Journal Of Biomedical Investigation (JBI) Vol. 12 no. 1 April-May 2024

DOMINANT BODY SOMATOTYPE AND GENDER DIFFERENCES IN HAND GRIP STRENGTH OF YOUNG ADULTS IN A NIGERIAN UNIVERSITY

Authors:

IBIKUNLE, Peter O. [1]; EZIKE, M. I. [1]

Author Affiliations:
[1].Department of Medical Rehabilitation, Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi campus.

Corresponding Author:
Prof. Peter Olanrewaju Ibikunle,
email: po.ibikunle@unizik.edu.ng.

Received: 16/3/2024; accepted for publication 21/4/2024

Abstract

Background: Hand Grip Strength (HGS) is a measure of the grasping power of an individual and a known indicator of physical capability in males and female who evidently have different body compositions, and may be used to evaluate patient recovery progress throughout injury treatment and rehabilitation.
Aim/ Objective: To determine the influence of dominant body somatotype and gender on hand grip strength of young Adults in a Nigerian University.
Material/Methods: This was an ex-post facto research which was carried out among 162 undergraduates in Southern Nigeria. An electronic handheld dynamometer was used to evaluate the handgrip strength while the Heath-Carter Instruction Manual was used to determine the anthropometric dominant body somatotype. Data collected was summarized using descriptive statistics of frequency, percentages, mean and standard deviation, and analyzed using inferential statistics of Pearson's Product Moment Correlation, Two-way and one-way ANOVA at an alpha level of 0.05.
Result: Endomorphy was more predominant in the population than mesomorphy and ectomorphy (48.1%, 25.3% and 26.5%). A significant effect was found in dominant body somatotype on the left and right hand grip strength ($t = 11.959$, $p = 0.001$ and $t = 9.817$, $p = 0.001$) with mesomorphy having the strongest effect on HGS, Furthermore, differences between genders and dominant body somatotypes in the left and right HGS was not significant statistically ($F_2 = 0.821$, $p = 0.442$) and ($F_2 = 0.553$, $p = 0.576$) but there was a significant main effect for dominant somatotype ($F_1 = 149.188$, $p = 0.001$) and ($F_1 = 135.552$, $p = 0.001$). Mesomorphic males were seen to have greater HGS. Result also revealed significant correlations between height and weight and HGS of both left and right hands ($r = 0.453$, $p = 0.001$), ($r = 0.408$, $p = 0.001$ and $r = 0.420$, $p = 0.001$).
Conclusion: Dominant body somatotypes as well as gender differences had a very significant

influence on handgrip strength.

Keywords: *Somatotype, Anthropometry, Kinesiology, Body Mass Index. Biomechanics*

Introduction

Somatotype is a quantitative term used to characterize the human body's current structure and makeup; it is based on a variety of features[1,2,3]. Also, it is a person's current morphological configuration[2]. According to Slankamenac *et al*., The Heath and Carter method is the approach to somatotype assessment that is most frequently utilized and this approach is most effective for sports science and is typically utilized in its anthropometric version which can reveal information about the body's proportions, composition, and shape [2,3]. Slankamenac *et al*. further proceeded to suggest that with respect to body height, the somatotype is made up of three basic elements: Endomorphy, Mesomorphy and Ectomorphy[2].

Ectomorphy is a body type in which people have small frames, quick metabolisms, minimal body fat, and a bony structure, narrow shoulders, are naturally thin, and genetically find it more difficult to put on weight or develop muscular mass than other body types[3]. Walden also defined Mesomorphy as a body type with a medium frame and bone structure, slender, muscular body mass, and naturally athletic body types. Mesomorphs typically have a growth hormone-dominant phenotype[3]. They are physically predisposed to gaining muscle easily and naturally maintaining reduced body fat levels as a result. Endomorphy was defined according to Walden, as a body type with a slower metabolism than other body types, a higher body fat ratio, and a naturally "softer" body mass[3]. Endomorphs are also insulin dominant, meaning their bodies readily store energy as body fat and yet, endomorphs can also easily put on muscle[3]. Endomorphs can maximize their performance by properly utilizing their natural strength with the right training and nutrition[3].

Nonetheless, body somatotype changes occur from birth through adulthood, although they can be influenced by nutrition and/or training[4]. Body somatotype varies greatly between individuals and may be influenced by calorie consumption, physical activity, sex, age, genetic variability, and the sociocultural environment, among other factors [5]. Somatotype assessment quantifies the body's shape and makeup, including the relative fatness, the relative robustness of the musculoskeletal system, and the relative linearity of the body[6]. For example, a 3-5-2 gives the magnitude of each of the component in fixed order, endomorphy is 3 mesomorphy is 5 while ectomorphy is 2. These figures give the magnitude of each of the three components. Ratings for each component that were less than or equal to ½-2½ were judged low, 3-5 are moderate or usual, while 5½ -7 are high[1].

The differences in physical features between males and females are referred to as "sex or gender difference"[7]. The limitations of human performance are assumed to vary depending on the physical and physiological distinctions between males and females [8]. According to Bhargava *et al*., understanding sex differences in disease etiology, therapies and outcomes begins with an awareness of differences in baseline physiology and associated mechanisms [9]. In this regard, both the general and athletic populations have repeatedly shown that men and women have different physical somatotypes, with men being more mesomorphic and women having a higher endomorphy rating [7,10].

Hand Grip strength (HGS) refers to the ability of muscle or group of muscles to exert or generate maximal voluntary force in relation to motor fitness and total body strength [11,12]. The Hand Grip Strength is a dependable, easy-to-use, and non-invasive test that evaluates the power of the hand muscles utilized for grasping or gripping [13]. Infact, literature supports the claim that HGS is an impartial and valid indicator of physical ability, frailty and risk of disability among adults as is associated with cardiovascular, respiratory, and cancer outcomes and also with mortality[14]. In this sense, handgrip strength refers to the amount of power needed to grab an object, which is essential for daily activities [15]. It is an essential source of energy for actions related to work. Stronger HGS indicates a firmer grasp or grip[15]. Moreover, according to Liao, HGS forecasts changes in muscle strength, physical movement, and capacity for daily activities as well as upper extremity function[15].

According to De *et al.*, many variables, including age, gender, limited range of motion, nutritional health, muscle strength, pain, and fatigue, have an impact on the strength of the grip[16]. Additionally, later studies established that gender, age, height, weight, and handedness affect the strength of the hand grip, hence making gender and age common and consistent variables in HGS performance[15,17]. Studies have even shown that there is a high preponderance for poor HGS amongst females as compared to males [18,19]. In spite of all these, there have been very few studies done on the influence of dominant body somatotypes and gender difference on the hand grip strength.

The quantification of grip strength is too great an importance. Given that it helps in identification and determination of the effectiveness of different treatment strategies in rehabilitation of the hand[20]. According to Depp, having good wrist and hand strength is a marker for overall muscle strength[21]. In athletes, it's important to have a strong grip to improve athletic performance and to help prevent injuries, but it's just as important in healthy adults[21]. Low grip strength can predict an increased risk of functional limitations and disability as we get older [21].

Also, in a study on healthy adults, it was observed that grip strength was lower in individuals with diagnosed and undiagnosed diabetes and hypertension[22]. Faris Almashaqbeh confirms the effect of gender difference on maximal hand grip strength, with a higher grip strength reported in males than that of females[23]. Despite all these, most studies compare HGS of males and females across different ages but fail to consider the dominant body somatotypes of these participants. Therefore, knowledge of dominant body somatotypes and different sexes on the hand grip strength of young adults will help in identification and determination of effectiveness of different treatment strategies in hand rehabilitation and also provide normative values for young adults, providing a basis for effective assessment of physicality as is affected by body somatotypes and gender difference. With the earlier highlighted gaps in mind, the researchers sought to bridge this gap by further determining the influence of dominant body somatotypes and gender on HGS amongst undergraduates of a South-Eastern Nigerian University.

Consequently, clinicians may better monitor the effectiveness of surgical and non-surgical hand problems across body somatotypes and different sexes[24]. This study may as well help clinicians have a reference data on the function of the upper extremity and changes in muscle strength, physical movement and ability to undertake activities of daily living, aiding the overall rehabilitation process of individuals with hand injuries[15]. This study may also provide a basis for comparison of handgrip strength in cases of hand injuries of right and left hands in hand rehabilitation, the data gotten from this study will give a clear identification for distinguishing normality and abnormality across different body somatotypes of different sexes on handgrip strength.

Materials and methods

The research design was an ex-post facto research design in which the attribute of the participants was measured once and for all. The research was conducted on both male and female undergraduates of a Nigerian University who were 200-500 level students of all departments under the Faculty of Health Science and Technology with a gross total of 2,901 students. These departments in no specific order include Medical Rehabilitation (562 students), Radiography (785 students), Nursing Science (402 students), Medical Laboratory Sciences (756 students), and Environmental Health Sciences (396 students).

Inclusion Criteria

All apparently healthy male and female undergraduates of the Faculty/Departments as listed above.

Exclusion Criteria

Members of the Faculty excluded from this research included pregnant students, and students apparent hand deformities.

Sampling Technique

The sampling technique was a proportionate stratified random sampling technique where participants were selected at random according to each stratum.

Sample Size

The sample size[25] of 162 participants was arrived at using G-power software version 3.1.9 with a 90% power to detect a large effect size at an alpha level of 0.05.

In no particular order, 31 students were recruited from the Department of Medical Rehabilitation, 43 students were recruited from Radiography, 22 students were recruited from Nursing Science, 44 students were recruited from Medical Laboratory Sciences and 22 students were recruited from Environmental Health Science. Using the formula (***No. of students/No. of students in faculty) * Sample size*** with all sub strata represented significantly.

Research Instruments

i. Height meter (locally made, Nigeria): This was used to measure the height of the participants to the nearest 0.1cm.
ii. Bathroom weighing Scale (HANA model, China): This was used to measure the weight in kilograms (kg) of the participants.
iii. Skinfold calipers (Slim guide model, China): This was used to measure the skinfold of the triceps, subscapular, supraspinale and medial calf skinfold in millimetres.
iv. Sliding/Venier calipers (Vogel, Germany): This was used to the biepicondyle breadth of the humerus and femur of the participant in millimetres.
v. Flexible Tape (butterfly brand, Nigeria): This was used to measure the girth circumference of the participants in centimetres.
vi. Tip felt marker (Nigeria): This was used to make marks on the area identified for measurement.
vii. Gripx Electronic Hand Dynamometer (EH101BL, made in China): This was used to measure hand grip strength by measuring the amount of tension produced in kilograms (kg) of the participants.

Procedure for Data Collection

Prior to commencement of this study, Ethical approval was sought and obtained from the Ethical Review Committee of the Faculty of Health Sciences and Technology, the Protocol number of the ethical approval is FHSTREC/023/00113. Before the commencement of the study, the researchers ensured all research instruments were well calibrated before use. The participants were fully informed about the purpose of the study and consent was sought and obtained before taking the measurements.

Measurement of handgrip strength

This was measured using a Gripx electronic handheld dynamometer (EH101BL). Each participant was instructed to sit on a chair with elbow flexed at 90 degrees and the forearm in semi-pronated position resting on the armrest of the chair. The participant was then asked to hold and squeeze the dynamometer for at least 3 seconds in order to get the maximal voluntary contraction. This was then read and recorded for both hands. It was measured three times with the mean average recorded as the handgrip strength in kilograms (kg).

Measurement of body somatotype

The body somatotype of each participant was assessed using the ***Heath-Carter anthropometric somatotype instruction manual.***

The Ten anthropometric dimension used to calculate the anthropometric somatotype were:

i. **Height:** This was taken against a height scale. Take height with the participant standing straight against an upright wall, touching the wall with the heels, buttocks and back.
ii. **Weight:** This was taken with a weighing scale with the participants wearing a minimal clothing and standing with shoes off.
iii. **Triceps skinfold:** A fold was raised at the back of the arm halfway along a line connecting the acromion and the olecranon process. This was taken with the participant's arm hanging loosely in the anatomical posture.
iv. **Subscapular skinfold:** The fold was raised on a line from the inferior angle of the scapula in a direction that is obliquely downwards and laterally at 45 degrees.
v. **Supraspinale skinfold:** The fold was raised 5-7cm (depending on the size of the participant) above the anterior superior iliac spine on a line to the anterior axillary border and on a diagonal line going downwards and medially at 45degrees.
vi. **Medial calf skinfold:** A vertical skinfold was raised on the medial side of the leg, at the level of the maximum girth of the calf.
vii. **Biepicondylar breadth of the humerus (right):** With the shoulder and elbow were bent to 90 degrees, this is the distance between the medial and lateral epicondyles of the humerus. The calipers was used at an angle that approximately bisects the elbow's angle.
viii. **Biepicondylar breadth of the femur (right):** The participant sat with the knee bent at right angle. The greatest distance between the lateral and medial epicondyle of the femur was measured with firm pressure on

the crossbar in order to compress the subcutaneous tissues.

ix. **Upper arm girth (right):** With the elbow flexed to 45 degrees and tensed, shoulder flexed to 90 degrees and hand clenched, elbow flexors and extensors maximally contracted, measurement of the greatest girth was taken with a tape.

x. **Calf girth (right):** The participant stood with feet slightly apart. The tape was placed around the calf and the maximum circumference was measured.

Method of calculating body somatotype from the Heath-Carter anthropometric somatotype instruction manual.

The equation to calculate Endomorphy is:

Endomorphy = - 0.7182 + 0.1451 (X) - 0.00068 (X 2) + 0.0000014 (X 3)

Where X = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm). This is called height-corrected endomorphy and is the preferred method for calculating endomorphy.

The equation to calculate mesomorphy is:

Mesomorphy = 0.858 x humerus breadth + 0.601 x femur breadth + 0.188 x corrected arm girth + 0.161 x corrected calf girth – height 0.131 + 4.5.

The equation to calculate Ectomorphy:

There are three different equations used to calculate ectomorphy according to the height-weight ratio (HWR):

If HWR is greater than or equal to 40.75 then;

Ectomorphy = 0.732 HWR - 28.58

If HWR is less than 40.75 but greater than 38.25 then

Ectomorphy = 0.463 HWR - 17.63

If HWR is equal to or less than 38.25 then

Ectomorphy = 0.1

Data Analysis

The data collected from this study was summarized using descriptive statistics of frequency distribution and percentage count, mean and standard deviation.

The inferential statistics of:

1. Pearson's Product Moment Correlation was used to analyze the correlation between hand grip strength of left and right hands and the height and weight of the participants
2. One-Way ANOVA was used to analyze the statistical effect of dominant body somatotype on handgrip strength.
3. Two-Way ANOVA was then used to analyze the statistical effect of dominant body somatotype and sex difference on handgrip strength to an alpha level of 0.05.

Results

The purpose of this study was to determine the Hand grip strength (HGS) using an Electronic Hand Dynamometer across various dominant body somatotypes of male and female apparently healthy undergraduates of the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University. One Hundred and Sixty-Two (162) undergraduate students participated in the study. They comprised of 80 males (49.4%) and 82 females (50.6%). Their mean Heights (X = 169.08, SD = 8.58) and Weight (X = 69.01, SD = 13.26) were taken, their Height-Weight Ratio (HWR) were also calculated. The magnitude of each participant's components was expressed in 3 categories Endomorphy (48.1%), Mesomorphy (25.3%) and Ectomorphy (26.5%). After this, the hand grip strength of both hands was measured. Exactly 65.4% of the participants had right hand grip strength dominance, 32.7% of the participants had left hand grip strength dominance, while 1.9% were ambidextrous.

Table 1 summarizes the socio-demographic and physical characteristics of the participants.

Table 2 reveals a statistical significant influence of dominant body somatotype on the left and right hand grip strength ($F = 11.959$, $p = 0.001$ and $F = 9.817$, $p = 0.001$) respectively.

A post-hoc analysis revealing the interacting effect between dominant body somatotypes and left and right-hand grip strength using the Turkey HSD test can be seen in Table 3. The interaction between Endomorphy and Mesomorphy was the only one of which had a significant difference with hand grip strength of the left and right hands.

Table 4 reveals that gender differences and dominant body somatotypes on the Left HGS did not significantly influence HGS ($F_2 = 0.821$, $p = 0.442$) but there was a statistically significant influence of dominant body somatotype ($F_1 = 149.188$, $p = 0.001$). However, the effect size was small (Partial Eta Squared = 0.010).

Table 5 also reveals that the interaction effect between gender difference and dominant body somatotype on the Right HGS was not statistically significant ($F_2 = 0.553$, $p = 0.576$); although a statistically significant main effect for between males and females was seen ($F_1 = 135.552$, $p = 0.001$). However, there was a small effect size (Partial Eta Squared = 0.007).

The post-hoc comparison using Turkey HSD test in Table 6 indicates an all-round statistical significance in the interaction effect of different body somatotypes and hand grip strength of the left and right hands, with dominant body somatotype significantly of main effect.

Table 7 reveals the correlation between the anthropometric variables of height and weight and HGS. There were significant positive correlations between height and right and left HGS ($r = 0.45$, $p = 0.001$ and $r = 0.48$, $p = 0.001$). Also, significant correlations between weight and right and left HGS ($r = 0.41$, $p = 0.001$ and $r = 0.42$, $p = 0.001$) were respectively revealed.

Table 1: Sociodemographic and Physical Characteristics of Participants

Variables	N	X±SD	Minimum	Maximum
Height (cm)	162	169.08 ± 8.58	146.00	196.00
Weight (kg)	162	69.01 ± 13.26	40.00	116,00
HWR	162	41.47 ± 2.18	34.33	46.55

KEYS: N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy

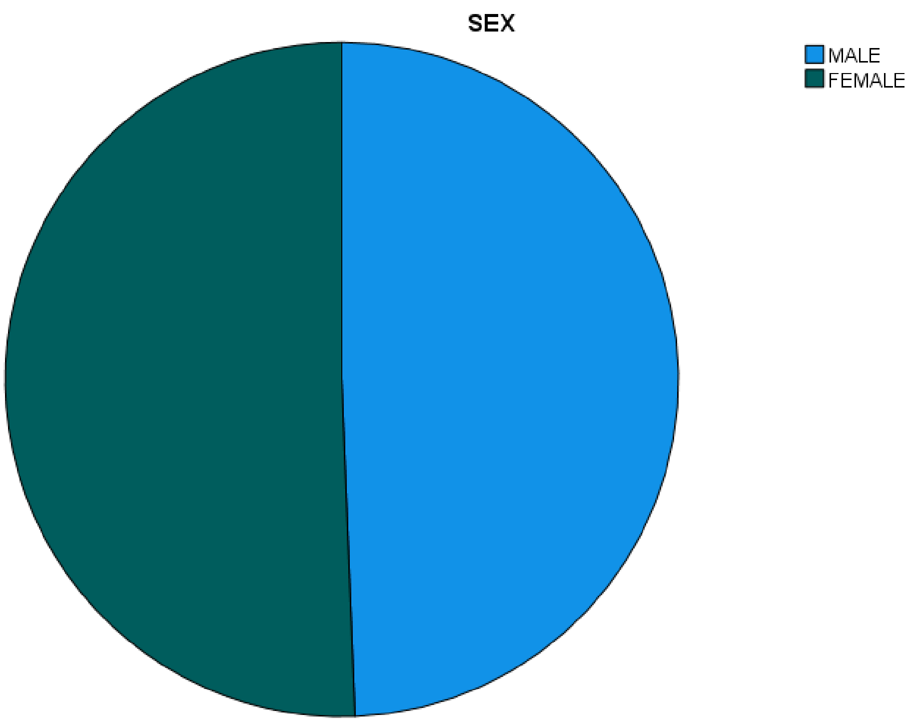

Figure 1: Gender distribution of participants

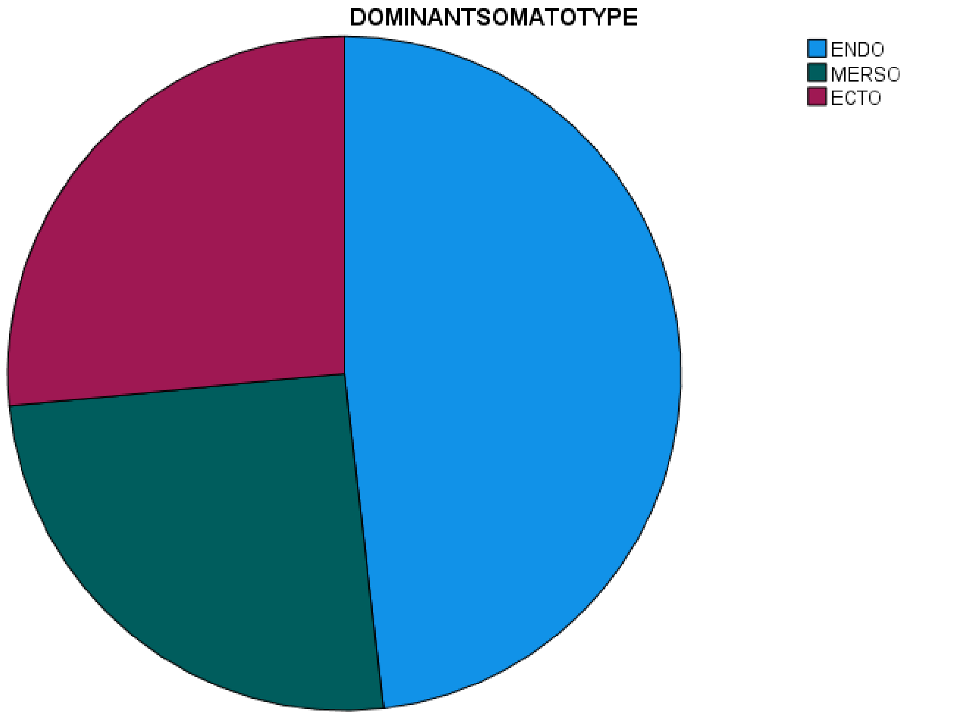

Fig 2 Distribution of Dominant body somatotype

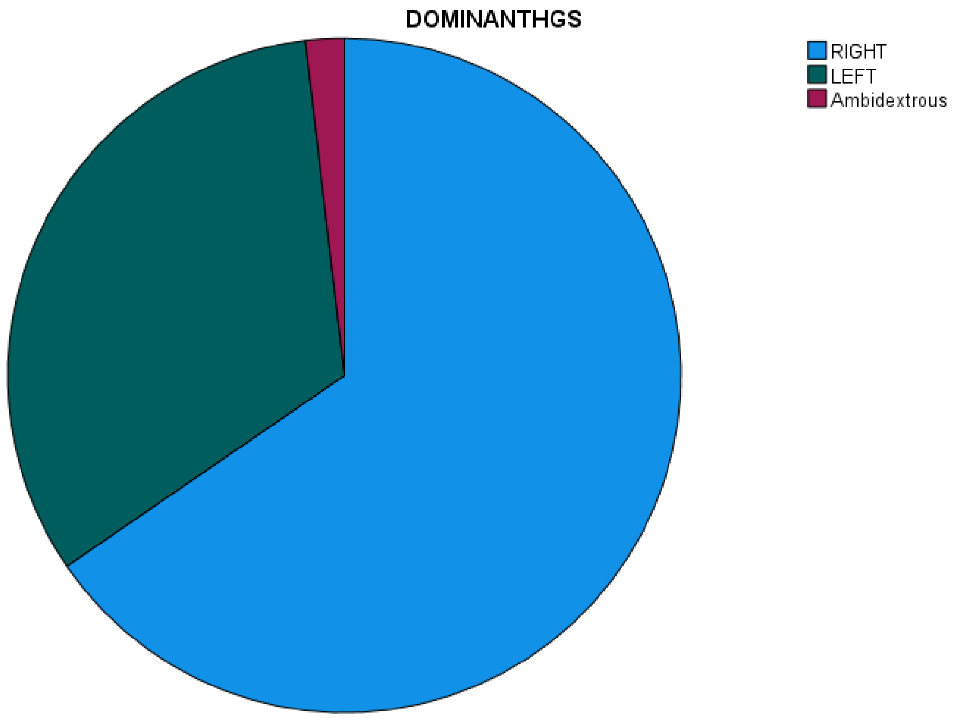

Figure 3: Distribution of Hand dominance of participants.

Table 2: Analysis of Variance Showing the Effect of Dominant Body Somatotype on Hand Grip Strength (Left and Right)

Variables	Dominant Body Somatotype	N	X ± SD	F-value	p-value
Left HGS (Kg)	Endo	78	31.80 ± 9.56		
	Meso	44	41.49± 11.98	11.959	0.001*
	Ecto	43	36.11 ± 9.99		
Right HGS (Kg)	Endo	78	33.86 ± 9.98		
	Meso	41	43.20± 12.34	9.817	0.001*
	Ecto	43	38.48± 11.68		

KEY
* - Significant at α = 0.05, N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy

Table 3: Post Hoc Analysis Using Turkey HSD Test Showing Interactive Effect of Dominant Body Somatotypes on Hand Grip Strength (Left and Right)

Variable		Dominant Body Somatotype (I)	Dominant Body Somatotype (J)	MD	p-value
HGS	**Left**	Endo	Meso	-9.6892	0.001*
			Ecto	-4.3108	0.075
		Meso	Endo	9.6892	0.001*
			Ecto	5.3784	0.048*
		Ecto	Endo	4.3108	0.075
			Meso	-5.3784	0.048*
	Right	Endo	Meso	-9.3408	0.001*
			Ecto	-4.6136	0.075
		Meso	Endo	9.3408	0.001*
			Ecto	4.7272	0.127
		Ecto	Endo	4.6136	0.075
			Meso	-4.7272	0.127

KEY
MD – Mean Difference, *- Significant at α = 0.05, N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy

Table 4: Two-Way ANOVA Showing Effect of Sex and Dominant Body Somatotype on Left Hand Grip Strength (HGS)

HGS	Sex	Dominant Body Somatotype	N	X ± SD	F_2-value	p-value	Comment
Left	Male	Endo	23	42.19 ± 7.79			
		Meso	28	47.30 ± 9.05			
		Ecto	29	40.84 ± 7.63			
					0.821	0.442	ns
	Female	Endo	55	27.45 ± 6.34			
		Meso	13	28.96 ± 6.72			
		Ecto	14	26.30 ± 6.61			

KEY:
MD – Mean Difference, *- Significant at α = 0.05, N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy, NS – Not Significant, S - Significant

Table 5: Two-Way Anova Showing Effect of Sex and Dominant Body Somatotype on Right Hand Grip Strength (HGS)

HGS	Sex	Dominant Body Somatotype	N	X ± SD	F_2 - value	p-value	Comment
Right	Male	Endo	23	44.46 ± 7.84			
		Meso	28	48.39 ± 10.40			
		Ecto	29	44.50 ± 8.41			
					0.553	0.576	NS
	Female	Endo	55	29.43 ± 7.01			
		Meso	13	32.05 ± 8.16			
		Ecto	14	25.99 ± 6.29			

KEY:
MD – Mean Difference, *- Significant at α = 0.05, N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy, NS – Not Significant, S – Significant

Table 6: Post Hoc Analysis Using Turkey HSD Test Showing Multiple Comparison Of Sex Difference And Dominant Body Somatotype On Hand Grip Strength (HGS) of Left And Right Hands

HGS	Dominant Body Somatotype (I)	Dominant Body Somatotype (J)	MD	p-value
Left	Endo	Meso	-9.6892	0.001*
		Ecto	-4.3108	0.007*
	Meso	Endo	9.6892	0.001*
		Ecto	5.3784	0.003*
	Ecto	Endo	4.3108	0.007*
		Meso	-5.3784	0.003*
Right	Endo	Meso	-9.3408	0.001*
		Ecto	-4.6136	0.009*
	Meso	Endo	9.3408	0.001*
		Ecto	4.7272	0.022*
	Ecto	Endo	4.6136	0.009*
		Meso	-4.7272	0.022*

KEY:
MD – Mean Difference, *- Significant at α = 0.05, N – Number of Participants, X – Mean, SD – Standard Deviation, HGS – Hand Grip Strength, Endo – Endomorphy, Meso – Mesomorphy, Ecto – Ectomorphy, NS – Not Significant, S - Significant

Table 7: Pearson Correlation between Anthropometric Variables (Height and Weight) and Hang Grip Strength (Left and Right)

Variables	HGS	p-value	r-values
Height	Right	0.001*	0.45
	Left	0.001*	0.48
Weight	Right	0.001*	0.41
	Left	0.001*	0.42

KEY:
*- Significant at α = 0.05, HGS – Hand Grip Strength

Discussion

The aim of this study was to determine the influence of dominant body somatotypes and gender difference on handgrip strength among young adults in a University in Southeast Nigeria.

Their grip strength was measured using an electronic hand dynamometer. The outcome of this research revealed that dominant body somatotype and gender difference had no significant influence on Handgrip strength. The dominant body somatotype among the male participants was ectomorphs and mesomorphs while those of the female participants was endomorphy. This was in line with a study done by Gaur *et al*., whose work enlisted 218 boys and 220 girls for participation[26]. The study concluded that there were notable sex differences in the dominant body somatotypes of adolescents with girls being significantly more endomorphic and boys being more mesomorphic, it was revealed in the study that this was because females had overall more fat deposits than males[26], possibly because of the somewhat less physically strenuous life female students lived in the school. The result of this study was also similar to the work of Awotidebe et al., whose interpretations were also that males were majorly ectomorphs and mesomorphs while females were dominantly endomorphic[27]. Findings from this research revealed positive significant correlation between anthropometric variables of height and weight and hand grip strength (HGS) of right and left hand of the participants. This is in line with the findings of Amaral *et al*., who found a positive correlation between hand grip strength, weight and height among adult and elderly populations in Rio Branco, Brazil[28]; and in line with the results of Awotidebe et al. which revealed that some selected anthropometric characteristics like body weight, height and body mass index had significantly positive correlation with HGS. This result was consistent with the findings of previous studies indicating that body compositions is related to muscle mass and distribution of fat deposit in human[15,17,27,29,30].

The results also revealed endomorphy as a more predominant somatotype among the research population with females having a higher endomorphy rating than males. From the findings of this study, dominant body somatotype had a significant statistical effect on hand grip strength. Mesomorphs who were characterized with muscular body mass and naturally athletic body had higher handgrip strength on both left and right hands than ectomorphs who had small frames and bony structures, and endomorphs with their higher body fat ratio respectively in that order . This finding is in line with that of Awotidebe *et al*., which found that body somatotype influenced the degree of handgrip strength[27]. This was revealed in a cross-sectional survey involving 385 young adults which showed that mesomorphs and then ectomorphs had higher hand grip strength in that order than endomorphs. This may be due to the fact that mesomorphs were characterized by muscular dominance than the other body somatotypes[27].This was consistent with the works of previous authors who noted that there is little doubt that variations in human anatomical structures could influence certain differences[31, 32]. This indicated that endomorphs expresses degree of adiposity development greater in females than in males whereas mesomorphs reflects muscle development known to be positively associated with strength and motor performance greater in males than females [18,19,27,31, 32].These findings are consistent with the findings of previous studies that mesomorphy is associated with males while endomorphy is related to female body shapes [27], [33]. A likely elucidation for these results may be due to the increased fat content in females for endomorph and increased muscular development in males for mesomorph[33].

Males had significantly higher handgrip strength on both right and left hands as compared to females as seen from the result of this study. This was in line with the study done by Ibikunle *et al.,* whose research revealed that boys showed more strength in their peak grip and grip strength on both dominant and non-dominant hands more than females[34].This is also in line with other authors who revealed from their works that Males had higher HGS than females[15, 17,18,19]. This might be attributed to the obvious physical disparity between males and females, the males presented more with a dominant mesomorphic body somatotype as compared to the females whose dominant somatotype was endomorphy[31, 32].

The result of this study also revealed a non-significant effect of sex-difference on the HGS across various dominant body somatotypes. However, though not significant the mesomorphs still had higher HGS than Endomorphs and ectomorphs in that order.

Conclusion

The following conclusions were drawn from the findings of this study: there were significant correlations between hand grip strength of the right and left hands with height and weight among the participants. Also there were significant differences in the hand grip strength of the right and left hands across different dominant body somatotypes of participants. However, across different dominant body somatotypes, there was no significant influence of gender on the handgrip strength of left and right hands of the participants.

Recommendation

Based on the findings of this study, it is recommended that:

1. There is a need for continuous research on the influence of dominant body somatotype across different genders on hand grip strength among a larger and more diverse population.
2. More sensitization should be carried out on clinicians, enlightening them on the effect of dominant body somatotype on measures associated with hand rehabilitation.

Funding

The authors did not receive any funds or support from any organization to conduct this research.

Acknowledgement

The authors thank all participants for being part of the research. Without them this work would not be possible.

Declaration of conflicting interests

The authors declare no conflict of interest.

References

1. Carter JEL & Heath BH. Somatotyping - Development and Applications, Cambridge University Press; 1990.New York.
2. Slankamenac J, Bjelica D, Jaksic D, Trivic T, Drapsin, M, Vujkov S, Modric T, Milosevic Z, Drid P. Somatotype Profiles of Montenegrin Karatekas: An Observational Study. International Journal of Environmental Research and Public Health, [online] 2021; 18(24), p.12914. doi:https://doi.org/10.3390/ijerph182412914
3. Walden, M. Somatotypes.[online] TeachPE.com. Available at: https://www.teachpe.com/training-fitness/somatotypes; 2019.

4. Ronco AL, Mendoza B, Varas X, Jaumandreu S, De Stéfani E, Febles G, Barboza R Gateño M. Somatotype and risk of breast cancer: a case-control study in Uruguay. Revista Brasileira de Epidemiologia,2008, 11(2);.pp.215–227. doi:https://doi.org/10.1590/s1415-790x2008000200004.
5. Duquet W & Carter JEL .Somatotyping In: Kinanthropometry and Exercise Physiology Laboratory Manual Tests, Procedures and Data. Vol 1: Anthropometry 2009(Chap 2), (3rd ed). Routledge, New York.
6. Sanchez-Martinez, J. and Hernández-Jaña, S. Morphological Differences of Street Workout Athletes According to the Training Experience. International Journal of Morphology,2022;40(2),pp.320–326.doi:https://doi.org/10.4067/s0717-95022022000200320
7. dictionary.apa.org. (n.d.). APA Dictionary of Psychology. [online] Available at: https://dictionary.apa.org/sex-differences
8. Ansdell P, Thomas K, Hicks KM, Hunter SK, Howatson G, Goodall S. Physiological sex differences affect the integrative response to exercise: acute and chronic implications. Experimental Physiology, 2020;105(12), pp.2007–2021
9. Bhargava A, Arnold AP, Bangasser DA, Denton KM, Gupta A, Hilliard Krause LM Mayer EA, McCarthy M, Miller WL, Raznahan A Verma R. Considering Sex as a Biological Variable in Basic and Clinical Studies: An Endocrine Society Scientific Statement. Endocrine Reviews, 2021; 42(3). doi:https://doi.org/10.1210/endrev/bnaa034
10. Patrik D, Sergey T, Sergey E, Nihad S, Damjan J, Tatjana T, Sergej O. Somatotypes of elite male and female junior sambo athletes. Archives of Budo 2018;14:189-195
11. Bohannon, R.W. Hand-Grip Dynamometry Predicts Future Outcomes in Aging Adults. Journal of Geriatric Physical Therapy, 2008; 31(1), pp.3–10. doi:https://doi.org/10.1519/00139143-200831010-00002.
12. Günther C, Rickert M, Bürger A, Schulz C. Die Beugefähigkeit im Daumengrundgelenk des gesunden Erwachsenen. Handchirurgie · Mikrochirurgie · Plastische Chirurgie, 2007; 39(4), pp.272–275. doi:https://doi.org/10.1055/s-2007-965166.
13. Lam N, Goh H, Kamaruzzaman S, Chin A, Poi P , Tan M. Normative data for hand grip strength and key pinch strength, stratified by age and gender for a multiethnic Asian population. Singapore Medical Journal, 2016; 57(10), pp.578–584. doi:https://doi.org/10.11622/smedj.2015164
14. Celis-Morales CA, Welsh P, Lyall DM., Steell L, Petermann F, Anderson J, Stamatina Iliodromiti, Sillars A, Graham N, Mackay DF, Pell JP, Gill JMR, Naveed Sattar Gray, SR. Associations of grip strength with cardiovascular, respiratory, and cancer outcomes and all-cause mortality: prospective cohort study of half a million UK Biobank participants. BMJ, 2018; [online] 361. doi:https://doi.org/10.1136/bmj.k1651.

15. Liao KH. Experimental Study on Gender Differences in Hands and Sequence of Force Application on Grip and Hand-Grip Control. International Journal of Occupational Safety and Ergonomics, 2014; 20(1), pp.77—90.
16. De S, Sengupta P, Maity P, Pal A, Dhara PC. Effect of Body Posture on Hand Grip Strength in Adult Bengalee Population. Journal of Exercise Science and Physiotherapy, 2011;7(2), p.79.
17. Liao KH. Hand Grip Strength in Low, Medium, and High Body Mass Index Males and Females. Middle East Journal of Rehabilitation and Health, 2016; 3(1).
18. Mitsionis G, Pakos EE. Stafilas KS, Paschos N, Papakostas T Beris, AE. Normative data on hand grip strength in a Greek adult population. International Orthopaedics, 2008; 33(3), pp.713–717. doi: https://doi.org/10.1007/s00264-008-0551-x.
19. Nagasawa Y, Demura S. Age and Sex Differences of Controlled Force Exertion Measured by a Computer-generated Sinusoidal Target-pursuit System. Journal of PhysiologicalAnthropology, 2009; 28(4), pp.199–205. doi:https://doi.org/10.2114/jpa2.28.199 .
20. Koley S, Kaur N, Sandhu JS. A Study on Hand Grip Strength in Female Labourers of Jalandhar, Punjab, India. Journal of Life Sciences, 2021; 1(1), pp.57—62.
21. Depp J. Why a strong grip is important and how to strengthen those muscles. [online] health.osu.edu. Available at: 2022; https://health.osu.edu/wellness/exercise-and-nutrition/why-a-strong-grip-is-important#:~:text=Having%20good%20wrist%20and%20hand.
22. Mainous AG, Tanner RJ, Anton SD, Jo A. Grip Strength as a Marker of Hypertension and Diabetes in Healthy Weight Adults. American Journal of PreventiveMedicine, 2015; 49(6), pp.850–858.doi: https://doi.org/10.1016/j.amepre.2015.05.025.
23. Faris Almashaqbeh S. The Effect of Gender and Arm Anatomical Position on the Hand Grip Strength and Fatigue Resistance during Sustained Maximal Handgrip Effort. Journal of Biomedical Physics and Engineering,2022; 12(02). doi: https://doi.org/10.31661/jbpe.v0i0.2009-1197.
24. Mitsionis G, Pakos EE, Stafilas KS, Paschos N, Papakostas T, Beris AE. Normative data on hand grip strength in a Greek adult population. International Orthopaedics 2008; 33(3), pp.713–717. doi:https://doi.org/10.1007/s00264-008-0551-x.
25. Faul F, Erdfelder E, Lang A, Buchner A. G*Power 3: A flexible Statistical Power Analysis Program for the Social, Behavioral and Biomedical Sciences. Behav Res Methods, 2007; 39(2). doi:10.3758/bf03193146.
26. Gaur R, Talwar I, Devi I, Negi V.Age and sex variation in the somatotype of Rajput Adolescents of the Kullu District of the Himachal Pradesh Province, North India. International Journal of Anthropology 2014; 29(40):227-244.
27. Awotidebe TO, Olawoye AA, Fasakin OM, Odetunde MO, Okonji AM, Afolabi TO, Odunlade AJ,

Bello OS, Adedoyin RA. Relationship between body somatotype and handgrip strength of young Nigerian undergraduate students. Arch Phys Glob Res, 2021; 25(1). Doi: HTTPs://doi.org/10.15442/apgr.25.1.2.

28. Amaral CA, Amaral TLM, Monteiro GTR, Vasconcellos MTL, Portela MC. Hand grip strength: Reference values for adults and elderly people of Rio Branco, Acre, Brazil. PLOS ONE, [online] 2019;14(1), p.e0211452. doi: https://doi.org/10.1371/journal.pone.0211452
29. Das A, Dutta M. Correlation between body mass index and handgrip strength and handgrip endurance among young healthy adults. Journal of Evidence-based Medicine and Healthcare 2015; 2: 3995-4001
30. Luna-Heredia E, Martin-Pena G, Ruiz-Galiana J. Handgrip dynamometry in healthy adults. Clinical Nutrition. 2005; 24(2):250–8. Doi: 10.1016/j. clnu.10.007.
31. Malina RM, Bouchard C. Growth, maturation, and physical activity, Champaign, IL: Human Kinetics, 1991; 371-390.
32. Incel NA, Ceceli E, Durukan PB, Erdem HR, Yorgancioglu ZR Grip strength: effect of hand dominance. Singap Med J 2002; 43:234-7.
33. Zaccagni L, Barbieri D, Gualdi-Russo E. Body composition and physical activity in Italian university students. J Transl Med 2014; 12, 120.
34. Ibikunle PO, Okpagu C, Ihegihu YE, Okonkwo P. Sex Difference and relationship among peak grip strength, grip strength and anthropometric measures of dominant and non-dominant hands of children aged 4-16 in south east Nigeria. Tropical Journal of Medical Research, 2012; 16(2).