



Relationship between the Self-Concept and Muscular Strength in Southern Spanish Children

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Abstract

Objective: The purpose of this study was to analyze the relationship between self-concept and muscular strength in elementary schoolchildren.

Design: Ex post facto cross-sectional design and descriptive court.

Method: 256 schoolchildren (142 females) aged 8 to 11 participated in the handgrip strength and longitudinal jump assessment to calculate the muscular strength index. Self-concept was assessed by the Self-Concept Scale Piers-Harris.

Results: In both genres, higher muscular strength levels were significantly associated with the behavioral ($p=0,002$), physical ($p<0,001$), lack of anxiety ($p=0,022$) and social self-concept dimensions. A positive correlation ($p=0,004$) was found between muscular strength and global self-concept, showing significant differences in favor of males in all the dimensions analyzed and the global self-concept.

Conclusion: The results of this study suggest that muscular strength is a distinctive element in the schoolchildren self-concept. Further longitudinal studies are needed to analyze the complex relationship between self-concept and physical fitness, considering the results emerged from this study.

Keywords: Self-concept; Self-esteem; Physical fitness; Muscular strength; Children

Introduction

Within the last few years, several studies have analyzed the role of muscle strength in physical exercise, daily life activities and disease prevention [1,2]. Muscle strength is an important exponent of the fitness state and represents a direct measure of overall biological health, especially skeletal and joint, cardiovascular and metabolic system [3,4].

Recent evidence suggests that muscle strength is inversely related to several parameters associated with the metabolic syndrome in males [5]. Prospective investigations have found that those men with higher levels of muscle strength showed lower prevalence of metabolic syndrome [6]. Therefore, developing and accessing the level of muscle strength is a medical need to improve the welfare of the population and public health [3]. The hand-grip strength and power of horizontal jump are two indicators when assessing the level of muscular strength and have been used in numerous international researches [6-8].

Hand-grip strength has been recognized as an important predictor of quality of life [8]. The hand-grip dynamometer is known as an accurate instrument related to longevity and mortality [6].

The assessment of lower body power is also a reliable marker of the individual biological health. It was found in patients with heart condition that muscle strength of the lower extremities is positively and directly associated with morbidity and mortality, even above other physiological parameters analyzed as maximum oxygen consumption [3].

With regard to schoolchildren and adolescents, cross-sectional investigations have shown the association between some cardiovascular risk factors and the level of muscle strength in both the upper body and lower body [9].

The importance of muscle strength as a biological indicator of health is a proved aspect and its association with other biological parameters

has been empirically tested. Some studies have analyzed the association between muscular strength and several parameters of mental health, such as health perception, self-esteem and self-concept [10-15].

Self-concept is an important psychological construct in human development, and refers to the descriptive and evaluative labels a person self-attribute, it is often related to physical appearance, behavior patterns and emotional aspects [12].

The development of the self-concept is especially relevant during the final period of childhood. At this stage there are significant changes in the students' competences, which may affect the consolidation of personality [16,17]. It has been reported that some dimensions of the self-concept (emotional, social, physical or behavioral) may be originated at 9-10 years and culminate towards the end of adolescence [12]. According to some authors [18], the adoption of behaviors that will determine the lifestyle during adulthood would be more feasible in earlier life periods when the identity and security is being developed.

Most studies examining the relationship between self-concept and physical condition set aside indicators such as hand grip strength or overall muscle strength. However, one of the variables on which the school children could build their self-concept is their muscular-

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strength level [14]. Several studies have reported that adolescents with higher levels of lower body strength (measured by horizontal jump) have a higher physical self-concept profile [11]. In previous studies conducted among Italian teenage girls, was found that the level of fitness, competence and strength were more optimized along with the increase of muscular strength, which favored their global self-concept profile [10]. Other studies, however, conclude that muscle strength has a very weak association with the self-concept profile in elementary school children [12].

Few studies have analyzed so far the relations mentioned; besides most of the research done has focused on the physical dimension of self-concept and not in the general self-concept. Therefore, the objective of this study is to analyze the possible relationship between the muscular strength levels and self-concept profile among schoolchildren from the southeast of Spain.

Material and Method

Participants and design

A descriptive cross-sectional study was conducted with a sample of 256 Spanish schoolchildren from the Southeast of Spain aged between 8 and 11 years. Once obtained the approval of the headmaster of every school by informing of the purpose and research protocol, an informed consent was required to each participant as a requirement to participate in the study. In addition, a number of exclusion criteria, such as the presence of mental illness or osteo-muscular disorders were considered.

The study was conducted following the ethical standards recognized by the Declaration of Helsinki (revised 2008), and following the recommendations of Good Clinical Practice EEC (document 111/3976/88 July 1990) and the current Spanish government legislation of clinical research in humans (Real Decreto 561/1993 on clinical trials).

Measures

The schoolchildren aptitude to performance muscle strength test was measured through the Readiness Questionnaire Physical Activity and a healthcare paper required participating in physical education lessons.

Weight test: Weight (kg) was measured using an electronic scale (model 220, SECA, Hamburg, Germany) with an accuracy of 0.1 kg. The subject stood in the center of the platform wearing light, barefoot sportswear, distributing weight on both feet, staring straight ahead, arms along the body, and without any movement. Two measurements were taken and the average of both was recorded.

Muscle strength assessment: The test selected belong to the ALPHA-fitness Battery evidence based, and are aimed to objectively assess the muscle strength [19]. Also, these tests are directly related to health, according to the principles of the American College of Sport Medicine (ACSM) [20].

The handgrip strength (kg) was assessed by manual dynamometry through a digital dynamometer with adjustable grip (TKK Grip D 5041, Takei, Tokyo, Japan), and a rule-table to adjust the amplitude of the grip [21]. A training process was established to the researchers to achieve adequate levels of reliability and validity of the measures. Once completed the preparation process, a double-blind design was performance scoring an intraclass correlation coefficient (ICC) of 0.91 for the intra-explorer test and 0.89 for inter-explorer tests.

For assessing the lower body strength was used the horizontal jump (in centimeters) which was perform with the feet together and

previous impulse [22]. An ICC of 0.91 for intraexplorer and 0.89 for interexplorer was obtained.

The muscular strength index (MSI) was calculated as the sum of the standardized z scores of the dynamometer /weight test and the horizontal jump test [23]. The MSI classified the schoolchildren into three groups according to the level of muscular strength: low muscle strength index, $X < P_{20}$; average muscle strength index $P_{20} < X < P_{60}$ and high muscular strength index $X \geq P_{60}$.

Self-concept assessment: To assess the self-concept of schoolchildren was used the Piers-Harris Self-Concept scale [24]. It was specifically developed for being used in children among 7 and 12 years and was adapted by Cardinal Fierro [25]. The scale is widely used in education and is composed of 80 items formulated in simple sentences with dichotomous nature (yes/no), which indicate the degree of agreement or disagreement with the item statement. There are several dimensions assessed through this scale:

Behavioral (18 items), which describes the extent to which the child affirms or denies problematic behavior.

Intellectual (17 items), reflecting the child self-assessment in relation to academic tasks, including a general perception towards school.

Physical (12 items), evaluating the behaviors relating to their physical features (appearance and physical attributes), and issues such as leadership and ability to express their ideas.

Lack of anxiety (12 items), which describes an altered mood and cover different emotions regarding concerns, nervousness, sadness or fear.

Social or Popularity (12 items), which measures how the schoolchildren value its relationships of popularity and acceptance among their peer group.

Happiness-satisfaction with life (9 items), reflecting a general feeling of being happy and satisfied with live.

General (80 items), which describes the individual perception related to physical attributes, behavior patterns, social relationships, academic performance, emotions and life satisfaction.

A positive self-concept is related to high scores on the different dimensions except for the anxiety subscale, in which higher scores describe lower levels of anxiety.

The psychometric properties of this scale have been documented in other studies showing adequate internal consistency and high reliability and validity ([12]; $\alpha=0.982$). In this paper we have applied reliability testing of scale items and a confirmatory factor analysis to verify the grouping of items in the different subscales originally defined. All scale items have consistency and reliability, if any item is removed, it significantly reduce the explained variance and overall reliability in each scale sub-construct and global scale. The scale shows good reliability as measured by Cronbach's Alpha (0.892) test. The reliability of the different sub-constructs was: behavioral (0.921), intellectual (0.935), physical (0.845), lack of anxiety (0.901), social or popularity (0.856) and happiness-satisfaction (0.845).

The confirmatory factor analysis with varimax rotation confirmed the 6 sub-scales on which the instrument is structured. Each of the scale sub-constructs and the global scale explained a variance that provides consistency to the scale applied. These sub-constructs were behavioral (15.11%), intellectual (14.89%), physical (13.98%), lack of anxiety

(13.06%), social or popularity (11.65%) and happiness-life satisfaction (0.94%). The total variance explained was 78.66%.

After the tests mentioned, we can say that the scale used in this study is a valid and reliable instrument for assessing self-concept among schoolchildren.

Procedure

The researchers conducted a theoretical and practical session at the participating centers to standardize the measurement protocol of the muscular strength tests. He advised the participants not to do sports in the evening before the test administration. The field work was carried out during one session in each of the schools. Weight measurement was performed first in a school adjacent room properly conditioned before the measurement process. The horizontal jump test and the handgrip strength with a dynamometer were administered in the school sports hall. Measurement tests were performed within the same week, in the same time of the day and similar environmental conditions. Participants used lightweight sportswear and suitable trainers. Prior the test the

participants warmed up through 8 minutes of light intensity run, joint mobility exercises and dynamic and active stretching.

The Piers-Harris scale was administered in groups of 20-25 students in a classroom that allowed maintaining the privacy and freedom in application. To complete the questionnaires the participants were given examples and verbal instructions. The research team remained in the classroom to answer any questions and verify the proper filling of the questionnaire. The time average to fill the questionnaire was 45 minutes. Fieldwork was conducted in November 2014 during the academic year (2014/15).

Data analysis: Mean and standard deviation are shown for the continuous variables, whereas in the categorical variables are shown the values of frequencies and percentages. For the analysis of normal variables Kolmogorov-Smirnov was used. To analyze the differences in the self-concept profile and the muscle strength between groups was implemented the one-way ANOVA analysis, the Pearson χ^2 test with residue analysis was used. The significance level was set at 5% ($p \leq 0.05$). For all the statistical analysis was used the SPSS version 19.0 (SPSS Inc., Chicago, Illinois, USA).

Results

Descriptive analysis

The descriptive results of the different variables analyzed are presented in Table 1. These results show the existence of statistically significant differences in the horizontal jump test ($p=0.031$) and the muscular strength index ($p=0.027$). No statistically significant differences were observed in the variables of weight, hand dynamometry test, self-concept dimensions and global self-concept. The distribution according to the Muscular Strength Index showed significantly higher values in males.

Relationship between self-concept profile and muscular strength level by gender

The differences in the self-concept profile according to the muscular strength level are presented in Table 2. In both, men and women, the ANOVA analysis showed the existence of statistically significant differences between the participants with a high level of muscular

	Males (n=114)	Females (n=142)	p-value
Age (years)	9,4 ± 1,3	9,5 ± 1,3	0,833
Weight (kg)	38,1 ± 11,1	37,4 ± 10,9	0,616
Maximun dynamometry (kg)	16,8 ± 6,2	15,8 ± 5,3	0,147
Horizontal jump (cm)	104,9 ± 19,9	99,5 ± 20,2	0,031
Muscular Strenght Index (puntuaciones Z)	0,2 ± 1,4	-0,2 ± 1,4	0,027
Low (%)	16,7	22,5	0,069
Medium (%)	34,2	45,1	0,014
High (%)	49,1	32,4	0,322
Behavioral (0-18)	15,5 ± 2,6	15,4 ± 2,4	0,882
Intellectual (0-17)	12,70 ± 2,7	12,8 ± 2,3	0,561
Physical (0-12)	10,0 ± 2,0	9,6 ± 2,0	0,083
Anxiety (0-12)	8,5 ± 2,4	8,5 ± 2,3	0,525
Social (0-12)	10,4 ± 1,6	10,2 ± 2,0	0,885
Life satisfaction (0-9)	7,77 ± 1,3	7,8 ± 1,5	0,659
Global (0-80)	64,8 ± 9,0	64,4 ± 8,8	0,525

Table 1: Descriptive data classified by gender.

Self-concept	Muscular strenght level			F	p value
	Low (n=19)	Medium (n=39)	High (n=56)		
Males					
Behavioral (0-18)	14,8 ± 3,1	14,2 ± 3,0	16,2 ± 1,6	4,892	0,009
Intellectual (0-17)	12,3 ± 3,2	13,0 ± 2,4	13,2 ± 2,6	0,899	0,410
Physical (0-12)	9,0 ± 2,8	10,3 ± 1,7	10,7 ± 1,6	5,678	0,004
Anxiety (0-12)	7,8 ± 2,9	9,2 ± 1,7	8,7 ± 2,5	2,247	0,110
Social (0-12)	9,3 ± 2,2	10,0 ± 1,5	10,7 ± 1,5	5,245	0,007
Life satisfaction (0-9)	7,0 ± 1,7	7,8 ± 1,2	8,0 ± 1,1	3,941	0,022
Global (0-80)	60,3 ± 13,4	65,2 ± 7,0	67,7 ± 7,8	5,068	0,008
Females					
Behavioral (0-18)	14,46 ± 3,0	16,0 ± 1,8	15,8 ± 2,3	5,050	0,008
Intellectual (0-17)	12,0 ± 2,7	13,1 ± 2,3	12,9 ± 2,4	2,068	0,130
Physical (0-12)	9,0 ± 2,2	9,96 ± 1,9	10,2 ± 1,8	4,253	0,016
Anxiety (0-12)	7,8 ± 2,5	8,6 ± 2,2	8,9 ± 2,1	2,304	0,104
Social (0-12)	9,5 ± 2,3	10,6 ± 1,5	10,1 ± 2,2	3,512	0,033
Life satisfaction (0-9)	7,6 ± 1,4	7,9 ± 1,3	7,9 ± 1,7	0,520	0,596
Global (0-80)	60,6 ± 10,5	66,3 ± 7,2	65,9 ± 9,1	5,176	0,007

Mean and standard deviation are shown in the table. The gender differences are also analyzed through ANOVA.

Table 2: Relationship between self-concept and muscular strength level by sex.

strength in relation to those with a low level. Males with high level of muscular strength had on average higher values in the behavioral dimensions ($p=0.009$), physical ($p=0.004$), social ($p=0.007$), life satisfaction ($p=0.022$) and in the global self-concept ($p=0.008$). Women with high levels of muscular strength showed on average higher values in behavioral dimensions ($p=0.008$), physical ($p=0.016$) and social ($p=0.033$), as well as the global self-concept ($p=0.007$) (Table 2).

Discussion

In this study, muscular strength is directly related to the schoolchildren self-concept profile. We found that schoolchildren with a higher level of muscle strength (expressed in this paper as handgrip strength and lower body power) have higher levels of behavioral, physical, lack of anxiety and social self-concept. Global self-concept is positively associated to schoolchildren with higher muscular strength. These differences in the self-concept profile are maintained when gender differentiation is performed.

The results found in this study are consistent with findings observed in previous studies with primary schoolchildren [12,14,15,26] and adolescents [10,11,13], which have revealed existing associations between some parameters of the physical condition, such as muscle strength and self-concept.

The coincidence of the results of these studies with those reported in the present study could be due to the use of multidimensional instruments used for the assessment of self-concept and the existence of similar tests measuring muscle strength, such as horizontal jump test. In a study with 283 Spanish adolescents (153 girls) was analyzed the relationship of fitness (measured through EUROFIT battery) and self-concept (evaluated using the Self-Concept Questionnaire Form 5) finding that the horizontal jump test was associated with physical and emotional self-concept, suggesting that subjects with a higher lower body power had better physical and emotional self-concept [13].

In another study, was conducted a meta-analysis suggesting that strength training was more effective than improving parameters of aerobic endurance (as the maximum oxygen consumption) for the development of self-concept and the improvement of self-esteem [27]. In the same study was outlined that women tend to link physical attractiveness to the general self-concept. More evidence is shown in a study which concluded that men are more likely to build their overall self-perception based on aspects related to muscle strength and personal ego [28].

However, the results of other studies are inconclusive, either some of them have not observed any relationship between muscle strength and self-concept or have found weak relationships unable to draw firm conclusions. In a study conducted with 75 Spanish students (36 girls) of 10-13 years on the relationship between self-concept (evaluated through the Piers Harris scale) and fitness (measured through EUROFIT test battery) was found a weak relationship between the two variables, only statistically significant associations between abdominal strength-endurance and behavioral self-concept and life satisfaction were found. Therefore the authors concluded that some parameters of fitness and muscle strength have a weak relationship with self-concept [12].

The cross-sectional design of this study was unable to establish a cause-effect relationship between the variables analyzed. It is also necessary to mention that the use of self-report measures to assess self-concept may involve the presence of failures in completing the items. However, false information was intentionally minimized because the schoolchildren completed the questionnaire anonymously. Apart from

that, the tests of reliability and validity established in some studies were confirmed in the present study giving us consistency in these relationships [12,24,25].

The results of this study suggest that muscular strength is a distinctive element in the schoolchildren self-concept. Thus, an optimal level of muscular strength may have a positive impact on balanced personality development and social well-being among children. Further longitudinal studies are needed to analyze the complex relationship between self-concept and physical fitness, considering the results emerged from this study.

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