



## Associations among Handgrip Strength, Dietary Pattern, and Physical Activity Level in Physical Education Students

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### Abstract

**Aim:** The purpose of this study was to determine the relationships among handgrip strength (HGS), dietary pattern, and physical activity level in students from a physical education and sport department.

**Material and Methods:** In this study, 124 men and 77 women aged 18–29 y participated. HGS was evaluated in the dominant hand by using an adjustable handgrip dynamometer and expressed in Newton. Dietary pattern was evaluated by using the Dietary Pattern Index (DPI) adapted into the Turkish. Physical activity level was measured by using the short version of the International Physical Activity Questionnaire (IPAQ).

**Results:** The Spearman correlation coefficient showed that HGS positively correlated with IPAQ score ( $r=0.204$ ,  $p=0.004$ ), body mass index ( $r=0.559$ ,  $p<0.001$ ), and age ( $r=0.205$ ,  $p=0.003$ ), but negatively correlated with DPI score ( $r=-0.179$ ,  $p=0.01$ ).

**Conclusion:** HGS is a useful, simple, and objective assessment tool for monitoring the physical activity levels and dietary patterns of young subjects.

### Keywords

Lifestyle habits,  
Fitness level,  
Physical strength,  
Correlation.

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## INTRODUCTION

The incidence of obesity is increasing worldwide. According to the World Health Organization, about 13% of the world's adult population were obese in 2014 (<http://www.who.int/mediacentre/factsheets/fs311/en/>). As obesity is preventable, health and fitness experts recommend improvement of physical fitness level (Garber et al., 2011).

Muscular strength is a major component of physical fitness (Mazzeo et al., 1998). Westcott (2012) reported that strength training has positive effects on controlling type 2 diabetes, reduced muscle mass loss, resting blood pressure, low back pain, and body fat. In addition, strength training recharges resting metabolism; facilitates physical function; improves cardiovascular health, blood lipid profile, vascular condition, and bone mineral density; and enhances mental health. In this case, screening for the strength levels of middle-aged and young people are highly important in preventing disability, morbidity, and mortality from chronic illness (Sayer & Kirkwood, 2015).

Reports have described the use of various questionnaires, diaries, or logs for evaluating physical fitness level, and monitoring body or physiological responses by using the International Physical Activity Questionnaire (IPAQ) and Borg's Scale, among others (Haskell & Kiernan, 2000).

Many studies have explained associations among handgrip strength (HGS), dietary pattern, and physical activity level in elderly and older subjects (Mattioli et al., 2015; Singh et al., 2015; Pieterse et al., 2002; Rantanen et al., 1999). Recently, some authors argued that HGS test is a simple but powerful predictor of future disability, morbidity, and mortality (Sayer & Kirkwood, 2015; Mattioli et al., 2015; Haskell & Kiernan, 2000).

Moreover, HGS is often used as an indicator of overall physical strength, hand and forearm muscle performances, and physical performance (Saha, 2014). Some authors reported that HGS should be used as a functional index of nutritional status (Thompson, 2011; Pieterse et al., 2002). Leong et al. (2015) suggest that low grip strength represents poor health.

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However, we could not find an adequate number of studies that investigated the associations among HGS, dietary pattern, and physical activity level in young individuals. This issue is also verified by Ortega et al. (2008).

Therefore, the purpose of this study was to examine the associations among the HGS, dietary pattern, and physical activity level of students from a physical education and sport department. This is a novel study that aimed to examine the associations among HGS, dietary pattern, and physical activity level in young subjects.

## METHOD

**Participants:** In this study, 124 men and 77 women, aged 18–29 y (mean,  $20.92 \pm 2.18$  y), from a physical education and sport department voluntarily participated. Their heights and body masses were recorded based on their self-reports. The subjects were fully informed about the research protocols.

This study required no local ethics committee approval because it carries no risks and burdens to the subjects.

**Handgrip strength:** HGS was evaluated in the dominant hand after 5 min of light jogging, by using an adjustable digital handgrip dynamometer (Takei Scientific Instruments Co., Ltd., Japan). All the subjects were tested thrice in 20-s intervals. The best of three measurements was recorded as the HGS of the subject. Grip tests were performed at standing position, with the shoulder adducted and neutrally rotated, and the elbow in full extension (Saha, 2014). The peak isometric force generated was quantified by multiplying the maximal measurement detected by the dynamometer by  $9.81 \text{ m}\cdot\text{s}^{-2}$  (gravitational constant) in order to convert kilograms into Newtons (Kurt & Pekünlü, 2015).

**IPAQ and DPI:** The physical activity level of the subjects was evaluated by using the short-form version of the IPAQ (Öztürk, 2005). The dietary pattern of the subjects was evaluated with the DPI adapted into the Turkish language by Demirezen & Cosansu (2005). The questionnaires were answered with guidance by a lecturer. The DPI questionnaire consists of 6 items graded in a 5-point scale (0: never, 4: everytime for questions 1–5 and 0: everytime, 4: never for question 6) (Demirezen & Coşansu, 2005). The lowest and highest possible scores are 0 and 24, respectively. A low score represents a low-risk dietary pattern.

**Analysis of Data:** Data were analysed by using the IBM SPSS Statistics version 20 software for Windows (IBM Corp., 2011, Armonk, NY). The Kolmogorov-Smirnov test was performed to test for normality. As the data were not normally distributed, the Spearman correlation test was used to determine associations among the variables. Descriptive statistics were presented as mean, standard deviation, and range values. The statistical significance level was set at  $p < 0.05$ .

## RESULTS

The descriptive data of the subjects and the Spearman correlation coefficients for IPAQ, DPI, body mass index (BMI), and age are presented in Tables 1 and 2, respectively. Table 2 shows that HGS positively correlated with IPAQ score ( $r=0.204$ ,  $p=0.004$ ), BMI ( $r=0.559$ ,  $p<0.001$ ), and age ( $r=0.205$ ,  $p=0.003$ ), but negatively correlated with DPI score ( $r=-0.179$ ,  $p=0.01$ ). Results of the Spearman correlation analysis are presented in Figures 1–4.

**Table 1.** Descriptive statistics of the subjects

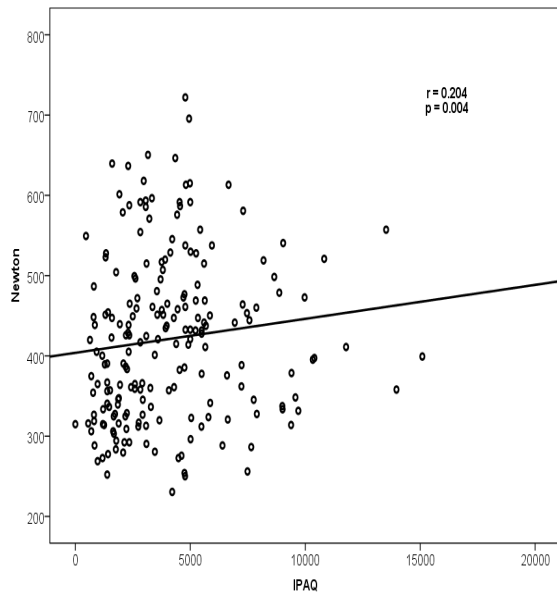
Parameters	Minimum	Maximum	Mean	Standard Deviation
Age (y)	18.00	29.00	20.92	2.18
IPAQ	0.00	15093.00	4055.57	2750.19
DPI	0.00	22.00	9.77	3.98
BMI ( $\text{kg}/\text{m}^2$ )	16.61	31.55	22.52	2.58
Newton	230.54	722.02	421.02	102.78

IPAQ: International Physical Activity Questionnaire, DPI: Dietary Pattern Index, BMI: Body mass index

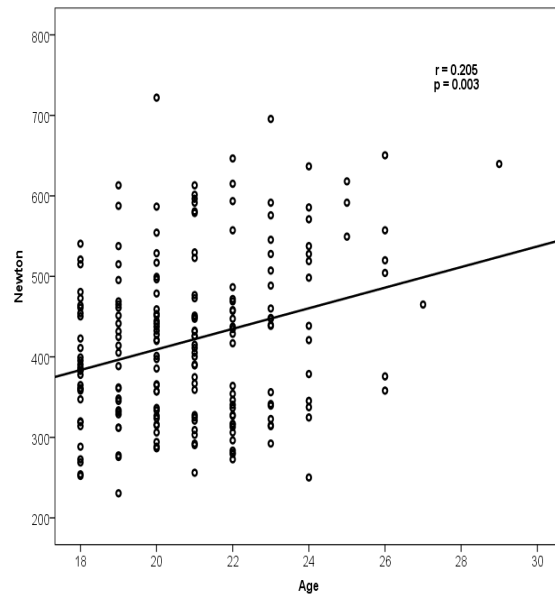
**Table 2.** Correlation among HGS, IPAQ, DPI, BMI, and age

Parameters	HGS in Newton	
	<i>r</i>	<i>p</i>
IPAQ	0.204	<b>0.004</b>
DPI	-0.179	<b>0.010</b>
BMI (kg/m <sup>2</sup> )	0.559	<b>&lt;0.001</b>
Age (y)	0.205	<b>0.003</b>

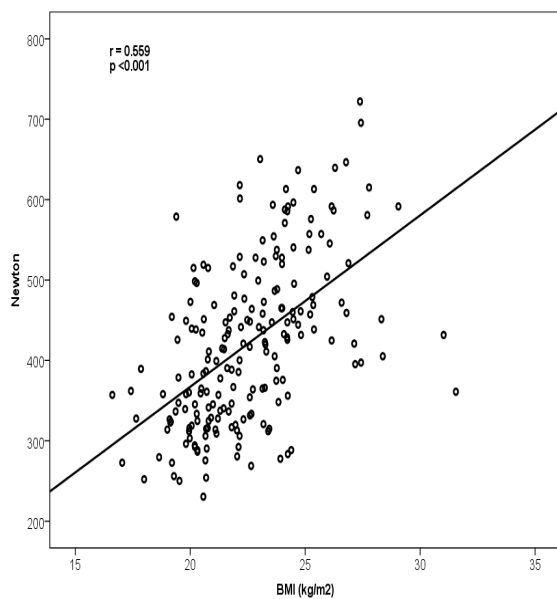
IPAQ: International Physical Activity Questionnaire, DPI: Dietary Pattern Index, BMI: Body mass index



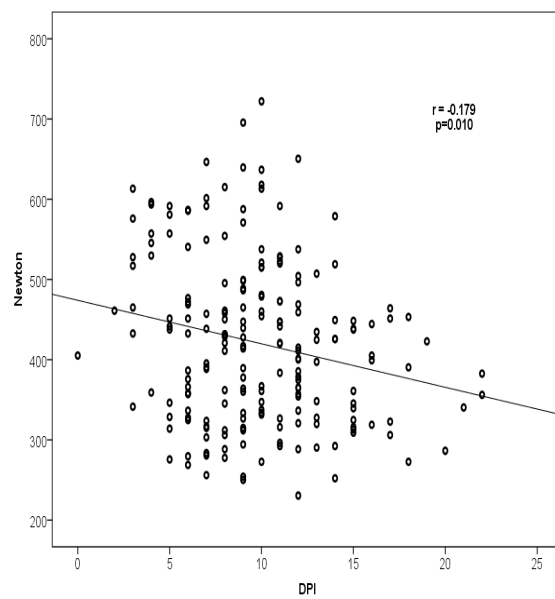
**Figure 1.** Correlation between HGS and IPAQ score



**Figure 2.** Correlation between HGS and age



**Figure 3.** Correlation between HGS and BMI



**Figure 4.** Correlation between HGS and DPI

## DISCUSSION

The main finding of this study is that HGS positively correlated with IPAQ score, BMI, and age, but negatively correlated with DPI score. The finding of this study is similar to those reported by Saha (2014) and Norman et al. (2011). According to Saha (2014) physical activity has a strong positive relationship with HGS. In addition, Norman et al. (2011) reported that HGS is a good marker of nutritional status.

Sayer & Kirkwood (2015) reported on a relationship between HGS and future mortality. In addition, Ortega et al. (2012) showed a positive association between muscular strength and cardiovascular fitness. Al Snih et al. (2002) and Artero et al. (2011) suggested that low muscular strength in adulthood predicts all-cause mortality and mortality due to cardiovascular disease and cancer in healthy people and those with diseases (Artero et al., 2011).

Although Pieterse et al. (2002) reported that poor nutritional status is associated with low HGS in relation to sex, age, and height. However, Thompson (2011) suggested no significant associations between malnutrition and HGS in surgical and medical patients.

According to Puh (2010), HGS correlated negatively with age but positively correlated with body mass and height. Our study results partially differ from those of Puh's study. This discrepancy may be caused by the different equipment and procedures used between our study and that of Puh's. We realized that HGS was measured in the seated position and in different angles of the elbow, shoulder, wrist, and forearm in Puh's study.

Mattioli et al. (2015) reported that physical activity level has no effects on HGS in hypertensive elderly people. However, a study found positive effects of physical activity on HGS in the elderly (Skelton et al., 1995). This discrepancy might be caused by the differences in the applied tools, methods, and examined populations. Araujo et al. (2010) informed that lean mass, muscle strength, and physical function differed among black, Hispanic, and white males. Similarly, Puh (2010) informed that sex, age, body mass, and height influenced grip strength, as do occupation and leisure activities. Shyamal & Yadav (2009) suggested that HGS is a significant predictor of performance in various sports activities such as rock climbing, bowling, volleyball, and lawn tennis.

## CONCLUSION AND SUGGESTIONS

As stated in the literature, HGS is a simple, primary, objective predictor of nutritional status, physical activity level, muscular and cardiovascular fitness, mortality, morbidity, disability, and preoperative and postoperative outcomes.

Our study results confirmed that HGS is a simple and important tool in determining the physical activity level and dietary pattern of moderately physically active young subjects.

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