

García, J.A.; Cárdenas, A.; Burgos, S.; Santiago, C.; Hernández, F.; Sanz, V.; Fernandez-del-Valle, M.; Rubio, M. y Pérez, M. (2019). Estilo de vida y distribución de grasa en adolescentes asmáticos y sanos / Lifestyle and Fat Distribution in Asthmatic and Healthy Adolescents. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 19 (73) pp. 107-118
[Http://cdeporte.rediris.es/revista/revista73/artefectos999.htm](http://cdeporte.rediris.es/revista/revista73/artefectos999.htm)
DOI: <http://doi.org/10.15366/rimcafd2019.73.008>

ORIGINAL

LIFESTYLE AND FAT DISTRIBUTION IN ADOLESCENTS WITH AND WITHOUT ASTHMA

ESTILO DE VIDA Y DISTRIBUCIÓN DE GRASA EN ADOLESCENTES ASMÁTICOS Y SANOS

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ACKNOWLEDGEMENTS AND/OR FUNDING

Funded through the Project "VII Convocatoria Real Madrid-Universidad Europea" (Ref 2015/03RM). Awarded third prize in "XV Premios Neumomadrid": Grant Young Researchers of the SENP 2015.

Código UNESCO / UNESCO code: 3201.10 Ciencia Clínica Pediátrica / Clinical Science Pediatric

Clasificación del Consejo de Europa / Council of Europe classification: 11. Medicina Deportiva / Sports Medicine

Recibido 3 de abril de 2017 **Received** April 3, 2017

Aceptado 16 de diciembre de 2017 **Accepted** December 16, 2017

ABSTRACT

Objectives: This study examines the effects of lifestyle on nutritional status, fat distribution and respiratory health in adolescents with or without asthma.

Methods: This was a descriptive study including 207 subjects aged 13.20 ± 0.62 years. Lifestyle was assessed in terms of physical activity (PA) levels, Mediterranean diet, nutritional status, and respiratory health measured through FEV₁ (z). **Results:** In the non-asthma group, boys were more active ($p = 0.01$) and showed a lower waist-to-height ratio (WHtR) than girls ($p = 0.001$).

Participants without asthma were more active ($p = 0.003$), and had a better WHtR ($p = 0.001$) and FEV₁ ($p = 0.001$) than those with asthma. **Conclusions:** In this Spanish population sample, non-asthmatic adolescents were more active and showed a better nutritional status, fat distribution and respiratory health than their peers with asthma.

KEYWORDS: asthma, adolescents, physical exercise, Mediterranean diet

RESUMEN

Introducción: El objetivo de este trabajo fue analizar el efecto del estilo de vida en el estado nutricional, la distribución de grasa y la función pulmonar en adolescentes sin asma y con asma. **Metodología:** Estudio descriptivo de 207 sujetos que valoró el estilo de vida a partir del nivel de actividad física (AF), adherencia a la dieta mediterránea, el estado nutricional y la distribución de grasa, y la salud respiratoria. **Resultados:** Se encontraron diferencias significativas dentro del grupo sin asma en nivel de AF siendo los varones más activos ($p=0,01$) y presentando menor índice cintura-talla (ICT) que las mujeres ($p=0,001$). El grupo de no asmáticos fue más activo ($p=0,003$) y presentó menor ICT ($p=0,001$) que el grupo de asmáticos. Además, el grupo de no asmáticos presentó mejores valores en el FEV₁ ($p=0.001$). **Conclusiones:** Los adolescentes no asmáticos fueron más activos y presentaron mejor distribución de grasa que los asmáticos.

PALABRAS CLAVE: asma, adolescentes, ejercicio físico, dieta mediterránea

INTRODUCTION

The findings of epidemiological studies indicate a worldwide trend towards physical inactivity and warn that today's children and adolescents are the first generation with a life expectancy lower than that of their parents¹. Physical inactivity is the fourth leading mortality risk factor in developed countries causing 6% of deaths around the world. Spain is among the countries most affected by the epidemic of physical inactivity, increasing risks of heart disease, diabetes, obesity and metabolic syndrome and thus reducing life expectancy².

Asthma is a chronic inflammatory disorder of the airways in whose aetiology participate various cells and mediators of inflammation. It is conditioned partly by genetic and environmental factors. Bronchial hyperresponsiveness and

airflow obstruction are hallmarks of asthma³. Symptoms include recurrent episodes of breathing difficulty, wheezing, chest tightness and/or coughing. Symptoms in children and adolescents can be aggravated by physical activity and often trigger a fear of exercise which eventually translates to a decline in the patient's general health state limiting normal activities⁴. The sedentary lifestyle associated with adolescents with asthma can worsen the disease course and promote the appearance of overweight and obesity⁵.

According to the World Health Organization, there are currently 235 million persons with asthma leading to 18,000 deaths per year⁶. Developed countries show an increasing prevalence of asthma especially in urban environments where adolescents are less active, more obese and show lower adherence to the Mediterranean diet⁷. The economic burden of paediatric asthma in Spain is approximately 532 million Euros, oscillating between 392 and 693 million Euros. The mean annual cost of asthma management per patient has been estimated at 1149 Euros, with figures ranging from 403 Euros for milder cases to 5380 Euros for patients with severe asthma⁸.

The reason for the increase over the past 10 years in the prevalence and severity of asthma seems multifactorial. Among the factors proposed so far are exposure to allergens or irritants, temperature changes, viral respiratory infections, and genetic predisposition⁶. However, there is increasing scientific evidence indicating the role played by environmental factors such as exercise and the Mediterranean diet in asthmatic subjects and their direct relationship with obesity⁹ and the extent of visceral fat¹⁰, worsening symptoms. The PANACEA study revealed that the Mediterranean diet has a protective effect on asthma symptoms, airways inflammation and lung function¹¹.

Having asthma can become a risk factor for developing an inadequate nutritional state as it can be conducive to being overweight or obese. This is because today's adolescents are participating less in physical activities inside and outside the school environment adopting a sedentary lifestyle and dedicating more time to watching TV or playing video games in their spare time^{4,12}. This has served to confirm the link between a lower level of physical activity and a higher prevalence of asthma¹³.

Physical activity plays an important role in asthma as it better controls BMI and reduces the percentage of visceral fat determining a lower systemic inflammatory response indicated by lower IgE levels. All this could have beneficial impacts on improving the quality of life of the individual with asthma¹⁴.

The present study was designed to examine the lifestyle of a group of adolescents in the Madrid region according to their sex or whether or not they have asthma and the relationship between each of these two factors and nutritional status, fat distribution and lung function.

MATERIALS AND METHODS

This descriptive observational study was approved by the Ethic Committee for Clinical Research of the *Hospital Infantil Universitario Niño Jesús* in Madrid (Reference R0031/14).

Subjects

The study population was comprised of 207 children (132 boys) aged 12 to 14 years of similar anthropometric characteristics (age, weight and height). Of these, 60 were asthma patients (40 boys) who visited the Pneumology outpatient's clinic of the Hospital Infantil Universitario Niño Jesús de Madrid over the period October 2015 to June 2016; and 147 (92 boys) were first and second year secondary school students (Madrid) without asthma. Anthropometric measurements and questionnaires were administered over the period February to March 2016.

Variables

Lifestyle: Mediterranean diet

To assess the quality of the Mediterranean diet in the study participants we used the KIDMED questionnaire. This questionnaire has 16 items or questions that should be answered as true or false of which 12 are concerned with healthy habits and if fulfilled are positively scored (+1); and the remaining 4 are concerned with incorrect habits and are negatively scored (-1). A total score of under 3 indicates a poor quality, from 4 to 7 indicates intermediate quality and greater than 8 indicates an optimal quality of the Mediterranean diet.¹⁵

Lifestyle: physical activity level

The questionnaire PAQ-C (Physical Activity Questionnaire for Children) is used as a measure of the physical activity (PA) practised in the last 7 days by children and adolescents aged 7 to 14 years (both inclusive). It consists of 10 items, 9 of which serve to measure the physical activity level and the final item is designed to obtain information about an illness or other event that prevented the child or adolescent carrying out their regular activities.

The final score was 1 to 5. When this score was lower than 2.33 this indicated a low physical activity level, from 2.33 and 3.66 a moderate level and higher than 3.66 a high level. We excluded from the analysis all participants who replied yes to the question *Have you been ill over this past week?*¹⁶.

Nutritional status and fat distribution

The weight and height of each participant was measured using a mechanical balance ASIMED model BARYS PLUS C equipped with a telescopic stadiometer to calculate body mass index (BMI). The cut-offs used to describe

nutritional status were those proposed for subjects aged 5 to 19 years according to the World Health Organization converted into z-scores. This system allows for standardization of nutritional status with correction for relevant variables such as sex, age and race via the link:

<http://www.who.int/growthref/tools/en/>. Nutritional status was classified as: obese: $\geq +2SD$; overweight: $> +1SD$; normal weight: -1 to $+1SD$; thin: $\leq -2SD$; severely thin: $\leq -3SD$ ¹⁷.

The waist-to-height ratio (WHtR) is a measure of visceral, or intraabdominal, fat. This ratio was calculated as waist circumference (centimetres), measured using a KaWe tape (1.5 m x 8 mm) at an equidistant point between the lower rib and iliac crest¹⁸, divided by height in centimetres. The visceral fat distribution cut-offs defined for the paediatric age range are: normal ≤ 0.47 ; moderate 0.47 to 0.50; and excess > 0.50 ¹⁹.

Respiratory health

The ISAAC questionnaire was used to detect symptoms of asthma in the participants from control group. The questionnaire was completed by each child under the supervision of the researchers according to the protocol used in prior international studies addressing the prevalence of asthma symptoms among children and adolescents²⁰.

Breathing patterns were assessed using a Spirostik spirometer with a Blue Cherry diagnostic software platform (Geratherm Respiratory GmbH, Bad Kissingen, Germany). The variables recorded were FEV₁, FVC, FEV₁/FVC and FEF₂₅₋₇₅. The data obtained were interpreted using the unified approach of the Global Lung Initiative (GLI) of 2012²¹. Thus, we established as lower limits of normal (LLN) FEV₁ z-scores of -1.96 to 1.96 for healthy subjects and of -1.64 to 1.64 for subjects with symptoms of respiratory disease²².

Statistical analysis

Frequencies of qualitative variables are expressed as absolute numbers and percentages. The quantitative variables examined are provided as the mean \pm standard deviation (SD). Relationships between qualitative variables were assessed using the Pearson χ^2 test. Quantitative data were compared using the Student *t*-test for independent samples after confirming the normal distribution of the variable using the Kolmogorov-Smirnov test. Significance was set at $p < 0.05$.

All statistical tests were performed using the software package SPSS version 19.0 (Chicago, IL, USA).

RESULTS

Subject characteristics

The age, weight and height of the 207 participants (132 boys) are detailed in Table 1.

Table 1. Participant characteristics

	Asthmatic (n=60)		Non asthmatic (n=147)	
	Male (n=40) M±SD	Female (n=20) M±SD	Male (n=92) M±SD	Female (n=55) M±SD
Age	13.13±0.56	12.96±0.57	13.06±0.53	13.08±0.45
Weight	51.53±11.94	53.30±17.02	49.24±10.81	49.15±9.25
Height	1.56±0.08	1.54±0.09	1.58±0.09	1.59±0.07

Age (years); weight (kilograms); height (metres)

Lifestyle and nutritional status according to sex and the presence or not of asthma

The variables examined according to the sex of the participants are provided in Table 2. Within the non-asthma group, boys were significantly more physically active than girls ($p=0.01$). In addition, boys without asthma showed a significantly better WHtR than girls ($p=0.001$).

The results of data comparisons between non-asthmatic and asthmatic subjects are provided in Table 3. The significant differences detected indicated a greater physical activity level ($p=0.003$) and smaller WHtR ($p=0.001$) in the individuals without asthma (Figure 1). Similarly, FEV₁ (z) was improved in the group of children without asthma ($p=0.001$).

Table 2. Lifestyle, nutritional status and respiratory health according to sex and the presence or not of asthma

	Asthmatic (n=60)			Non-asthmatic (n=147)		
	Boys (n=40) M±SD	Girls (n=20) M±SD	<i>P</i>	Boys (n=92) M±SD	Girls (n=55) M±SD	<i>P</i>
KIDMED	6.78±1.84	6.70±1.89	0.88	7.16±2.05	6.82±2.13	0.33
PAQ-C	2.59±0.65	2.31±0.59	0.20	3.00±0.79	2.67±0.63	0.01
BMI/Age (z)	0.46±1.60	0.58±1.49	0.79	0.10±1.09	-0.13±0.90	0.18
WHtR	0.48±0.08	0.46±0.57	0.40	0.41±0.39	0.44±0.05	0.001
FEV ₁ (z)	-0.83±1.34	-1.34±1.08	0.14	0.89±1.14	0.89±1.10	0.98

KIDMED: Mediterranean diet quality index for children and adolescents; PAQ-C: Physical activity questionnaire for children; BMI/Age (z): body mass index by age and z-score; WHtR: waist:height ratio; FEV₁ (z): forced expiratory volume in one second classified by z-score.

Table 3. Lifestyle, nutritional status and respiratory health in subjects with and without asthma

	Asthmatic (n=60)	Non-asthmatic (n=147)	
	M±SD	M±SD	P
KIDMED	6.75±1.84	7.03±2.08	0.36
PAQ-C	2.48±0.63	2.88±0.75	0.003
BMI/Age (z)	0.50±1.55	0.01±1.02	0.03
WHtR	0.47±0.08	0.43±0.04	0.001
FEV ₁ (z)	-1.00±1.27	0.89±1.12	0.001

KIDMED: Mediterranean diet quality index for children and adolescents; PAQ-C: Physical activity questionnaire for children; BMI/Age (Z): body mass index by age and z-score; WHtR: waist:height ratio; FEV₁ (Z): forced expiratory volume in one second classified by z-score.

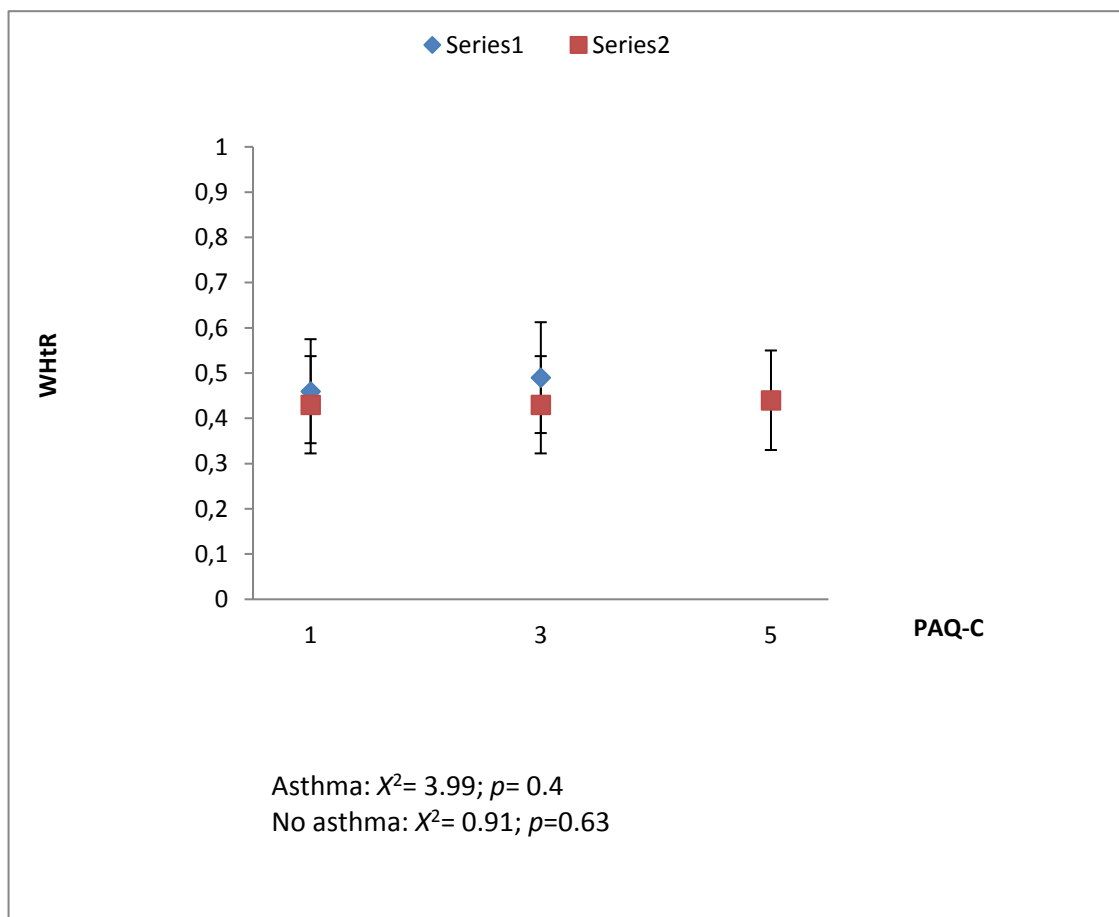


Figure 1. Relationship between PA level and WHtR

DISCUSSION

According to the mean PAQ-C questionnaire score recorded in our study

participants, physical activity levels were moderate and within the non-asthma group, boys were significantly more active than girls. These data were consistent with those of the study by Corder *et al.*²³, in which it was found that adolescents are replacing ten minutes per day of physical activity with sedentary activities, especially girls. Based on prior research, increased sedentary activities has been linked to increased screen time, especially in females²⁴. This increase in sedentary time that has been linked to significant reduction of PA levels, seems to be larger in females. Sex differences have been observed in children and adolescents from several countries in Europe²⁵, and they have been associated to increased risk of overweight, obesity, and development of cardio-metabolic in adulthood. For this reason, the development of intervention programs to promote physical activity are recommended with special emphasis in females²⁶. In addition to the reduced levels of PA, scores in the KidMed questionnaire indicate a need to improve dietary habits to adjust them to the Mediterranean diet. These findings are in line with the increased tendency of Mediterranean countries to abandon the Mediterranean diet during the last few years, especially in children and adolescents²⁷. This finding is in agreement with data from the PANACEA study¹¹, suggesting a need for policies designed to improve education and dietary habits. Poor dietary habits have been linked to decreased physical activity levels as we report in our study²⁵.

When we compared lifestyle between our two participant groups it was observed that those without asthma were more active and had a smaller WHtR. According to Walders-Abramson *et al.*⁵, adolescents with asthma show a 21% greater risk of being overweight and of being obese as adults because of their low physical activity level. High PA levels and physical exercise have been shown to improve disease prognosis, reduce inflammation, improve cardiorespiratory fitness and improve respiratory muscle function¹². When we examined respiratory health among our participants without asthma it emerged that the greater the level of PA and compliance with the Mediterranean diet, the lower the value of FEV₁ (z). Besides, among the children with asthma, the lower the PA level the more affected was their FEV₁ (z). This suggests a need for PA programmes targeting children and adolescents with asthma to improve their general and respiratory health state^{5,12,13}.

Despite the results obtained in PA and diet met our hypothesis, our results regarding the Mediterranean diet were not those expected in the asthma group. Thus, an optimal diet could not be related to an improved FEV₁ (z). Similar findings were reported by González *et al.*²⁴, who observed no protective effect of the Mediterranean diet on the respiratory health of patients with asthma. In contrast, other authors have observed an inverse relationship between Mediterranean diet and the prevalence of asthma symptoms along with improved respiratory health^{7,9,11}. It is not very clear how adherence to the Mediterranean diet relates to asthma symptomatology. However, it seems that some macronutrients might have a positive effect in the oxidative stress and inflammation⁹.

Our study has some limitations. Some subjects could have started to exercise and improve their diet when they were diagnosed with asthma. The sample size was substantially reduced as we avoided confounding factors (i.e. age, weight

and height). Therefore, the conclusions cannot be extrapolated to the population. BMI (z) and WHtR are estimated variables that may be affected by the age of the participants. This is because at the development stage considered here (12 to 14 years), a large component of body weight may be muscle weight. Lastly the utilization of subjective tools (i.e. questionnaires), although validated, might have resulted in minor differences in the diet quality and PA levels. To resolve some of these limitations in future studies, we propose the combined use of the tools employed here with other more objective measurement methods such as the use of accelerometers to quantify PA as described by Eijkemans *et al.*²⁵ or of densitometry for body composition as reported by Rosenkranz *et al.*²⁶. This last method is currently the most objective tool available for this purpose. However, all the tools selected to carry out this study have been utilized before in children with and without asthma with very similar results to the reported in this study.

This type of studies, as reported here, might help to determine more precisely the needs of the population (i.e. children and adolescents diagnosed with asthma), and might provide key information to design interventions to improve lifestyle and overall health.

CONCLUSIONS

The findings of our study indicate that children of this age group both with or without asthma need to improve their dietary habits to adjust them more to the Mediterranean diet model. Among the children without asthma, boys were more active and had a lower WHtR than girls. This was also the case for non-asthmatic participants compared to those with asthma. According to these findings we propose a need for interventions designed to improve both the dietary habits and physical activity levels of adolescents with a main focus on girls.

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