



THE RELATIONSHIP BETWEEN PHYSICAL FITNESS AND ACADEMIC PERFORMANCE IN ADOLESCENTS FROM THE BALEARIC ISLANDS

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Abstract

The aim of this study is to see if there are significant relationships between different variables of physical condition and academic performance.

Most literature shows that a relationship does exist, mainly emphasizing maximal oxygen consumption and academic performance. With regard to the other variables, more differences can be found.

A total of 79 students participated in the study from the island of Majorca (Spain), ranging in age from 12.5 to 14.5 years. Students passed fitness tests, which were compared with their academic results.

The results show a significant positive relationship between BMI and hand grip strength and significant negative relationships between BMI and note and between BMI and maximal oxygen consumption. No significant relationships have been found, however, between maximal oxygen consumption and note.

Assessment of the importance of physical condition and therefore physical education in academic performance is of interest in order to implement the necessary hours of Physical Education. Furthermore, this subject should be characterised further in terms of its relation to the issue of health.

Key words: *physical fitness, physical activity, academic performance, adolescents.*

Introduction

Obesity and the problem of weight gain in young people is one of the real problems that societies are currently suffering around the world. In the last 37 years, according to the World Health Organization (WHO), data concerning obesity have doubled. In the year 2014, 1,900 million people over the age of 18 (39% of the population) were overweight, of whom 600 million (13% of the population) suffered from obesity [20]. At state level, in Spain 52.7% of people were above the weight considered normal in 2014 according to the National Institute of Statistics (INE). In the case of the Balearic Islands and in the youth and juvenile population the prevalence of child and juvenile obesity in the Balearic Islands is 9.3% (95% CI: 7.7-11.0). One in five students from the Balearic Islands is

overweight (19.3% CI: 17.3-21.7). The frequency of low weight is less than 1%. The frequency of being overweight and obesity is similar in men and women [1]. Related to the concepts of being overweight and obesity, sedentary lifestyle is one of the main causes of these two problems. In Spain, 4/10 people are sedentary in their free time. This figure is higher amongst Spanish women (49.8%), than men (38.8%) [18].

In this way, it can be seen that levels of regular physical activity are quite low. In addition, due to levels of low physical activity, obesity and being overweight are present in today's society, which can lead to various health problems that also affect the economy in terms of the increase of possible illnesses related to sedentary lifestyle. "Noncommunicable diseases such as coronary heart disease or type II diabetes mellitus cause costs for the health system to

increase" [13]. The WHO indicates the following diseases (not transmissible) and those that most affect the planet: cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes. It also claims that these diseases are mainly due to sedentary and unhealthy lifestyles, poor nutrition, alcoholism, and smoking. Specifically, physical inactivity is associated with being overweight and obesity, which are for example underlying causes of heart disease and diabetes mellitus type II, [13].

Performing moderate or vigorous physical activity more than once a week has a positive effect on health by decreasing type II diabetes. However, all studies show a negative relationship between physical activity and the risk of diabetes type II [7]. Other investigations [9] show that physical activity has a positive relationship with mental health. Specifically, physical activity is positively related to a decrease in stress, an increase in mood, an improvement in self-awareness and decreases in the levels of anxiety and depression.

The assessment of the physical condition, insofar as it is related to the habits and levels of physical activity in a population, allows us to obtain information about the state of health and the quality of life of this population [10].

The original conception of the evaluation of physical condition in schools has changed radically over the last 20 years. While physical condition was initially focused on performance, it was subsequently related to health [4]. This relationship between physical condition and health has been employed relatively recently, but it is currently a much exploited and very necessary field with regard to establishing the current health status of the general population.

Having observed and verified the relationship between having a good physical condition, performing physical activity on a regular basis and having good health, we then focus on analyzing whether the level of physical condition is related to the qualifications of students in educational centers.

A recent study found a relationship between academic performance and physical condition. In the case of boys, a significant relationship was observed between all the tests of physical condition passed by students (explosive force of

lower train, agility, speed, and flexibility) and the subject of Mathematics, but no relation to the subject of Spanish Language and Literature. The capacity presenting a significant relationship lasting for 3 years of the study is cardiovascular capacity, in both sexes [3]. Other studies have also emerged that show the significant relationship between cardiovascular capacity and academic performance, but the latter cannot claim to be related to other physical abilities [5, 14].

The significant relationship between cardiovascular resistance and academic performance has been corroborated by different studies [6] and also adds other relationships such as poor academic performance amongst underweight people as opposed to people with normal weight.

A study recently carried out in Spain shows a significant relationship between academic performance and physical condition, only in terms of the body mass index and the waist circumference, both negatively related. That is to say, the greater the BMI or waist perimeter, the lower the academic performance and vice versa. These same authors, on the other hand, do not observe a significant relationship between cardiovascular capacity and flexibility [12].

Another interesting finding is the significant relationship between academic performance and flexibility, speed test and resistance test. Regarding the tests of flexibility and speed, there is a greater relationship with academic performance in women, while the resistance test is higher in men [15].

There is evidence that it supports the effectiveness of interventions that improve aspects of physical condition to enhance school performance among school-age children who are overweight or obese [16]. These authors, on the other hand, also affirm that the interventions that take place at the level of physical condition in students who are overweight or suffer from obesity suppose an important support for these on the academic stage. However, other factors such as culture and socioeconomic level can also have an influence. In the same way, other studies argue that schoolchildren with obesity have lower academic performance compared to others [14]. On the other hand, there are studies

that show the BMI values do not have a significant relationship with almost any of the subjects [17].

Related to this latest idea, the aim of this study is to establish the relationship between academic performance and physical condition in adolescent students at an educational center of the island of Majorca.

Materials and methods

Participants

The present study was carried out with a sample of 79 participants (46 boys and 33 girls) from Majorca (Spain). All the students who took part in the study were in the 2nd grade of secondary education.

Before performing the tests, the students were informed that their data would be used for the study and that they would be totally anonymous. In the same way, the educational center also gave its consent and provided the data with reference to the academic results.

The inclusion criteria in the study stipulated that participants should not be suffering any form of pathology or have been injured in such a way as to inhibit performance in the tests in an optimal way. In this way, the participants had to be students of 2nd grade, present during the session designated for performance of the tests, without impediments which would prevent appropriate performance.

Procedure

The collection of data was carried out in April 2017, at the final stage of the second school quarter 2016-2017. The test site was the indoor sports center located next to the center itself, which enabled the execution of all the tests.

Instruments

The variables analyzed were as follows: level of physical condition (strength of manual pressing

(N), VO₂max (ml/kg/min), (BMI)), academic performance (0-10 points) and sex.

The physical tests chosen were carried out during one session: manual dynamometry, Course-Navette and BMI (weight and height, requested orally).

All participants had a single attempt at The Course-Navette test, whereas the best of two possible attempts was recorded for the test of manual presses force. In addition, before the completion of the tests, the protocol was explained to each participant.

Regarding academic performance, the arithmetic averages (of the second quarter) were used for all subjects studied in the 2nd grade. The average note was obtained, thus obtaining a single figure, which encompasses all the subjects.

Statistical analysis

For the extraction of data, several types of analysis have been used in order to accumulate all the data and make good use of them. The program used was IBM SPSS Statistics 23. In the first place, a descriptive analysis of the different variables has been carried out, using frequencies, percentages, and standard deviations.

Average comparisons have also been made, in the cases of the different BMI ranks and the academic notes (T-student).

Finally, a type of inferential analysis has been performed, which has allowed establishing of meaning between the different variables analyzed, in order to determine if there is a relationship between them (Pearson's correlation coefficient).

Results

The results shown below were obtained from the frequencies, percentages, and averages established for each of the 4 variables analyzed.

Table 1. Frequencies and percentages of the 4 variables analyzed

	All X (SD)	Boys X (SD)	Girls X (SD)	t	Sig (p)
Strength	25,87 (6.28)	28.65 (6.20)	22.00 (3.90)	5.42	0.016
BMI	20,87 (3.35)	20.55 (3.50)	21.32 (3.20)	-1.01	0.422
VO2 Max	43,32 (7.22)	46.55 (6.90)	38.82 (4.80)	5.50	0.045
Academic mark	6,04 (1.64)	5.61 (1.60)	6.63 (1.50)	-2.83	0.436

As can be seen, the majority of participants who have participated in the study were boys, with a difference of almost 20% between both sexes.

On the other hand, it is remarkable that girls receive better grades in academic performance, exceeding boys with 1.02 points on the arithmetic average.

It is also interesting to note that, with both boys and girls, the BMI is within healthy limits and that the arithmetic averages of this variable are within the norm. Below is a table that classifies according to the health scale of the BMI for each gender.

Table 2. BMI frequencies by sex

	All N (%)	Boys N (%)	Girls N (%)
Underweight	22 (27.80)	14 (30.40)	8 (24.20)
Normal weight	47 (59.50)	27 (58.70)	20 (60.60)
Overweight	8 (10.10)	4 (12.10)	4 (12.10)
Obese	2 (2.50)	1 (2.20)	1 (3.00)

Underweight participants score an academic mark mean of 6.16; normal weight score 6.02; overweight score 5.92; and obese score 5.50.

Table 3 shows the correlations that have been observed between the variables (BMI, VO2Màx, strength, and marks) for which some meanings can be extracted.

Table 3. Correlation between variables strength, BMI, VO2 Max, and marks.*p<0.05 **p<0.001

	Strength	BMI	VO2 Max	Mark
Strength	1	0.387**	0.133	-0.232*
BMI		1	-0.432**	-0.078
VO2 Max			1	-0.117
Mark				1

As can be seen, it should be noted that there is a significant positive relationship ($p < 0.01$), among those students who have presented higher levels of strength and those with a higher BMI.

The other result to note is that there has been a significant negative relationship ($p < 0.01$), between BMI and maximum oxygen consumption. That is, those students who have obtained a better result in the test that recorded

the consumption of oxygen are those that had lower levels of BMI.

In Figure 1, it can be observed that there is a tendency for those subjects with a low body mass index to achieve higher oxygen consumption levels. Likewise, a significant relationship ($p < 0.05$), negative, is observed between "mark" and "strength" variables, where those with lower values of force obtain a better academic qualification.

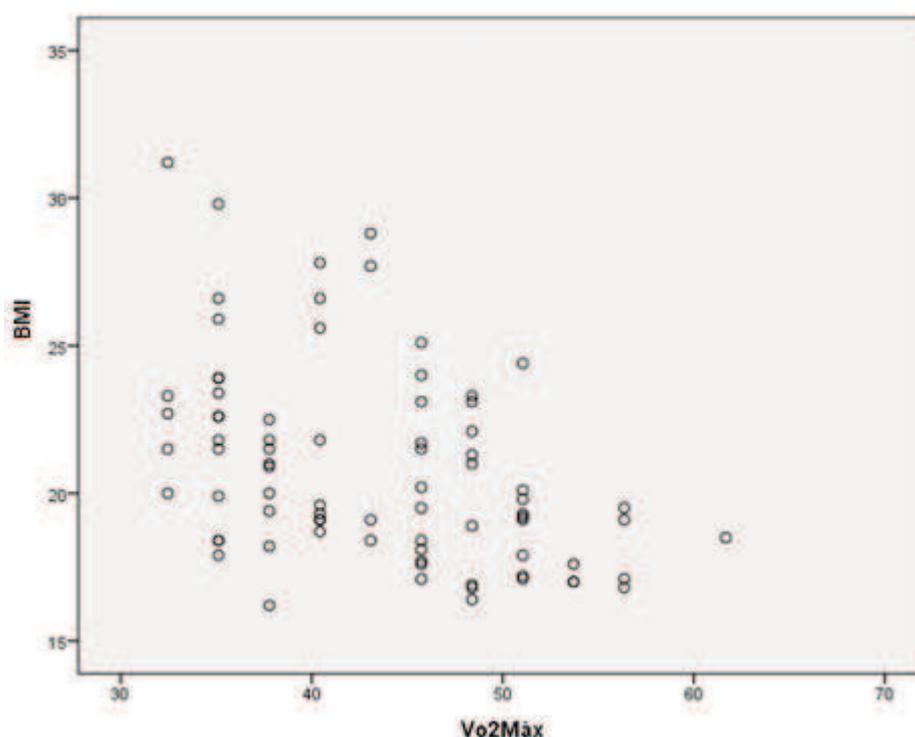


Figure 1. BMI and VO2 Max Maximum Dispersion

Discussion

The aim of the present study was to analyze the marks obtained by students from the 2nd grade of secondary education from Majorca, and to determine if their physical condition had a significant relation. Next, the concordances and disagreements with other studies related to the case will be presented, in order to establish whether they compare with other lines of investigation.

It was noted that people with normal weight in this study accounted for 59.5% while in

another study the figure was 79.7% [1]. This difference, however, could be due again, to the diversity of population studied in both cases. In relation to the physical condition; it can be observed that boys have higher values in the test of the force of manual pressing and also a greater consumption of oxygen, which enters the parameters of normality, due to the development of both sexes.

Differences between boys and girls begin to be appreciated after adolescence, around age 14 when boys develop their strength more quickly. Men have more strength than women (36-44%)

since they have more muscle tissue than women (25-29%), and men's ability to develop muscles is almost twice as high as that of women [2].

In relation to the VO₂ Max, there is no significant difference between boys and girls before puberty. It is after this that differences begin to present. Girls present between 30-35% lower levels of VO₂ Max. In the present study, however, these differences are smaller as the boys show a maximum consumption of 46.55 oxygen and girls 38.82 [11].

Focusing on academic record, we emphasize that the results show that girls (6.63) have an overall arithmetic mean in comparison with boys (5.61). Related to this, the European Commission [8], in a document of gender comparison, writes that generically boys gain higher qualifications in scientific subjects while girls get better results in the field of humanities.

Based on the results obtained in the correlation between strength and BMI, one might think that it is better to have low BMI levels, since this may mean having lower levels of manual strength and therefore obtaining better qualifications.

However, these results disagree with another study [19] carried out in seniors. The work affirms that those people with higher levels of hand grip strength have better cognitive capacity. However, these studies prove difficult to compare because of the age difference.

Regarding the relationship between BMI and marks, no significant relationships were

found according to another study [17]. On the other hand, a significant negative relationship was found between BMI and waist perimeter with academic performance [12].

A study has also indicates that underweight people get worse qualifications than people who are within normal weight parameters (18.5-25). These statements are in line with those in the present study, since those who were underweight (6.16) got better grades than people with normal weight (6.02) [6].

A recent study claims that obese schoolchildren have lower academic performance compared to others; according to our study, overweight students get an average of 5.5, followed by people with obesity (5.92) [14].

Finally, no significant relationship was found between maximum oxygen consumption and the academic grades achieved. These results are in line with those presented in another study carried out in Spain last year [12].

As for weaknesses of this study, it should be said that the sample used is scarce if we want to extrapolate from it results for the whole population, which is an important aspect to keep in mind. Although the results of the study are not powerful enough as regards the amount of data obtained, for the total population studied, the need to continue studying the relationship between physical condition and health/academic performance is assessed.

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