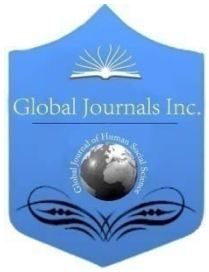
Volume 16 Issue 11
Originally issued as H1



Global Journal of human-social science: H
Interdisciplinary
Volume 16 Issue 1 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Anthropometry of Workers for Some Specific Regions in Bangladesh

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Abstract- The anthropometric measurements are mainly used to design human fitted tools, clothing, workstation, personal equipment, comfortable devices that increases human comfort, safety, quality of working and efficiency. The intension of this paper is to forecast the anthropometric characteristics of Bangladeshi population by geographical region (Khulna Division-Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira), age and gender which are used for various purposes of design. We have considered here both male and female. This is based on the study done with several industries from districts in Khulna Division of Bangladesh. There are almost 300 measurements in anthropometry but used only 36 of them because these measurements are commonly used in industry. The measurements are almost same and does not vary too much except the tribal region. Here we calculated 5P, 50P and 95P which will help to design an adjustable system which will consider flexible to all.

Keywords: *anthropometry, body dimension, industrial worker.*

GJHSS-H Classification: *FOR Code: 130205*



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Anthropometry of Workers for Some Specific Regions in Bangladesh

Subrata Talapatra [α], Moumita Saha [σ] & Md. Abnul Islam [ρ]

Abstract- The anthropometric measurements are mainly used to design human fitted tools, clothing, workstation, personal equipment, comfortable devices that increases human comfort, safety, quality of working and efficiency. The intension of this paper is to forecast the anthropometric characteristics of Bangladeshi population by geographical region (Khulna Division- Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira), age and gender which are used for various purposes of design. We have considered here both male and female. This is based on the study done with several industries from districts in Khulna Division of Bangladesh. There are almost 300 measurements in anthropometry but used only 36 of them because these measurements are commonly used in industry. The measurements are almost same and does not vary too much except the tribal region. Here we calculated 5P, 50P and 95P which will help to design an adjustable system which will consider flexible to all.

Keywords: anthropometry, body dimension, industrial worker.

I. Introduction

The word "anthropometry" means measurement of the human body. It is derived from the Greek words anthropos means man and metron means measure. Anthropometric data are used in ergonomics to specify the physical dimensions of workspaces, equipment, furniture and clothing so as to fit the task to the man (Grandjean, 1980) and to ensure that physical mismatches between the dimensions of equipment and products and the corresponding user dimensions are avoided. Anthropometry is important for both developed and developing countries. Many developed countries like U.S.A., European countries, Japan etc. have their own anthropometric measurement of people and workers. Developing country like Bangladesh has their own anthropometric measurements of people and workers. Bangladesh Bureau of statistics survey different regions of Bangladesh and collect their own data of people and workers. The purpose of anthropometry is to secure data on human body measurements which describes the use the data in such a way that can be used for deduction and anthropological comparison. Anthropometric data can be used for various tasks like determination of general characteristics of groups, workspace design and development, clothing and personal equipment design and development, components and devices, evaluation and testing, operator selection and so on. [1] [2] [3]

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II. Methods and Materials

Thirty six body dimensions and age, weight were included in the survey. We have taken sample size 200. We have surveyed Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira districts' different industries. From Magura, Meherpur and Narail we have taken local workers (day-labour) data. List of industries visited for this survey is shown in Table 1. We have taken 150 male workers and 50 female workers from every industries from different districts for our anthropometric data. For mean, standard deviation, Max and Min calculation we have considered two hundred workers (approximately 150 male and 50 female workers) of each industries. But in some places the female workers number was higher than fifty. We considered the male and female both genders separately and calculated the mean. The male workers participating in the survey were within the age group of 15-34 years, 35-54 years, 55-64 years and above 65 years. The percentages were 52.82% for 15-34years, 32.82% for 35-54years, 8.2% for 55-64 years and 6.13% for above 65 years. The female workers participating in the survey were within the same age groups as same as male. The percentages were 81.29% for 15-34years, 15.29% for 34-54years, 2.43% for 55-64 years and 1% for above 65 years. The data were obtained from the survey work were analyzed for mean, standard deviation and percentile values of population. The 5th, 50th and 95th percentile values were obtained for various anthropometric dimensions. Those dimensions are important for designing workstations, tools, clothing, furniture etc. The methodology, which was used in this, enables to collect valid and reliable information/data and to analyze those data to conclude with a correct decision. For this study we have used different statistics method. The data were analyzed by probability statics method, ratio scaling method, regression method. "Ratio scaling" (used by Pheasant in 1986 and 1996 to establish the British) is one technique to estimate data from known body dimensions (Pheasant, C.M 2003). It relies on the assumption that, though people vary greatly in size, they are likely to be

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relatively similar in proportions. Another way of estimating the relations among dimensions is through regression equation if we were able to do so, we would describe the parameters of that total population by the mean (average) and standard deviation (SD). [1] [2]

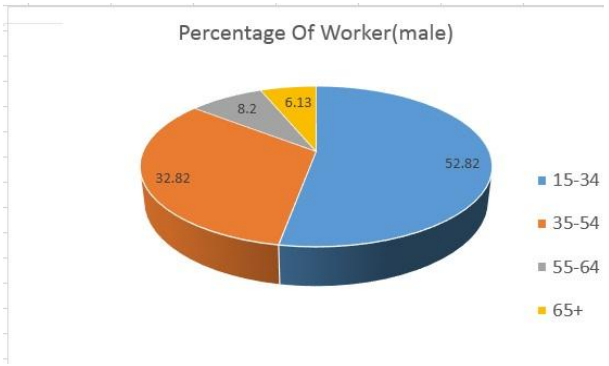


Fig. 1 : Age wise distribution sample of male workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira

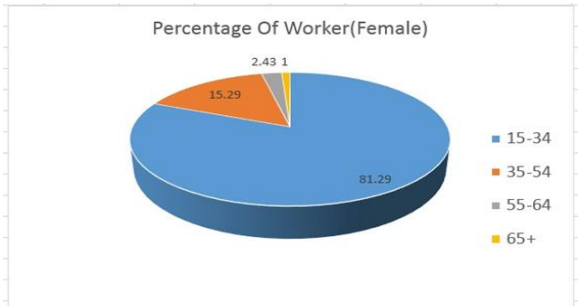


Fig. 2 : Age wise distribution sample of female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira

III. Result and Discussion

We have used 200 (approximately 150 male and 50 female workers) workers anthropometry measurements for each area. We have used nine districts and two hundred workers for each industry to calculate the mean and standard deviation. We have used Microsoft Excel for calculating mean and standard deviation. After calculating the mean and standard deviation we have calculated the 5th, 50th and 95th percentiles. The 95th percentile value of stature of workers were 70.89 inch. So any entry and exit to any workstation should not be less than 70.89inch. 95% of total population can easily enter and exit from workstation by using 70.89inch entrance. The 5th percentile value can be used for lower limit of designing workstation, tools, selecting operator etc. The 50th percentile value is the average value. We can use this value for designing workstation, tools, selecting operator etc. work which is perfect for 5th and 95th percentile. Most commonly the 5th percentile of female and 95th percentile of male dimensions are used to design. The 5th percentile of female dimensions are the smallest measurement for the design of population. 5th and 95th range accommodates approximately 90% of the population. Table 2 shows the Mean, Standard deviation and percentile calculation of male workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira and Table 3 shows Mean, Standard deviation and percentile calculation of female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira.

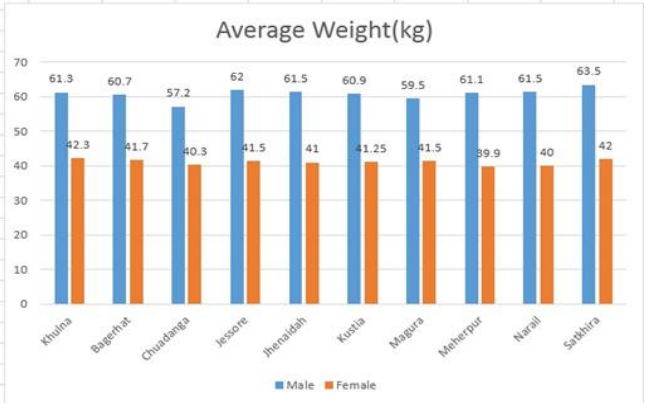


Fig. 3 : District-wise distribution of mean weight of workers both male and female of Bangladesh

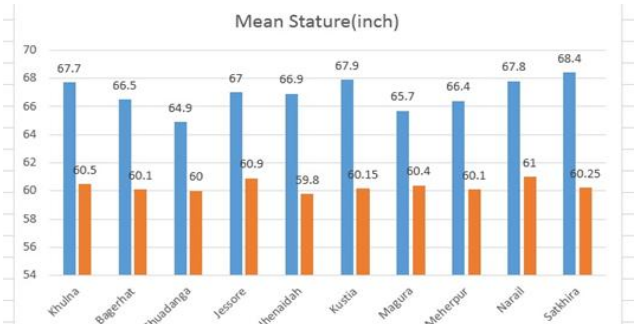


Fig. 4 : District-wise distribution of mean stature of workers both male and female of Bangladesh

From figure 2 we can see that the lowest average weight of male workers is from Chuadanga and the highest average weight is from Satkhira. The lowest average weight is 57.2kg and the highest average weight is 63.5kg. From the same figure we can see that the lowest average weight of female workers is from Meherpur and the highest average weight is from Khulna. The lowest average weight is 39.9kg and the highest average weight is 42.3kg. From figure 3 we can see that the lowest mean stature of male workers is from chuadanga and the highest mean stature is from Satkira. The lowest mean stature value is 64.9inch and the highest mean stature value is 68.4inch.

From the same figure we can see that the lowest mean stature of female workers is from Jhenidah

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and the highest mean stature is from Narail. The lowest mean stature value is 59.8inch and the highest mean stature value is 61inch. [1]

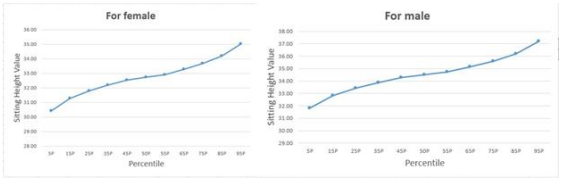


Fig. 5 : Sitting height of male and female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira of Bangladesh

Percentile	Sitting height (Female)	Sitting height(Male)
5th	30.4281	31.82836
50th	32.7241	34.50938
95th	35.0201	37.19039

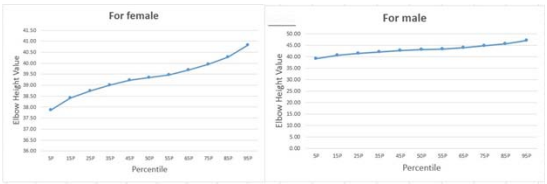


Fig. 6 : Elbow height of male and female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira of Bangladesh

Percentile	Elbow height(Female)	Elbow height(Male)
5th	37.8698	39.0548
50th	39.3458	42.98958
95th	40.8218	46.92437159

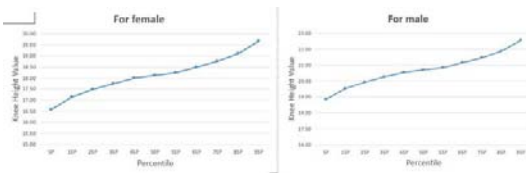


Fig. 7 : Knee height of male and female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira of Bangladesh

Percentile	Knee height(Female)	Knee height(Male)
5th	16.4854	18.84073596
50th	18.1254	20.69791667
95th	19.7654	22.55509737

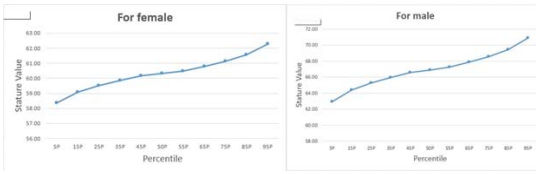


Fig. 8 : Stature of male and female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail andSatkhira of Bangladesh

IV. Conclusion

Anthropometry plays an important role in designing sector to improve efficiency, comfort and safety to human being. We have taken 200 people anthropometric measurements among them 150 are male and 50 are female in most cases. These data are taken from many industries of Khulna division of Bangladesh. We have taken 36 anthropometric measurements of workers. Then we have calculated mean, standard standard deviation, 5P, 50P and 95P. All these percentile values are important for designing devices, equipment, clothing, workspaces and so on. We have also shown the normal distribution curve of sitting height, elbow height, knee height and stature for both male and female workers and shown the 5P, 50P and 95P values of male and female workers individually in a chart to show the difference.

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Tables

Table 1 : List of industries visited for this survey

Industry name	No. of male worker(approximately)	No. of female worker(approximately)	District
Khulna shipyard	350	150	Khulna
Ahad Jute Mills Ltd. Akij jute mills	150 200	80 70	Jessore
BRB Cables Industries Ltd. Kushtia Leaf Factory	250 100	50 100	Kushtia
Maksons Spinning Mills LImited	350	150	Bagerhat
Button Tex Ltd. Fashion Apparel BD	100 250	75 75	Satkhira
Bangas bread and biscuit Carew & Company Bangladesh Limited	150 200	50 100	Chuadanga

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Table 2 : Mean, Standard deviation and percentile calculation of male workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira

Selected anthropometric data of workers

Serial	Anthropometric/Streanth Parameter	Mean(m)	SD(s)	Max	Min	5P=m+k*s	50P=m+k*s	95P=m+k*s
1	Age(year)	33.7	8.6	51	17	19.596	33.7	47.804
2	Weight(kg)	57.3	7.6	80	42	44.836	57.3	69.764
3	Stature	66.91979167	2.4	72.5	60.5	62.93963	66.91979	70.89995
4	Eye Height	62.64583333	2.3	67.3	55.6	58.80743	62.64583	66.48424
5	Shoulder Height	56.16458333	2.6	62.7	50.4	51.91193	56.16458	60.41723
6	Elbow Height	42.98958333	2.4	50.1	35.3	39.0548	42.98958	46.92437
7	Hip Height	35.09166667	2.5	39.8	30.8	30.95929	35.09167	39.22404
8	Knuckle Height	28.99375	1.7	33.3	23.7	26.25392	28.99375	31.73358
9	Finger Tip Height	25.07916667	1.4	28.7	22.5	22.76422	25.07917	27.39411
10	Sitting Height	34.509375	1.6	37.3	31.2	31.82836	34.50938	37.19039
11	Sitting Eye Height	29.95520833	1.5	32.8	27	27.55311	29.95521	32.35731
12	Sitting Shoulder Height	23.71041667	1.4	26.7	20.3	21.44977	23.71042	25.97106
13	Sitting Elbow Height	8.877083333	1.4	11.4	6.1	6.662833	8.877083	11.09133
14	Thigh Thickness	5.2375	0.6	6.3	4.1	4.177893	5.2375	6.297107
15	Tailbone knee length	22.23333333	1.7	25.1	19	19.4878	22.23333	24.97887
16	Tailbone politeal length	18.30833333	1.5	21.5	15.4	15.92613	18.30833	20.69053
17	Knee Height	20.69791667	1.1	23.6	17.5	18.84074	20.69792	22.5551
18	Popiteal height	17.43333333	0.9	19.0	15.9	15.98518	17.43333	18.88148
19	Shoulder Breadth (Bideltoid)	19.28333333	1.9	22.7	16	16.11998	19.28333	22.44669
20	Shoulder Breadth (Biacromial)	16.5125	1.7	19.7	12.7	13.65686	16.5125	19.36814
21	Hip Breadth	13.82708333	1.5	16.9	9.2	11.35057	13.82708	16.3036
22	Chest (bust) depth	8.077083333	1.2	11.0	6.1	6.166513	8.077083	9.987654
23	Abdominal Depth	8.360416667	1.5	11.7	5.7	5.947623	8.360417	10.77321
24	Shoulder elbow length	14.44583333	1.6	17.7	11.3	11.82783	14.44583	17.06384
25	Elbow finger tip length	17.89166667	1.0	20.0	15.1	16.24252	17.89167	19.54081
26	Upper limb length	29.31458333	1.7	34.5	25.2	26.50297	29.31458	32.1262
27	Shoulder grip length	26.60833333	1.5	29.3	23.6	24.13905	26.60833	29.07762
28	Head length	7.425	0.5	8.5	6.2	6.523932	7.425	8.326068
29	Head Breadht	6.527083333	0.6	8.0	5.1	5.546655	6.527083	7.507512
30	Hand Length	7.479166667	0.4	8.9	6.2	6.747298	7.479167	8.211035
31	Hand breadth	3.39375	0.2	3.9	2	3.026415	3.39375	3.761085
32	Foot length	9.83125	0.8	11.1	8.3	8.584438	9.83125	11.07806
33	Foot breadth	3.784375	0.4	4.9	2.9	3.187369	3.784375	4.381381
34	Span	67.89583333	3.0	73.8	60.5	62.9837	67.89583	72.80796
35	Elbow span	35.55	2.8	40.8	29.9	30.97352	35.55	40.12648
36	Vertical Grip reach(Standing)	81.32291667	3.4	87.9	70.3	75.7754	81.32292	86.87043
37	Vertical Grip reach(Sitting)	48.45208333	3.3	55.3	41.2	42.99	48.45208	53.91417
38	Forward grip reach	30.72291667	1.7	34.8	26.9	27.96762	30.72292	33.47821

All dimensions in inch

Percentile	k
5P	-1.64
50P	0
95P	1.64

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Table 3 : Mean, Standard deviation and percentile calculation of female workers of Khulna, Bagerhat, Chuadanga, Jessore, Kushtia, Magura, Meherpur, Narail and Satkhira

Selected anthropometric data of workers(Female)

Serial	thropometric/Streanth Parame	Mean(m)	SD(s)	Max	Min	5P=m+k*s	50P=m+k*s	95P=m+k*s
1	Age(year)	29.4	5.89	48	15	19.7404	29.4	39.0596
2	Weight(kg)	41.145	5.27	45	37	32.5022	41.145	49.7878
3	Stature	60.32	1.2	64.7	57.3	58.352	60.32	62.288
4	Eye Height	58.489	1.9	64.6	43.3	55.3894	58.489	61.5886
5	Shoulder Height	52.056	2.1	57.1	39.56	48.612	52.056	55.5
6	Elbow Height	39.3458	0.9	44.8	35.8	37.8698	39.3458	40.8218
7	Hip Height	30.021	2.2	37.4	25.25	26.3474	30.021	33.6946
8	Knuckle Height	24.456	1.5	31.3	19.45	22.078	24.456	26.834
9	Finger Tip Height	21.159	1.1	26.1	18.452	19.355	21.159	22.963
10	Sitting Height	32.7241	1.4	35.1	26.1	30.4281	32.7241	35.0201
11	Sitting Eye Height	24.184	1.0	29.5	21.24	22.5276	24.184	25.8404
12	Sitting Shoulder Height	19.25	1.1	23.3	17.985	17.446	19.25	21.054
13	Sitting Elbow Height	7.25	0.9	10.3	5.9	5.774	7.25	8.726
14	Thigh Thickness	5.011	0.4	6.1	3.9	4.355	5.011	5.667
15	Tailbone knee length	18.72	1.2	23.2	16.9	16.752	18.72	20.688
16	Tailbone politeal length	14.108	1.3	18.3	12.8	11.976	14.108	16.24
17	Knee Height	18.1254	1.0	21.2	16.2	16.4854	18.1254	19.7654
18	Popiteal height	14.045	0.8	18.5	12.745	12.733	14.045	15.357
19	Shoulder Breadth (Bideltoid)	16.925	1.5	20.1	14.328	14.547	16.925	19.303
20	Shoulder Breadth (Biacromial)	14.248	1.2	18.2	12.24	12.28	14.248	16.216
21	Hip Breadth	12.29	1.0	14.3	10.25	10.65	12.29	13.93
22	Chest (bust) depth	7.95	0.8	9.0	7.25	6.638	7.95	9.262
23	Abdominal Depth	6.5	0.9	8.6	5.5	5.024	6.5	7.976
24	Shoulder elbow length	12.945	1.1	15.1	9.97	11.141	12.945	14.749
25	Elbow finger tip length	15.248	0.7	18.2	12.852	14.1	15.248	16.396
26	Upper limb length	26.152	1.6	32.2	23.542	23.528	26.152	28.776
27	Shoulder grip length	23.802	1.2	27.7	19.258	21.834	23.802	25.77
28	Head length	7.05	0.4	8.2	5.9	6.394	7.05	7.706
29	Head Breadht	6.23	0.5	7.5	5	5.41	6.23	7.05
30	Hand Length	7.056	0.4	7.9	6.23	6.4	7.056	7.712
31	Hand breadth	3.25	0.3	3.8	2.6	2.758	3.25	3.742
32	Foot length	8.924	0.6	10.7	7.25	7.94	8.924	9.908
33	Foot breadth	3.529	0.4	4.7	2.89	2.931994	3.529	4.126006
34	Span	60.215	3.8	67.3	50.178	53.983	60.215	66.447
35	Elbow span	32.782	2.2	38.0	27.08	29.174	32.782	36.39
36	Vertical Grip reach(Standing)	73.248	3.2	81.3	60.248	68	73.248	78.496
37	Vertical Grip reach(Sitting)	45.0895	3.0	53.8	37.28	40.1695	45.0895	50.0095
38	Forward grip reach	28.945	1.5	32.5	25.34	26.4522	28.945	31.4378

All dimensions in inch

Percentile	k
5P	-1.64
50P	0
95P	1.64

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