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Original Article

The Association between Hand Grip Strength and Forearm Dimensions in Healthy Bangladeshi Female Tea Garden Workers

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Abstract

Background: The evaluation of anthropometry is beneficial to different prospective research. Anthropometric study data also provides information on what kind of labor is performed by an individual. Hand grip strength can vary based on several factors, the primary one being the type of work that the person performs. *In our country, the tea garden sector employs a large number of people*. The purpose of this study was to evaluate the forearm anthropometry and grip strength of the female tea garden laborers of Bangladesh. **Materials and methods:** This was a cross-sectional descriptive type of study. The study was carried out at the Anatomy Department of Sylhet MAG Osmani Medical College in Sylhet. The total duration of the study was one year. A total of one hundred female tea state employees were enlisted for this study. The women tea garden workers, age ranging in age from 20 to 50 years, were specifically chosen. Data was collected by researchers themselves and documented in a pre-designed data sheet. The individuals' forearm length and carrying angle of both sides were measured. The grip strength of the dominant and non-dominant hands was also measured. The data were displayed as a percentage and mean ± SD. Regression analysis for the correlation was conducted. Tables and figures were used for data presentation. **Results:** The mean carrying angle were 13.39±1.21 and 13.09±1.07 cm on the right and left side respectively. The mean forearm length was 22.77±1.67 cm and 22.64±1.63 cm on the right and left side respectively. The mean right hand grip strength was 25.82±2.76 kg. The mean left hand grip strength was 17.74±1.82 kg. Significant positive relationship of hand grip strength was found with carrying angle and forearm length of both side. **Conclusion:** Forearm length and carrying angle were positively correlated with the dominant handgrip strength of female tea garden workers in Bangladesh.

Keywords: female tea garden workers, Bangladesh, forearm anthropometry, handgrip strength, dominant, correlation

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Introduction

Bangladesh's economy heavily depends on the tea business, both in terms of employment and production. There are many workers involved in the sector. These laborers frequently come from under-represented groups and deal with difficult working environment[1].

For the commercial production of tea several processes are involved in collection, drying,

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wilting and oxidation. Growing, weeding, dressing tea plants, applying fertilizers and pesticides, plucking tea leaves and buds, clearing the forest land are the works done by tea garden workers. Besides these, they also do additional work like pruning vulnerable tea trees, repairing canals and roads of tea garden areas. Women labors mainly involved in plucking tea tree leaves. To the contrary, male labors mainly involved in rest of the activities[2]. Strong physical abilities, especially hand grip strength, are necessary for tea garden workers to carry out their duties. Their jobs require repetitive and demanding use of the hands and arms due to the nature of the work such as picking tea leaves, gardening, and lifting large loads. In comparison to people in sedentary employment, this may result in a higher requirement for hand grip strength[3]. Grip strength is frequently used to evaluate a person's physical state and predict possible health effects[4]. The hand grip test is a non-invasive procedure that measures maximal voluntary force, a forceful flexion including all finger joints by employing multiple hand and forearm muscles[5]. In particular, hand grip strength is an important indicator of physical capacity for manual labour-intensive occupations. Maintaining a strong hand grip is crucial for female tea garden workers to effectively perform the activities of carrying and plucking huge amounts of tea leaves. A few studies on tea garden workers were carried out to find their handgrip strength & anthropometric measurement. These might be helping to find out the nutritional status of female tea garden workers in Bangladesh. Therefore, to ascertain the association between dominant handgrip strength and forearm dimensions in Bangladeshi women employed in tea gardens, this study was carried out to provide quantitative baseline data on dominant handgrip strength.

Materials and Method

This cross-sectional descriptive study was carried out at the Department of Anatomy, Sylhet MAG Osmani Medical College, Sylhet, for the duration of one year. The research population consisted of female tea garden workers from various tea plantations in Sylhet, Bangladesh. The Ethical Review Committee of the Sylhet MAG Osmani Medical College granted ethical authorization prior to initiating the data collection. The method of convenient sampling was employed to collect data. Pre-formed data collecting sheets are used to collect data. For the purposes of the study, right-handed female tea garden workers between the ages of 20 and 50 were included. All the participants

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were right dominant hand. The study excluded participants with congenital limb deformities, upper limb trauma history, and a history of any chronic condition, including connective tissue disorder, musculoskeletal disorders, neurological disorders, endocrine disorders, and respiratory disorders. The calculated sample size was 96.04. However, a total of 100 female tea garden female workers were included in the study. Study variables were forearm length, carrying angle and handgrip strength of both sides. Forearm length was measured in by spreading caliper. The fixed arm of the caliper was placed on the olecranon process of ulna and the sliding arm was pointed at the styloid process of radius. By using a goniometer, the carrying angle was measured in anatomical position. The fixed arm of goniometer was placed on the median axis of arm and movable arm of goniometer *will be* placed on the median axis of forearm. In sitting position hand grip strength was measured by using Camry digital hand dynamometer. Feet of the subjects were flat on the floor, sitting with back support, the elbow was placed at the same side and bent at 90^0 angle. The dynamometer was placed on the subject's hand and instructed the subject to squeeze the dynamometer as hard as possible for 3 seconds then release, and measurement was recorded in both dominant and non-dominant hand.

Three readings were taken, and average value was recorded in both dominant and non-dominant hand. During the test, it was made sure that the subjects was not expand their arm or move their arm when they were squeezing.

Statistical Package for Social Sciences (SPSS) version 23 was used to analyze the data. The link between the dominant hand's grip strength and hand dimensions was determined by regression analysis. $p< 0.05$ was considered as statistically significant.

Photograph 1. Measurement of forearm length.

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Results

The mean carrying angles were 13.39±1.21 and 13.09±1.07 cm on the right and left side respectively. The mean forearm length was 22.77±1.67 cm and 22.64±1.63 cm on the right and left side respectively (Table 1). The mean right hand grip strength was 25.82±2.76 kg. The mean left hand grip strength was 17.74±1.82 kg (Table 2). A significant positive relationship of hand grip strength was found with carrying angle (r=0.270; p=0.007 and r=0.232; p=0.000). A significant positive relationship of hand grip strength was found with forearm length of both side (r=0.570; p=0.000 and r=0.569; p=0.000; Table 3).

Table I: Carrying angle and forearm length of the study subjects (n=?)

Variables	Side	Range		Mean±SD
		Minimum	Maximum	
Carrying angle (^{0})	Right	11.10	17.30	13.39±1.21
	Left	10.90	16.20	13.09±1.07
Forearm length (cm)	Right	20.30	26.80	22.77±1.67
	Left	20.10	26.50	22.64±1.63

Table II: Dominant and non-dominant hand grip strength (n=100)

Variables	Range		Mean±SD
	Minimum	Maximum	
Dominant hand grip strength (Kg)	17	29.90	25.82±2.76
Non dominant hand grip strength (Kg)	12.30	20.20	17.74±1.82

Table III: Multiple regression analysis of dominant hand grip strength with carrying angle and triceps skinfold thickness (n=100)

Variables	Side	Constant	B	Correlation with stature	
				r	p value
Carrying angle (^{0})	Right	10.313	0.119	0.270^s	0.007***
	Left	10.776	0.090	0.232^s	0.000***
Forearm length	Right	13.966	0.341	0.570^s	0.000***
	Left	13.954	0.336	0.569^s	0.000***

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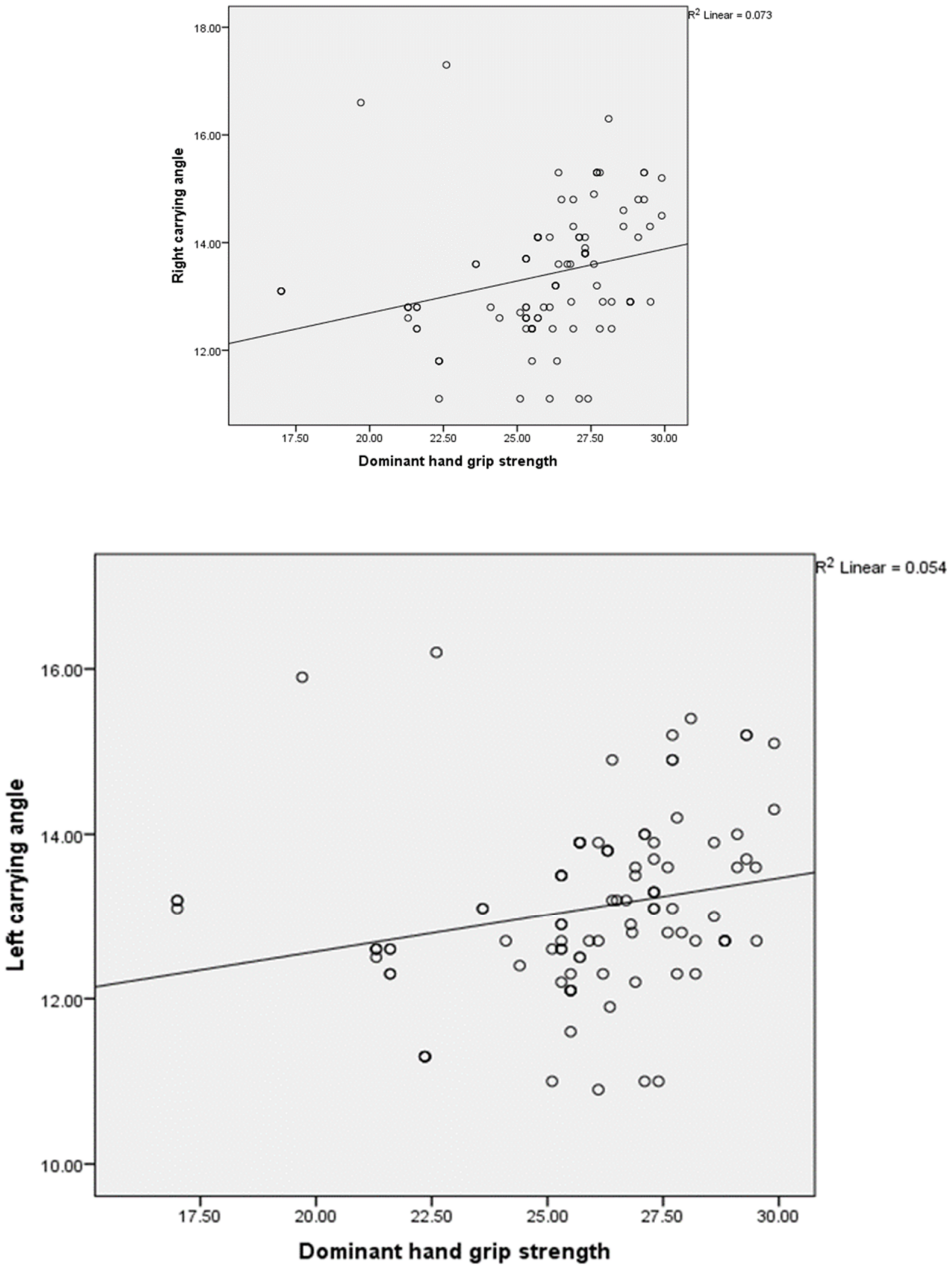

Fig 1: Scatter diagram showing significant positive correlation of right and left carrying angle with hand grip strength (n=?)

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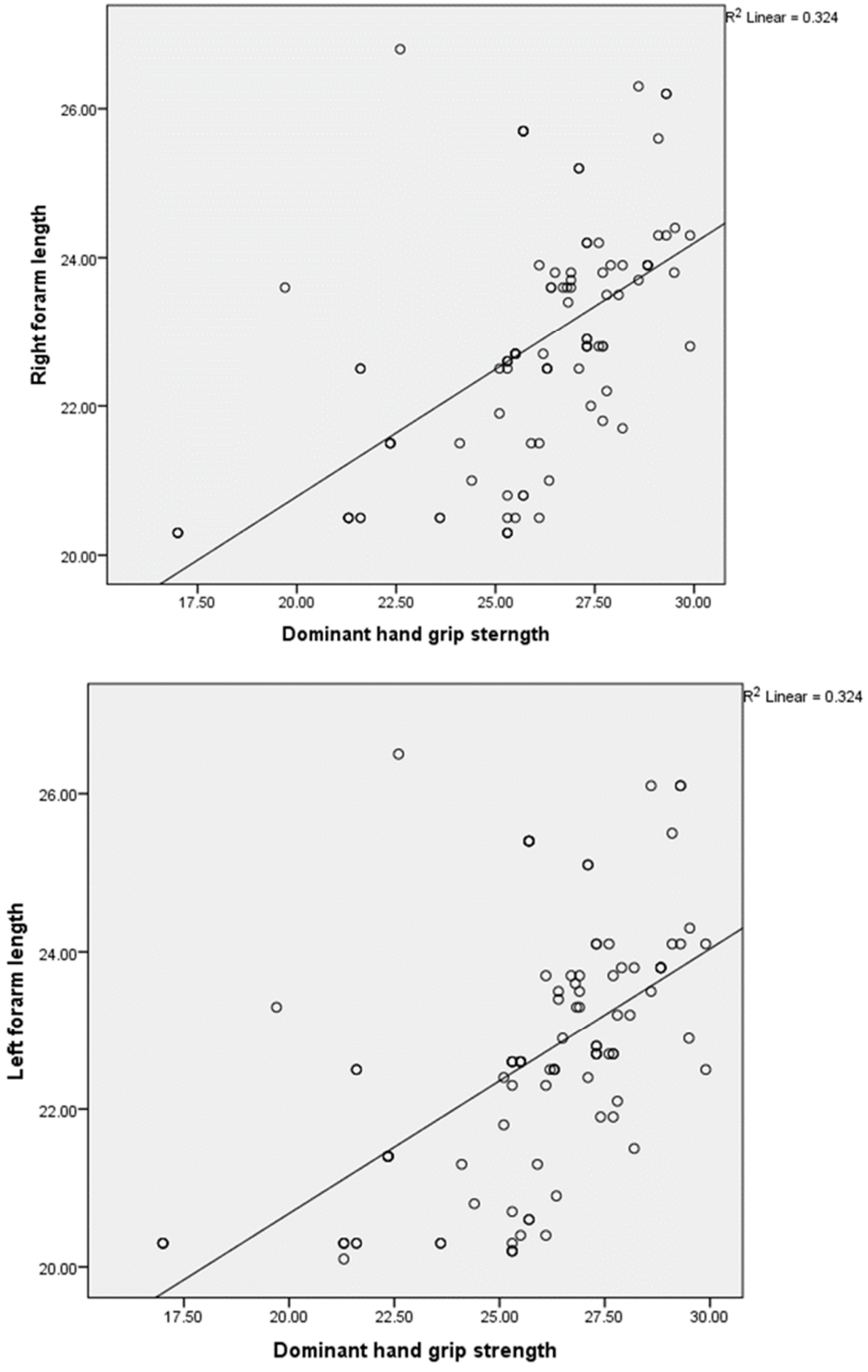

Fig 2: Scatter diagram showing significant positive correlation of right and left forearm length with hand grip strength (n=?)

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Discussion

Handgrip strength is widely used to evaluate the total muscular strength. In addition to being a predictor of future health outcomes including the risk of disability and mortality, handgrip strength is also a measure of nutritional status[6].

In present study findings, the right handgrip strength which is the dominant handgrip strength was 25.82±2.76 kg. The results of this investigation aligned with the data published in previous studies[6,7,8]. Akther et al in study observed the mean grip strength 25.59±3.24 kg[8]. Additionally, Razzaque et al observed that of the right side grip strength of subjects aged 21–25 was 24.40±2.24 kg, for subjects aged 26–30 it was 25.41±3.05 kg, and for subjects aged 31–35 it was 27.66±2.83 kg[6]. According to the current study, the left hand's handgrip strength ranged from 12.30 to 20.20 kg, with the mean value of 17.74±1.82 kg. The observation of the variable finding was noted by other investigators. The handgrip strength measured by Awotidebe et al. on the non-dominant hand was 20.08±6.39 kg in their study[7]. Moreover, Ashrafuzzaman et al observed that, on the left side, individuals aged 21-25 years exhibited mean hand grip strength of 20.88±1.45 kg, those aged 26-30 years showed 21.05±2.02 kg, and individuals aged 31-35 years had 21.46±1.61 kg[9].

In this study, carrying angle on the right side was 13.39±1.21 degree (range: 11.10-17.30 degree) and left side was 13.09±1.07 degree (range: 10.90-16.20 degree on left side). Ruparelia et al., found that the mean carrying angle of 173 female was 11.85±2.27 degree on right side and 11.04±2.20 degree on left side[10]. The findings were dissimilar to Nayak et al[11]. They observed that carrying angle is negatively correlated with grip strength. According to them, a larger carrying angle may cause the forearm muscles to function less effectively, which could result in a reduction in grip strength.

According to the present study, the mean forearm length of the subjects was 22.77±1.67 cm on the right side and 22.64±1.63 cm on the left side. On the right side, the minimum length was 20.30 cm, and the maximum length was 26.80 cm. On the left side, the minimum length was 20.10 cm, and the maximum length was 26.50 cm. Findings of present study were different from study of Fallahi and Jadidian and Uzun et al.[5,12]. Fallahi and Jadidianobserved that the mean forearm length of 40 athletes was 26.86±1.84 cm, and 40 non-athletes was 25.76±2.05 cm. The difference in forearm length of both groups was statistically significant ($p<0.05$) [5].

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Uzun et alfound the mean forearm length on the right side was 26.64 ± 2.19 cm in Turkish female university students[12]. There was a significant positive correlation ($p<0.001$) between the handgrip strength with forearm length observed in the *present* study[12]. Singh et al found a significant positive correlation ($p<0.05$) of handgrip strength on both sides in 320 boys and girls of Panjab, India[13].

Conclusion

The study revealed that forearm anthropometric parameters positively correlated with the dominant (right) handgrip strength of Bangladeshi tea garden workers. The data will be helpful in developing a set of anthropometric measurements that are standard for Bangladeshi women working in tea gardens

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