

RESEARCH ARTICLE

Evaluation of handgrip strength as an indicator of nutritional status in laborers

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ABSTRACT

Background: The laborers constitute an important workforce in the society. Their working efficiency very much depends on their muscle strength. Hand grip strength (HGS) determines the muscular strength of an individual. Nutritional deficiency can affect the muscle strength in laborers. The current study was carried out to assess whether HGS can be useful as an indicator of nutritional status. **Aims and Objectives:** To assess the relationship between handgrip strength and nutritional status in laborers and to compare it with sedentary counterparts. **Materials and Methods:** This cross-sectional study included 60 laborers and 60 age-matched sedentary counterparts (controls). HGS was measured with hand grip dynamometer. Anthropometric parameters were recorded by standard methods. Data obtained were tabulated and statistically analyzed. **Results:** HGS and anthropometric parameters were significantly lower in laborers compared to controls. Moreover, all the variables of nutrition, the mean height, weight, body mass index, mid-upper arm circumference, arm muscle girth and arm muscle area in laborers, and sedentary counterparts showed significant positive correlation with the handgrip strength in laborers except for triceps skinfold thickness. **Conclusion:** The study concluded that there exists a significant correlation between nutritional status and handgrip strength. Efforts should be taken to educate the workers on fundamentals of nutrition emphasizing role of good nutrition in improving work capacity.

KEY WORDS: Anthropometric Parameters; Handgrip Strength; Laborers


INTRODUCTION

Laborers form an important segment of the workforce of India. In developing countries like India, a large section of the labor force is employed in labor-intensive primary work. Nutrition not only plays an important role in the efficiency and welfare of the workers but also adequate diets are essential for optimum output.^[1]

Laborer is a person who does one of the construction trades, traditionally considered unskilled manual laborer as opposed to skilled laborer.^[2] The daily wage labor and members of specialist trade such as electricians, carpenters, painters, and plumbers are also included under the segment as workers.^[3]

Working efficiency and output are very much dependent on the health and physical fitness of the individual. Provision of nutritionally adequate diet for the workers was quickly appreciated not only as an important forward step in social practice but also for increasing work efficiency.^[1]

The functioning nutritional unit of the body is the lean body mass, of which muscle is the major component.^[4] The hand muscles play a key role in the performance of day to day

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activities of normal life. The maximal grip strength of the hand is an indication of peripheral muscle function and is related to the total amount of muscle mass in the body.^[5]

Handgrip strength is a measure of strength of several muscles in the hand and the forearm and is measured in either kilograms or Newton. The power grip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal biokinetic conditions.^[6,7] It is the most common assessment method for upper extremity muscle strength.^[8] Handgrip dynamometry has been proposed as a test of skeletal muscle function and thus a mean of detecting malnutrition.^[4]

Handgrip strength is a physiological variable that is affected by a number of factors including age, gender, and body size.^[9] A general rule often used suggests that the dominant hand is approximately 10% stronger than non-dominant hand.^[7] Handgrip strength is necessary for performing activities of daily living which, in turn, are required to maintain functional autonomy.^[10] It is of great use as a functional index of nutritional status.^[11-13]

Handgrip strength may be a useful nutritional status indicator, particularly where anthropometric measurements fail to distinguish undernourished from underweight persons.^[8] Information related to the correlations of handgrip strength and anthropometry in laborers in India is scanty. This study was therefore undertaken to test the hypothesis that poor nutritional status is associated with poor handgrip strength as an initial step toward assessing the role of nutrition in the livelihoods of laborers.

Objectives

1. To measure the handgrip strength in laborers using handgrip dynamometer and to compare it with sedentary counterparts
2. To know the relationship between handgrip strength and nutritional status in laborers.

MATERIALS AND METHODS

The present cross-sectional study included 120 subjects (convenience sampling) of Mangalore city of which 60 laborers were selected from construction sites and remaining 60 served as controls (age-matched sedentary lifestyle subjects of the same place) of age group between 18 and 60 years. Informed written consent was taken from the subjects. Approval for the study was obtained from the Institutional Ethics Committee. Subjects <18 years and >60 years of age or those with history of any medical illness such as diabetes/hypertension/tuberculosis/asthma; long-term medications or those with physical deformities were excluded from the study.

The self-structured questionnaire was used to collect demographic information such as name (identification number was allotted), age, gender, education, socio-economic status, history of past/present medical or surgical illness, occupation, working hours, and any history of medication.

Measurement of Handgrip Strength

The grip strength of dominant hand (right) was measured using hand grip dynamometer (Inco, Ambala, India) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The subjects were asked to put maximum force on the dynamometer thrice. The maximum value was recorded in kilograms. All the participants were tested after 3 min of independent warm-up. 30 s time intervals were maintained between each handgrip strength testing.^[7]

Anthropometric Measurements

Anthropometric parameters such as height (meters), weight (kilograms), body mass index (BMI) (kg/m²), triceps skinfold thickness (mm), mid-upper arm circumference (MUAC in cm), arm muscle area (AMA) (cm²), and arm muscle girth (AMG) (cm) were recorded as indicators of nutritional status using standard methodologies. Height of the subjects was recorded in centimeters using fixed wall stadiometer (range 60-200 cm) with an accuracy of 0.1 cm. Weight was measured to provide a general description of body size and total mass (fat-free mass + fat mass). Coupled with stature its measurement was also used to calculate body mass index (BMI = kg/m²). Weight was measured to the nearest 0.1 kg using a mechanical weighing scale.

MUAC, AMA, AMG were calculated as follows:^[14]

- MUAC: With the bent arm, a flexible measuring tape was wrapped around the mid-upper arm (midpoint of the arm between the shoulder and the tip of the elbow)
- $AMG \text{ (cm)} = MUAC - (\pi \text{ Skinfold triceps})$
- $AMA, \text{ (cm}^2\text{)} = [MUAC - (\pi \text{ Skinfold triceps})]/4 \pi$

Statistical Analysis

Data was analyzed by descriptive statistics. Continuous variables were expressed as mean \pm standard deviation (SD), and categorical values were expressed as percentage. SPSS 16 was the statistical software used for the analysis of data. Student's *t*-test (two-tailed, independent) was used to test the significance of the difference between the two groups. The level of significance was fixed at $P = 0.05$. The relationship between the hand grip strength (HGS) and nutritional status among the laborers were analyzed using Pearson correlation coefficient.

RESULTS

The mean values of nutritional parameters and handgrip strength were significantly higher in males compared to females in both the groups (Table 1).

Table 1 shows the mean height, weight, BMI, triceps skinfold thickness, MUAC, AMG, and AMA in laborers, and sedentary counterparts. Mean \pm SD of nutrition parameters in males and females laborers namely were significantly lower ($P = 0.001$) compared to males and females sedentary subjects.

Table 2 shows Pearson correlation of handgrip strength and nutritional parameters in laborers. All the variables of nutrition show significant positive correlation with the handgrip strength in laborers except for triceps skinfold thickness.

Triceps skinfold thickness (mm) showed a significant negative correlation with handgrip strength ($r = -0.46$, $P = 0.001$).

DISCUSSION

Grip strength has long been thought of as a possible predictor of overall body strength.^[10] The present study showed that the HGS is significantly higher in males compared to females. Pieterse *et al.* have indicated in his study that men had higher HGS than women. Men's higher muscle mass may contribute to this result.^[8] The mean and SD of handgrip strength, BMI, and AMA for men and women indicated that men had a significantly higher handgrip strength ($P < 0.001$) and

AMA ($P < 0.001$) than women. Similar sex differences were seen in other studies carried out in developing as well as in industrialized countries.^[6,15]

The present study reported that handgrip strength and nutritional status were lower in laborers compared to sedentary counterparts and also showed that there exists a positive correlation between the two determined variables. This is in line with other literatures. The study by Kaur and Koley indicates that female laborers have lower mean values in all variables (anthropometric parameters) measured including lower mean values of grip strength of both hands as compared to sedentary females.^[7] Chilima and Ismail reported that HGS was positively associated with nutritional status, even after controlling for potential confounders including health status and socio-economic conditions and also confirmed that those in lower BMI category had lower mean handgrip strength.^[16] Pieterse *et al.* also reported that poor nutritional status, defined by low BMI and low AMA, emerged as a significant determinant of impaired handgrip strength.^[8] Similarly, a study conducted in Nigeria showed a positive correlation between handgrip strength and anthropometric measures (AMA and arm muscle circumference) among young adults (aged 18 ± 64 years).^[17]

The low body mass index indicates low body fat and muscle. Thus, its association with poor handgrip strength is partly at least through the reduced muscle mass. Reduction in muscle mass has also been associated with a decline in muscle strength which may be caused by disuse, illness or to a decline in customary activity, or just to aging as a result of

Table 1: Descriptive statistics of nutritional parameters in laborers and sedentary counterparts with right-hand dominance

Parameters	Gender (N=30)	Mean \pm SD		P value
		Laborers	Sedentary counterparts	
Height (m)	Male	1.64 \pm 0.08	1.71 \pm 0.18	0.001**
	Female	1.50 \pm 0.08	1.67 \pm 0.07	
Weight (kg)	Male	54.6 \pm 7.13	63.60 \pm 8.69	
	Female	43.87 \pm 5.25	49.93 \pm 7.86	
BMI (kg/m ²)	Male	20.36 \pm 2.88	23.05 \pm 2.0	
	Female	19.49 \pm 3.09	22.84 \pm 3.06	
Triceps skinfold thickness (mm)	Male	3.26 \pm 1.31	4.23 \pm 1.33	
	Female	2.56 \pm 8.97	3.76 \pm 1.19	
Mid-upper arm circumference (cm)	Male	24.28 \pm 2.11	26.51 \pm 2.37	
	Female	18.31 \pm 1.67	22.23 \pm 2.52	
Arm muscle girth (cm)	Male	10.98 \pm 3.93	16.25 \pm 4.79	
	Female	10.39 \pm 3.81	14.48 \pm 4.20	
Arm muscle area (cm ²)	Male	28.16 \pm 4.39	40.26 \pm 6.67	
	Female	26.21 \pm 3.98	32.41 \pm 7.34	

m: Meter, kg: Kilogram, mm: Millimeter, cm: Centimeter, cm²: Centimeter square, N: Number of sample size; SD: Standard deviation,

**P value highly significant (Student's unpaired *t*-test). BMI: Body mass index

Table 2: Pearson correlation of hand grip strength and nutritional parameters in laborers

Nutritional parameters	Handgrip strength	
	<i>r</i> value	<i>P</i> value
Height (m)	0.52	0.001**
Weight (kg)	0.47	0.001**
BMI (kg/m ²)	0.40	0.02*
Triceps skinfold thickness (mm)	-0.46	0.001**
Mid-upper arm circumference (cm)	0.43	0.01*
Arm muscle girth (cm)	0.39	0.04*
Arm muscle area (cm ²)	0.37	0.04*

r: Correlation coefficient, m: Meter, kg: Kilogram, mm: Millimeter, cm: Centimeter, **highly significant *P* value. *Significant *P* value. BMI: Body mass index

alterations in muscle fiber composition or a decrease in the number of muscle fibers.^[16]

Laborers working in different constructional sites have poor nutritional status due to their lower socio-economic conditions, but they require more physical strength, i.e. handgrip strength to perform their daily work efficiently.^[7] Maintenance of functional ability and strength is particularly relevant to their survival and dependents. A decline in handgrip strength is also associated with measures of decreased functional ability.^[8] Quite naturally poor nutritional status fails to provide adequate handgrip strength to them affecting their functional skills.^[7] Varakamin *et al.* also suggested that lifestyle may influence both body composition as well as muscular strength and those who had access to better food and care and had higher body fat and lower handgrip strength.^[18] Therefore, the poor nutritional status is associated with poor functional status as assessed by handgrip strength.

CONCLUSION

The results of this study support the hypothesis that poor nutritional status is associated with poor handgrip strength. One's nutritional status would lead to specific levels of body mass, which, in turn, has been found to correlate directly to grip strength. This simple method of non-invasive measurement may provide nutritionists and medical professionals with valuable screening data, before further more invasive testing. Efforts should be taken to educate the workers on fundamentals of nutrition emphasizing role of good nutrition in improving work capacity. Mass education efforts to encourage choice of low-cost nutritious foods, better health care education, and discourage use of alcohol are also suggested. Further studies are required to investigate whether an increase in strength can be induced by improvement in nutritional status.

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