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Original research article

Association of grip strength with anthropometric measures: Height, forearm diameter, and middle finger length in young adults

Ukachukwu Okoroafor Abaraogu^{*}, Charles Ikechukwu Ezema,
Uche Nelson Ofofile, Sylvester Emeka Igwe

Department of Medical Rehabilitation, University of Nigeria, Enugu, Nigeria

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ABSTRACT

Introduction: Grip strength is routinely utilized in wide range of clinical setting as a physiological variable that is affected by a number of factors.

Aim: We examined the relationships of forearm circumference, middle finger length, height, and BMI with handgrip strength measured among a group of young adults.

Material and methods: This is a cross-sectional design among 517 young adults. Data was collected on one occasion using a hand held dynamometer for grip strength of dominant and non-dominant hands, commercial-scale for weight; tape measure for height, self report for age and gender.

Results and discussion: Forearm circumference, middle finger length and height showed significant positive correlation ($P < 0.01$) with grip strength across both the dominant and non-dominant limb. On the other hand, there was no significant correlation between BMI and grip strength for both limbs ($P > 0.05$).

Conclusions: In determining age and gender specific nomogram as well as assessing intervention outcomes for handgrip strength in young adults, anthropometrics of forearm circumference, middle finger length and height should be considered.

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1. Introduction

Handgrip strength may be an indicator of muscular strength of an individual,^{1,2} and is usually explored as a functional index of physical health.²⁻⁷ Because of its close association with the

neural and musculoskeletal systems, grip strength is routinely utilized in wide range of clinical settings including evaluation of individuals with pathologies affecting the upper limb function. It is also important in determining the efficacy of different treatment strategies in hand rehabilitation.⁸

^{*} Correspondence to: Department of Medical Rehabilitation, Faculty of Health Science and Technology College of Medicine, University of Nigeria, Enugu 400006, Nigeria. Tel.: +234 806 358 2105.

E-mail address: ukachukwu.abaraogu@unn.edu.ng (U.O. Abaraogu).

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As handgrip data is one of the important outcomes in certain patient populations, there is increasing interest in establishing normal values for handgrip strength. However, handgrip strength is a physiological variable affected by a number of factors. Most normative values did not include important anthropometrics which could introduce variation in handgrip strength among people of the same age and gender. For instance, differing BMI in individuals of the same age and gender could mediate differences in outcome of certain characteristics including strength. Similarly, both middle finger length and forearm diameter showed wide variation among individual of the same age and sex. However, relationship between middle finger length and forearm diameter and handgrip strength has remained largely understudied. Consideration of the hand dimension, including the middle finger is important from a biomechanical point of view. First the middle finger is usually the longest finger, and the length of the fingers weighs on the mechanical advantage of the hand in grasping tasks. Specifically, a longer middle finger will provide more surface variables required for grasping an object. This reduces the need to spread the digits wider, results to better ankle of pull, more biomechanical efficiency and less fatiguing.⁹ Accordingly, there is the question of comprehensiveness of the available handgrip reference values and accurate prediction of handgrip strength considering all possible predictors.

To identify studies on grip strength among young adults, we searched data bases – Medline, Embase, as well as gray literature utilizing a combination of keywords including young 'adults,' 'grip strength,' 'dynamometer,' 'anthropometrics,' 'BMI,' 'middle finger length,' 'forearm diameter.' Additionally, reference lists were further searched to identify possible articles that may not have appeared in earlier search. Many of these articles did not include sufficient anthropometric variables notably middle finger length, and forearm diameter as correlates when reference values were being drawn up. It is important to assess relationships between middle finger length, forearm diameter and grip strength in young adults to guide decision regarding their possible inclusion in predictive equation for age- and gender-specific normal values of grip strength this group. Also many earlier studies either did not differentiate between dominant and non-dominant score, used instrument that is now obsolete, or scored maximum instead of mean of scores of repeated evaluations.

According to Kisner and Colby,¹⁰ the age group when individuals develop maximum muscle mass is 18–25 years. Establishing a comprehensive and an inclusive reference values among this group is important since much of muscle mass and strength is less likely to decline until much later after middle age.^{11,12} An empirical data that establishes evidence of significant influence of handgrip strength by these anthropometrics is needed, before strong argument is made for their consideration and inclusion in future report on handgrip normal values.

2. Aim

The aim of this study is to investigate relationship of grip strength with BMI, height, forearm diameter, and middle finger length among young adults aged 18–25 years old.

3. Material and methods

3.1. Design

The study utilized a cross-sectional descriptive design among 517 young adults.

3.2. Participants

Participants were comprised of apparently healthy male and female undergraduate and postgraduate students of University of Nigeria aged 18–25 years. The aim was to include a near equal representation of male and female as well as age group within the study. The exclusion criteria were ambidexterity, hand deformity e.g. aneuploidy, pain in the hand, sensory abnormality, restricted movement of upper limb, any injury to the upper limb, diagnosed generalized bone disease, hypertension or diagnosed cardiac condition, or any condition that interfered with instruction on how to use dynamometer.

3.3. Procedure

Ethical approval for the study was received from the Research and Ethics Committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu. Also, all participants completed a voluntary written informed consent form for the study.

Before the study, participants were assessed using physical activity readiness questionnaire (PAR-Q)¹³ while blood pressure was evaluated to delimit those who had the risk of cardiovascular events. Como grip strength dynamometer (Xinjing Sports Company, China) was used to obtain the handgrip strength of the subjects to the nearest 1 kg. Tape measure (Butterfly 60 inch/150 cm tape, Shanghai, China) was used for measuring the middle finger length and the forearm circumference to the nearest 0.1 cm. Stadiometer (Holtain, Crymych, Dyfed, UK) was used to measure the height of the subjects to the nearest 0.1 cm while a weighing scale (Hana Bathroom Scale, China) was used to measure the weight of the subjects to the nearest 0.1 kg. Sphygmomanometer (Accoson, UK) was used to measure the blood pressure of the subjects to rule out high blood pressure.

Forearm circumference was measured from 12 cm distal to the olecranon process in a flexed elbow at 90°. The tape was applied closely to the skin but without causing compression.¹⁴ Middle finger length was measured from the tip of the middle finger to its proximal digit crease. Measurements were taken from the palmar side while digits were fully stretched and rested on a flat and hard surface with the 2nd and 5th digits abducted and thumb slightly extended.

The grip strength of both right and left hands was measured using a handgrip dynamometer according to the American Hand Therapist standardized arm position for handgrip testing. Each subject was positioned in a straight back chair (with an arm rest) with both feet on the floor. The arm position was demonstrated to the subjects. Each subject was asked to rest the arm to be measured on the ipsilateral thigh and to maintain a posture with shoulder adducted and neutrally rotated, elbow flexed by approximately 90° flexion, forearm and wrist in neutral position, and fingers flexed for the

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