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RESEARCH ARTICLE

Cross-sectional study on the relationship between physical activity and the quality of the Mediterranean diet in baccalaureate students in Murcia (Spain).

Estudio transversal sobre la relación entre la actividad física y la calidad de la dieta mediterránea en estudiantes de Bachillerato de Murcia (España)

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ABSTRACT

Introduction: The aim was to determine the relationship between the level of physical activity and the quality of the Mediterranean diet in baccalaureate schoolchildren.

Material and method: Cross-sectional study carried out with 119 schoolchildren from Murcia (Spain) with an age range of 16-17 years. These schoolchildren were selected by non-probabilistic purposive sampling. The quality of the Mediterranean diet (QD) was assessed through the Mediterranean Diet Quality Index in children and adolescents questionnaire and physical activity (PA) through the International Physical Activity Questionnaire for Adolescents. Statistical analysis was carried out using Pearson's chi-square statistical tests, Student's T, One-way ANOVA and a linear regression analysis.

Results: The results of the analyses showed significant differences in the average of PA, where men showed higher values than women ($p < 0.001$). Among women, those with a lower level of PA showed a greater use of olive oil and a regular breakfast of industrial pastries ($p < 0.005$). Among men, those with a higher PA level showed a higher consumption of fresh vegetables, pasta or rice, and nuts ($p < 0.005$). Considering the total, regarding the differences in the level of PA as a function of QD, differences were found between a high level of QD and its homologous pairs with a low level ($p < 0.001$). Finally, an association was found between PA and QD ($p < 0.001$) with a value of $R^2 = 0.275$.

Conclusions: Increased physical activity is related to higher average diet quality in baccalaureate students. The development of these constructs is of particular interest in guiding towards adherence to healthy lifestyles that will last into adulthood. Training programmes must also be created that are appropriate to the needs and characteristics of 21st century society.

Keywords: Life Style; Exercise; Diet, Mediterranean.

RESUMEN

Introducción: El objetivo fue determinar la relación existente entre el nivel de actividad física y la calidad de la dieta mediterránea en escolares de Bachillerato.

Material y método: Estudio transversal realizado con 119 escolares de Murcia (España) con un rango de edad comprendido entre los 16-17 años. Estos escolares fueron seleccionados mediante muestreo no probabilístico intencional. Se valoró la calidad de la dieta mediterránea (CD) a través del cuestionario Mediterranean Diet Quality Index in children and adolescents y la actividad física (AF) a través del cuestionario *International Physical Activity Questionnaire for Adolescents*. El análisis estadístico ha sido llevado a cabo mediante las pruebas estadísticas ji al cuadrado de Pearson, T Student, One-way ANOVA y un análisis de regresión lineal.

Resultados: Los resultados de los análisis mostraron diferencias significativas en el promedio de la actividad física, donde los varones mostraron valores más elevados que las mujeres ($p < 0.001$). Entre las mujeres, aquellas con un menor nivel de AF mostraron un mayor uso de aceite de oliva y desayunar habitualmente bollería industrial ($p < 0,005$). Entre los varones, aquellos con un nivel de AF mayor mostraron un mayor consumo de verduras frescas, de pasta o arroz y, frutos secos ($p < 0,005$). Considerando el total, respecto a las diferencias en el nivel de AF en función de la CD, se encontraron diferencias entre un nivel alto de CD y sus pares homólogos con un nivel bajo ($p < 0,001$). Por último, se halló una asociación entre la AF y la CD ($p < 0,001$) con un valor de $R^2 = 0,275$.

Conclusiones: Una mayor actividad física se relaciona con una mayor calidad de la dieta mediterránea en escolares de Bachillerato. Estos resultados son de interés para el contexto sanitario y educativo ya que un correcto desarrollo de ambos constructos resulta de especial interés para orientarse hacia la adherencia de estilos de vida saludables. Asimismo, se deben crear programas formativos adecuados a las necesidades y características que presenta la sociedad del siglo XXI.

Palabras clave: Estilo de Vida; Ejercicio Físico; Dieta Mediterránea

KEY MESSAGES

- Higher physical activity is related to higher dietary quality in baccalaureate students.
- The development of these constructs is of particular interest in guiding towards adherence to healthy lifestyles that will last into adulthood.

INTRODUCTION

The latest data from the PASOS study on lifestyles in Spanish children and adolescents¹ show a growing trend of unhealthy behaviours such as increasing levels of overweight and obesity, which have increased slightly in the last 20 years. They also estimate that 35.4% of children and adolescents are currently within these levels at national level, reflecting the fact that 70% of adolescents do not comply with the physical activity (PA) recommendations recommended by the World Health Organisation (WHO).

The problem of obesity is multifactorial and has been approached from different perspectives². A review study on the causes and consequences of childhood obesity points to family eating habits, the characteristics of the food eaten and a sedentary lifestyle as three of the factors contributing to overweight and obesity. As for the consequences, they point out that they could be medical, socio-emotional and academic, if this problem persists during the paediatric, infant and adolescent age.

One of the variables that has been found in the literature to be related to a decrease in abdominal perimeter is the quality of the diet (QD)³. In this sense, the Mediterranean diet (MD) has been identified as a dietary pattern characterised by being rich in vegetables (fruits, cereals, vegetables, legumes and nuts), with a significant intake of olive oil, moderate consumption of fish, seafood, eggs, chicken and dairy products, together with a low consumption of red meat⁴. However, levels of adherence to DM vary according to place of residence as they are culturally nuanced. I would point out that South Eastern Europe is an area that followed this Mediterranean dietary pattern when it was defined, and that, although adherence is currently moderate (and not as low as in North America or Oceania - which did not follow this dietary pattern characteristic of Mediterranean areas), it is decreasing over the years⁵.

Among all the variables associated with adherence to MD in young people, the level of PA has been associated in international studies^{6,7} and in other studies conducted in different autonomous communities in Spain⁷⁻¹⁴. All the studies, despite varying in adherence to MD or level of PA, show the same directionality, with MD being positively associated with PA and inversely with sedentary behaviour.

In the Region of Murcia, in a study conducted with primary school children, associations were found between compliance with the WHO PA recommendations and greater adherence to MD¹⁵. In another study with primary and secondary school children¹⁶⁻¹⁸, they found the same trend,

adding that students classified as physically active had a higher adherence to MD than their more sedentary peers.

With regard to the PA level of young people, it has been reported in a worldwide survey that there is a marked prevalence of physical inactivity in the adolescent stage¹⁹, being more marked in the female gender, and without finding a relationship with the socioeconomic level of the countries studied. In Spain, it has been stated that there has been no improvement in the level of PA in recent years, alluding to screen time as an influential factor²⁰. In the Region of Murcia, they found that 77% of children and adolescents did not comply with PA recommendations (estimated through metabolic equivalent of task (Mets)), with males being more active than females²¹.

Therefore, it can be observed that the variables PA and MD have been related in international and national studies in recent years, especially in secondary school children and adolescents. However, there is an absence in the literature of studies that investigate the relationship between these variables in baccalaureate students. Given that this stage is critical for the continuity of PA, sports practice and the maintenance of healthy habits in adulthood, the aim of this study is to determine the relationship between the level of PA and the quality of the Mediterranean diet in baccalaureate students in the Region of Murcia.

MATERIAL AND METHODS

Type of study and participants

This study presents a cross-sectional-descriptive design. The population consisted of students studying at baccalaureate level. In total, the sample consisted of 119 schoolchildren (16 and 17 years old; 67 females and 52 males; mean age \pm standard deviation: 16.53 \pm 1.14 years), belonging to three public schools located in an urban area of Murcia (Spain). For reasons of access to the sample, these schoolchildren were selected through convenience sampling.

Procedure

Those responsible for the research (doctors of education and physical education teachers) arranged meetings with the directors of the schools and with the legal guardians of the pupils. Informed consent was requested from the parents or legal guardians, so that the schoolchildren could participate after the study, and their approval was mandatory, otherwise they would be excluded.

All schoolchildren returned this informed consent form to those responsible for the research. Schoolchildren were excluded from the study if: I) did not provide informed consent with the signature of legal guardians and II) were unable to engage in physical activity in the last week for a justified cause such as illness. The questionnaires were completed in the presence of the research staff with an average total duration of 25 minutes. Prior to the completion of the questionnaires, all doubts were answered to the participants. Likewise, during the course of the research, all the doubts that the participants had were resolved. It should be noted that one of the questionnaires contained socio-demographic variables (gender, age and school year). After completing the questionnaire, the participants handed the questionnaire to the researchers, who ensured that the instrument was completely filled in, so there were no missing cases. The anonymity of the respondents was also ensured. The work was carried out during school hours from 09:00 to 14:00. Data collection was carried out by visiting schools during the month of November of the academic year (2018/2019). The participation rate for each grade was over 80%. This research followed the Helsinki research ethics agreement (2013) and what was agreed in the Research Ethics Committee of the University of Murcia.

Variables and instruments

Predictor variable

The questionnaire used for the assessment of PA was the Spanish International Physical Activity Questionnaire for Adolescents (IPAQ-A), which assesses the PA performed by the adolescent

schoolchildren in the last 7 days using a Likert-type scale with five response options²². From these options, the schoolchildren must select the response option that best adapts to their degree of PA in terms of both frequency and intensity. In an estimated average time of 15-20 minutes, schoolchildren are asked to complete the questionnaire. The questionnaire asks questions about free time spent before, during and after PE lessons, after-school hours and weekends. At the same time, the questionnaire asks about a possible impediment to normal physical activity (last item). Depending on the score, some studies have classified participants into percentiles corresponding to the level of PA: low, medium and high¹⁷. However, in order to define useful cut-off points in the paediatric context, participants were intuitively classified into three groups: lower PA (< 25th percentile), medium PA (\geq 25th percentile and < 75th percentile) and higher PA (\geq 75th percentile). For males, a 25th percentile of 1.62 and a 75th percentile of 2.03 were recorded in 16 years. In 17 years a 25th percentile of 1.60 and a 75th percentile of 2.14 were obtained. In females, a 25th percentile of 1.35 and a 75th percentile of 1.77 were obtained at age 16. In 17 years a 25th percentile of 1.16 and a 75th percentile of 1.94 were obtained.

Criterion variable

The quality of the Mediterranean Diet was assessed using the Mediterranean Diet Quality Index in children and adolescents (KIDMED) questionnaire²³. This questionnaire consists of 16 dichotomous questions to be answered in a yes-no manner. These questions deal with the consumption of certain foods associated with the typical Mediterranean pattern. Affirmative answers to the questions representing a positive aspect add one point, while affirmative answers to the questions representing a negative connotation subtract one point. Participants' scores on each item should generate an overall score ranging from -4 to 12 points. This rating categorises students as having a high (\geq 8 points), medium (4-7 points) or low (\leq 3 points) quality diet.

Statistical analysis

The test for normality of variances was obtained using the Kolmogorov Smirnov statistic ($p = .089$). As a normal distribution of the recorded values was observed, a parametric analysis was chosen. Pearson's chi-squared, Student's t-test and analysis of variance (ANOVA) were used to compare the groups. The p-value of the post hoc hypothesis tests was calculated using the Bonferroni correction. Linear regression analysis was also performed to study the relationship between PA and QD adjusted and unadjusted for sex and age. Data were analysed with SPSS statistical software (v.25.0 from SPSS Inc., Chicago, IL, USA) for Windows, with the significance level set at 5% ($p \leq .05$).

RESULTS

Table 1 presents the results of the descriptive analysis of the study sample according to sex. With regard to QD, no differences were detected in the average values in any category. In reference to the level of PA, significant differences were only found in the average PA, where males showed higher values compared to females (1.91 vs. 1.58; $p < 0.001$).

Table 1. Distribution of the sample according to diet quality and level of physical activity considering sex.

Descriptive values of the sample			
	Males (n=52)	Females (n=67)	P value
Age (years)	16,75 ± 0,48	16,58 ± 0,49	0,660
QD^a Low	1,56 ± 1,14	1,27 ± 1,16	0,712
QD^a Media	4,86 ± 1,02	4,52 ± 0,89	0,281
QD^a High	10,30 ± 2,69	8,89 ± 1,23	0,0
Average^a QD	5,08 ± 5,14	4,12 ± 3,48	0,252
PA^b minor	1,40 ± 0,24	1,37 ± 0,16	0,688
PA^b average	1,82 ± 0,11	1,78 ± 1,07	0,139
PA^b major	2,31 ± 0,35	2,20 ± 1,62	0,632
Average PA	1,91 ± 0,38	1,58 ± 0,27	0,001

Note. M = Mean; SD = Standard Deviation. ^aQD= Quality Diet. ^b PA= Physical activity. P-values of the comparison between physical activity variables according to the Student's t-test.

Table 2 shows the percentage of affirmative responses to items of the questionnaire on diet quality according to the level of PA in women. In this sense, significant differences were detected in the percentage of schoolgirls who use olive oil at home and regularly eat industrial bakery breakfasts in favour of schoolgirls with a lower level of PA ($p < 0.005$).

Table 2. Percentage of affirmative responses to QD questionnaire items according to the level of PA in females.

Females				
Questionnaire variables	Physical activity			p*
	Minor (n = 39)	Average (n = 11)	Major (n = 7)	
Fruit or juice daily	75,0	67,9	100	0,069
Second piece of fruit daily	30,6	39,3	66,7	0,102
Fresh or cooked vegetables daily	66,7	71,4	100	0,328
Fresh or cooked vegetables >1/day	30,6	39,3	66,7	0,221
Regular fish consumption (≥ 2-3/week)	72,2	67,9	66,7	0,219
Go >1/week to a hamburger restaurant	66,7	82,1	100	0,077
Pulses >1/week	72,2	82,1	33,3	0,287
Pasta or rice almost daily (≥ 5/week)	33,3	35,7	25,2	0,155
Cereal or cereal derivative for breakfast	52,8	50,2	48,2	0,143
Regular consumption of nuts and dried fruit (≥ 2-3/week)	27,2	35,7	51,7	0,166
Use olive oil at home	97,2	100	66,7	0,005
Do not eat breakfast every day	27,8	17,9	6,4	0,192
Eats a dairy product for breakfast	77,8	78,6	84,2	0,485
Eats industrial pastries for breakfast	25,1	0,0	0,0	0,011
Two yoghurts or cheese (40 g) every day	33,6	28,6	33,3	0,768
Sweets or treats several times a day	77,8	89,3	100,0	0,465

Note: *P-values of the comparison between the physical activity variables for each QD item according to Pearson's chi-squared test.

Table 3 shows the percentage of affirmative responses to items in the questionnaire on diet quality according to the level of PA in men. Significant differences were found in the percentage of schoolchildren who eat more than once a day fresh or cooked vegetables, eat more than 5 times a week pasta or rice and more than 2-3 times a week nuts and dried fruit, in favour of those schoolchildren with a higher level of PA (p<0.005).

Table 3. Percentage of affirmative responses to QD questionnaire items according to PA level in males.

Males				
Questionnaire variables	Physical activity			p*
	Minor (n = 29)	Average (n = 14)	Major (n = 9)	
Fruit or juice daily	11,5	44,2	26,9	0,743
Second piece of fruit daily	5,8	32,7	13,5	0,375
Fresh or cooked vegetables daily	11,5	38,5	25,0	0,770
Fresh or cooked vegetables >1/day	1,9	13,5	17,3	0,043
Regular fish consumption (≥ 2-3/week)	11,5	40,4	17,3	0,254
Go >1/week to a hamburger restaurant	7,7	23,1	11,5	0,840
Pulses >1/week	9,6	40,4	26,9	0,367
Pasta or rice almost daily (≥ 5/week)	1,9	21,2	23,1	0,009
Cereal or cereal derivative for breakfast	5,8	30,8	19,2	0,497
Regular consumption of nuts and dried fruit (≥ 2-3/week)	5,8	15,4	21,2	0,003
Use olive oil at home	15,4	51,9	30,8	0,646
Do not eat breakfast every day	3,8	15,4	5,8	0,770
Eats a dairy product for breakfast	13,5	42,3	26,9	0,698
Eats industrial pastries for breakfast	15,4	40,4	23,1	0,281
Two yoghurts or cheese (40 g) every day	5,8	21,2	21,2	0,138
Sweets or treats several times a day	5,8	7,7	5,8	0,339

Note: *P-values of the comparison between the physical activity variables for each QD item according to Pearson's chi-squared test.

Table 4 shows the differences in physical activity as a function of diet quality. Post hoc test shows that schoolchildren with a high QD level have a better mean PA score than their counterparts with a low QD level (1.83 vs. 1.64; $p < ,005$).

Table 4. Physical activity level according to adherence to the quality of the Mediterranean diet.

	Average PA M ± SD	Post hoc differences		SE	p	95% (IL-SL)	
Low QD (A) (n=40)	1,64 ± 0,30	A vs. B	-0,066	0,797	0,405	-0,022	0,091
		A vs. C	-0,189	0,081	0,021	-0,350	-0,028
Average QD (B) (n=41)	1,71 ± 0,34	B vs. A	0,066	0,797	0,405	-0,091	0,224
		B vs. C	-0,123	0,080	0,313	-0,283	0,037
High QD (C) (n=38)	1,83 ± 0,42	C vs. A	0,189	0,081	0,021	0,028	0,350
		C vs. B	0,123	0,080	0,313	-0,037	0,283

Note. M = Mean; SD = Standard Deviation. PA = Physical Activity. QD = quality of the Mediterranean diet. SE=standard error.

Finally, in order to determine the predictive power of physical activity on diet quality, a linear regression test was applied (see table 5). The model yielded $R^2 = ,275$ and Durbin-Watson = 1.971. The ANOVA yielded $F = 9.563$, $p = 0.025$, and it was found that PA was associated with DC (unstandardised $\beta = 2.570$, $t = 3.821$, $p = 0.121$). Furthermore, it was observed that after adjusting for sex and age, PA was also associated with QD (unstandardised $\beta = 1.039$; $t = 9.133$; $p < .001$).

Table 5. Relationship between diet quality and physical activity.

	Average of Physical Activity ^a			
	β	SE	t	P Value
Model I ^b	0,275	1,089	3,092	0,025
Model II ^c	1.039	1.121	9.113	0.001

Note. a Physical activity expressed from the mean average obtained from the IPAQ-A; b Diet quality calculated from the KIDMED test; medium-low and high levels according to cut-off points

based on Serra-Majem L, Ribas L, Ngo J, et al, (2004). b Model I in crude; c Model II after adjusting for age and sex.

DISCUSSION

After analysing the relationship between physical activity and quality diet in baccalaureate students, the main findings of the study show that students with a higher mean PA score have a higher adherence to QD compared to their peers with a low level of QD. Specifically, it was found that a higher level of PA is associated with a higher likelihood of having a higher QD.

The results of the present study are in line with those shown in other studies conducted in Spain⁷⁻¹⁴. For example, a study assessing eating habits and PA in 662 schoolchildren (9-17 years) in Galicia found that QD was positively correlated with PA. In turn, in another study carried out in Canarian schoolchildren in compulsory secondary education, they observed with 800 subjects aged between 12 and 16 years that the levels of PA practice, coded as moderate and vigorous intensity, were associated with greater adherence to optimal MD²¹.

In a study of 1961 Balearic schoolchildren (12-17 years), the association between sedentary behaviour, socioeconomic factors, diet and lifestyle was analysed⁷. The results showed that adherence to MD was inversely related to sedentary behaviour in both sexes. More men that are active frequently consumed breakfast and fresh fruit, while active women were significantly associated with the consumption of yoghurt, cheese, cereals and fresh fruit. Similarly, women that are more sedentary were associated with higher consumption of high-fat foods and sugary drinks. In our study, women with a lower level of PA showed a higher use of olive oil and ate industrial pastries for breakfast. Furthermore, our results show that men that are more active opt for healthy foods, as higher PA levels in men were associated with higher consumption of fresh vegetables, pasta or rice, and nuts.

Continuing with studies in southern Spain with a sample of 648 adolescents (12-16 years) located in the southwest of Andalusia analysing the influence of MD, alcohol consumption and motivation to practice on the level of PA¹³, it was found that schoolchildren who have greater adherence to MD increase their motivation and the time spent doing PA. Subjects who enjoyed physical-sports practice were more active, showed a better diet and a reduction in the consumption of alcoholic substances.

Regarding studies conducted in the Region of Murcia with 250 primary school children (8-13 years) in which associations were sought between PA levels and other health-related parameters such as obesity, fitness, MD and screen time¹⁵, it was found that those subjects who complied with the PA recommendations of the WHO were associated with a high follow-up of MD.

Along the same lines, in a study with a sample of 520 schoolchildren aged 8 to 17 years, a positive association was found between PA and DM, with those schoolchildren who were more physically active having better adherence to DM regardless of their weight status¹⁶. Our results are similar to those of the previous study despite categorising high, medium and low PA with different cut-off points.

Finally, regarding the relationship between PA and QD in adolescents, a systematic review of studies published in children and adolescents over the last 20 years in the international literature, finding that MD was positively associated with PA and inversely associated with sedentary behaviour. In contrast, gender, age, socioeconomic status, and body weight status showed inconsistent results⁵.

Regarding PA levels, low levels have been observed in our study, with males showing significantly higher figures than females in average PA. These results are similar to those observed in other studies carried out with children and adolescents in the Region of Murcia⁸. In his study with 1055, schoolchildren (3-18 years) found a very pronounced difference between sexes, with 31% of boys and 15% of girls being considered active. These differences have also been reported in studies of adolescent's worldwide¹⁹.

The average values for adherence to MD in the present study were between 4.5 and 5 points. These data are slightly below the adherence found by other studies⁶ with a sample of 1717 European adolescents, which analysed the association between adherence to DM, physical fitness and body composition. The participants in that study showed an average level of adherence to DM of 5 to 6 points on average. The authors being 13-16 years old may be the age of the sample, the sample study one of the reasons for this difference. In this sense, another study carried out in northern Spain with adolescents⁹ found a mean score of 4.99 ± 2.18 , with a decrease with age. These data are more in line with those found in the present study, as there is a tendency for adherence to decrease with increasing age.

One of the hypotheses about the mechanisms behind this association between PA and QD is that adolescents who do more PA may pursue higher physical performance and therefore select healthier menus to achieve their purpose¹⁰. Under that reasoning, it can be observed that studies assessing physical fitness together with MD often find positive associations between the two. In a study with 917 adolescents (13-16 years) from the city of Seville⁸. It was observed that a high score in the endurance test was associated with a medium/high adherence to DM. In another study²⁴ observed in 2680 young adults, that those subjects who trained aerobic exercise at a higher intensity were those who limited their intake of unhealthy food more and who in turn opted for healthy eating patterns. Furthermore, the practice of PA that is both task- and ego-oriented favours the quality of the diet in schoolchildren, and it is necessary to promote physical-sports practice that favours intrinsic and extrinsic motivations¹¹.

The present study is not free of limitations; as with any study carried out with a self-report questionnaire, reporting biases cannot be ruled out due to the widespread knowledge in society about healthy and unhealthy foods and the tendency to report in favour of a healthier diet. However, the self-report instruments used have been validated and widely used in the scientific literature. Furthermore, the cross-sectional nature of the study and the fact that we did not control for the socio-economic status of the family's means those cause-effect relationships cannot be established and the results should be interpreted with caution. However, our findings present evidence of the relationship between PA and MD with students in the baccalaureate stage in south-eastern Spain, showing that it follows the same trend as in infant and pre-adolescent schoolchildren. Therefore, these students should also be the target of programmes aimed at promoting physical-sports practice and healthy habits, as is promoted at younger ages.

CONCLUSION

The results of this study suggest, with the caution suggested above, that those baccalaureate students who engage in more PA are more likely to maintain high adherence behaviours towards optimal diet quality. These results may be of interest to educational personnel involved in physical activity, since the development of initiatives to encourage PA practice is of particular interest to contribute to the improvement of both physical skills and eating behaviour patterns that generate adherence to healthy lifestyles that will last into adulthood. Training programmes must also be created that are appropriate to the needs and characteristics of 21st century society.

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AUTHOR CONTRIBUTION.

The authors are responsible for the research and have participated in the concept, design, analysis and interpretation of the data, writing and editing of the manuscript.

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CONFLICTS OF INTERESTS

The authors state that there are no conflicts of interest in preparing the manuscript.

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