ORIGINAL RESEARCH ARTICLE

Relationship of Hand-Grip Strength and Endurance Time With an Individual's Anthropometric Parameters - A Study in Adolescent Population of Jammu.

Manvi Gupta[1], Manisha Jindal[2], Bijli Nanda[3] & Sushant Suri[4]

[1]Junior Resident, [2]Professor & Head and Associate Dean, [3]Associate professor, Department of Physiology, SMS & R, Sharda University, Plot 32-34, Knowledge Park-III, Greater Noida, U.P.-201306.

[4]Director, Fin Guru Education Private Limited, 29 Babar Road, Bengali Market, New Delhi-110001.

Abstract:

***Purpose:** To find relationship of hand grip strength and hand grip endurance time with anthropometric parameters in adolescent population.*

***Procedure:** A cross-sectional study was conducted on 301 randomly selected participants of age 12-14 years. Participants' weight and height were measured, BMI calculated and subjects classified as normal weight, overweight and obese as per Consensus Statement on diagnosis of obesity and metabolic syndrome in Asian-Indians in 2009. Handgrip strength and endurance time were recorded at 70% submaximal contraction using INCO handgrip dynamometer. The data was compiled and statistically analysed using paired and unpaired t-tests and Pearson's coefficient of correlation.*

***Findings:** Endurance time and handgrip strength was higher in males than females (p-value<0.05). Significant positive correlation was seen between both height and weight with endurance time and handgrip strength among normal weight subjects (p-value<0.05 for both). However there was no significant correlation of overall BMI with endurance time.*

***Conclusions:** Good height would lead to longer arms with greater lever arm for force generation, resulting in an efficient amount of force, which may positively influence endurance time. BMI is an indicator of body mass and does not account for fat percentage. It is unable to differentiate between weight changes due to change in muscularity and body fat percentage hence results may vary in overweight and underweight subjects. Percentage of Body fat (PBF) may be a better tool than BMI. Hand Grip Strength and Hand Grip Endurance may be used for assessing an individual's physical performance for both occupational and non-occupational tasks.*

***Key words:** Adolescent population of Jammu, Body Mass Index (BMI), Hand Grip Endurance, Hand Grip Strength.*

Introduction

Clark HH in 1971, described physical fitness as the ability to carry out daily tasks with vigour and alertness without undue fatigue, to have ample energy to enjoy leisure time pursuits, to meet unusual situations and unforeseen situations [1]. In other words it is the ability to make physiological adjustments to the stress imposed by a specific task. It is the prime criterion for survival, to achieve any goal and to lead a healthy life. Ancient Vedas have also mentioned about the advantageous effects of exercise in achieving good physical fitness [2]. In last few years, childhood obesity is increasingly being observed with the changing lifestyle of middle and upper class families, increasing hours of inactivity due to television, video games and computers and fast food culture.

Address for correspondence:
Dr. Manvi Gupta
Junior Resident
Department of Physiology
School of Medical Sciences and Research Sharda University, Greater Noida, U.P. - 201306, India.
Email: mani.smiles@gmail.com

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In last few years, childhood obesity is increasingly being observed with the changing lifestyle of middle and upper class families, increasing hours of inactivity due to television, video games and computers and fast food culture. Globally, an estimated 10% of school-aged children, between 5 and 17 years of age, are overweight and obese. Obesity – "New World Syndrome" as it has been recently renamed, is creating an enormous socio-economic and public health burden in poorer countries. Alongside, high prevalence of underweight children in urban set up has also been observed due to increasing fussiness for selected food and readymade items with low protein content and being over conscious about their body image. This may also have impact on their physical efficiency. Body Mass Index [BMI] is a summary measure of an individual's height and weight. It is an easy, inexpensive and non-invasive method for establishing weight status [4].

Most of our routine activities as well as sports activities require a good usage of muscles involved in gripping strength. Hand Grip Strength (HGS) is a form of isometric static contraction test which measures the flexor mechanism of hand and forearm. It is an easy to assess parameter for evaluation of physical fitness and nutritional status. It has come to be regarded as a highly reliable clinical measure of human strength [5] and provides an objective index of functional integrity of upper extremity. It assesses the patient's initial limitations and provides a quick assessment of patient's progress through treatment. Maximum voluntary Contraction of grip strength has been suggested as a subjective measure of assessing the worthiness of upper limbs and an overall good measure of muscle strength [6] [7]. Endurance of the muscle refers to its capacity to withstand the power produced during activity. In other words, Handgrip endurance (HGE) is ability to sustain a muscular force [5]. It has often been used as a measure of physical performance. Both HGS & HGE play a pivotal role in prevention of injuries especially during sports activities.

HGS has been found to be affected by various known factors including age, body size, posture, hand dominance, forearm girth etc, however the impact of some anthropometric parameters especially BMI is controversial. In the past, conflicting results have been reported by studies conducted on this parameter and many more factors have been found to influence it. However, not many studies have been conducted in Northern India on this subject.

Since today's adolescents are tomorrow's workforce, hence the importance of conducting this study.

This study would be of value in medical anthropology research, population studies and in physical therapy treatment strategies for diagnosis and rehabilitation of upper limbs [13].

Material & Methods:

A cross-sectional study was conducted on 301 randomly selected apparently healthy participants of age 12-14 years.

BMI was assessed using a standardized weighing machine and height scale according to the following formula: BMI = mass in kilograms/ (height in meters)^2. Subjects were classified according to Consensus Statement for Diagnosis of Obesity and Metabolic syndrome for Asian-Indians 2009 [14].

Classification as per Consensus Statement for Asian Indians 2009:

Underweight : <18 kg/ m^2

Normal BMI: 18-22.9 kg/m^2

Overweight: 23.0-24.9 kg/m^2

Obesity: 25& above kg/m^2

Maximal Handgrip strength (Tmax) was recorded and endurance time measured at sub maximal contraction (70% Tmax) using INCO handgrip dynamometer. Participation of subjects was voluntary. Informed consent was obtained by the concerned parents of subjects. Confidentiality of the data was ensured.

The data was compiled and statistically analyzed using paired and unpaired t-tests and Pearson's coefficient of correlation. Paired t-tests were done to compare anthropometric data v/s grip strength and endurance time. Unpaired t-tests were done to compare normal weight with overweight groups. Gender-wise comparisons were also done. Descriptive data are presented as mean ± standard deviation. Results were considered to be significant if their associated p-value were less than 0.05.

Observations and Results:

In Present study 301 subjects were selected, out of that 178 (59.1%) were male and 123(40.9%) females.

Table 1: ***Gender wise distribution of subjects as per BMI category, out of total male and female subjects.***

Category	*Male*	*Female*	*Total*
Under Weight	*12(7%)*	*7(6%)*	*19(6%)*
Normal	*112(63%)*	*90(73%)*	*202(67%)*
Overweight	*36(20%)*	*17(14%)*	*52(17%)*
Obese	*18(10%)*	*09(8%)*	*28(9%)*

6% of total subjects were underweight and 26% were overweight (including obese).

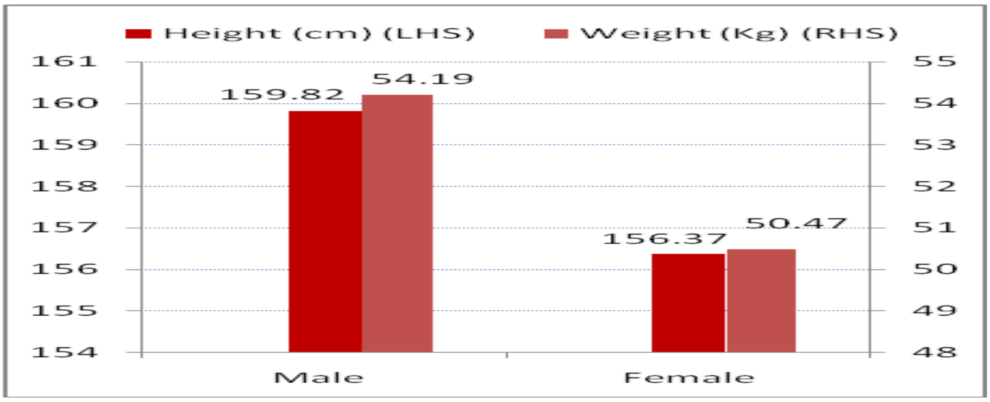

Figure 1: Gender Differences of Height & Weight

Mean observed height and weight of subjects was 158.22 cm (range - 117 to 197cm) and 52.47 kg (range - 30 to 95kg) respectively.

Table 2: Gender differences in HGE & HGS with p-values

	Male Mean±SD	**Female Mean±SD**	**P-value**
HGE(sec)	43.55±28.84	32.38±21.25	0.00
HGS (Kg)	39.12± 8.79	35.08±7.94	0.00

Mean values of Endurance time in males and females were 43.55 sec and 32.38 sec respectively. Mean value of HGS in males and females were 39.12 kg and 35.08 kg respectively, with mean of 37.25 kg.
Endurance time and handgrip strength were significantly higher in males (p-value<0.05)
Significant positive correlation was observed between

i) Height, Weight, BMI and HGS
ii) Height, Weight, with HGE

HGS was found to be significantly higher in obese category as compared to normal category. There was positive correlation of BMI with HGE, however it was not significantly different in the various BMI categories (r = 0.05)

Table 3: HGE & HGS under different BMI Categories

	Underweight	**Normal**	**Overweight**	**Obese**
HGE (sec)	**35**	**37**	**38**	**49**
P-values Normal vs. others	**0.80**		**0.83**	**0.07**
HGS (kg)	**35**	**36**	**39**	**41**
P-values Normal vs. others	**0.58**		**0.12**	**0.02**

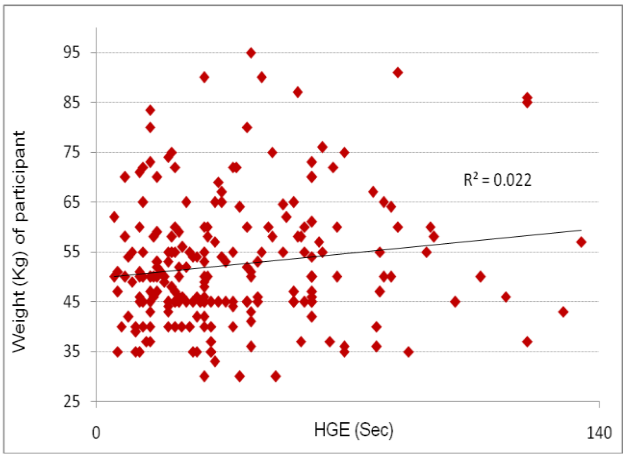

Figure 2: Scatter Plot of Weight vs. HGE for all subjects

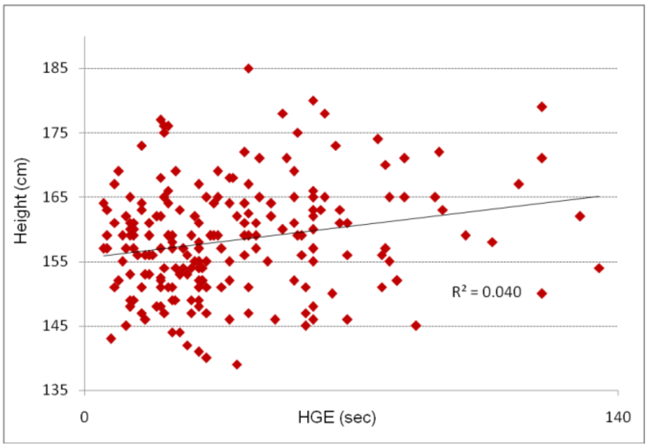

Figure 3: Scatter Plot of Height vs. HGE for all subjects

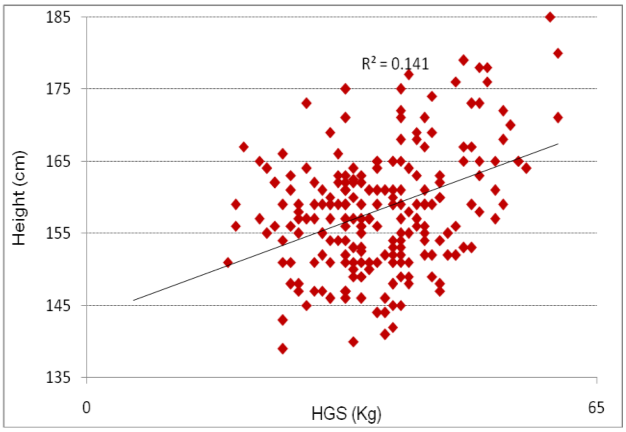

Figure 4: Scatter Plot of Height vs. HGS for all subjects

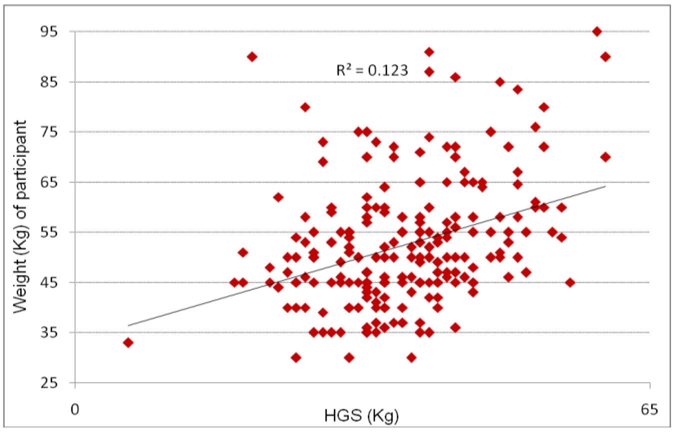

Figure 5: Scatter Plot of Weight vs. HGS for all subjects

Discussion:

Endurance time and handgrip strength were significantly higher in males than females (p-value<0.05) conforming to the findings of Ibegbu Augustine Oseloka et al (2014) [15]. These results could be attributed to different energy metabolisms and effect of testosterone in males. Morehouse LE et al (1967) attributed muscle strength to be largely determined by muscle girth; a muscle with a larger cross-sectional area can generate more force and therefore lift more weight than one with a smaller cross sectional area [16]. In consonance with these findings, Astrand PO et al (1970) reasoned that because the male hormone testosterone enlarges muscles, men tend to be stronger than women [17]. This gender disparity is independent of the measuring device. Gutmann E et al (1970) further added that since testosterone also increases type II fibres [18] which are the fast fibres with high activity of glycolytic enzymes and a higher proportion of type II fibres in males would thus be consistent with our findings of greater muscle strength in males.

Significant positive correlation was seen between both height and weight with endurance time and handgrip strength (p value<0.05 in all cases). Our findings were in agreement with studies of Chatterjee S et al (1991) [9] and Ibegbu Augustine Oseloka et al (2014) [15] who also found that hand grip strength when measured by Jammer hand dynamometer was positively correlated with weight and height. Sartorio et al (2002) [19] have reasoned that good height would lead to longer arms with greater lever arm for force generation, resulting in an efficient amount of force, which may positively influence endurance time. On similar lines Chillima DM et al (2001) [20] found poor muscle strength and HGS to be associated with lower body weight and poor nutritional status whereas Bandyopadhay A (2008) [21] reported that muscle strength may be impaired in obese and this impairment may be a consequence of both obesity and low physical fitness.

This study showed that there was no significant correlation of overall BMI with endurance time in coherence with the findings of Umesh Pralhadrao Lad et al (2013) [6] and Chatterjee S et al (1991) who did not find a positive correlation between BMI with HGE. In fact they observed that on both sides of the BMI, HGE tended to decrease in both males and females. In tune with the above findings, Mahmut Eksioglu (2011) [22] also demonstrated that HGE did not show any relationship with physical parameters and rather found endurance time to have a negative correlation with BMI. Umesh Pralhadrao Lad et al (2013) [6] reasoned that absolute handgrip strength may not be hampered with but the handgrip endurance will start declining with increasing body fat percentage but not with increasing body weight. Their study revealed that the overweight group had negative correlation with handgrip endurance unlike the findings of our study. This suggests that excess fat was a limitation for the endurance of the overweight participants and that it was expected to be significant with the increasing body fat percentage.

Malina RM et al (1999) and Kok P et al (2004) [23,24] commented that BMI being an indicator of body mass, does not take the fat percentage into account as an index, and is unable to differentiate between weight changes which are due to an increase or decrease in the muscularity and the body fat percentage. Goacher PJ et al (2012) [25] suggested that perhaps PBF (Percentage Body Fat) would be a more accurate indicator of body composition related health risk.

Conclusion:

Hand Grip Endurance & Hand Grip Strength are reliable measures of isometric muscle activity and can be easily used as inexpensive tools to assess functional muscle fitness of upper extremity and general motor power. Thus we can safely conclude that Hand Grip Strength and Hand Grip Endurance may be used for assessing an individual's physical performance for both occupational and non-occupational tasks.

Though our study was not vast, it does provide a glimpse of the gender differences and influence of various anthropometric parameters on handgrip strength and endurance on handgrip strength and endurance in young males and females.

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