the activity, then after the performance of the activity. The grip fatigue is calculated by using the following formulae:

$$\text{Grip strength in \%} = \frac{Sr - SW}{Sr} \times 100$$

Where, Sr=strength of muscle at rest, SW=strength of muscle at work. Reduced muscular strength during activity is the indicator of muscular stress.

Hand anthropometry-The hand anthropometry is the measurement of human hand dimension in static condition. This measurement is necessary to ascertain human machine compatibility in design of manual systems such as hand tools.

RESULT AND DISCUSSIONS

The findings of the study are presented in the following headings:

Physical Characteristics of the Women Weavers

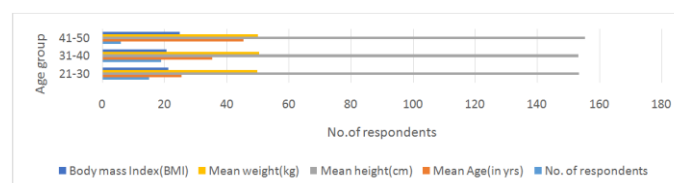


Figure 1: Distribution of the Respondents According to Physical Characteristics

It was observed from the study that the majority (47.5%) of the respondents belong to age group 31 to 40 years. The highest mean heights of the respondent were found to 155.33cm and the highest mean weight was found to be 55.08 kg. While assessing body mass index for physical fitness maximum (90%) respondents belonged to the category 18.5-25.0 was found normal. Maximum (60%) of the respondents were engaged in various activities in the handloom industry for 5-10 years. The hours of work were found to be 7-8 hours per day for all the respondents in all the handloom industry.

Table 1: Hand Anthropometric Measurements of the Women Weavers Number of Samples=40

Sl. No.	Hand Dimensions	Mean	Standard Deviation	Coefficient of Variance	Percentile	
					5th	95th
1	Handle Length	16.77	1.22	7.27	14.76	18.77
2	Height: Perpendicular to wrist crease	16.77	1.22	7.27	14.76	18.77
3	Length: Finger to crotch level (cm)	7.61	0.80	10.51	6.298	8.92
4	Handle length: Thumb to forefinger (cm)	10.20	1.06	10.39	10.01	11.93
5	Hand breadth	9.36	0.94	10.04	7.81	10.90
6	Wrist breadth	7.39	0.78	10.55	6.11	8.66
7	Grip breadth(inside)	5.61	0.49	8.73	4.80	6.41
8	Grip breadth(outside)	8.11	0.64	7.89	7.06	9.1596
9	Hand circumference	20.98	1.60	7.62	18.35	23.60
10	Hand depth	1.36	0.33	24.26	0.81	1.90

Hand dimensions from Sl. No. 1 to 10 correspondents to the illustration given in figure.

Table 1. Shows the physical dimension of the hand of the respondents corresponding to the illustration given in figure 2. Results show that mean values of anthropometric measurements of hand dimensions of women workers did not show a wide variation within the ranges except hand circumference and hand depth. These measurements were mostly to find out the hand grasping of the tools. Further elicited in the data for design of tools, it was not feasible to consider the average value of various dimensions but it is customary to indicate size limits for different age groups of people. Hence 5th and 95th percentile values were calculated and depicted in the above table.

Hand Anthropometry of Women Weavers

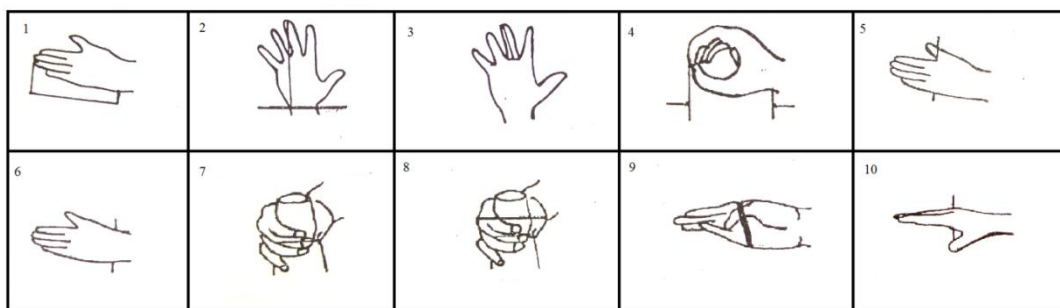


Figure 1: Selected Hand Dimensions of Women Weavers

1. Hand length, 2. Height: Perpendicular to wrist crease, 3. Length: figure to crotch level (cm), 4. Hand length: Thumb to forefinger (cm), 5. Hand breadth, 6. Wrist breadth, 7. Grip breadth inside, 8. Grip breadth outside, 9. Hand circumference, 10. Hand Depth.

Hand dimension and grip strength of women weavers while performing the weaving activities on handloom

Table 2: Comparisons of Selected Hand Dimensions of the Respondents Number of Samples=40

Sl. No.	Hand dimensions	Present Values		Reference Values		Z value
		Mean	S.D.	Mean	S.D.	
1	Hand length	16.77	1.22	16.96	0.94	0.98
2	Length: Finger to crotch level(cm)	7.61	0.80	7.60	0.57	0.07
3	Hand length: Thumb to forefinger(cm)	10.20	1.06	9.35	0.79	5.06*
4	Hand Breadth	9.36	0.94	6.8	0.51	17.21*
5	Wrist breadth	5.39	0.78	4.61	0.48	6.32*
6	Grip breadth(inside)	5.61	0.49	4.5	0.56	14.31*
7	Grip breadth(outside)	8.11	0.64	8.4	0.67	2.86*
8	Hand circumference	20.98	1.60	22.53	1.62	6.12*
9	Hand depth	1.36	0.33	2.22	0.24	16.97*

*5% level of significance

¹Reference Values: Nag et al.2003 (Hand anthropometry of Indian women, National institute of occupational health, ICMR, Ahmadabad)

Table 3: Mean Value of Grip Strength of the Respondents while Performing Weaving Activities number of Samples=40

Sl. No.	Weaving Activities	% Decrease in Grip Strength(Right Hand)	% Decrease in Grip Strength(Left Hand)	% Decrease in Grip Strength (Both Hands)
1	Spinning	8.32	8.26	6.09
2	Winding	9.03	7.91	5.36
3	Twisting	8.34	7.71	5.25
4	Warping	8.98	8.51	5.64
5	Threading the healds	10.11	8.74	5.60
6	Threading the reeds	8.97	7.27	5.59
7	Setting the warp on the loom	7.17	8.47	4.44
8	Preparing the loom for weaving	6.82	7.82	4.14
9	Paddling	-	-	-
10	Throwing the shuttle	9.65	9.28	6.62
11	Drawing the reed to and fro	10.46	10.07	5.88
12	Reaching for doobby	9.68	9.63	5.90
13	Putting the Designs in the fabric	9.48	9.66	4.93
14	Drawing the Harness	8.96	9.30	4.78
15	Beam getting	5.32	6.02	3.59
	CD at 5% level of significance	2.16	1.72	1.17

Anthropometric measurements have little meaning unless compared to some standard or reference values. With the limitations of sample size in the present study the hand dimension of the present study was compared with the study of hand anthropometry of Indian women (National Institute of Occupational Health) ICMR Nag et al 2003 Table 2 shows that the data of the present study does not differ significantly from the reference data. Regarding comparative analysis of different hand anthropometric measurements of the present study with reference study shows that most of the hand anthropometric measurements of the present study have lower mean values than the reference value. Z test was calculated for mean values for different hand dimensions to show the difference at 5% level of significance between present data and reference data. Stress on grip strength was discussed in terms of decrease in grip strength during performing different types of activities. From the result given in the table 3 it is observed that percentage decrease in grip strength of both hands

together was less compared to right and left hand. The minimum decrease in left and right hand was found to be 6.02kg and 5.32 kg for beam getting. It may be due to minimum consumption of time while performing the activity. The maximum decrease in grip strength was found to be 10.46 kg and 10.07kg for right hand grip and left hand grip while drawing the reed to and fro. From over all discussion it is found that the percentage decrease in grip strength is more in the left hand than the right hand in the activities like setting the warp on the loom, preparing the loom for weaving, throwing the shuttle, reaching for the doobby, putting the designs in the fabric, drawing the harness and beam getting. The value of CD 2.16 for right hand grip strength, 1.72 for left hand grip strength and 1.17 for both hands grip strength was found significant at 5% level of significance. It may be concluded that more stress and static contraction of grip muscles decrease in grip strength.

Table 4: The Coefficient of Correlation Value between Grip Strength and Hand Dimensions of the Respondents

Particulars	Dimensions(cm)	Correlation co-efficient®
% decrease in grip strength	Hand length	-0.108
	Height -perpendicular to wrist crease	-0.108
	Length-Finger to crotch level	-0.129
	Hand length: thumb to fore finger	-0.219*
	Hand breadth	-0.0634
	Wrist breadth	-0.047
	Grip breadth(inside)	-0.201
	Grip breadth(outside)	-0.053
	Hand circumference	-0.063
	Hand depth	-0.177

*Significance at 5% level

Table 5: Co-Efficient of Correlation Value Showing Relationship between Dependent Variables and Independent Variables

Dependent variables	Independent variables	Correlation co-efficient®	't' value
Right hand grip strength	Age	0.251*	1.694
	Years of involvement	0.233*	1.566
	Body mass index	-0.109	-0.702
Left hand grip strength	Age	0.272*	1.858
	Years of involvement	0.286**	1.970
	Body mass index	0.007	0.044

*significance at 5% level of significance

** Significance at 1% level of significance

From table 4 it is clear that correlation of different hand dimensions with grip strength were negatively or somewhere positively non-significant except hand length (thump to fore finger).Correlation value of Grip strength -0.219* was found to be negatively significant with hand length. This means that the percentage decrease in Grip strength is high with the decrease in hand length

Table 5 illustrates the correlation value of right hand grip was found significant with age and years of involvement at 1 percent level of significance and 5% level of significance. That' value of right hand grip and left hand grip was found non-significant with age and years of involvement.

CONCLUSIONS

It can be concluded that the repetitious work, high perceived work load and time pressure in the handloom industry has lead to grip fatigue in the women weavers. The percentage decrease in grip strength is high due to long period of service and low efficiency of work. This shows that hand tools which are not optimally designed for female strength range, might have higher prevalence of clinical symptoms. In view of human tool requirement the present data on women workers would be useful for ergo-design application of hand tools and devices for weaving activities.

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