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Trabajo Original

Pediatría

# Mediterranean diet adherence among Catalonian adolescents: socio-economic and lifestyle factors

## *Adherencia a la dieta mediterránea en adolescentes catalanes: factores socioeconómicos y de estilo de vida*

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**Key words:**

Mediterranean diet adherence. Adolescents. Screen time. Physical activity. Socio-economic and lifestyle factors. Ordinal logistic regression.

## Abstract

**Aim:** This study aims to describe the adherence to the Mediterranean diet (MD), using the KIDMED questionnaire, in a sample of Catalonian adolescents and to assess the association between the MD adherence and socio-economic and lifestyle behaviours.

**Material and methods:** Data are part of a multi-centre longitudinal study designed for the reduction of risk factors of eating and weight-related problems in adolescents. Here, a cross-sectional analysis was performed with the baseline data, academic period 2010-11. The participants were 1,502 adolescents recruited from 11 schools from the province of Barcelona.

**Results and conclusions:** The results showed a higher level of MD adherence when parents had higher educational level, and when adolescents reported a low level of screen-time, and high weekly physical activity.

**Palabras clave:**

Adherencia a la dieta mediterránea. Adolescentes. Tiempo de pantalla. Actividad física. Factores socioeconómicos y de estilo de vida. Regresión logística ordinal.

## Resumen

**Objetivo:** el objetivo del artículo consiste en describir, mediante el cuestionario KIDMED, la adherencia a la dieta mediterránea (DM) de una muestra de adolescentes catalanes y la asociación entre los niveles de adherencia a la DM y determinadas conductas relacionadas con el estilo de vida y los factores socioeconómicos.

**Material y métodos:** los datos forman parte de un estudio longitudinal multicéntrico diseñado para evaluar los factores de riesgo relacionados con los problemas de la alimentación y el peso. En este trabajo se analizan, en un corte transversal, los datos de la línea base recogidos en el periodo académico 2010-11. Los participantes fueron 1.502 adolescentes reclutados en 11 escuelas de la provincia de Barcelona.

**Resultados y conclusiones:** los resultados indican un elevado nivel de adherencia a la DM cuando los padres tienen un nivel educativo alto y cuando los adolescentes presentan un bajo consumo de tiempo de pantalla y un nivel elevado de actividad física semanal.

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## INTRODUCTION

The Mediterranean diet (MD) eating pattern was credited in 2010 as Intangible Cultural Heritage of Humanity by UNESCO. The MD is considered one of the healthiest dietary patterns and several studies have shown that greater adherence to a Mediterranean-like dietary pattern is associated with a significant improvement in health status (1-3). Although it is not clear which components of diet provide the greatest health benefits, it is likely that certain components, when consumed collectively, provide a protection against chronic diseases (4). However, despite the increasing evidence about benefits on health, recent data indicate that adherence to this eating pattern is decreasing in the Mediterranean regions, particularly among children and adolescents (5-7). Globalization and the adoption of Western dietary patterns explains, in part, the low adherence rates in adolescent people living in Mediterranean region (8-12).

Adolescence is a transitional stage of development between childhood and adulthood in which nutritional requirements are increased in order to meet the physiological demands, being one of the two stages of the life where dietary needs are greater. In addition, poor nutrition in adolescence affects quality of life and is associated with both short-term and long-term adverse health consequences (13). In this stage, ensure a better nutrition and the promotion of healthy lifestyles that include more physical activity and less sedentary time, is essential to ensure a better health status and prevent the development of nutritional and chronic diseases (14).

Studies have demonstrated that children and adolescents' eating patterns and the types of food consumed are strongly influenced by several factors: individual factors (e.g. age, gender, food preferences, nutritional knowledge, physical, and sedentary behaviours), characteristics of the physical environmental (e.g. food availability, portion size, and mealtimes structures), and socioeconomic factors (e.g. parents' education, time constraints, and origin) (15-17).

Recently, the number of studies designed to explore the individual, environmental and socioeconomic factors associated with the adherence to the MD in children and adolescents have increased (6,8,15,16,18-25). The main associations were found between MD adherence and a) lifestyle behaviours like physical activity (6,16,19,22,23,25), sedentary behaviours, predominantly with screen time (8,16,19,21,24,25), and smoking and alcohol consumption (23); b) nutritional knowledge (15); c) socioeconomic status (8,16,20), mostly with parental educational level (8,18,21,23-25); and d) environmental factors, particularly with rural and urban areas (6,19,20). Nevertheless, to date, no studies investigating these characteristics in adolescents from Catalonia (northeast of Spain), one of the most representative Mediterranean regions, have been carried out.

Therefore, the aims of this study were to describe the MD adherence using the KIDMED index in a sample of Catalonian adolescents and to assess the association between the MD adherence and socio-economic and lifestyle behaviours.

## METHODS

### DESIGN

The present data are part of the baseline of the MABIC study (26,27), a multi-centre non-randomized controlled effectiveness trial for the reduction of risk factors of eating and weight-related problems in adolescent girls and boys. MABIC is a Spanish acronym for four risk factors of disordered eating with strong empirical support: "M" for media pressures and beauty-ideal internalization ("Medios de comunicación" in Spanish); "A" for dieting and disordered eating ("Alimentación alterada" in Spanish); "B" for weight-related teasing ("Burlas relacionadas con el peso" in Spanish); and, "IC" for body dissatisfaction ("Insatisfacción corporal" in Spanish). The study MABIC is registered in the international register of Current Controlled Trials (28) (ISRCTN47682626). Here, a clustered cross-sectional analysis was performed with the baseline data, academic period 2010-11. All the study protocols were approved by the Clinical Research Ethics Committee of the Parc Taulí Health Corporation and The Animal & Human Experimentation Ethics Committee of the Universitat Autonòma de Barcelona. Parental consent and participant assent were obtained. The confidentiality of participating adolescents was protected with coded data and data processing was anonymous.

### PARTICIPANTS

Adolescents from the Mandatory Secondary Education years of the Spanish system (7$^{th}$ to 10$^{th}$ grades in the USA) coming from the control group of the MABIC project were included in the study. The Parc Tauli Health Corporation (PTHC) was the basic intermediary for recruiting the health community providers responsible for implementing part of the MABIC project. Sabadell, which is a city located in the province of Barcelona, constitutes the PTHC's main area of influence. The PTHC, as the only public health tertiary care center in this area, has the ethical commitment to provide health care to the entire population, so all the public secondary schools in the city were contacted in order to participate in the MABIC study. Possible demographic differences, derived from the fact that schools representing diverse sociodemographic levels were included in the study, might be controlled with strategies at hand to match samples according to specific demographic characteristics or, alternatively, through statistical modeling including these sociodemographic variables as covariates. The current study employed the second approach to control those possible effects derived from demographic differences. The participants were recruited from a total of 11 public secondary schools, with a baseline sample of 1,502 students who completed in-class surveys. Adolescents were excluded from the present study if they did not complete the MABIC protocol, were absent on the assessment day, no parental consent, and/or unwillingness to participate. Final participation rate was 92%, which represents a final effective sample size of 1,381 subjects (53.1% of males), with a mean age of 14.1 years old (standard deviation, SD = 1.1; range = 13-17 years) and a mean body mass index (BMI) of

21.0 kg/m$^2$ (SD = 3.9 kg/m$^2$). In general, most of the participant had a medium level of MD adherence (57.9%), followed by a high level (25.9%) and finally a low level (16.2%). Participant's origin was as follow: Spanish (72.6%), Hispanic (12.3%), and Other (15.1%); importantly, "Other" category includes Europeans (non-Spanish, 2.2%), North African (4.9%), Sub-Saharan (0.4%), mixed (5.4%), and others (mainly Asian origin, 2.2%). Table I shows the socio-demographic characteristics of the sample.

## MEASURES

### Socio-demographic and anthropometric data

Adolescents provided information regarding age and origin. Weight and height were measured *in situ* by trained research staff in a private room using standardized equipment and procedures. Weight was assessed without shoes, wearing light clothing and without any personal objects (such as watches, bracelets or mobile phone). Weight values were subsequently corrected by subtracting 0.9 kg from the boys and 0.7 kg from the girls, which were average values estimated after weighing several sets of clothes similar to those used at the assessment. BMI was calculated as [weight(kg)/height(m)].

### Educational level and employment status

The educational level of the father and the mother was grouped as "no study", "elementary/middle school", "high school", and "higher education", depending on the completed level of studies. Meanwhile, the employment status of the father and the mother was coded as "no active", "partial time", and "full time" depending on whether at the time of the study they had a paid job. Employing these measures is that so you can separately evaluate the effect of these individual factors of character socio-economic on the adherence to the MD (29,30). The "no study" response to the educational level and "no active" for employment status were taken as reference categories.

### Screen time

Screen time, considered an indicator of sedentary behaviour associated with unhealthy dietary patterns, was evaluated following the recommendations for media time proposed by the American Academy of Pediatrics (31). Thus, separately assessing weekdays and weekend, the average screen time (either TV and computer with no academic purpose) was recorded. The categories of each measure of screen time (weekdays and weekend) were: less than 2 hours (reference category), between 2 and 4 hours, and more than 4 hours.

### Physical activity

physical activity was assessed from the proposal of Neumark-Staizner et al. (32) and the Leisure Time Exercise Questionnaire of Godin and Shephard (33,34) and Godin (35). For each subject the average weekly time spent performing a mild (little effort, slow walking, yoga, etc.), moderate (not strenuous, dancing, light cycling, etc.) and intense (hearts beats rapidly, intense cycling, aerobic dancing, etc.) physical activity was recorded. Examples of leisure time physical activity are provided for each intensity category. The overall weekly physical activity time was generated as an aggregate of the three individual measures (32).

### Assessment of adherence of Mediterranean diet

The degree of adolescents' MD adherence was assessed using the KIDMED questionnaire that allows evaluating the MD adherence

**Table I.** Socio-demographic characteristics of the sample by adherence to Mediterranean diet[1]

| | | Adherence to Mediterranean diet | | | |
|---|---|---|---|---|---|
| | **Total (n = 1,381)** | **Low (n = 223)** | **Medium (n = 800)** | **High (n = 358)** | **p** |
| Age | 14.12 (1.07) | 14.26 (1.09) | 14.11 (1.04) | 14.05 (1.12) | 0.068 |
| BMI | 21.00 (3.85) | 20.72 (3.52) | 20.98 (3.86) | 21.26 (4.00) | 0.234 |
| *Sex* | | | | | |
| Male | 734 (53.1) | 102 (13.9) | 432 (58.9) | 200 (27.2) | *0.045* |
| Female | 647 (46.9) | 121 (18.7) | 368 (56.9) | 158 (24.4) | |
| *Origin* | | | | | |
| Spanish | 1003 (72.6) | 150 (15.0) | 586 (58.4) | 267 (26.6) | 0.092 |
| Hispanic | 170 (12.3) | 26 (15.3) | 103 (60.6) | 41 (24.1) | |
| Others | 208 (15.1) | 47 (22.6) | 111 (53.4) | 50 (24.0) | |

*[1]Quantitative variables are expressed as M(SD) and categorical variables are expressed as N(percent). Italics indicates significance. For assessing the association between adherence to Mediterranean diet and sociodemographic variables two different types of statistic tests were applied: F test for quantitative sociodemographic variables and chi-squared test for the categorical ones. P: p-value; BMI: body mass index.*

in a population of children and adolescents (36,37). The total score of KIDMED, so-called Mediterranean Diet Quality (adherence) Index, ranged from 0 to 12 and is based on a 16-questions test that can be self-administered or conducted by interview (psychologist, pediatrician, etc.). Questions denoting a negative connotation with respect to the MD are assigned a value of -1, and those with a positive aspect +1. Usually, KIDMED index is categorized by practitioners into three levels: ≥ 8 as high MD adherence, 4-7 as medium MD adherence (improvement needed to adjust intake to Mediterranean patterns), and ≤ 3 as low MD adherence. The total score of the KIDMED was coded into the three categories to be used in the data modelling as the response variable; "Low adherence" was considered the reference category.

## STATISTICAL ANALYSIS

The analysis strategy comprised of two phases. First, we proceed to the statistical description of the study variables. Continuous variables were expressed as the mean and standard deviation and categorical variables as frequencies (percentages). The KIDMED total score coded into ordered categories (low, medium, and high adherence) was considered as the outcome variable.

Second, since adolescents within the same schools display likely similar correlated values on several variables, in line with, among other factors, the teacher's or peers' influence, we analysed the data by means of an ordered logistic regression with covariates in the general framework of the random-intercept mixed-effects model. Thus, the data analysis strategy was based on defining "School" as the cluster variable and evaluating the effect of the parents' education level and work status, screen time and physical activity on the MD adherence. The specified model was adjusted by sex, age, BMI and origin. In this sense, and from an exploratory approach, two models were obtained, a full model that included all the variables and a reduced model with those predictors that have been shown to have an effect on KIDMED. Additionally, and with descriptive purposes, for the exposure variables effect size was estimated in terms of a kind of standardized mean difference known as *logit d*. The interpretation of the values of *logit d* was made following the criteria of Cohen: small (d = 0.2), medium (d = 0.5) and large (d = 0.8). Importantly, the terms "small", "medium" and "large" are relative, not only to each other, but also to the scientific area or to the specific content and research method being employed in any given investigation. Hence, the impact or effect of the exposure variables on MD adherence (outcome variable) must be understood in the sense of a measurement of statistical effects, as the evaluation of the magnitude of association, and not in a causal sense. Data entry was performed by trained personnel in a standardized database with quality control, pertaining to the MABIC study, and analysed using STATA 14/SE statistical software package. The level of significance was established at 0.05.

## RESULTS

Table II shows the descriptive statistics of the study variables for each level of the MD adherence (low, medium, high). Broadly speaking, there was a positive relationship between parents' education and MD adherence level ($p < 0.001$). The results show that an increase in weekly physical activity was associated with an increase in the level of MD adherence ($p < 0.001$). With respect to sedentary behaviour in general, an increase in screen-time was associated with a reduction in the level of MD adherence. Except for watching TV at weekend, the results indicated that higher level of MD adherence occurred when screen-time was lower ($p < 0.001$). This result, considered as an indicator of the effect of sedentary behaviour on the adherence to the MD, is in line with the finding of physical activity. In contrast, the results showed no relation between parents' occupational status and the level of MD adherence.

The effect of the exposure variables on adherence to the MD was evaluated using mixed-effects ordered logistic regression model with random-intercepts adjusted by sex, age, BMI and origin (Table III). The results for the full model show the adequacy of the model, which reinforces the use of a variance-component model, tested using the likelihood-ratio test ($\chi^2 = 3.59$, $p = 0.029$). The educational level of the father and mother, the screen-time associated with the computer on weekdays and weekly physical activity level were statistically significant (Table III).

With regard to the educational level of the parents, in overall terms, there was an increase of the MD adherence level when the education was higher ($\chi^2 = 11.69$, $p < 0.001$ in the case of fathers; and, $\chi^2 = 16.89$, $p < 0.001$ for mothers). In the specific case of the mothers, this effect was confirmed through all the educational levels when comparing them with the reference category. Thus, the expected odds of a high MD adherence compared to medium, or a medium MD adherence compared to low adherence, was 1.56 times greater amongst the mothers with an elementary education than those without education ($p = 0.007$, $d = 0.25$, small effect size). This value increased to 1.88 ($p = 0.001$, $d = 0.35$, small-medium effect size) and 2.30 ($p < 0.001$, $d = 0.46$ medium effect size) amongst mothers with high school education and university education, respectively. In contrast, the effect of the educational level in the case of fathers only yielded significant results when comparing higher education level to that corresponding to the reference category, that is, without formal education. According the estimated model, the expected odds is 1.72 times greater when the educational level is the highest compared to the lowest one ($p = 0.013$, $d = 0.30$, small-medium effect size). Although the same trend was also observed when comparing fathers with a "high school" educational level to those in the reference category, this effect was non-significant.

When TV or daily computer use increases, adherence to MD was lower. However, the use of computer on weekdays was the only variable that reached statistical significance ($\chi^2 = 13.21$, $p = 0.001$). In this regard, daily computer use greater than 4 hours was associated with an expected odds of higher MD adherence 0.45 times lower than the expected one for the reference category, that is a daily use less than two hours ($p < 0.001$, $d = -0.44$, medium effect size). The effects for computer use between 2 and 4 hours daily, compared to the reference category, were non-significant.

Finally, weekly physical activity showed a statistically significant effect on the level of MD adherence ($p < 0.001$, $d = 0.03$, very small effect size); for each one-unit increase in physical activity, there was a 5% increase in the odds of a high MD adherence compared to medium, or a medium MD adherence compared to low adherence.

Additionally, we adjusted a reduced model that included the variables that had proved to be statistically significant in the full model obtaining, practically, the same effects. Regarding this, when modelling the effect of computer use on weekdays, in the reduced model, the comparison between the category "between two and four hours" and the reference category ("less than two

**Table II.** Descriptive statistics of the adolescents sample by adherence to Mediterranean diet[1]

| | | Adherence Mediterranean diet | | | |
|---|---|---|---|---|---|
| | **Total (n = 1,381)** | **Low (n = 223)** | **Medium (n = 800)** | **High (n = 358)** | **p** |
| *FES* | | | | | |
| No study | 284 (20.6) | 64 (28.7) | 157 (19.6) | 63 (17.6) | *< 0.001* |
| Elementary/middle | 589 (42.7) | 103 (17.5) | 364 (61.8) | 122 (20.7) | |
| High school | 326 (23.6) | 43 (13.2) | 184 (56.4) | 99 (30.4) | |
| Higher education | 182 (13.2) | 13 (7.1) | 95 (52.2) | 74 (40.7) | |
| *MES* | | | | | |
| No study | 277 (20.0) | 70 (25.3) | 157 (56.7) | 50 (18.1) | *< 0.001* |
| Elementary/middle | 563 (40.7) | 93 (16.5) | 344 (61.2) | 125 (22.2) | |
| High school | 327 (23.7) | 41 (12.5) | 186 (56.9) | 100 (30.6) | |
| Higher education | 215 (15.6) | 19 (8.8) | 113 (52.6) | 83 (38.6) | |
| *FEPS* | | | | | |
| No active | 275 (19.9) | 44 (16.0) | 158 (57.5) | 73 (26.5) | 0.571 |
| Partial time | 219 (15.9) | 40 (18.3) | 129 (58.9) | 50 (22.8) | |
| Full time | 887 (64.2) | 139 (15.7) | 513 (57.8) | 235 (26.5) | |
| *MEPS* | | | | | |
| No active | 461 (33.4) | 89 (19.3) | 251 (54.4) | 121 (26.2) | |
| Partial time | 332 (24.0) | 49 (14.8) | 206 (62.0) | 77 (23.2) | 0.160 |
| Full time | 588 (42.6) | 85 (14.5) | 343 (58.3) | 160 (27.2) | |
| *WDTV (hours)* | | | | | |
| Less than 2 | 588 (42.6) | 87 (14.8) | 328 (55.8) | 173 (29.4) | *0.006* |
| Between 2 and 4 | 678 (49.1) | 113 (16.7) | 402 (59.3) | 163 24.0) | |
| More than 4 | 115 (8.3) | 23 (20.0) | 70 (60.9) | 22 (19.1) | |
| *WKTV (hours)* | | | | | |
| Less than 2 | 396 (28.7) | 73 (18.4) | 223 (56.3) | 100(25.3) | 0.967 |
| Between 2 and 4 | 798 (57.8) | 112 (14.0) | 469 (58.8) | 217 (27.2) | |
| More than 4 | 187 (13.5) | 38 (20.3) | 108 (57.8) | 41 (21.9) | |
| *WDCO (hours)* | | | | | |
| Less than 2 | 495 (35.8) | 55 (11.1) | 287 (58.0) | 153 (30.9) | |
| Between 2 and 4 | 664 (48.1) | 108 (16.3) | 388 (58.4) | 168 (25.3) | *< 0.001* |
| More than 4 | 222 (16.1) | 60 (27.0) | 125 (56.3) | 37 (16.7) | |
| *WKCO (hours)* | | | | | |
| Less than 2 | 324 (23.5) | 46(14.2) | 180 (55.6) | 98 (30.2) | |
| Between 2 and 4 | 721 (52.2) | 99 (13.7) | 436 (60.5) | 186 (25.8) | *< 0.001* |
| More than 4 | 336 (24.3) | 78 (23.2) | 184 (54.8) | 74 (22.0) | |
| *WPA* | 7.58 (4.97) | 6.61 (4.77) | 7.41 (4.89) | 8.53 (5.13) | *< 0.001* |

*[1]Quantitative variables are expressed as M(SD) and categorical variables are expressed as N(percent). Italics indicates significance. P: p-value; FES: father educational status; MES: mother educational status; FEPS: father employment status; MEPS: mother employment status; WDTV: weekdays TV; WKTV: weekend TV; WDCO: weekdays computer; WKCO: weekend computer; WPA: weekly physical activity.*

**Table III.** Adherence to Mediterranean diet adjusted by sex, age, BMI and origin[1]

| | Full model | | | | | Reduced model | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | β | z | p | CI (0.95) | d | β | z | p | 95% CI | d |
| *WPA* | 1.05 | 4.17 | *< 0.001* | 1.03 to 1.07 | 0.03 | 1.05 | 4.21 | *< 0.001* | 1.03 to 1.07 | 0.03 |
| *FES* | | 11.69 | *< 0.001* | | | | 11.37 | *0.001* | | |
| Elementary | 0.91 | -0.57 | 0.569 | 0.66 a 1.25 | -0.05 | 0.88 | -0.80 | 0.425 | 0.64 to 1.21 | -0.07 |
| High school | 1.14 | 0.71 | 0.479 | 0.79 a 1.63 | 0.07 | 1.11 | 0.55 | 0.581 | 0.77 to 1.58 | 0.06 |
| Higher education | 1.72 | 2.47 | *0.013* | 1.12 a 2.64 | 0.30 | 1.64 | 2.28 | *0.023* | 1.07 to 2.50 | 0.27 |
| *MES* | | 16.89 | *< 0.001* | | | | 15.90 | *0.001* | | |
| Elementary | 1.56 | 2.71 | *0.007* | 1.13 to 2.16 | 0.25 | 1.51 | 2.54 | *0.011* | 1.10 to 2.09 | 0.23 |
| High school | 1.88 | 3.41 | *0.001* | 1.31 to 2.71 | 0.35 | 1.82 | 3.28 | *0.001* | 1.27 to 2.61 | 0.33 |
| Higher education | 2.30 | 3.86 | *< 0.001* | 1.51 to 3.52 | 0.46 | 2.21 | 3.75 | *< 0.001* | 1.46 to 3.34 | 0.44 |
| *FEPS* | | 1.48 | 0.478 | | | | | | | |
| Partial time | 0.84 | -0.92 | 0.358 | 0.59 to 1.21 | -0.10 | na | na | na | na | na |
| Full time | 0.84 | -1.18 | 0.238 | 0.64 to 1.12 | -0.10 | na | na | na | na | na |
| *MEPS* | | 1.34 | 0.512 | | | | | | | |
| Partial time | 0.84 | -1.15 | 0.249 | 0.63 to 1.13 | -0.10 | na | na | na | na | na |
| Full time | 0.91 | -0.67 | 0.501 | 0.71 to 1.19 | -0.05 | na | na | na | na | na |
| *WDCO (hours)* | | 13.21 | *0.001* | | | | 31.04 | < 0.001 | | |
| Between 2 and 4 | 0.77 | -1.87 | 0.062 | 0.59 to 1.01 | -0.14 | 0.72 | -2.75 | *0.006* | 0.57 to 0.91 | -0.18 |
| More than 4 | 0.45 | -3.63 | *< 0.001* | 0.29 to 0.69 | -0.44 | 0.40 | -5.55 | *< 0.001* | 0.29 to 0.55 | -0.51 |
| *WDTV (hours)* | | 1.75 | 0.420 | | | | | | | |
| Between 2 and 4 | 0.86 | -1.20 | 0.230 | 0.67 to 1.10 | -0.08 | na | na | na | na | na |
| More than 4 | 0.79 | -1.01 | 0.314 | 0.49 to 1.26 | -0.13 | na | na | na | na | na |
| *WKTV (hours)* | | 2.60 | 0.273 | | | | | | | |
| Between 2 and 4 | 1.20 | 1.34 | 0.182 | 0.92 to 1.56 | 0.10 | na | na | na | na | na |
| More than 4 | 0.99 | -0.02 | 0.981 | 0.66 to 1.50 | -0.01 | na | na | na | na | na |
| *WKCO (hours)* | | 0.69 | 0.800 | | | | | | | |
| Between 2 and 4 | 0.88 | -0.83 | 0.409 | 0.66 to 1.19 | -0.07 | na | na | na | na | na |
| More than 4 | 0.90 | -0.49 | 0.627 | 0.60 to 1.36 | -0.06 | na | na | na | na | na |

*[1]Italics indicates significance. β: effect (expressed as odds ratio); z: Wald statistic test (a linear hypothesis test was applied to categorical variables to test the hypothesis of equality of coefficients); in this sense, joint test of the main effects on each variable was performed by means the $\chi^2$-Wald test);p: p-value; 95% CI: confidence interval at 95%; d: logit d; WPA: weekly physical activity; FES: father educational status; MES: mother educational status; WDCO: weekdays computer; FEPS: father employement status; MEPS: mother employement status; WDTV: weekdays TV; WKTV: weekend TV; WKCO: weekend computer; na: not applicable.*

hours") yielded a significant result not shown in the full model. In this case, the odds ratio was 0.72 (z = -2.75, p = 0.006), which indicates a lower probability of having higher adherence to MD for adolescents with a weekdays use of computer between two and four hours compared to those with an use of less than two hours.

## DISCUSSION

The aims of the current study were to describe the MD adherence using the KIDMED index in a sample of Catalonian adolescents and to assess the association between MD adherence and socio-economic and lifestyle behaviours. Some 74% of adolescents reported low to moderate adherence to the dietary patterns of MD and only 26% reported high adherence to the MD principles. After controlling for several confounders, the levels of adherences varied significantly depending on hours of physical activity, using a computer during weekdays and the educational level of both the mother and the father.

The rate of high adherence of the Catalonian sample was lower than the reported in the EndKid study, around 45%, which had a similar age range to our sample (36). Our findings support previous evidence for low to medium adherence to the dietary patterns of MD among younger generations in Mediterranean regions (10,11). However, it is surprising that while our sample was from one of the most representative Mediterranean regions

of Spain, the rates of high adherence was noticeably lower than those found in recent studies conducted in other regions of Spain (16,19,38). One possible explanation could be that the adolescents in the current study were from urban locations. The effect of the environment, rural or urban, on the MD adherence has previously been reported in recent studies conducted in different Mediterranean regions, and the results indicated that children and adolescents residing in rural populations had more Mediterranean eating habits than those who resided in urban locations (6,19,20). Indeed, a study conducted with adolescents from Madrid reported similar MD adherence rates to those reported in our study with students from the Metropolitan area of Barcelona. Although we do not have conclusive evidence, an environmental factor that might influence on the degree of MD adherence could be the urbanization. This finding needs to be further explored.

One of the most influential factors on MD adherence in young populations was socio-economic status, particularly the educational level of parents (16,18,21,23-25). Similar trend was observed in other adult populations (39,40). In the present study, we also found a relationship between educational status of parents and the MD adherence level. It remains unclear if this association depends on economic possibilities of family and, thus, greater availability of healthy foods, or rather cultural level that implies increased knowledge on health issues like nutritional knowledge (20,21). Indeed, it has been previously documented that nutrition knowledge is related to nutritional choices, eating habits and higher MD adherence (15). Although more studies are needed to assess this relationship, we may conclude that the parents' educational level is a socioeconomic factor with a relevant effect on the MD adherence of their children.

Regarding the relationship of the degree of MD adherence and other lifestyle behaviours our results indicate a significant association between KIDMED score and weekly physical activity and sedentary behaviour, particularly with the time of consumption of computer during week-days. These associations are in agreement with previous literature from studies conducted with children and adolescent samples from other regions of Spain and Europe (6,8,16,19,21-25). The consumption of computer on weekdays as indicator of screen-time, and therefore of sedentary behaviour, had a significant and relevant effect on MD adherence. On the contrary, no relationship between MD adherence levels and consumption of TV and computer during weekend were found. Therefore, our results indicate that computer, particularly more than two hours per day during weekdays, but no TV was related to follow MD principles. We may conclude that sedentary and low-active adolescents showed lower adherence to MD and those with more physical activity and who spent less than two hours per day in front of computer showed greater adherence to MD. These findings suggest that healthy behaviours are interrelated and tend to co-occur. However, this evidence needs to be further explored in order to know if public health interventions require a multifaceted approach that incorporates lifestyle changes.

The current study had strengths that enhance our ability to draw conclusions from the findings. First, the population-based nature allows for more generalizability than would be possible from clinic-based samples. Second, height and weight were measured *in situ* in comparison with many large population-based studies of youth that rely on self-reported height and weight data. Finally, to the best of our knowledge, this is the first study of these characteristics carried out only with adolescents from north-east of Spain. Some limitations of the present study need to be addressed. First, the sample is not nationally representative; thus, extrapolations to the larger Spanish populations should be made carefully. However, the sample is large and our study findings are consistent with previous studies conducted in different representative samples from other Spanish and European regions (6,8,16,20,21,24,25). Second, the cross-sectional study design does not allow for an assessment of temporality of relationships between variables, but the conclusions are valuable indications that can be used in future investigations. And third, adherence to MD, socio-economic indicators and lifestyle behaviors were self-reported measures. This may lead to the questions were misinterpreted or deliberately answered incorrectly by some adolescents.

In conclusion, low adherence rates to the Mediterranean diet were observed in a sample of Catalonian adolescents and the findings suggest that healthy behaviours are interrelated and tend to co-occur. Adolescents constitute priority targets for action and educational polices and healthy lifestyle strategies should be introduced among new generations. The promotion of not only the MD eating pattern but also the Mediterranean lifestyle, including greater physical activity and less screen time, should be reinforced among adolescents and their families.

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