

Synopsis of the Ph.D. Thesis

**ASSESSMENT OF GRIP STRENGTH IN RELATION TO AGE,
SEX, OCCUPATION AND BODY POSTURE IN BENGALEE
POPULATION AND FORMULATION OF NORMS FOR THE
SUBJECTS OF DIFFERENT AGE GROUPS**

By

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SYNOPSIS

Muscle strength is the maximum amount of force that a particular muscle or muscle group can exert against a resistance. Grip strength is a general term also used by strength athletes, referring to the muscular power and force that they can generate with their hands.

In the present investigation efforts have been made to assess the influence of handedness, age, sex, anthropometric dimension, body composition, nutritional status and occupation of the subjects on hand grip strength of Bengalee population. It was also aimed to establish the graded norms of grip strength in different age groups of male and female subjects. Further, efforts have also been made to standardize the measurement procedure of the hand grip strength.

To fulfil the above objectives studies were carried out in different districts of West Bengal State (India), e.g., Purba Medinipur, Paschim Medinipur, Burdwan, Purulia, Bankura and Howrah. For the studies 1851 subjects (859 male and 992 female) were selected at random. All the subjects volunteered for the present study.

The socioeconomic status of the Bengalee population was assessed by modified Kuppuswamy scale. The static hand grip strength was measured by using Lafayette (USA) hand grip dynamometer. The length of hand grip span was optimized for the target population by psychophysical study (paired comparison test) and EMG signal analysis of the forearm muscle. The EMG was recorded from flexor carpi radialis muscle of forearm by a BIO-PAC system and the EMG voltage and the RMS values were analyzed by BSL PRO 3.7 software.

The grip strength was evaluated with the variation of posture as well as body joint angles. Experiments were performed on three main postures, viz., standing, sitting, and lying. The grip strength was also measured with the variation of different body joint angles, viz., shoulder, elbow, wrist and trunk. The correlation between the hand grip strength and anthropometric measures as well as body compositional parameters was assessed.

After measuring hand grip strength values of different age groups and different occupational groups of subjects, attempts were made to find norms for categorizing them into different grades of strength. Grading of scores for the norms was made by percentile method.

Some anthropometric measures were taken by standardized method and its association with hand grip strength was also determined. WHO defined body fat percentage and BMI cut-off values were used to classify the subject into different nutritional categories and the grip strength was determined for those categories.

From the result of socioeconomic status of the subjects it was revealed that the most of the males (63%) were belonged to upper lower and lower middle classes and a larger percentage of female (68%) belonged to the upper lower socioeconomic status. The male and female subjects having lower socioeconomic status had lesser hand grip strength. The study of handedness showed that most of the subjects belonged to the right handed category.

It was observed that the hand grip strength of right hand was significantly greater ($p < 0.001$) in right handed male and female subjects than that of the left handed male and female subjects. The hand grip strength of the left hand was significantly greater ($p < 0.001$) in left handed male and female subjects than that of the right handed subjects.

Experiments were performed to optimize the length of grip span of the dynamometer for measuring hand grip strength of the subjects in Bengalee population. The hand grip strength of subjects was measured with the variation of grip span length of the dynamometer. From the results it has been noted that the highest value was recorded in case of 3 cm grip span length. The observation was evident by two further experiments – paired comparison test and EMG studies of forearm muscle. From the results of paired comparison test it was revealed that the grip span length of 3 cm had got the highest preference score in both male and female subjects. From the EMG study it has been noted that the grip span of 3 cm had significantly higher EMG values and RMS values in right hand and left hand than that of other grip span

lengths. Therefore, it was inferred that the grip span length of 3 cm was the optimum for exerting maximum force during hand grip testing and it would be suitable for the studied population.

The study of effect of posture on hand grip strength revealed that the hand grip strength was slightly higher (1.3% to 5.9%) in standing posture than other postures in both male and female subjects. From the results of variation of hand grip strength in different body joint angles it has been noted that there was no significant difference in hand grip strength between two angles at elbow joints, i.e., 90° and 180° and three angles at shoulder joint (0°, 90° and 180°) in both male and female subjects. However, in neutral positions of the wrist and trunk, the hand grip strength was significantly higher in both right and left hand than that of the wrist in ulnar deviation and trunk in flexed condition respectively. Thus the appropriate posture and limb position were defined for accurate measurement of hand grip strength for the target population.

The subjects were divided into different age groups. They were divided into three major age groups, i.e., adolescent group (15-19 years), younger adult group (20-50 years) and older adult group (51-60 years). The highest hand grip strength was found in the adolescent group and it was found to be decreased from lower to higher age groups in both male and female subjects. From the results of different subgroups of younger adult (20-50 years), it was observed that in case of male subjects the highest hand grip strength was found in the age group of 41-50 years. But in case of female subjects the highest hand grip strength was found in the age group of 20-30 years. The grip strength of two subgroups of older adults (51-60 years) have been shown that the higher hand grip strength was found in the age group of 51-55 years in case of male and female subjects in both right and left hand. In all age group, the male had higher hand grip strength than their female counterpart.

Occupational variation was also observed for hand grip strength measurement. Different categories of job were selected for measuring the hand grip strength in both male and female subjects. From the results of male and female subjects it was revealed that there was a significant difference in hand grip strength among different occupational groups. The students had higher hand grip strength than that of other

occupational groups and the agricultural workers had lower grip strength than that of other occupational groups in both the sexes.

In case of male and female subjects the hand grip strength was positively correlated with some anthropometric measures. The hand dimensions of all group of subjects had a little difference, non-significantly, between left and right hand. Most of the hand dimensions were significantly different between adolescent female and adult female subjects in both right and left hand.

The subjects were categorized into underweight, normal weight, and overweight / obese according to WHO recommended BMI cut-off value and it was observed that most of the male (55.16%) and female (62.5%) subjects were in normal weight category in the studied population. The results revealed that there was a significant difference in hand grip strength in different nutritional groups. In case of male subjects the highest hand grip strength was found in overweight groups, although it was not significantly different from that of normal weight group. In case of female subjects the hand grip strength in the normal weight group was significantly higher than that of both underweight and overweight groups.

According to WHO classification for percentage of body fat (BF %) the subjects were divided into normal weight (male: BF% < 15%; female: BF% < 25%) and overweight (male: BF% > 15%; female: BF% > 25%) groups. The result showed that the body fat percentage had not effect on hand grip strength.

The graded norms of hand grip strength of the subjects were determined for male and female subjects of the Bengalee population. The norms were classified into five grades – poor, fair, average, good and excellent. The graded norms were determined for sex wise, age wise, and occupation wise. The norms were found to vary slightly in different age groups in both sexes. It was also found that there were variations in hand grip strength among the different occupational group of subjects. The graded norms may be used as database for various purposes.

From the above discussion it may be concluded that the hand grip strength may vary with change of age, sex, body joint angles, hand grip span, and hand span etc. Socio economic status of the subject might be an influencing factor for hand grip strength. The hand grip span length of 3.0 cm would be the optimum for putting the maximum force for measuring the hand grip strength. The grip span of the dynamometer should be adjusted before taking the measurement. The standing posture will be the best for measuring hand grip strength in Bengalee population.

The hand span is positively correlated with the hand grip strength. The magnitude of the strength can be predicted from the hand span values. Variation of grip strength in different occupational groups was found from this study. The magnitude of grip strength was higher in sedentary persons (students and office workers) than that of the workers who performed strenuous jobs. Body dimension and body composition might be an influencing factor for grip strength. The normative data for Bengalee population should be assessed and used for the selection of workers in different jobs. It may be used for selection of sports person for some selected sport event. The database may also be used for clinical purpose.