

Original Article

Handgrip dynamometry of Greek healthy university students

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Abstract

Problem Statement Maximal voluntary handgrip strength is a reliable and accurate tool but few data in university people are available. **Approach** Data were obtained from a representative sample of 360 adults (180 male and 180 female university students) of a Technological Institution of Greece. HGS was measured using a Jamar tool. Three trials were collected for both hands, and the mean value of three was further analyzed. **Purpose** This paper presents reference values for handgrip strength of healthy adults (age 18-24) from a Greek university and determines associated factors among them. **Results** Mean values of dominant and non-dominant hand were 48.7 and 46.6 kg for males and 25.8 and 23.4 kg for females, respectively. The body height correlated with handgrip strength in both sexes. Body mass index (BMI) was associated with handgrip strength only in male students. **Conclusions** This study provides reference data for handgrip strength in Greek university students. These values of strength may be similar to other European data and norms and should be stratified to gender.

Key Words: hand dynamometry, handgrip strength, university population

Introduction

The evaluation of handgrip strength (HGS) is often used in each population since hand dynamometry is non expensive, very simple and fast, and adopts a well-assessed method for calculating the strength of wrist and digits flexor muscles. Recent studies have highlighted as well, the validity of using hand dynamometer as a method for nutritional evaluation, considering the above mentioned characteristics efficacious enough for muscular function (Budziareck, Pureza Duarte, & Barbosa-Silva, 2008). In addition, like aerobic fitness, muscular fitness as well is an important factor of overall health related fitness and an important predictor for future health (Castro-Pinero et al., 2009; Inskip et al., 2007). Low values of strength in hand may predispose hormone complications or even mortality (Lazarus, Sparrow, & Weiss, 1997; Newman et al., 2006). However, there are few studies in HGS in healthy subjects but with not adequate participants in order to propose normative values (Crosby, Wehbe, & Mawr, 1994; Mathiowetz et al., 1985; Schluskel, dos Anjos, de Vasconcellos, & Kac, 2008). Therefore, the aim of the present study was to examine the HGS values of particular group of people (students of a peripheral institution of Greece) and even to attempt to establish normal reference values for the hand strength among the students of this Technological Educational Institution of Serres, and to study the possible influence of anthropometric variables to this parameter in a more homogeneous sample of healthy adult students comparing with earlier studies.

Material & methods

Participants: Three hundred and sixty healthy Greek students (180 males and 180 females) volunteered and participated in this study. The age range was 18- 24 years and all of them were active students in the Technological Educational Institution of Serres, Greece. The study had a cross-sectional design, and was carried out during a six- month period (October 2011- March of 2012) in the laboratory of physical education of the above mentioned institution. This study met the ethical standards suggested by Technological Educational Institution of Serres, Greece.

Procedure/Test protocol: Following the selection process, participants were asked to read and sign an informed consent. As they agreed to meet with the criteria of the study, they proceed to the measurements. Initially, we collected all the data which were useful for the purposes of the current study including age, weight, and height (Table 1). As well as that, a questionnaire was filled by each participant including information such as sports activities, dominant and non-dominant hand, and potential injuries in any of the hands were collected given that these may influence the final results. HGS was measured using a Jamar hydraulic dynamometer (Asimow Engineering C., Los Angeles, CA). For hand grip strength, subjects were seated, with their elbows flexed at 90°

and supported at the time of measurement (Hillman et al., 2005). Then they were asked to grip and tighten the dynamometer with maximum effort and to hold the grip for at least 3 sec (Montalcini et al., 2012; Rantanen et al., 2000). Three measurements from each hand and each participant were collected and the mean value of these used in analyses. The measurement unit used was kilogram.

Data collection and analysis: The following data were collected and recorded for each participant: age (years), weight height (cm), body mass index (BMI, kg/m²), grip strength of dominant and non-dominant hand.

Table 1. Anthropometrical characteristics and main variables of participants

Variables	All (n= 360)	Male (n=180)	Female (n=180)
	Mean ± SD	Mean ± SD	Mean ± SD
Age (years)	20.9± 1.7	21.0± 1.7	20.8± 1.6
Height (cm)	172.4± 8.9	179.1± 6.2	165.7± 6.9
Weight	67.3± 11.1	75.6± 7.6	59.1± 7.0
BMI (kg/m ²)	22.6± 3.1	23.6± 3.0*	21.5± 2.7
HGS dominant hand	37.3± 13.4	48.7± 8.1**	25.8± 5.5
HGS non-dominant hand	35.0± 13.9	46.6± 9.7**	23.4± 4.8

n: number; SD: standard deviation; BMI: body mass index; HGS: handgrip strength; *p<0.05 t test between genders

Statistical analysis

The demographic profile of the subjects such as age, sex, hand grip strength and variation was analyzed through *descriptive analysis*. The mean, standard deviation the hand grip and their determinants would be presented. The correlations between dependant variable handgrip strength and independent variables age, height, weight, body mass index (BMI) were analysed through Pearson Product—moment correlation (intra—class correlation coefficient). We added the body mass index along with height and weight because we assumed transformation of mass and height might reduce the handgrip correlation. All the determinants of hand grip strength were analyzed by step wise multiple regression model. The statistical analysis was solved by using statistical software “SPSS 18”

Results

General and anthropometric data and main variables of all 360 participants are summarized in Table 1. Mean age of participants was 21.0± 1.7 for males and 20.8± 1.6 for females. The large majority of participants were right-handed (87%). HGS in dominant hand was significantly higher than HGS in non-dominant in both genders (+4.8% and +10.2% in males and females). BMI varied from 16.2 to 31.2 kg/m² in males and from 15. to 28.6 kg/m² in females.

Height and body mass index (BMI) The body height correlated directly with handgrip strength in both sexes (Fig. 1ab). Regarding BMI and handgrip strength, there was correlation in dominant hand only in male students and correlation in non-dominant hand in female students (Fig. 2ab).

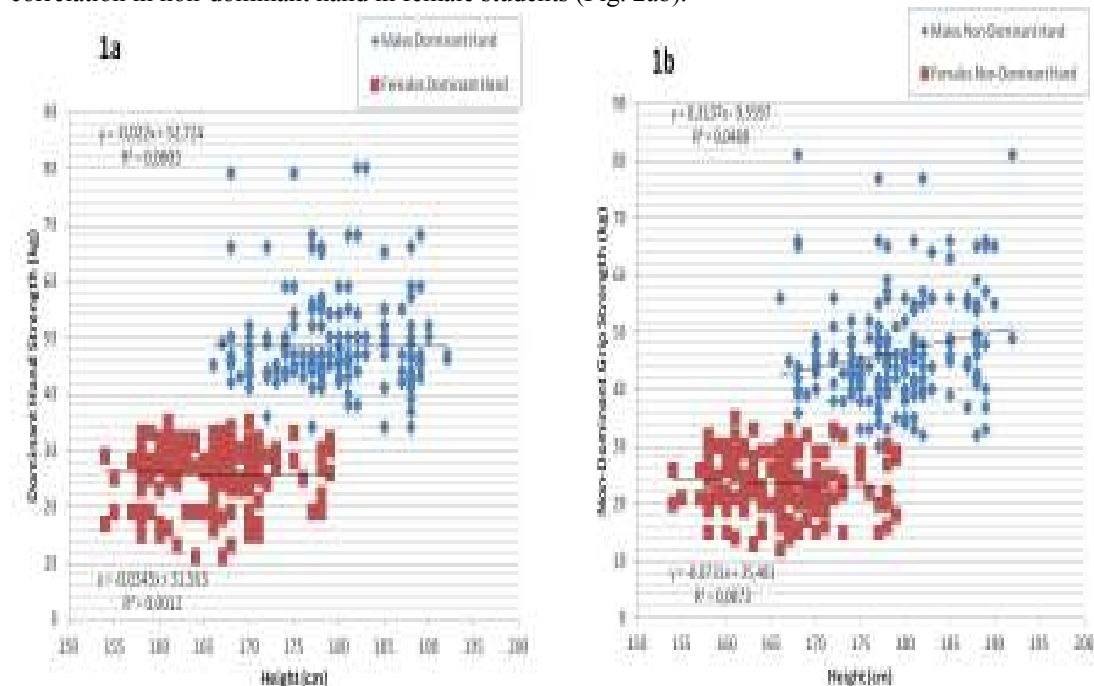


Figure 1ab. Correlation between height and maximum strength in the dominant and non-dominant hand in males and females students.

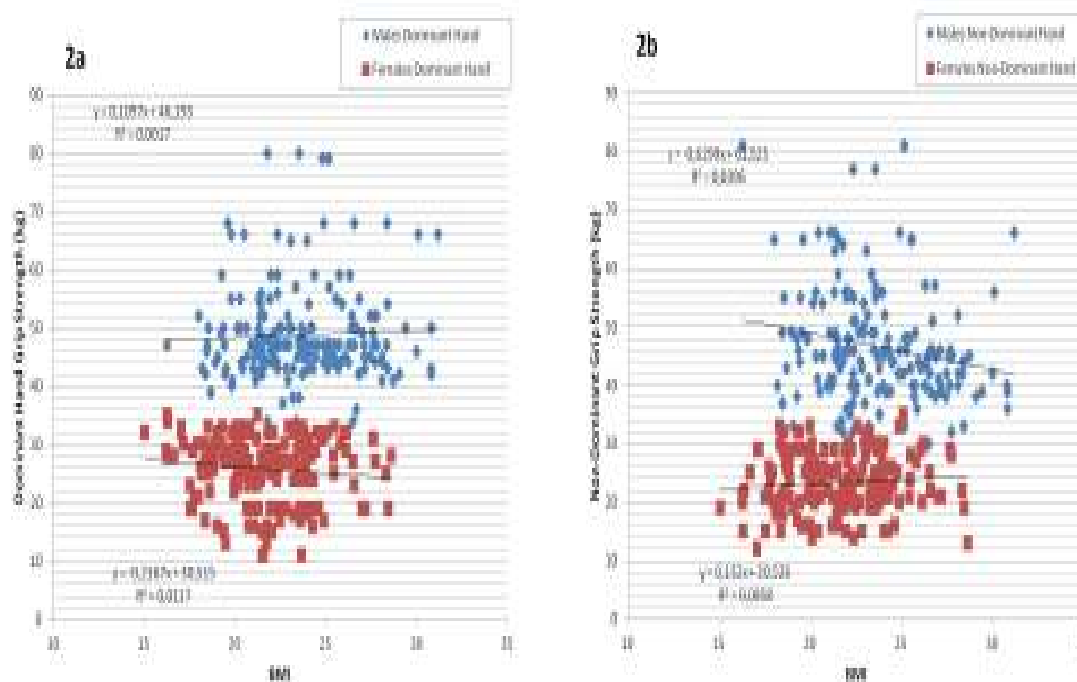


Figure 2ab. Correlation between BMI and maximum strength in the dominant and non-dominant hand in males and females students.

Discussion

The main aim of the present study was to generate normative values in 18 to 22 year old Greek students of a Technological Educational Institution so as to assess HGS in similar populations. As well as that, the association of HGS with gender in this representative sample of students was of high priority. Reference values for HGS in a population which was considered as healthy can be then used to identify differences and variations with other groups such as patients and hospitalized thus comparing muscular function among them.

Similarly to relevant studies in the literature, males exhibited higher HGS mean values than females for both hands. Gender has a major impact on HGS when assessed similar ages, and males presented higher strength levels compared to females. The above provides clear justification for separate reference values in both genders as supported in previous studies. It has been recently supported (Leyk et al., 2007) that HGS was linearly correlated with lean body mass in a similar sample of 20-25 year-old males and females. In the same trend, recently it was shown that BMI and HGS are well-correlated (Schlüssel, et al., 2008). In fact, underweight participants ($BMI < 18.5 \text{ kg/m}^2$) presented lower HGS values than those with higher BMI. This relationship occurred in our study verifies and reinforces the above mentioned findings.

Several studies have used the mean values of dominant plus non-dominant hand (Lazarus, et al., 1997; Sherriff et al., 2009). Both of them examined the hand dominance on HGS and suggested that the dominant hand is almost 10% stronger. The same was shown in the current study and particularly for females (+10.2% dominant vs. non-dominant hand) as males seemed to adopt almost the same strength for dominant and non-dominant hand (+4.8% difference). This probably occurred due to differentiation in their training background.

Height is directly correlated to handgrip strength, mainly because height is a parameter which is more closely related to the lean mass. However, the BMI depicts a negative correlation in males and mainly in non-dominant hand (the handgrip strength decreases as the BMI increases) and this occurred due to the fact that parameter height was included in the estimation of BMI. So, height does not seem to be a strong parameter for handgrip strength in this current sample (students of a Technological Department).

There is a crucial factor that categorizes HGS full application in methods with lack in fully validity as there is no agreement in a cut-off point establishment in order to define malnourishment or normality. Despite this lack, the application still can be used mostly in clinical practice to predict complications (Guo, Zhang, Ma, Zhang, & Huang, 1996; Kalfarentzos, Spiliotis, Velimezis, Dougenis, & Androulakis, 1989).

Type of dynamometer (differentiation) during a study could contribute to the variability in HS values (Espana-Romero et al., 2010; Richards, Olson, & Palmiter-Thomas, 1996). Most recent scale studies in HGS evaluation use Jamar and Takei dynamometer as are among those with high validity and reliability. Similarly, in our study Jamar was the tool we used in order to assess HGS. As well as that, the shape of dynamometer and differences in hand size of participant can influence the score. This lack was attempted to be diminished by including our with small age-range. Data in the present study are based on the mean value of three trials; however there are many researches at which two trials were employed to their methodology section (Cohen et al., 2010; Sherriff, et al.,

2009) as they were described as more suitable for large scale evaluations of HS given that three trials can provide a more accurate maximum HGS.

Conclusions

Summarizing, normal handgrip strength values have to be stratified by age and sex. Although the results of the present study offer the largest sample of values in the ages 18-22 years, probably cannot be used as general values for other subjects or different age groups.

Conflict of interest statement

None declared

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