

Linkage between Select Anthropometric Measures and Hand Grip Strength: Study on Bengalee Male Agricultural Human Resources

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Abstract: Agriculture is one of the most important domains in India, with 56.6% of Indian population depending on it. Agricultural works require several types of hand operating tools for different types of crop cultivation. For better performance, hand musculature, specifically hand grip is necessary. In this backdrop, a study was conducted on Bengalee male agricultural workers to assess their hand grip strength (HGS) and find out relationship, if any, between HGS and different anthropometric parameters. The study was conducted on 35 (age range 35- 45 years) male agricultural workers, residing in Hooghly, WB. Basic anthropometric parameters like stature (cm) using anthropometric measurement kit, and body weight (kg) using a pre calibrated weighing scale, were recorded. BMI was calculated. Different hand dimensions such as hand length (cm) and palm length (cm) were measured. The hand grip was measured using hand grip dynamometer as per ASHT. Obtained data were recorded and analysed. On performing Pearson correlation, selected anthropometric parameters were found to have significant ($P < 0.05$) positive correlation with hand grip strength; Hand length and palm length both have been found to have positive correlation with the hand grip strength in vertically downward and horizontal position. Based on the correlation, regression analysis was performed and prediction equations were developed. It may be concluded that there was significant relationship between selected anthropometric parameters and hand grip strength of Bengalee male agricultural workers.

1 Introduction

Agriculture is one of important sector in Indian economy [11]. Yet, the agricultural sector of India, till date, is significantly dependent on non-mechanized techniques. Among different manual tools, used for agriculture, hand operated equipments are extensively used starting from seedbed preparation to post-harvest operation [12]; and hence performance depends on hand musculature, particularly hand grip, an act of taking and holding any object firmly [4]. Several hand operated agricultural activities require high activity of flexor musculature of the forearms and hands, to execute the strength for gripping. Hence, agricultural equipments, especially those operated by the hand, should be compatible with



the physical characteristics of the human resources. Studies indicate that mismatches between human anthropometric dimensions and equipment dimensions decrease the performance and increase discomfort, accidents and fatigue [9]. Hence, the hand grip strength and hand anthropometry are extensively used for redesigning tools in order to reduce or eliminate work related stress. Furthermore, grip strength data, an easily obtainable measure of physical health and muscle function, is used in evaluating the integrated performances of hand muscles specifically the upper extremity. In this backdrop, a study was conducted on Bengalee male agricultural workers to assess their hand grip strength (HGS) and find out the relationship, if any, between HGS and different anthropometric measures.

2 Methodology

Initially, occupationally engaged agricultural workers were approached for their willingness to participate in the study. On obtaining initial consent, the names of participants with minimum working experience of 3 years, were enlisted. The measurements were obtained on mutually convenient dates. The participants with any history of hand related problems (self-reported) were excluded from the study. 35 Bengalee male agricultural workers, residing in Hooghly district of West Bengal, aged between 35-45 years, constituted the experimental group (EG). Information regarding their age (years), working experience (years) and socio economic status was recorded in a pre-designed schedules. Basic anthropometric parameters like Stature (to the accuracy of 0.5 cm) using an anthropometric measurement kit, and body weight (to the accuracy of 0.1 kg) using a pre calibrated weighing scale, with subjects in light clothing and without shoes, were recorded, and Body Mass Index (BMI) was calculated. Hand length (HL) (cm) [6] and palm length (PL) (cm) [13] were measured using Vernier caliper. The hand grip strength (kg) was measured for both hands at standing posture using hand grip dynamometer [1]. The data were recorded and analyzed using appropriate statistical tool. Regression modeling was carried out for the purpose of predicting hand grip strength. Generated regression models were validated using a new set of data of 41 randomly chosen male individuals, constituting the validation group (VG) , whose constituting members were comparable in terms of occupation and socioeconomic status with EG individuals.

3 Results

The basic profile in terms of age (year), stature (cm), body weight (kg) and BMI of the EG individuals have been presented in table 1.

Table 1 Background information of the EG participants

Parameters	EG
Age (years)	38.2 ± 6.89
Stature (cm)	164.6 ± 7.36
Body Weight (kg)	61.8 ± 13.22
BMI (kg.m ⁻²)	22.7 ± 4.26
AM±SD	

The hand anthropometric parameters - hand length and palm length - and hand grip strength of EG individuals have been presented in table 2.

Table 2 Hand anthropometric measures and hand grip strength of EG individuals

Parameters	EG
Anthropometric Measures	
Hand Length (cm)	17.8 ± 0.73
Palm Length (cm)	10.1 ± 0.58
Hand grip strength	
RH (kg)	46.8 ± 8.35
LH (kg)	39.5 ± 5.52

AM ± SD

The magnitude of correlation between hand anthropometric parameters and hand grip strength has been graphically presented in figure 1.

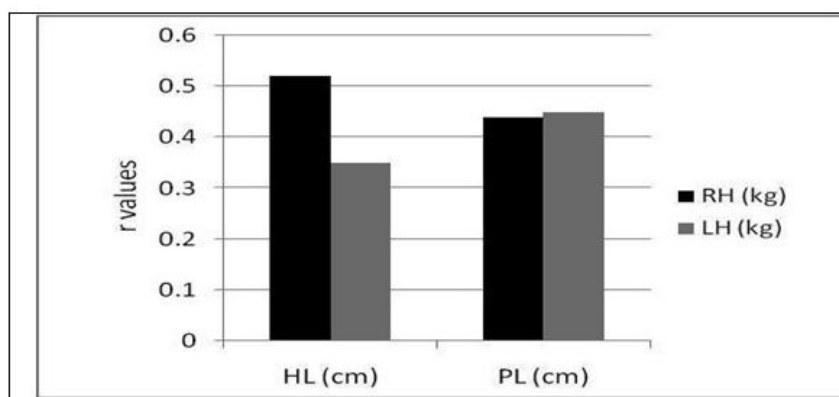


Fig 1: The degree of correlation between hand anthropometric measures and hand grip strength

Table 3 Regression Equations for predicting Hand grip strength from Anthropometric Measures

Model	F	Sig.
$\hat{Y}_{RH} = - 61.24 + 4.72 X_2 + 2.37 X_3$	6.55	0.004
$\hat{Y}_{LH} = - 9.87 + 0.72 X_2 + 3.62 X_3$	4.08	0.026

where X_2 : HL (cm), X_3 : PL (cm)



On the basis of the relationship between anthropometric measures and hand grip strength, the multiple regression models have been developed assuming the hand grip strength to be the criterion and anthropometric measures, the predictor. The prediction models of both the right and left hand have been presented in table 3.

Basic physical and physiological variables of validation group individuals have been presented in Table 4.

Table 4 Background information about the validation group participants

Parameters	VG
Age (years)	37.3 ± 6.95
Stature (cm)	165.2 ± 7.21
Body Weight (kg)	60.7 ± 12.49
BMI (kg.m ⁻²)	22.3 ± 4.24
Hand Length (cm)	17.9 ± 0.71
Palm Length (cm)	10.0 ± 0.53
Hand grip strength – Right (kg)	47.3 ± 7.82
Hand grip strength – Left (kg)	39.6 ± 5.25

AM ± SD

4 Discussions

Human muscular strength especially the hand grip strength is of fundamental importance and is extensively used for operating various tools and equipment in agricultural activities; hence the increase in grip strength increases the performance level of the individual workers. Studies also indicate that higher level of physical fitness have positive impact on the hand grip strength [2-3]. In the present study, it has been found that the right hand grip strength was significantly higher than the left hand grip strength of the male agricultural workers; the finding is in consonance with the observations of earlier studies [14-15].

On performing Pearsonian correlation, significant ($P < 0.05$) positive correlation between the hand anthropometric measures - hand and palm length - and hand grip strength (figure 1) has been found; this is in agreement with the findings of the several earlier studies [5, 7-8]. Moreover, it has also been observed that the hand length was highly correlated with the right hand grip strength, compared to the left hand. Conversely, the palm length has been more correlated with the left hand grip strength, in comparison to the right hand. Similar trend of result has also been observed in an earlier study [10]. Based on the correlation between select anthropometric measures and hand grip strength, prediction equations were developed and it has been found that the developed prediction models have strong test-

retest validity. Additionally, the F value (6.55) for predicting the grip strength of right hand has been found to be significant at 0.004 level. Hence, the prediction model, developed in the present study, could be used to estimate the likely values of hand grip strength.

5 Conclusion

In the light of the observations discussed, it has been found that there was significant positive relationship between select hand anthropometric measures and hand grip strength of Bengalee male agricultural workers.

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