Correlation between hand grip strength and anthropometric measurement among undergraduate medical students

Shrestha P,[1] Mansur DI,[2] Maskey S,[1] Shrestha S,[3] Reena Kumari Jha[4]

[1]Pragya Shrestha, Assistant Professor; [2]Dil Islam Mansur, Professor; [1]Sunima Maskey, Assistant Professor; [3]Sheprala Shrestha, Lecturer, Department of Anatomy; [4]Reena Kumari Jha, Associate Professor, Department of Physiology, Kathmandu University School of Medical Sciences, Chaukot, Kavrepalanchok, Nepal.

Abstract

Background: Hand grip strength is a simple procedure of assessing the function of hand and forearm. It can be used as a tool to evaluate nutritional status of individual, neurological disorder and to assess the post-operative status of the patient. The grip strength is affected by different variables such as geographical variation, gender, height, weight, body mass index and handedness of the individual.

Objective: This study aims to correlate hand grip strength with gender, height, weight, body mass index and handedness among Nepali population.

Methods: The study was analytical cross-sectional study conducted in students of Kathmandu University School of Medical Sciences. Convenience sampling was used. The height of the participants was taken by using Stadiometer in centimeter and weight was taken by using weighing machine in kilogram and body mass index was calculated. Hand grip strength was obtained by using Dynamometer measured in kilogram. The data were entered in Microsoft Excel Sheet and analysis was done in SPSS version 16.0.

Results: Hand grip strength showed moderate positive correlation with both height and weight both in both dominant and non-dominant hands. Hand grip strength was positively correlated in underweight, normal weight and obese category of body mass index whereas overweight category was negatively correlated.

Conclusion: Hand grip strength shows correlation with the gender, height, weight and body mass index.

Key words: Body height; Body mass index; Body weight; Hand grip strength.

INTRODUCTION

Hand Grip Strength (HGS) has been described as the power of combined contraction of extrinsic and intrinsic muscles of hand that flex joints of the hand.[1] It can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer.[2] Hand grip strength measurement is a simple procedure of assessing the function of hand and forearm.[3]

Many studies in the world have shown higher value of HGS among male compared to female.[4,5] Study shows positive correlation with body height and body weight.[5] Most of Researchers have claimed the difference in HGS up to 10% based on dominance of the hand.[6]

It can be used as a tool to monitor and evaluate nutritional status, evaluation of patients with Rheumatoid Arthritis, to get information about neuro-muscular co-ordination, as well as to identify patients at risk of poor health care outcome.[7-10]

Besides, there are a very few studies regarding the correlation of HGS with anthropometric measurements among Nepali population. Therefore, this study aims to obtain the correlation between HGS and anthropometric measurements which may ultimately help the clinicians in their patient evaluation and treatment plan.

METHODOLOGY

An analytical cross-sectional, quantitative study was conducted in the Department of Anatomy, Kathmandu University School of Medical Sciences (KUSMS), Dhulikhel, Kavrepalanchok, Nepal after the approval from Institutional Review Committee (Ref. IRC-KUSMS 168/22). The study was conducted from 2022 October to 2022 December. The apparently healthy students of KUSMS were included in the study after they were explained about the objective of the study and written informed consent was taken. The students with recent hand injury or surgery and with some congenital deformities were excluded from the study. Convenient sampling was used.

The sample size was calculated as: n= Z^2 x p x q / e^2
= $(1.96)2$ x (0.5) x (0.5) / $(0.06)^2$
= 266.77 ≈ 270.

Where, n= minimum sample size required; Z= 1.96 at 95% Confidence Interval (CI); p = past prevalence (0.5); q= 1-p e = 0.06 (margin of error, 6%). The sample size obtained was 266.77 and the study was done among 270 students.

Body height was recorded in centimetres from Stadiometer while the subject standing in "Anatomical Position" and body weight was recorded from weighing machine recorded in kilogram. The subject was subsequently instructed to sit on the chair with straight back and shoulders close to the body. The forearm was placed on the table with the elbow flexed at 90° without rotation. After that the subject was instructed to squeeze the dynamometer with the maximum force and the hand grip strength was recorded in kilogram. Similarly, the hand grip strength of the non-dominant hand was also recorded.[4]

The body mass index (BMI) was calculated using Centres for Disease Control and Prevention (CDC) guideline. The BMI was categorised as: <18.5 kg/m^2 as underweight; 18.5 - 24.99 kg/m^2 as the normal weight; between 25 - 29.99 kg/m^2 as overweight; ≥30 kg/m^2 as obese.[11] The confidentiality of the data was maintained.

The data were entered in Microsoft Excel Sheet and analysis was done in SPSS Statistics for Windows, version 16.0 (SPSS Inc., Chicago, Ill., USA). The gender wise calculation of HGS was tabulated and correlation of the variable was done with Pearson's Correlation.

RESULTS

The study was done in 270 individuals, out of which 143 (53%) were male and 127 (47%) were female. The mean age of the individuals was 20.41 ± 1.84 years.

The association between HGS with height and with weight were assessed by Pearson's correlation coefficient (R). Height and HGS indicated moderate positive correlation both in dominant and non-dominant hand. Likewise, weight and HGS also showed moderate correlation in both dominant and non-dominant hand (Table 1).

On the basis of categorisation of BMI, the maximum number of the participants (200, 74.1%) were in normal weight category. The HGS among normal individual showed significant and weak positive correlation. However, there was negative correlation of HGS among overweight participants. The minimum HGS value was observed in overweight category (Table 2).

Among the participants, right hand was dominant in 258 (95.6%) individuals and left hand was dominant among 12 (4.4%)individuals. The difference in HGS of dominant and non-dominant hand was insignificant both in right and left-handed individuals as assessed by paired sample t-test (p >0.05) (Table 3).

The HGS value of male and female showed significant difference (p>0.05) in both dominant and non-dominant hand (Table 4).

Table 1: Correlation of HGS with height and weight

		Dominant HGS	Non-dominant HGS
Height	R	0.50	0.46
	p-value	<0.001	<0.001
Weight	R	0.49	0.50
	p-value	<0.001	<0.001

Correlation is significant at 0.05 level (two-tailed)

Table 2: Correlation of HGS and BMI

BMI	Dominant Hand			Non-dominant Hand		
	Mean(kg)	R	p-value	Mean(kg)	R	p
Underweight	38.06±22.49	0.30	0.94	36.81±21.65	0.20	0.26
Normal weight	40.41±22.69	0.14	0.04	41.63±21.86	0.20	<0.001
Overweight	46.28±20.85	-0.05	0.79	46.20±22.19	-0.92	0.66
Obese	29.45±22.00	0.14	0.67	31.73±16.97	0.33	0.31

Table 3: Correlation between dominant and non-dominant on the basis of dominance

Handedness	Dominant Hand (kg)	Non-dominant hand (kg)	p-value
Right Handed	40.11±22.68	40.95±21.35	0.27
Left Handed	49.17±20.26	52.00±27.58	0.53

Table 4: HGS value of dominant and non-dominant hand

	Male (kg)	Female (kg)	p-value
Dominant Hand	53.62± 22.36	25.43±10.29	<0.001
Non-dominant Hand	53.90±21.29	27.06±11.04	<0.001

DISCUSSION

The study has shown the value of HGS increase with increase in height and weight. On the basis of BMI category, the value of HGS was minimum among the obese individuals. There is significant difference in the HGS among male and female. But the difference between dominant and non-dominant hands show insignificant difference both in right and left-handed individuals.

The HGS value of the male population of the present study is 53.62 ± 22.36 kg and 53.90±21.29 kg in dominant and non-dominant hands respectively which is slightly more than a study among the Nepali population.[12] Another study among the Nepali population reported the value of HGS of female population similar to the present study. But the value of male population was less than the present study.[13] The studies among Indian population reported the value of HGS less than the present study among both male and female.[14,15] HGS shows geographical variation and imposes the need of region specific HGS.[16] Besides the inclusion of different age groups of the participants in various studies may vary the result from the present study.

Studies conducted in different part of the world has revealed that value of HGS of male significantly more than that of female which is in congruence with the present study.[17,18] The reason behind more grip strength among male could be greater lean body mass as well as more amount of fast twitch fiber compared to female.[19] Hormonal difference in puberty leads to increased lean body mass for male and increased body fat for female resulting in difference in strength.[17]

The present study reported no significant difference in value of HGS among dominant and non-dominant hands both in right handed as well as left handed individuals. In contrast, a study among Turkish population reported the dominant hands had significantly more value than non-dominant in right handed individuals. But in left handed individuals the difference was insignificant.[20]

Based on correlation analysis there was moderate positive correlation between height and HGS both in dominant and non-dominant hand in this study. Moreover, the study among Mexican population formulated strong correlation between height and HGS (R=0.75, p<0.01).[21] A study in Brazilian population postulated a weak correlation between the aforesaid parameters (r=0.28,p<0.01).[22] The ethnicity and genetic variations may instigate such disparity.

A study reported moderate and positive correlation between the dominant body weight and HGS (r =0.316, p<0.01) comparable to the present study.[22] The value presented by a study in Saudi Arabian population was analogous.[23]

A study among Korean population reported that HGS of underweight category of BMI was weaker and overweight category was stronger comparable to the present study.[24] A study has hypothesised decrease

in strength due to lower muscle mass in underweight individuals.[25]

Interestingly, the grip strength was least in the obese individuals similar to this study among Indian population.[14] The reason behind the decrease in HGS with obesity may be owing to decreased muscle mass due to fat accumulation and phenotypical transition of fast twitch fibers to slow twitch fibers.[26] Besides a longitudinal study among American population has stated that muscle strength is inversely proportional to the excessive body fat and excessive abdominal fat.[27]

The Pearson's correlation analysis of normal weighed individuals indicated increase in HGS with increase in BMI which is in congruence to this study.[14] This may be supported by a hypothesis that states increase in muscle mass result in increase in strength.[25] However, a study reported decrease in HGS with increase in BMI among normal weighed individuals.[18]

A study revealed a decrease in HGS with increase in BMI in overweight individuals alike the present study.[18] A study in the Jammu Kashmir of India has shown the value of HGS increase along with increase in BMI among obese individuals similar to this study.[14]

The present study has certain limitations. The study was done in specific age group with limited sample size due to time limit. As the value of HGS is affected by age groups the future study with larger sample size and inclusion of different age groups need to be done. Besides the study should represent the sample from different part of Nepal.

CONCLUSION

The study reported the influence of gender and BMI on the value of HGS. Thus, it emphasizes the need of sex specific value of HGS. This study also highlights the correlation of HGS with height and weight of the individuals.

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