

Hand Anthropometry Survey for Bangladeshi Female Population

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Abstract

This study represents hand anthropometric dataset of Bangladeshi female population. One hundred and ten females of Dhaka and Chittagong regions participated in the survey. Their age varies from 18 to 45 years. Standard deviation, mean and percentile values were calculated from the dataset of fifteen anthropometric dimensions. Various anthropometric comparisons were estimated among Bangladeshi female people and other populace. It was investigated that there is significant contrast in hand anthropometric dimensions of Bangladeshi female people with other considered female population. The target of the work is to improve existing design or provide new design of handmade tools, equipment and machineries according to the hand anthropometry of the female people of our country to mitigate their troubles while using those for various activities. It will also enhance the interest to among people to establish more anthropometric works in our country to improve the existing design of handmade tools and equipment.

Keywords

Bangladesh, Hand Anthropometry, Equipment Design, Ergonomics, Mitigate Trouble

1. Introduction

In regular day to day life, human beings are used to various types of tasks that generally require different types of hand tools, machineries and equipment. To ensure safety, productivity at the work place and to mitigate disorders, hazards and risks, it is necessary to assure higher matches between anthropometric measurements and dimensions of the tools or the equipment. So for manufacturing and furnishing hand tools, other equipment and accessories, it plays a vital role to evaluate anthropometric measurements of a certain population to ensure safety and to reduce musculoskeletal disorders. The research was done to make a survey on Bangladeshi female population.

The objective of the research work is to assess various parameters of female hands through a survey. The survey was done so that the perimeters can be utilized further to make hand tools, machineries and equipment according to the anthropometric dimensions of the female population of Bangladesh to ensure their refuge while using tools.

2. Literature Review

Many researches were performed on hand anthropometry of population. A study was done about measuring human stature from the anthropometric dimensions of Bangladeshi population. And to perform the study, different parameters of hands were taken from respective participants (Asadujjaman et al. 2019). For Czech population, another work was performed to measure hand anthropometric dimensions of the certain population (Bures et al. 2015). In Turkey another research was done. It was about biomechanical measurements of dentistry students and also hand anthropometric dimensions of the previous mentioned students. All the measurements and decisions were taken by performing a survey on Turkey dentistry students (Cakit et al. 2014). Additional work was pointed out by the same researchers about relationship assessment of dexterity performance done manually by the same dentistry students and hand dimensions of the same population mentioned before (Cakit et al. 2014).

For manufacturing hand tools for an industry, it is essential to match up the dimensions of the tools with the hand anthropometric measurements of the industrial workers. For this reason, a research work was done to perform a survey on industrial workers to measure their hand anthropometric dimensions at Haryana State, India (Chandra et al. 2011). In the same way another work was done on Hong Kong Chinese female population to make a survey on

hand anthropometric measurements in comparison with other ethnic groups (Courtney 1984). Similar study was performed on Thai female workers and a survey was performed to measure their different hand anthropometric dimensions (Saengchaiya and Bunternghit 2004).

A research was performed to make the anthropometric measurements of Filipino workers who work on manufacturing sectors of industries to ensure their safety at the work place while using machineries and also for better future of the industry by increasing productivity (Del Prado-Lu 2007). Additional research was done in Bangladesh to gauge hand anthropometric data of Bangladeshi male population to assure their security while experimenting works with handmade equipment (Imrhan 2006).

A complete new approach for estimating anthropometric data by utilizing an inference system named adaptive neuro-fuzzy was used in a research work (Kaya et al. 2003). An anthropometric research was performed on Kashmiri population by determining the stature taking measurements of hand dimensions such as hand length, hand breadth and others (Khan 2017). Additional research was done on North Indian population to estimate stature from taking the dimensions of hands and feet of the same population (Krishan and Sharma 2007).

A study pointed out the hand anthropometric dimension of the Jordanian population. In this research the percentage differences were found out among the hand dimensions of Jordanian people and population of other countries like American, Mexican, Bangladeshi and others (Mandahawi 2008). Anthropometric dimensions and characteristics of the hands on the basis of sex and literary among Jordanian population were evaluated in a certain study (Mohammad 2005). Also hand anthropometric dimensions of Indian women were measured in a research work (Nag et al. 2003). Another study was done on the rural farm workers living in South-Eastern Nigeria. It was about performing a survey to find out their hand anthropometric measurements (Obi 2006). Similar study was done on rural female agricultural workers in Ibadan to make a survey on their hand anthropometry (Okunribido 2006).

Another work was done for agricultural farm workers in Bangladesh. A survey was done for anthropometric measurements of the workers and the differences in mean with other countries were also evaluated. The purpose of the work to ensure safety of the agricultural workers while using hand tools (Shahriar et al. 2020). A study was done on hand anthropometry dimension of middle-aged male and female population living in Hamadan (Shabnai 2018). In a research fundamental, the evaluation of two-handed pinch force by utilizing different pinch patterns for both male and female population were done (Shurrab et al. 2017). An experimental design-based research work was done to establish the influence of anthropometric factors on force powered by hand and exertion of grip force (Shurrab et al. 2015).

By some research work sex of population was determined by using hand anthropometric measurements through a survey (Varu et al. 2016). Anthropometric characteristics of finger and palm shapes to evaluate the current glove-sizing systems were found in some research-based works (Vergara et al. 2019). A study was performed to measure biomechanics and anthropometric measurements using various pianists' hands dimensions (Wagner 1988). Additional research work was done on Chinese sample population to measure anthropometric characteristics and isometric muscle strength.

3. Methodology

To perform the study sample population and data analysis were performed.

3.1 Sample Population

This research work was conducted by taking hand anthropometric measurements of 110 female workers, age ranging from 18 to 45 years old, from Dhaka and Chittagong divisions of Bangladesh. A survey form, containing 15 hand anthropometric measurements, was prepared to collect data from these areas. The dimensions were measured using meter scale, tape and sliding caliper. The process of taking measurement data was accurate and reliable. For the justification of the sample size, general requirement set by ISO 15535, based on an equations (Prado-Leon et al 2009) and (Aghazadeh and Mital 1987) was taken into consideration.

$$n \geq (3.006 * CV / a)^2 \quad (1)$$

$$CV = 100 * SD / x \quad (2)$$

Where CV was expressed as the coefficient of variation which is calculated as the proportion between the mean and standard deviation (SD) of a population x (multiplication with hundred). Also, a was considered as the percent value of estimated accuracy and n is considered as size of the sample population. Taking exactness as five percent, a similar study for Nigerian Farm workers by (Okunribido 2000) where CV was 16.62, SD was 24.20 and Mean was 145.63 was used in the equations. In the result, the minimal population size was 100. Therefore, a sample size of 110 was taken into consideration to conduct this study. **Table 3.1** was drawn to demonstrate the socio-demographic features of participants.

Table 3.1 Socio- Demographic Features of the Survey Participants

Characteristics		Participant Number
Age Group	18-25	25
	25-30	35
	30- 40	35
	40-45	15
Living Area	Dhaka	60
	Chittagong	50

3.2 Data Analysis

Data were taken from Bangladeshi female population of a specific age range mentioned before Tip of finger to the root at digit 5, 1st link to the root at digit 5, 2nd link to root digit 5, Breadth at tip digit 5, Span at tip digit of 5, Span at 2nd digit 5, Profundity at the tip digit of 5, Profundity at the 1st digit of 5, Profundity at 2nd digit of 5, Breadth of knuckles, Depth of knuckles, Wrist breadth, Maximum hand depth, Length of hand and Grip Diameter (inside) data were taken. All the measurements were taken at straight stature position and values were measured thrice to avoid any kind of error. Data represented in **Table 3.2** were found out by using software SPSS (version 25) and MINITAB software. Mean, Standard deviation and percentile values (5th, 25th, 50th, 75th and 95th) of different dimensions of hand anthropometry of 110 female population were identified for further utilization.

Table 3.2: Data of Standard Deviation, Mean and Percentile Values for Bangladeshi Female Population

Dimensions	Mean	Standard Deviation	5 th Percentile	25 th Percentile	50 th Percentile	75 th Percentile	95 th Percentile
1) Tip of finger to the root at digit 5	54.32	4.41	48.03	51.34	54.65	58.54	60.88
2) 1 st link to the root at digit 5	31.89	5.34	26.51	33.37	34.02	35.90	36.82
3) 2 nd link to root digit 5	17.43	2.34	14.23	16.43	18.64	20.32	22.79
4) Span at tip digit of 5	11.59	1.62	10.53	11.02	10.78	11.59	12.71
5) Span at 1 st digit of 5	12.54	1.56	10.29	11.23	12.54	14.60	15.42
6) Span at 2 nd digit of 5	15.74	1.07	12.02	14.49	15.51	16.92	18.58
7) Profundity at the tip digit of 5	9.53	1.33	6.37	8.59	9.02	9.86	11.77
8) Profundity at the 1 st digit of 5	11.32	2.56	6.29	8.76	8.92	9.87	10.53
9) Profundity at 2 nd digit of 5	12.76	2.55	8.72	9.54	10.67	12.79	14.52
10) Breadth of knuckles	74.59	4.73	69.39	73.42	74.59	79.61	83.78
11) Depth of knuckles	24.92	2.34	20.67	22.94	25.62	27.28	29.41

12) Wrist breadth	48.86	3.78	43.96	47.71	49.29	52.62	55.04
13) Maximum hand depth	36.21	4.92	29.66	32.08	35.55	38.43	42.92
14) Length of hand	174.79	7.32	152.89	162.45	174.89	194.09	212.32
15) Inside Diameter of Grip	46.24	3.66	38.69	42.58	44.67	46.62	49.68

4. Results and Discussion

Few hand anthropometric survey of various nationalities such as India, Jordanian, Singaporean and Nigerian as well as Bangladeshi female population were shown in **Table 4.1**. Here, age range and sample population size for different nationalities' population are quite similar with the present study. Mean stature and standard deviation of different population can be compared from this table.

Table 4.1: Sample Population Features of Various Works on Different Population.

Studies	Nationality	Range of Age	Sample Population	Stature Mean \pm Standard Deviation
Present Study	Bangladeshi	18-45	110	158.07 \pm 4.88
Nag et al. 2003	Indian	18-60	37	157.22 \pm 8.76
Mandahawi 2008	Jordanian	18-59	120	162.19 \pm 5.20
Saengchaiya and Bunternghit 2004	Singaporean	18-59	120	149.88 \pm 6.28
Okunribido 2000	Nigerian	22-60	100	Not Reported

According to Nag et al. 2003; Mandahawi 2008; Saengchaiya and Bunternghit 2004; Okunribido 2000, mean and standard deviation of fifteen anthropometric dimensions regarding Indian female population, Jordanian female population, Singaporean female population and Nigerian female population were presented in **Table 4.2**.

Table 4.2: Mean and Standard Deviation of Indian, Jordanian, Singaporean and Nigerian female population

Dimensions	Indian Population		Jordanian Population		Singaporean Population		Nigerian Population	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1) Tip of finger to the root at digit 5	55.21	4.56	56.63	3.4	55.89	3.34	54.88	3.20
2) 1 st link to the root at digit 5	33.50	4.57	34.16	2.97	34.46	3.02	34.74	2.83
3) 2 nd link to the root at digit 5	16.83	0.58	18.74	1.79	17.02	2.18	19.37	2.18
4) Span at tip digit of 5	10.43	1.23	9.96	1.91	12.08	0.80	11.83	1.03
5) Span at 1 st digit of 5	14.98	2.56	13.54	0.96	12.85	0.68	13.00	1.14

6) Span at 2 nd digit of 5	13.67	2.89	15.30	1.05	15.21	0.69	14.88	1.41
7) Profundity at tip digit of 5	10.02	1.98	11.92	1.94	9.04	0.68	10.57	1.18
8) Profundity at 1 st digit of 5	11.74	1.27	11.46	1.12	10.62	0.85	11.77	1.61
9) Deepness at 2 nd digit 5	10.76	1.42	13.94	1.17	13.72	0.92	16.28	2.24
10) Breadth of knuckles	73.00	3.5	77.82	3.92	71.96	3.36	83.48	18.28
11) Depth of knuckles	25.80	1.8	28.36	2.26	27.30	2.09	30.38	6.99
12) Wrist breadth	49.52	4.13	50.77	4.35	51.82	4.89	52.21	5.04
13) Maximum hand depth	34.61	3.65	36.35	4.26	35.63	3.88	38.39	4.31
14) Length of hand	175.9	7.00	171.27	7.44	177.22	7.04	176.26	13.67
15) Inside diameter of Grip	45.00	2.90	47.54	3.21	48.31	3.2	49.22	3.8

Table 4.3 results in the comparison of mean hand anthropometric dimensions of Indian female population, Jordanian population, Singaporean population and Nigerian population with Bangladeshi population respectively. It shows that there is slight difference of the dimensions of Indian female population with Bangladeshi female population. But in case of Jordanian, Singaporean and Nigerian female population, the contrast is noteworthy with Bangladeshi female population.

Table 4.3: Comparison of Indian, Jordanian, Singaporean and Nigerian Population with Present Study

Dimensions	Bangladeshi Vs Indian	Bangladeshi Vs Jordanian	Bangladeshi Vs Singaporean	Bangladeshi Vs Nigerian
1) Tip of finger to the root at digit 5	-0.016	-0.014	-0.028	-0.100
2) 1 st link to the root at digit 5	-0.050	-0.039	-0.048	-0.0560
3) 1 st link to the root at the digit 5	0.034	-0.075	0.023	-0.111
4) Span at tip digit 5	0.095	0.140	-0.046	-0.117
5) Span at 1 st digit of 5	-0.194	-0.220	-0.025	-0.037
6) Span at the 2 nd digit of 5	0.131	-0.038	-0.032	-0.009
7) Profundity at the tip at the digit 5	-0.052	-0.146	0.051	-0.109
8) Profundity at the 1 st digit 5	-0.037	-0.110	-0.029	-0.141

9) Profundity at 2 nd digit of 5	0.156	0.025	0.096	-0.001
10) Breadth of knuckles	0.021	-0.043	0.035	-0.119
11) Depth of knuckles	-0.035	-0.138	-0.095	-0.219
12) Wrist breadth	-0.014	-0.039	-0.061	-0.685
13) Maximum hand depth	0.044	-0.003	0.016	-0.060
14) Length of hand	-0.006	0.020	-0.013	-0.003
15) Inside Diameter of Grip	-0.017	-0.075	-0.091	-0.112

5. Conclusion

Every person around the globe generally used handmade equipment not only in their workplace but also for various aspects. So continuous use of the tools may cause accidents and wound. So, if the tools are agreeable with hand anthropometry then it will reduce their trouble to use those. This study focuses on fifteen anthropometric dimensions of Bangladeshi female population with age ranging from 18 years to 45 years old. Standard deviation as well as mean values of the dimensions were evaluated and collated with other population such as Indian, Jordanian, Singaporean and Nigerian female population. It was found that hand dimensions of Bangladeshi female population are different from others. Some dimensions are higher and some are lower than others. While the dimensions of Indian female population are much similar with present study of Bangladeshi female population, there is noteworthy contrast in hand anthropometry of other mentioned population with Bangladeshi female population. However, this survey can provide aid to improve existing design and provide new design for equipment, machineries and hand tools for female population of Bangladesh relative to the hand anthropometric data to mitigate their wound and disorders. The application also paves the way to visualize the hand dimensions of every female individual of our country and also to motivate others to do survey in other region of our country to establish a dataset to improve hand tool design.

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