Anthropometric Study on Hand Length and Breadth of Male Laundry Ironing Professionals Working at the Northern Part of Dhaka Metropolitan City

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Abstract

Context: *"Fitting the person to the task" is a modern day ergonomic principle. This shift of paradigm emphasizes on a match between the requirements of the task and the physical and mental capabilities of the people performing the task. Since the industrial revolution, ergonomic concepts have become even more pertinent to the health, safety and productivity of the workers as interaction between man and machine is increasing day by day. The present study primarily aimed at generating a baseline data on hand length and breadth of the Bangladeshi population. Comparisons between the right and left hands of the present study group as well as between the results of the present work with the findings of other nationals were also done to see whether these two dimensions vary in respect to handedness and nationality. Taking account of such variations is crucial in designing of hand tools and workspaces for a particular population.*

Materials and method: *This is a cross sectional analytical study conducted at the Department of Anatomy, Dhaka Medical College, Dhaka from July 2013 to June 2014. The study was carried out on 100 right-handed male laundry ironing professionals working at the Northern part of Dhaka Metropolitan City. The subjects were selected purposively.*

Results: *Findings of the present study indicate that the right hand breadth varies significantly from the left hand breadth in the laundry ironing professionals working at the Northern part of Dhaka Metropolitan City whereas no significant difference in hand length is observed between the right and left sides of the same population. It is also noted that significant differences in hand length and breadth exist between the subjects of the present study and the subjects of other countries.*

Conclusion: *This article highlights the differences in anthropometric dimensions between the right and left hand of the same study group of Bangladeshi population as well as between the study groups of different nationalities. The data gathered here can hopefully be utilized as a reference pool in ergonomic designing of hand tools, workstations and layout designs unique for Bangladeshi workers.*

Keywords: *Hand length, Hand breadth, Ergonomic designing.*

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Introduction

Use of hand tools and gloves for performing manual work is still common throughout the world. On the other hand, technological advancements have brought about an unprecedented surge in economic activities. As a consequence, demands for modern machines and devices in industrial settings have increased many folds in recent times.

Anthropometric data is one of the essential factors in designing of machines and devices.[1] Particularly the size and shape of the tool and its operational features needs to be compatible with

the anthropometric and biomechanical characteristics of the hand of the user. Any incompatibility herein is likely to affect the quality of job as well as the productivity, safety and health of the worker.[2]

Even small differences in hand size are important for efficient gripping of the tool handle and generation of muscular forces. Tools that fit well in worker's hand require less muscular effort for operation than the tools that are too small or too large and do not conform to the contours of the hand. Accumulated musculo-tendinous strains resulting from repetitive use of mismatched equipments may lead to cumulative trauma disorders of the hand.[2]

Length and breadth of the hand are two crucial factors that affect the hand grip strength.[3] These two hand dimensions are measured for estimating the lengths of the kinematic hand segments.[4] Internal biomechanical loads of the hand are also estimated from hand length and breadth.[5] Hand anthropometric measurements, especially the hand breadth, are better predictors of hand strength than stature and body weight.[6] For these reasons, length and breadth of the hand are strongly considered during production of hand tools designed for precise works.[7]

Studies have also shown that hand dimensions vary significantly between nations.[1,2,8,9] Hence, anthropometry of the hand must be known for any target population for whom hand tools and other manual devices are to be designed.[2]

Review of existing literature reveals that data for hand anthropometry on Bangladeshi population is insufficient. The present study aims primarily at generating a reference data on two important hand dimensions, the hand length and breadth, for a particular group of Bangladeshi professional group-namely the laundry ironing professionals. Compilation of the findings of the present study with the data collected from studies on other professionals will help in building up a national database.

Comparison of hand length and breadth between right and left hands of the study group might aid in highlighting the requirement of hand-specific tools. Comparison between the results of the present work with the findings of other nationals is likely to be useful in developing and designing of the tools that are specific, hence, user-friendly for Bangladeshi population.

Materials and Methods

Subjects: The study was conducted on 100 right-handed male laundry ironing professionals working at the Northern part of Dhaka Metropolitan City. Age of all subjects ranged between 23 to 53 years. To obtain accurate results, persons with any congenital or acquired deformity of hand were excluded from the study. Study subjects were classified into three groups to describe the changes in hand length and breadth in relation to age.[10] Table I shows the age distribution of the study subjects.

Table-I

Grouping of study subjects of the present study (n=100)

Group	Age range (in years)	Number
A	23 – 32	43
B	33 – 42	31
C	43 – 53	26

Equipment: A digital Vernier caliper (0-200mm, China) was used for measurement of hand length and breadth (Fig 1 & 2).
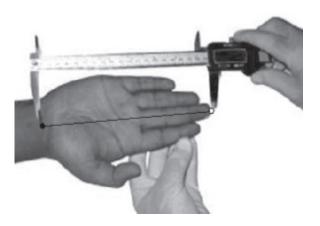
Operational Definitions:

a) **Hand length-** the distance along the long axis of hand, from the midpoint of the distal transverse wrist crease to the midpoint of the tip of the middle finger.[5,8]

b) **Hand breadth-** the distance from the 2nd metacarpophalangeal joint to the 5th metacarpo-phalangeal joint.[5,8]

c) **Distal transverse wrist crease-** the distal-most crease or wrinkle of skin present on the wrist joint at the junction of palmer aspect of hand with the flexor aspect of forearm. This is the best landmark for easy identification of hand measurements.[11]

d) **Tip of the finger-** It is the extreme end of the finger that is furthest from the hand.[12]

Methods of measurement: For measurement of hand length and breadth, the subject was requested to put his palm extended and facing up with digits in extended and adducted position.

a) **Procedure of measurement of hand length:** Hand length was measured from the midpoint of the distal transverse wrist crease to the midpoint of the tip of the middle finger along the long axis of the hand[5,8] (Fig 1).

b) **Procedure of measurement of hand breadth:** Hand breadth was measured by sliding caliper as a straight distance from the radial side of the second metacarpo-phalangeal joint to the ulnar side of the fifth metacarpophalangeal joint[13] (Fig 2).

- Black dot: midpoint of the distal transverse wrist crease
○ White dot: midpoint of the tip of the middle finger

Fig-1 : *Straight line showing the length of hand*

Black arrow: Hand breadth

Fig-2: Black arrow showing the breadth of hand

Ethical Clearance:

This study was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

Results:

Mean right and left hand lengths and standard deviations of the present study subjects all together as well as in age groups A, B and C are presented and compared in Table II. Results showed no significant difference in length between the right and left hand of the study subjects as a whole (P>0.05) but in Group C, the right hand was significantly greater than the left hand (P<0.05). Significant difference of mean hand length was also observed between the age groups B and C, in right hand (P<0.05).

Mean right and left hand breadths and standard deviations of the present study subjects all together as well as in age groups A, B and C are presented and compared in Table III. Findings show that the mean breadth of right hand was significantly greater than that of left hand of the study subjects as a whole (P<0.001), also in Group A (P<0.001). No significant difference of mean hand breadth was observed between the age groups, in either hand.

Mean values and standard deviations of the subjects of different age groups show that hand length is larger in middle age group whereas hand breadth tends to have an increase along with age (Table II & Table III).

Table II

Comparison of hand length of the study subjects (n = 100)

Study population	Length (mm)		P value
	Right hand Mean±SD	Left hand Mean±SD	
Total study subjects (n = 100)	181.35±8.21	180.90±9.69	0.453 ns
Age group			
A (n = 43)	181.67±8.44	180.85±8.51	0.133ns
B (n = 31)	183.54±7.23	181.88±11.90	0.327ns
C (n = 26)	178.21±8.24	179.81±8.79	0.025*
	P value	*P value*	
A vs. B	0.589ns	0.359ns	
B vs. C	0.038*	0.445ns	
A vs. C	0.196ns	1.000ns	

- SD = Standard Deviation
- Comparison between values of right & left hands of same age group was done by Paired Student's 't' test.
- Comparison between different age groups of the study group was done by ANOVA test.
- ns = not significant, * = significant

Table- III

Comparison of hand breadth of the study subjects (n = 100)

Study population	Breadth (mm)		P value
	Right hand Mean±SD	Left hand Mean±SD	
Total study subjects (n = 100)	73.42±4.38	72.32±3.77	0.000*
Age group			
A (n = 43)	74.08±4.01	72.59±3.60	0.000*
B (n = 31)	73.08±4.55	72.36±4.06	0.090ns
C (n = 26)	72.74±4.75	71.83±3.77	0.125ns
	P value	*P value*	
A vs. B	0.596ns	0.964ns	
B vs. C	0.954ns	0.855ns	
A vs. C	0.436ns	0.694ns	

- SD = Standard Deviation
- Comparison between values of right & left hands of same age group was done by Paired Student's 't' test.
- Comparison between different age groups of the study group was done by ANOVA test.
- ns = not significant,
- s= significant

Table- IV
Comparison of the findings of present study with the findings of other researchers

Sl. No.	Researcher(s) Year	Study population (Male) Country	Sample size (n)	Hand length (mm) Mean ± SD		Hand breadth (mm) Mean ± SD	
				Right	Left	Right	Left
1	Present study 2014	Laundry ironing professionals Bangladeshi	100	181.35 ± 8.21	180.90 ± 9.69	73.42 ± 4.38	72.32 ± 3.77
2	Kar S.K. et al 2003	Agricultural workers West Bengal, India	200	175.1 ± 8.5 (p<0.001)	175.9 ± 8.8 (p<0.001)	82.3 ± 044 (p<0.001)	80.3 ± 0.41 (p<0.001)
3	Chittababu B. 2014	Handball players Maharastra, India	144	198.23 ± 3.00 (p<0.001)	198.75 ± 2.70 (p<0.001)		

Discussion

The formal tests of differences between the results of the present study and those of different nationalities are summarized in Table IV. All these study population repeatedly use power grip in their professional activities.

Results of the present study indicate that the laundry ironing professionals working at the Northern part of Dhaka Metropolitan City have larger hands than the agricultural workers of West Bengal, India (P<0.001) but smaller hands than the Handball players of Maharashtra, India (P<0.001). It is also observed that the agricultural workers of West Bengal, India (P<0.001) and Handball players of Maharashtra, India (P<0.001) have wider hands than the present study subjects.

Conclusion

The anthropometric data provided on the hand length and breadth in this study may not only be used in designing of hand-held devices and access spaces but also for guiding professionals in the selection and purchasing of equipments that are used in performing manual works. The data should be used with caution because of the relatively small sample size. Hence, findings of the present study are not conclusive, but they provide a starting point for further investigations in hand anthropometry among Bangladeshi and other populations.

Recommendations

Sample size needs to be increased, not only in terms of age range, but also to encompass other major occupational groups such as agricultural workers, household workers, industrial workers & construction workers. Furthermore, studies on female workers should be carried out in greater numbers as their participation in nation-building activities is constantly increasing in our country.

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