Research article

Relationship between perceived physical fitness and self-reported anthropometric measures in university students

Relación entre la percepción de condición física y medidas antropométricas auto reportadas en estudiantes universitarios

Relação entre percepção de condicionamento físico e medidas antropométricas autorreferidas em estudantes universitários

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ABSTRACT

The physical fitness perception of college students refers to how they see themselves in terms of their physical condition and health. In this stage, anthropometric variables may be affected by stress, changes in sleep and eating habits, and decreased participation in physical activities, impacting academic performance and general health. The objective of this study is to relate the perception of physical condition with self-reported anthropometric measures in university students. This is a descriptive-correlational, observational, cross-sectional research. Forty-six university students from the city of Talca were evaluated. Physical condition was measured by means of the International Fitness Scale (IFIS) and anthropometric measures by means of self-report. General physical condition was inversely related to waist circumference (r=-0.32; p=0.028), waist circumference (r=-0.44; p=0.002) and IFIS (r=-0.43; p=0.003). Inverse correlations were observed between cardiorespiratory fitness with BMI (p=0.008; r=-0.38), waist circumference and ECI (p=0.008; r=-0.38). Speed/agility was inversely correlated with body mass index (BMI) (p=0.001; r=-0.46), waist circumference (p=0.019; r=-0.34), hip (p= 0.004; r= -0.40) and ECI (p=0.004; r=-0.41). Flexibility was inversely correlated with BMI (p=0.041; r=-0.30), waist circumference (p=0.023; r=-0.33), waist hip index (WHI) (p= 0.001; r=-0.45)). Lastly, muscle was not correlated with the anthropometric variables. It is concluded that there is an inverse correlation between the perception of physical condition and some anthropometric measures.

Key words: Physical Fitness; Health; Body composition.

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RESUMEN

La percepción de la condición física en estudiantes universitarios se refiere a cómo se ven a sí mismos en términos de su estado físico y salud. En esta etapa, las variables antropométricas pueden verse afectadas por estrés, cambios en hábitos de sueño y alimentación, y menor participación en actividades físicas, impactando el desempeño académico y salud general. El objetivo fue relacionar la percepción de la condición física con medidas antropométricas auto reportadas en estudiantes universitarios Esta Investigación es de tipo descriptivo–correlacional, de diseño observacional y corte transversal. Fueron evaluados 46 estudiantes universitarios de la ciudad de Talca. La condición física se midió por medio del *International Fitness Scale* (IFIS) y las medidas antropométricas por medio de auto reporte. La condición física general se relacionó de manera inversa con la circunferencia de cintura (r=-0,32; p=0,028), la circunferencia de cintura(r=-0,44; p=0,002) y el ICE (r=-0,43; p=0,003). Se observaron correlaciones inversas entre la condición cardiorrespiratoria con el IMC (p=0,008; r=-0,38), circunferencia de cintura e ICE (p=0,008; r=-0,38). La velocidad/agilidad se correlacionó de forma inversa con el índice de masa corporal (IMC) (p=0,001; r=-0,46), circunferencia de cintura (p=0,019; r=-0,34), cadera (p= 0,004; r= -0,40) y el ICE (p=0,004; r=-0,41). La flexibilidad se correlaciono de forma inversa con el IMC (p=0,041; r=-0,30), circunferencia de cintura (p=0,023; r=-0,33), índice cintura cadera (ICC) (p= 0,001; r=-0,45)). Por último, la fuera muscular no se correlaciono con las variables antropométricas.-Se concluye que existe correlación inversa entre la percepción de la condición física y algunos autore portes de las medidas antropométricas.

Palabras clave: Aptitud física; Salud; Composición corporal.

RESUMO

A percepção da aptidão física em estudantes universitários refere-se a como eles se veem em termos de sua condição física e saúde. Nessa fase, as variáveis antropométricas podem ser afetadas pelo estresse, por mudanças nos hábitos de sono e alimentação e pela diminuição da participação em atividades físicas, o que afeta o desempenho acadêmico e a saúde em geral. O objetivo foi relacionar a percepção da aptidão física com medidas antropométricas autorreferidas em estudantes universitários. Trata-se de uma pesquisa descritiva, correlacional, transversal e observacional. Foram avaliados 46 estudantes universitários da cidade de Talca. A condição física foi medida por meio da Escala Internacional de Aptidão Física (IFIS) e as medidas antropométricas por meio de autorrelato. A aptidão física geral foi inversamente relacionada à circunferência da cintura (r=-0,32; p=0,028), circunferência da cintura (r=-0,44; p=0,002) e IFIS (r=-0,43; p=0,003). Foram observadas correlações inversas entre a aptidão cardiorrespiratória com o IMC (p=0,008; r=-0,38), a circunferência da cintura e o ECI (p=0,008; r=-0,38). A velocidade/agilidade foi inversamente correlacionada com o índice de massa corporal (IMC) (p=0,001; r=-0,46), circunferência da cintura (p=0,019; r=-0,34), quadril (p= 0,004; r= -0,40) e ECI (p=0,004; r=-0,41). A flexibilidade foi inversamente correlacionada com o IMC (p=0,041; r=-0,30), a circunferência da cintura (p=0,023; r=-0,33), o índice cintura-quadril (WHI) (p= 0,001; r=-0,45). Por fim, a musculatura não foi correlacionada com as variáveis antropométricas. Concluise que há uma correlação inversa entre a percepção da condição física e algumas medidas antropométricas**.**

Palavras chave: Aptidão física; Saúde; Composição corporal**.**

INTRODUCTION

In recent years, a worrying increase in health risk factors such as sedentary lifestyle, physical inactivity, overweight and obesity has been observed in people between 15 and 24 years of age, which translates into a deterioration in the health and quality of life of the population (Concha-Cisternas et al., 2018; Guzmán-Muñoz et al., 2020). Unfavorable indicators generate a high long-term health cost for

countries, since they can translate into the appearance of chronic non-communicable diseases (Durán et al., 2017). In addition, being in reproductive age, these negative habits could be transmitted to new generations (Eyzaguirre et al., 2005).

Lack of physical activity, sedentary lifestyle and excess weight have been recognized as the most determining factors in the decline of physical fitness in young people (Civan & Sayin, 2017; Sackett & Edwards, 2019). Physical fitness is a general term that describes a person's ability to perform physical activities efficiently and without excessive fatigue (Escalante, 2011). Therefore, assessing physical fitness is important to understand an individual's health status and functional capacity.

The level of physical fitness is assessed through different protocols, including laboratory tests, field tests, and fitness assessment questionnaires. The latter represent a greater advantage in terms of their easy execution and time, since they do not require investing large economic resources; in addition, a greater number of subjects can be assessed simultaneously (Español-Moya & Ramírez-Vélez, 2014). Among the most recommended questionnaires to assess physical fitness is the International Fitness Scale (IFIS), which is capable of assessing self-perceived physical fitness in less than 5 minutes (Ortega et al., 2013). The IFIS is a scale that has been translated into nine different languages (including Spanish) and that aims to assess physical fitness in general and each of its main components in a specific way, that is, aerobic capacity, muscle strength, speed-agility and flexibility (Ortega et al., 2013).

On the other hand, to know the health status of people, the use of some anthropometric measurements has been suggested, which study the proportions and measurements of the human body (Baena et al., 2005). Among the most used evaluations are body weight and height, with which it is possible to determine the body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR) and waist-height ratio (WHR) (Neovius et al., 2005). The BMI relates weight and height (weight/height2), and it has been described that the higher the BMI, the greater the cardiovascular risk (Bryce et al., 2017; Sahakyan et al., 2015). The WHR corresponds to a relationship between waist circumference/hip circumference, while the WHtR is generated with minimum waist circumference/height. Both variables have been associated with a poor health status of the population (Hidalgo, 2011). Among the highlighted advantages are a low cost, it is non-invasive, it is universally applicable and has good acceptance by the population (Costa et al., 2015).

The literature agrees on the existence of an inverse relationship between anthropometric measurements and physical condition, which means that the further the anthropometric measurements are from normal, the greater the loss of physical condition (Petersen et al., 2021). According to what is expressed in the literature, it suggests that both weight and height based on self-reported data in university students are a valid estimate to be used in the implementation of a surveillance and monitoring system (Díaz-García et al., 2012). On the other hand, self-reporting of waist circumference and hip circumference requires trained personnel to avoid an inadequate classification of obesity (Díaz-García et al., 2012). This is why self-reporting of basic anthropometric indicators has been well accepted when there is adequate measurement and supervision of evaluators through video-conferencing to ensure that the delivery of data is as accurate as possible (Boldrini et al., 2020)

Based on the above, the objective of this research is to relate self-reported anthropometric measurements and the perception of the physical condition of university students.

METHODS

This research is descriptive-correlational, observational and cross-sectional. The study's approach is quantitative, where anthropometric measurements and self-perceived physical condition of university students were related.

POPULATION AND SAMPLE

This study has a non-probability sampling for convenience and the sample was 46 students. The included participants presented the following criteria: a) Students who agree to be part of the research through informed consent; b) Students aged 20 to 30 years; c) Male and female students. Subjects were excluded if they presented: a) Musculoskeletal injury such as: tear, fracture, sprain, dislocation with less than 6 months of evolution; b) Students with neurological or vestibular pathologies, c) use of technical aid for walking; d) Presence of any inflammatory or painful condition at the time of the evaluation.

All participants voluntarily signed an informed consent approved by the ethics committee of the Universidad Santo Tomás (Chile) (resolution No. 68-19).

ANTHROPOMETRIC MEASUREMENTS

Self-reported anthropometric measurements were obtained through video calls made by the researchers to the participants via the Zoom platform (Zoom Inc. California, USA). One week before the video call, participants were instructed to measure and weigh themselves barefoot and in light clothing to report the data on the day of the telematic meeting. BMI was then calculated according to internationally established criteria, which indicate dividing body weight by bipedal square height (kg/m2). To measure waist and hip circumference, each participant was required to have a measuring tape. To measure waist circumference, participants were asked to place the measuring tape horizontally around the narrowest part of the abdomen. Participants were required to stand and relax, without holding their breath or tensing their abdominal muscles. Hip circumference was also measured by placing the measuring tape around the most prominent region of the gluteus and hip. In these assessments, researchers gave verbal instructions, observed and provided feedback to participants via video call so that the measurement was performed as correctly as possible. Once these two measurements in centimeters were obtained, the waist-hip ratio was calculated by dividing the waist circumference by the hip circumference, while the waist-height ratio was obtained by dividing the waist circumference by the height.

Physical condition

During the video call, the International Fitness Scale (IFIS) questionnaire was also applied, which has been validated so that each person reports their perception regarding physical condition (Ortega et al., 2013). The IFIS subdimensions are evaluated through a series of items that group and collect information corresponding to each component of physical condition. Item 1 addresses general physical condition, while item 2 inquires about the perception of cardiorespiratory physical condition. Muscular strength is reported in item 3, while item 4 reports on speed/agility and item 5 on flexibility. The IFIS uses Likert-type scales to assess the level of physical condition. Responses are answered with multiple options and there are 5 possible categories: "Very poor", "Poor", "Acceptable", "Good" or "Very good".

These options allow a clear and precise classification of the physical condition of the individuals evaluated.

Statistical analysis

SPSS Software (version 25.0) was used for statistical analysis. Normal distribution was calculated using the Shapiro Wilk test. Results were described by the mean and standard deviation. Pearson's test was then used to correlate the study variables. A correlation coefficient r of 0 to 0.4 was considered a weak relationship, a coefficient of 0.4 to 0.7 was considered a moderate relationship, and a coefficient of 0.7 to 1.0 was considered a strong relationship. A significance level of $p<0.05$ was used for all analyses.

RESULTS

Table 1 shows the main characteristics of the sample, whose age range was between 20 and 30 years, with an average of 25.54 ± 2.84 years, the average weight was 70.50 ± 17.11 kg, as for height, the average is 1.66 ± 0.08 m and, finally, the BMI has an average of 29.24 ± 6.00 kg / m2. Of the total number of students evaluated, it is observed that the population has an average BMI value of 29.24 kg / m2, which means that they are classified as overweight. The average waist circumference had a value of 87.37 ± 14.94 and hip circumference a value of 87.13 ± 13.04, being valued as normal. The physical condition results measured by IFIS are presented in Table 2.

Table 1

Characteristics of the sample.

Variable	Mean	SD
Age (years)	25,54	2,84
Weight (kg)	70,5	17,11
Height (meters)	1,661	0,08
BMI (kg/m2)	29,24	6,00
Waist circumference	83,37	14,94
Hip circumference	97,13	13,04
WHtR	0,49	0,08
WHR	0,85	0,11

SD: Standard deviation; KG: Kilograms; BMI: Body mass index; WHtR: Waist-to-height ratio; WHR: Waist-to-hip ratio.

Table 2

IFIS results (score).

Variable	Mean	SD
General physical condition	3,02	0,80
Cardiorespiratory condition	3,13	0,90
Muscle strength	3,39	0,61
Speed/agility	3,17	0,82
Flexibility	2,95	1,05

SD: Standard deviation.

Relationship between general physical condition and anthropometric variables

Table 3 shows a weak negative relationship between general physical condition and waist circumference (p = 0.028; r = -0.32). Meanwhile, with regard to the relationship between general physical condition and hip circumference (p = 0.002; r = -0.44) and WHtR (p = 0.003; r = -0.43), a moderate negative relationship is observed. On the other hand, with regard to the analysis between general physical condition and BMI (p = 0.056; r = -0.28) and WHR (p = 0.866; r = -0.02), these do not report a significant relationship.

Relationship between cardiorespiratory condition and anthropometric variables

Table 2 shows that when relating cardiorespiratory fitness, waist circumference (p = 0.021; r = -0.33) and hip circumference (p = 0.040; r = -0.30) there is a weak negative relationship. On the other hand, when relating cardiorespiratory fitness with BMI (p = 0.008; r = -0.38) and WHtR (p = 0.008; r = -0.38) a moderate negative relationship is observed. Finally, when relating cardiorespiratory fitness with WHR (p = 0.152; r = -0.21) there is no significant relationship.

Table 3

Relationship between anthropometric variables and general and cardiorespiratory physical condition.

Variable	GPC		CRC	
	p	r	p	r
BMI	0,056	-0,28	0,008*	-0,38
Waist circumference	0,028*	-0,32	0,021*	-0,33
Hip circumference	0,002*	-0,44	0,040*	-0,30
WHR	0,866	-0,02	0,152	-0,21
WHtR	0,003*	-0,43	0,008*	-0,38

BMI: Body mass index; WHR; Waist-hip ratio; WHtR; Waist-to-height ratio; GPC: general physical condition; CRC: cardiorespiratory fitness. * indicates statistically significant relationship (p<0.05).

Relationship between muscle strength and anthropometric variables

Table 4 shows that, when relating muscle strength to: BMI (p = 0.391; r = 0.12), waist circumference (p = 0.409; r = -0.12), hip circumference (p = 0.450; r = -0.11) and in this same line the WHR (p = 0.547; r = -0.09)

and the WHtR (p = 0.087; r = -0.25), these do not report a significant relationship when related to muscle strength.

Relationship between speed/agility and anthropometric variables

Table 4 relates speed/agility with waist circumference (p = 0.019; r = -0.46) showing the existence of a weak negative relationship. In this same line, when relating speed/agility with BMI (p = 0.001; r = -0.46), hip circumference (p = 0.004; r = -0.41) and WHtR (p = 0.004; r = -0.41) a moderate negative relationship is distinguished. On the other hand, when relating speed/agility with WHR (p = 0.413; r = -0.12), which means that they do not report a significant relationship.

Table 4

Relationship between anthropometric variables with muscle strength and speed/agility.

Variable	Muscle strength		Speed/agility	
	p	r	p	r
BMI	0,391	0,12	0,001*	-0,46
Waist circumference	0,409	-0,12	0,019*	-0,34
Hip circumference	0,45	-0,11	0,004*	-0,40
WHR	0,547	-0,09	0,413	-0,12
WHtR	0,087	-0,25	0,004*	-0,41

BMI: Muscle mass index; WHR; Waist-hip ratio; WHtR; Waist-to-height ratio.
* indicates statistically significant relationship (p<0.05).

Relationship between flexibility and anthropometric variables

Table 5 relates flexibility with anthropometric variables such as BMI (p = 0.041; r = -0.30) and waist circumference (p = 0.023; r = -0.33) and a weak negative relationship is found. Meanwhile, when relating flexibility with WHR (p = 0.001; r = -0.45) a moderate negative relationship is distinguished. On the other hand, regarding the relationship between flexibility with hip circumference (p = 0.812; r = -0.03) and WHtR (p = 0.066; r = -0.27) these do not report a significant relationship.

Table 5

Relationship between flexibility and anthropometric variables.

Variable	p	r
BMI (kg/m 2)	0,041*	-0,30
Waist circumference	0,023*	-0,33
Hip circumference	0,812	-0,03
WHR	0,001*	-0,45
WHtR	0,066	-0,27

BMI: Body mass index; WHR; Waist-hip ratio; WHtR; Waist-to-height ratio. * indicates statistically significant relationship (p<0.05).

DISCUSSION

The main findings of this study indicate that there is a correlation between self-reported physical fitness and some anthropometric measurements such as BMI, waist circumference, hip circumference, WHR and WHtR. Specifically, general physical fitness is related to hip circumference and WHtR. Along these lines, cardiorespiratory fitness was correlated with BMI and WHtR, while speed/agility showed correlations with BMI, hip circumference and WHtR. Likewise, flexibility is related to most of the variables analyzed except for hip circumference and WHtR. Similar results were previously reported in a study investigating the relationship between anthropometric variables and physical performance in Chilean physical education university students, finding that individuals with less body fat exhibited higher performance in physical tests of strength and speed (Almagià et al., 2009). On the other hand, in the physically active Asian university population, BMI and body fat percentage have been shown to have inverse correlations with muscle strength and cardiorespiratory fitness (Koley et al., 2010). In adolescents between 14 and 16 years of age, a relationship has also been found between physical fitness and certain anthropometric measurements, with BMI being the main predictor of physical fitness (Zenić et al., 2013). Although body composition was not evaluated in our study, correlations were observed with other anthropometric measurements of clinical use and rapid measurement such as BMI, waist circumference, hip circumference, WHR and WHtR, which are also considered strong predictors of health in the general population (Ortega et al., 2016).

Regarding the relationships found between general physical capacity and anthropometric measurements, in the present research significant relationships were observed in waist circumference, WHtR, and waist circumference. These findings are similar to those observed by Koster et al. (2008), in which it was reported that by remaining close to values established as normal in anthropometric measurements, the university population maintains a better physical capacity in general (Koster et al., 2008). In addition, another research indicates that anthropometric measurements are related to general physical condition, but this relationship is influenced by the level of physical activity that students present, showing that, although physical condition is related to anthropometric measurements, these reach a better relationship when university students remain physically active (Almagià et al., 2009).

The relationships found between cardiorespiratory fitness and anthropometric measurements were significant with respect to BMI, WHtR, waist circumference, and hip circumference. These findings coincide with previous studies that also link these anthropometric measurements with cardiorespiratory fitness and mitochondrial efficiency, coinciding with the findings of our research (Peterson et al., 2012). A lower cardiorespiratory fitness alters mitochondrial function and increases the risk of obesity, which in turn leads to an increase in anthropometric parameters such as BMI, WHtR, and waist and hip circumferences. In addition, another research that examined the relationships between physical condition and body composition in students reported that there is an inversely proportional relationship between cardiorespiratory fitness and BMI, waist circumference, and hip circumference. This means that as cardiorespiratory fitness increases, it is associated with a decrease in these anthropometric measurements (Ara et al., 2010). On the other hand, flexibility is one of the least studied components of physical fitness in the age group of young adults (which includes university students), which translates into little evidence available to analyze this result. However, in our study, a

relationship between flexibility and WHR, BMI and waist circumference was observed. Similar results were described in a study conducted in older women, where the relationships between anthropometric measures, health and physical fitness were analyzed (Valdés-Badilla et al., 2017). This study indicates that excess body weight in physically active women does not affect their physical-functional performance; however, cardiometabolic risk is inversely associated with functionality.

Regarding muscle strength, in our research no significant relationships were observed with anthropometric variables. These results may be explained because a higher body weight and consequently a higher proportion of fat mass and muscle mass lead to greater maximum strength in young adults (Ten Hoor et al., 2018).

Regarding speed and agility, no significant relationship was found with WHR. This may be due to the fact that WHR, which measures intra-abdominal fat, is not directly related to speed and agility, since these assessments do not focus on the physical ability of this body area. Therefore, the students' perception may have influenced the lack of a direct relationship observed. Another research that addressed the issue of speed and agility in the youth population reported that this quality does not depend primarily on the physical characteristics of the individual evaluated, but rather places it as a complex neural ability, which obeys various factors, both physical and motor, emphasizing the aspects of muscle excitability, recruitment and stiffness of the muscles involved, in addition to space-time perceptions, which are essential to control and quickly change movements with high precision (Felez-Nobrega et al., 2018).

The use of the IFIS as a self-report tool in the assessment of physical fitness has been previously validated in young adults (Ortega et al., 2013) and Chilean university students (Palma-Leal et al., 2022). Specifically, it has been found that university students who maintain a physically active life experience an improved perception of their physical condition. In addition, they obtain higher scores on the IFIS compared to those who lead a sedentary lifestyle (Valdés-Badilla et al., 2015; Yuing et al., 2021). The relevance of these findings is reinforced by the research carried out by Peña-Ibagon et al. (2021), where they observed in a sample of 1,206 university students that self-reported physical fitness is positively related to PA levels (Peña-Ibagon et al., 2021). In the university population, the existence of certain barriers to the practice of PA has been observed. These barriers include lack of time, social influence, lack of energy and willpower (Henao & Arévalo, 2016), academic workload, and time spent on social media (Calestine et al., 2017). These barriers can increase the risk of presenting and perceiving low physical fitness, which negatively impacts the health of university students and the general population (Calestine et al., 2017; Henao & Arévalo, 2016; Vargas et al., 2023). Fonseca-Camacho et al. (2015) reported that a worse perception of physical fitness is associated with a higher prevalence of metabolic syndrome, with abdominal obesity having a higher prevalence (33%).

Among the main limitations of this study are the evaluation of anthropometric variables by means of self-report, together with the assessment of physical condition by means of the IFIS, since it can lead to biases on the part of the person being evaluated. However, the use of self-report for the assessment of anthropometric measurements can be a useful technique to cover a larger population, especially in public health. Likewise, the use of this IFIS questionnaire is widely accepted as a reliable and validated tool for the assessment of physical condition.

CONCLUSION

The results found by this study show a relationship between the perception of physical condition and some variables of anthropometric measurements such as: waist circumference, hip circumference and WHtR, showing significant correlations. Meanwhile, the significant correlations in cardiorespiratory capacity and the observed anthropometric measurements are BMI, waist circumference, hip circumference and WHtR. Finally, the statistically significant correlations reported in speed/agility and anthropometric measurements are BMI, waist circumference, hip circumference and WHtR.

The results of this study affirm the importance of a physically active life in the university population, in order not to alter anthropometric parameters related to health. In future research, scientific evidence should advance in proposing specific physical exercise programs in this population and its influence not only on anthropometric parameters, but also on improvements in body composition and other dimensions such as mental health.

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