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Original Article

Study of Age-Related Finger Span and Hand Grip Strength of Adult Female Garment Workers in Bangladesh

Laila Razzaque[1*]
Md. Ashrafuzzaman[2]
Monjurul Hakim[3]

[1]Department of Anatomy
Shaheed M. Monsur Ali Medical College
Serajganj, Bangladesh.

[2]Department of Anatomy
Chittagong Medical College
Chattogram, Bangladesh.

[3]Department of Community Medicine
Rangamati Medical College
Rangamati, Bangladesh.

Abstract

Background: *Age related hand anthropometry is important for the effective designing of dimensionally compatible hand tools, gloves, machine access spaces and hand-held devices. The present study was designed to measure and compare finger spans and the hand grip strength of both hands of adult female garment workers of different age groups in Bangladesh and to establish correlation between finger spans and the hand grip strength of same hand.*

Materials and methods: *The study was a descriptive, observational and cross sectional in nature with some analytic component; carried out in the Department of anatomy, Chittagong Medical College, Chattogram, from January 2015 to December 2015. A purposive non random convenient sampling was done to select 300 female garment workers, age ranging from 21-35 years. Hand grip strength and 5 finger spans were measured. ANOVA test was performed to correlate of finger spans and hand grip strength of different age groups.*

Results: *Difference of hand grip strength with age showed significant in both hands. Difference of finger spans with age showed non-significant. There was positive correlation between finger spans and hand grip strength of the same hand.*

Conclusion: *Study of age related anthropometric measurements of hand can play an important role to design same workplace, same hand tools, and same access spaces for the hand of the age group (21-35) years of adult female garment workers in Bangladesh and increase the usage of human resources.*

Key words : Finger span; Hand grip strength; Female garment workers.

INTRODUCTION

"Anthropometry" created by the Belgian mathematician, Quetlet in 1870, is the science of measurement of the human body[1,2]. The dimensions of the human body are affected by ecological, biological, geographical, racial, gender and age factors[3]. The human hand is of great scientific importance to investigators in the field of anthropometry, forensic pathology and orthopedic surgery.

Hand grip strength and finger span are physiological variables that is affected by a number of factors. It is observed that finger span and hand grip strength changes with ages[4-6]. Grip strength increases with age and approximately parallel for boys and girls until 10 years of age, after that boys grow significantly stronger than girls; and decreases after 4th decade of life[6,7]. Effect of hand dominance on grip strength studied by various researchers and a statistically significant difference was found between the grip strength of dominant and non dominant hands in favour of the dominant hand[5].

Hand anthropometric data are one of essential factors in designing machines, devices workplace, hand tools and many products for human use[8,9]. Lack of properly designed machines and equipment may lead to lower work performance and higher incidence to work related injuries.

*Correspondence to:
Dr. Laila Razzaque
Assistant Professor
Department of Anatomy
Shaheed M. Monsur Ali Medical College
Serajganj, Bangladesh.
Mobile : +88 01717 27 53 03
Email : laila26779@gmail.com

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In Bangladesh, the Ready Made Garments (RMG) accounts for 75% of the foreign currency and 25% of GDP of Bangladesh[10]. In this sector about 2.4 million people are working; where 85% are women. The tools and equipment used in this sector by these women has been designed based upon the anthropometric data of the Industrialized Countries which will leads to equipment mismatches, and after a period of use, it will be a contributing factor in decreased productivity, discomfort, accidents, biomechanical stresses, fatigue, injuries, and cumulative traumas[11,12]. It was observed that soldiering tools, pliers and wire strippers caused frequent complaints in women workers, due to dimensional incompatibility and improper usage of tools[13,14].

Many countries have been working in establishing a database for different population groups e.g. students, workers, civilians and armed persons[15]. Some research institutes are generating database of hand parameters for male and female workers as one design cannot be accounted for men and women[16,17].

There is not enough existing work on hand anthropometry in our country. We need our own standard baseline data that can be used for the design of hand tools, gloves, machine access spaces and hand-held devices and for selection of hand tools for use by various industries. Therefore, the present study was designed to establish the baseline measurements of the hand anthropometric parameters of the adult female garment workers in Bangladesh. As a result, the persons can work in appropriate places according to their ages related hand dimensions and hand grip strength.

MATERIALS AND METHODS

The study was descriptive, observational and cross sectional in nature with some analytical components. The study was carried out in Anatomy Department, Chittagong Medical College, Chattogram during the study period of January 2015 to December 2015. Data were collected from 8 garment factories of Chattogram and Dhaka districts.

The study group consisted of a purposive nonrandom convenient sample of 300 adult female garment workers in Bangladesh, categorized into three groups – 21 to 25 years (n1 = 100), 26 to 30 years (n2 = 100) and 31 to 35 years (n3 = 100).

Inclusion criteria

- Right hand dominance
- Minimum 1 year working experience in garment factories as cutting operator or sewing operator or ironer (Figure 1)
- Normal body weight (BMI=18.5-24.9 kg/m^2)

Exclusion criteria

- Having any genetic & endocrine disorder
- Having any trauma in hand that can affect physically measured variables
- Having any neurological findings that can affect the extremities.

At first, the participants were explained the aim of the study and procedures of data collection. Informed written consent was taken. Age of the participants were verified by seeing their national identity cards. After taking weight and height, BMI of the participants were calculated and the subjects within normal range were selected. The hand grip strength was measured using Camry Electronic Hand Dynamometer (Model: EH 101) with the elbow flexed at 90º, 0 to 30º extended wrist and forearm in semi-pronation lying on an arm rest. Figure of both hands were drawn in a white paper and finger spans were measured as shown in Figure 2.

Mean, Ranges, standard deviation and percentile values of all variables of both hands were done using Statistical Package for Social Science (SPSS) Version 20.0. ANOVA test was done to evaluate comparison among the mean of variables of three age groups & correlation was done to evaluate the relationship between hand grip strength and finger span of the same hand.

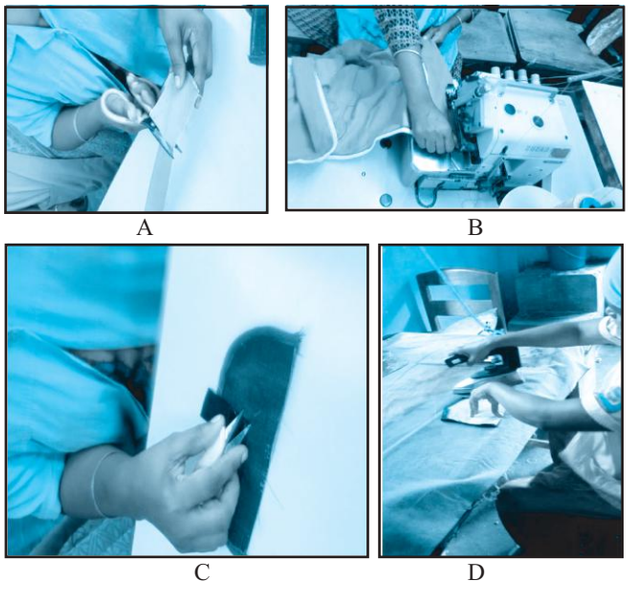

Figure 1 : The Cutting operator (A, B) sewing operator (C) and ironer (D).

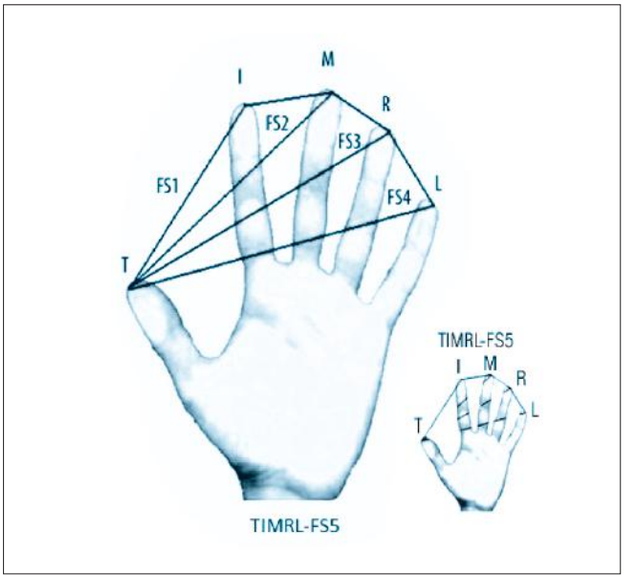

Figure 2: Procedure of measuring finger span.

Finger span 1 / FS1- Tip of Thumb / T to tip of index finger / I
Finger span 2 / FS2 - Tip of Thumb / T to tip of middle finger / M
Finger span 3 / FS3- Tip of Thumb / T to tip of ring finger / R
Finger span 4 / FS4- Tip of Thumb / T to tip of little finger / L
Finger span 5 / FS5- TI + IM + MR +RL
Hand Grip Strength

RESULTS

Range, mean ± SD, p value and percentile value of finger spans of right and left hand are shown in Table I, II and Figure 3, 4. The difference of mean finger spans of the right and left hand among different age groups were not significant.

Table III and Figure 5 presents range, mean ± SD, p value and percentile value of hand grip strength of right and left hand of different age groups. In ANOVA test there is highly significant difference of hand grip strength of right hand among the age groups (p= 0.000) and significant difference of hand grip strength of left hand among the age groups (p = 0.048).

Table IV shows that there are positive correlation of HGS-R with finger span, where FS3 and FS4 are highly significant, but FS1 is not significant, FS2 and FS5 are only significant. In case of left hand, there are positive correlation of HGS-L with finger span where FS2, FS3 and FS4 are significant but FS5 and FS1 is not significant.

Table I : Measurements of finger spans of right hand with age (ANOVA test).

Variables	Age Groups*	Mean (cm)	SD	Range (cm)	Significance of difference p value†
FS1	n1	8.72	1.11	6.20 – 12.70	0.311 (NS‡)
	n2	8.88	1.28	6.70 – 13.30	
	n3	8.64	1.05	6.70 – 11.60	
	Total	8.75	1.15	6.20 – 13.30	
FS2	n1	12.83	1.35	9.70 – 18.50	0.180 (NS)
	n2	13.04	1.47	10.00 – 18.70	
	n3	12.69	1.19	10.20 – 15.50	
	Total	12.86	1.34	9.70 – 18.70	
FS3	n1	15.08	1.17	12.20 – 18.10	0.084 (NS)
	n2	15.39	1.45	12.50 – 21.00	
	n3	15.01	1.14	12.40 – 18.00	
	Total	15.16	1.27	12.20 – 21.00	
FS4	n1	16.88	1.07	13.60 – 19.30	0.081 (NS)
	n2	17.28	1.37	14.00 – 22.10	
	n3	16.84	1.13	13.50 – 19.60	
	Total	17.00	1.21	13.50 – 22.10	
FS5	n1	23.37	1.67	18.50 – 28.50	0.125(NS)
	n2	23.74	2.03	19.10 – 30.90	
	n3	23.24	1.66	19.30 – 27.00	
	Total	23.45	1.80	18.50 – 30.90	

* n1 = 100, n2 = 100, n3 = 100, † p>0.05, the result was considered as not-significant, ‡ NS = Not-significant.

Table II : Measurements of finger spans of left hand with age (ANOVA test).

Variables	Age Groups*	Mean (cm)	SD	Range (cm)	Significance of difference p value†
FS1	n1	9.86	1.22	7.30 – 13.60	0.176 (NS‡)
	n2	9.90	1.45	7.20 – 14.40	
	n3	9.58	1.19	5.30 – 12.60	
	Total	9.78	1.29	5.30 – 14.40	
FS2	n1	14.11	1.31	11.10 – 17.40	0.177 (NS)
	n2	14.05	1.54	10.80 – 19.20	
	n3	13.78	1.20	10.70 – 17.00	
	Total	13.98	1.36	10.70 – 19.20	
FS3	n1	16.30	1.26	13.30 – 19.50	0.175 (NS)
	n2	16.21	1.60	12.60 – 21.80	
	n3	16.00	1.75	10.30 – 26.60	
	Total	16.17	1.55	10.30 – 26.60	
FS4	n1	17.66	1.18	14.90 – 20.50	0.611 (NS)
	n2	17.74	1.43	13.80 – 21.90	
	n3	17.37	1.16	14.20 – 19.60	
	Total	17.59	1.27	13.80 – 21.90	
FS5	n1	24.29	2.37	13.25 – 29.40	0.344 (NS)
	n2	24.62	2.37	18.90 – 35.20	
	n3	24.18	1.73	19.80 – 28.20	
	Total	24.36	2.18	13.25 – 35.20	

* n1 = 100, n2 = 100, n3 = 100, † p>0.05, the result was considered as non-significant, ‡ NS = Non-significant.

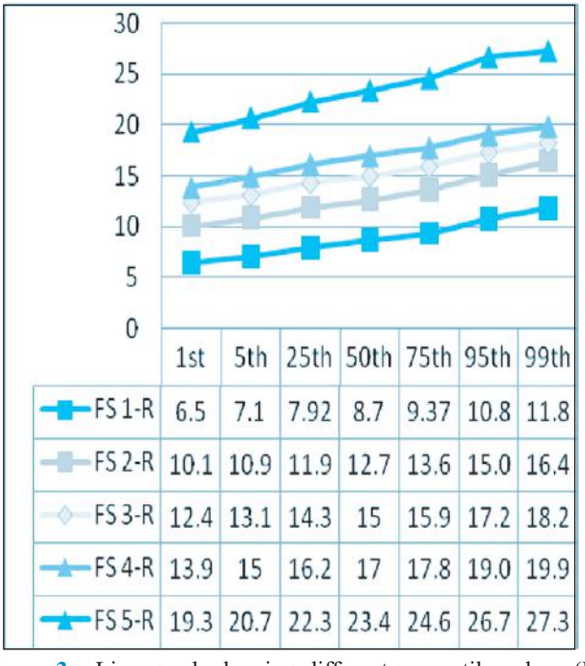

Figure 3 : Line graph showing different percentile values (In centimeter) for finger spans of right hands in the study subjects.

Figure 4 : Line graph showing different percentile values (In centimeter) for finger spans of left hands in the study subjects.

Table III : Measurements of hand grip strengths of right and left hands with age (ANOVA test).

Variables	Age Groups	Mean (Kg)	SD	Range (Kg)	Significance of difference p value
Hand grip strength (Right)	n1	24.40	2.24	20.90 – 33.40	0.000 (HS**)
	n2	25.41	3.05	20.10 – 35.00	
	n3	27.66	2.83	21.90 – 35.20	
	TOTAL	25.82	3.04	20.10 – 35.20	
Hand grip strength (Left)	N1	20.88	1.45	16.50 – 28.20	0.048 (S*)
	n2	21.05	2.02	17.20 – 30.40	
	n3	21.46	1.61	18.30 – 28.20	
	TOTAL	21.13	1.73	16.50 – 30.40	

n1 = 100, n2 = 100, n3 = 100, $p>0.05$, the result was considered as non-significant = NS, ** HS= Highly significant; *S = Significant.

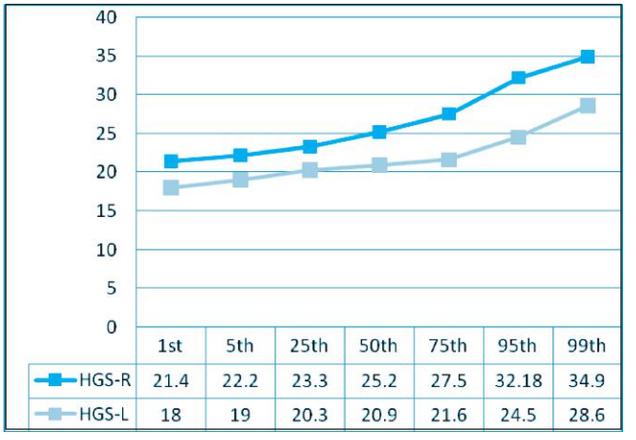

Figure 5 : Line graph showing different percentile values (Kg) for hand grip strengths of both hands in the study subjects (Here, HGS-R means hand grip strength of right hand and HGS-L means hand grip strength of left hand).

Table IV : Correlation between hand grip strength and finger spans of right and left hand.

Variables		Correlation with Hand grip strength Correlation coefficient (r)	p value
FS1	Right	+ 0.113	0.051 (NS)
	Left	+ 0.093	0.108 (NS)
FS2	Right	+ 0.144	0.013 (S)
	Left	+ 0.117	0.043 (S)
FS3	Right	+ 0.153	0.008 (HS**)
	Left	+ 0.114	0.048 (S)
FS4	Right	+ 0.151	0.009 (HS)
	Left	+ 0.140	0.015 (S)
FS5	Right	+ 0.147	0.011 (S)
	Left	+ 0.094	0.104 (NS)

$p>0.05$, the result was considered as non-significant, NS = Non-significant, S = Significant, ** HS = Highly significant.

DISCUSSION

Visnapuu have suggested that the effect of finger length and finger perimeters on handgrip strength is more than that of finger spans[18]. So that finger spans have a small influence on handgrip strength. The study of Fallahi and Jadidian showed that finger spans, except for FS5, were not different between handgrip-related athletes and non-athletes[19]. According to Milin, a significant positive correlation between hand span (From tip of the thumb to tip of the little finger, FS4) and hand grip strength was found in healthy adult male[20]. Bansode, Borse and Yadav also found that there was a positive relationship between hand span and hand grip strength of dominant hand[21]. Results of this study showed that finger spans positively correlated with hand grip strength of the same hand (Table IV).

In this study, Figures 3, 4 and 5 showed the percentile values (1^{st}, 5^{th}, 25^{th}, 50^{th}, 75^{th}, $95^{th}$and 99^{th}) for each dimension for adult female garment workers of different age (21-35 years). The extremes (1^{st}, 5^{th}, 95^{th} and 99^{th} percentiles) should be of interest to the designer of tools since they influence fit and comfort. These percentiles may also be used for comparison with those published for other populations. The author Mandahawi et al explained that except for a few extreme values, the range of the magnitude differences between Bangladeshis and other populations was similar to the range of the male–female Bangladeshi differences[11]. In that hand anthropometric study, comparison was done among Jordanian, Bangladeshi, Vietnamese, Mexican, Hong Kong Chinese, United Kingdom residents, Japanese, American and Nigerian. In the present study, due to limitation of hand anthropometric data collection in different populations of different countries, comparison among different populations was not done.

CONCLUSION

The present study indicates there is no significant difference in finger span with age among the three age groups of adult female garment workers (21 yrs-35 yrs) in Bangladesh. There is significant difference in hand grip strength with age. There is positive correlation between hand grip strength and finger span of the same hand.

The data presented in this study will be helpful in ergo-design application of hand tools and devices such as sewing machine, ironer, cutting machine, dye tube holder, cotton trolleys handle etc used in garment factories and choosing the appropriate person in the appropriate work station according to age.

DISCLOSURE

All the authors declared no competing interest.

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