

# ANALYSIS OF PHYSICAL ACTIVITY LEVELS AND ADHERENCE TO THE MEDITERRANEAN DIET IN SPANISH CHILDREN AND ADOLESCENTS DURING THE COVID-19 PANDEMIC

## ANÁLISIS DE LOS NIVELES DE ACTIVIDAD FÍSICA Y ADHERENCIA A LA DIETA MEDITERRÁNEA EN NIÑOS Y ADOLESCENTES ESPAÑOLES DURANTE LA PANDEMIA COVID19

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## Abstract

During the health crisis in Spain caused by the SARS-COVID19 pandemic, the activities that children and adolescents could usually engage in were disrupted, resulting in a decline in physical activity and dietary habits. The aim of this study was to assess the evolution of healthy physical activity and dietary habits among school-aged population in Spain during the school years affected by the pandemic and its restrictive measures. A longitudinal descriptive study was conducted with 1016 participants (8-14 years old) over 4 school years, using the PAQ-C questionnaire for physical activity and the KIDMED questionnaire to assess adherence to the Mediterranean diet. The results revealed a decrease in physical activity during the period with the strictest restrictions, which was not the case for healthy dietary habits, where adherence to the Mediterranean diet improved significantly year after year during the analyzed period. This study demonstrated a greater impact of confinement on the physical activity of children compared to another research. Regarding the Mediterranean diet, an increase was observed, likely due to family eating habits and awareness campaigns promoting healthy habits.

**Keywords:** COVID-19, healthy habits, mediterranean diet, physical activity, school population.

## Resumen

Durante la crisis sanitaria en España provocada por la pandemia SARS-COVID19 se alteraron las actividades que los niños y adolescentes podían realizar de forma habitual, viéndose perjudicada la actividad física, así como los hábitos alimentarios. El objetivo del presente estudio fue evaluar la evolución de los hábitos saludables de actividad física y alimentación en población escolar en España durante los cursos escolares afectados por la pandemia y sus medidas restrictivas. Se llevó a cabo un estudio descriptivo longitudinal con 1016 participantes (8-14 años) durante cuatro cursos escolares, utilizando los cuestionarios PAQ-C para actividad física y KIDMED para evaluar la adherencia a la dieta mediterránea. Los resultados revelaron un descenso de actividad física en el período con mayores restricciones, no siendo así en el caso de los hábitos alimentarios saludables, donde la adherencia a la dieta mediterránea, que ha ido mejorando significativamente año tras año en el período analizado. Este estudio mostró un mayor impacto del confinamiento en la actividad física de los niños/as en comparación con otras investigaciones. En cuanto a la dieta mediterránea, se pudo observar un incremento probablemente producido por la alimentación en el entorno familiar y las campañas de concienciación de hábitos saludables.

**Palabras clave:** COVID-19, hábitos saludables, dieta mediterránea, actividad física, población escolar.



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## Introduction

The correct physical and psychological development is crucial for children and adolescents. In this regard, physical activity (PA) plays a decisive role in this function, especially considering the levels reported in some cases, reaching approximately 80% of adolescents (Guthold et al., 2020). Furthermore, PA is considered a priority means for the prevention of various pathologies, the improvement of health, and the reduction of childhood obesity (Kunzle-Elizeche et al., 2018; Medina et al., 2018; United Nations, 2020), increasing its effectiveness when physical activity is accompanied by healthy eating habits (Aguilar-Cordero et al., 2014; Briones-Villalba et al., 2018). Based on this, the stages of maturational development should be considered as a crucial moment to promote healthy behaviors that mitigate negative effects on their health and proper development, including psychosocial well-being (Hinkley et al., 2018) and mental health (Loades et al., 2020).

Currently, obesity is considered the epidemic of the 21st century, constituting a highly detrimental chronic disease for people's health and well-being (Aguilar-Cordero et al., 2014). Obesity, along with overweight, represents the fifth leading risk factor for death worldwide. The World Health Organization (WHO) has classified childhood obesity as one of the most serious public health challenges of the 21st century, associated with a series of physical, social, and psychological consequences. In relation to this disease, a high body mass index (BMI) is an important risk factor that increases the likelihood of suffering from cardiovascular disorders (Freedman et al., 1999). Additionally, excess weight in children is associated with a decrease in quality of life (De Onis et al., 2010; Ul-Haq et al., 2013). Hence, the importance of addressing obesity with good daily physical activity, combined with healthy eating habits. There is a general consensus on the need to increase physical activity levels, and various studies highlight the beneficial effect that regular physical exercise has on weight loss (Aguilar Corberó et al., 2017; Siegrist et al., 2013). Despite this, there is currently a prevalence and trend of physical inactivity in school-aged children and adolescents (Hu & Staiano, 2022). For this and other reasons, and based on the health benefits for young people that physical activity brings, in 2018, the World Health Organization (WHO) launched a new action plan that included new goals for a relative reduction of 15% in the prevalence of physical inactivity by 2030 among adolescents and adults (World Health Organization, 2018). Currently, it is estimated that approximately 120 WHO member countries know their prevalence of sufficient physical activity, and 56% have an action plan to increase active minutes (World Health Organization, 2017).

During the lockdown resulting from the health crisis in Spain, the activities that children and adolescents could habitually perform were altered. In this way, a reduction in the levels of daily physical activity recommended by the World Health Organization (Geneviève et al., 2020; World Health Organization, 2010) was observed for various reasons such as the closure of schools, parks, recreational and sports facilities. The WHO and other researchers (Moore et al., 2020) warn that this could have led to an increase in physical inactivity, weight gain, and a notable increase in screen time during the COVID-19 pandemic (Geneviève et al., 2020; López-Bueno et al., 2020; World Health Organization, 2020; Xiang et al., 2020).

Physical activity greatly contributes to healthy behaviors, and the three-month lockdown prevented children from doing the necessary exercise (Geneviève et al., 2020) based on the recommendation to engage in one hour of intense or vigorous activity (World Health Organization, 2020). Additionally, there are the particular conditions in which each household faced the situation: limited space, diverse socioeconomic and cultural conditions, daily schedules and routines, work commutes, number of household members, or attendance to online classes, among other factors (Capel & Blair, 2019). While it is true that some authors have mentioned some advantages of virtual education (Gómez-Gerdel et al., 2020) such as the possibility for children to acquire greater autonomy in daily household tasks and improve family relationships by spending more time together (Moore et al., 2020). However, these improvements have not yet been demonstrated in the case of improvements in physical activity. In fact, regardless of the fact that in many cases the recommendations for physical exercise were met, in Europe healthy habits and the level of physical activity were reduced (Kovacs et al., 2021). Similarly, some available data from countries like China, Canada, and the USA showed a decrease in physical activity and a notable increase in screen time during the first wave of the COVID-19 pandemic (Geneviève et al., 2020; Haycraft et al., 2020; Kovacs et al., 2021; Xiang et al., 2020).

To mitigate the effects of the pandemic and lockdown, a series of recommendations were proposed with the aim of combating physical inactivity and bad habits (Cachón-Zagalaz et al., 2021; González-Valero et al., 2020; Lozano et al., 2019). These authors recommended a healthy combination of lifestyle behaviors in childhood that involved less screen time, healthy eating patterns, and balanced daily physical activity.

Among the possible factors of healthy eating patterns, we can highlight the Mediterranean diet, which is characterized by the predominant consumption of fruits, vegetables, whole grains, legumes, nuts, and seeds, with olive oil being the main source of fat (Idelson et al., 2017). Other characteristics of this diet are the regular but moderate intake of dairy products (milk, yogurt, and cheese), the low to moderate intake of fish and poultry, and the low consumption of red meat (Kafatos et al., 2000). Other aspects to highlight are the use of local products, seasonality, and biodiversity, in addition to the cultural influence where traditional recipes stand out (Psaltopoulou et al., 2004). According to Idelson et al. (2017), the eating

patterns associated with the Mediterranean diet are more established in the countries bordering the Mediterranean Sea (including Spain), although the children and adolescents of these regions do not seem to demonstrate greater adherence to these patterns.

Other researchers highlight the relationship between the Mediterranean diet and healthy habits (Aguilar et al., 2014; Cachón-Cuberos et al., 2018; Quiroga et al., 2019). Other publications state that weight loss is more successful in a program that includes diet plus exercise, rather than diet or exercise alone (Chomentowski et al., 2009; Foster-Schubert et al., 2012; Frimel et al., 2008; Ghroubi et al., 2009). Additionally, the good quality of a healthy diet is related to greater life satisfaction, a higher level of physical activity, and better academic performance (Grao-Cruces et al., 2013). Therefore, the practice of physical activity (PA) and sports has become an essential component of a healthy lifestyle along with healthy dietary patterns (Oberlin et al., 2017), with particular emphasis on habits established at an early age, as it has been shown that these tend to persist into adulthood (Kostecka, 2014).

Finally, recent studies have observed a significant reduction in the physical activity levels of adults during the COVID-19 lockdown (Giustino et al., 2020; López-Bueno et al., 2020). Despite this, there are only a few longitudinal studies on physical activity and the Mediterranean diet in Spain. Therefore, this study can provide the opportunity to relate the data obtained on a large school population over a prolonged period before, during, and after the pandemic. Consequently, the aim of the present study was to evaluate, through validated questionnaires, the evolution of healthy physical activity and eating habits in the school population of Spain during the pre- and post-COVID period, and to determine if the health crisis has caused these habits to vary from a normal situation to one with restrictions.

## Materials and Methods

### Design

A quantitative study with a longitudinal descriptive design was conducted, based on similar studies developed during the SARS-COVID19 pandemic (Kovacs et al., 2021; Martínez-de-Quel et al., 2021).

### Participants

The sample, selected by convenience, initially consisted of 5142 children enrolled in official education, aged between 8-14 years, and belonging to 31 public and private schools in the Community of Madrid, Valencian Community, Basque Country, and Andalusia. From the initial sample of 5142 children, a final sample of 1016 participants were selected who responded to the questionnaires over 4 years. Of the participants, 54.5% were male and the remaining 45.5% were female, with 53.8% in primary education and 46.2% in secondary education. The inclusion criterion for this study was being enrolled in courses for ages 8 to 14, while the only exclusion criterion was having suffered from any type of illness that prevented the practice of physical exercise during the last week.

### Instruments

An online questionnaire used by the NGO DES (Deporte para la Educación y la Salud) was utilized, including questions from the physical activity questionnaire for children (PAQ-C) (Kowalski et al., 2004) and the Mediterranean Diet Quality Index questionnaire (KIDMED) (Serra-Majen et al., 2004). The included variables were those belonging to the aforementioned questionnaires and validated for the Spanish population (Machola-González, 2017; Serra Majen et al., 2004), as well as the gender, age, and academic grade of the participants. The KIDMED questionnaire consists of 16 dichotomous response items (YES/NO), 12 of which have a positive value and the remaining 4 have a negative value. The results were expressed in a numerical value with a maximum score of 12 points and in different subcategories:  $\leq 3$ , Very low-quality diet; 4 to 7: Need to improve dietary pattern;  $\geq 8$ : Optimal Mediterranean diet. Regarding the PAQ-C questionnaire, it is composed of 9 items measured on a Likert scale of 1-5, from which a numerical score is obtained.

### Procedure

The questionnaire was electronically distributed to the schools participating in the program for the transformation of educational centers of "Schools Committed to Sport and Health," developed by the NGO Deporte para la Educación y la Salud (DES). After holding an in-person or telephone meeting with the physical education teacher responsible at each center, the questionnaire was sent via email with a direct link to a Google Forms and activated for 60 days. The school grades that participated in this study were those included between 3rd grade of Primary Education and 4th grade of Compulsory Secondary Education. The recommendations given by the researchers to the schools for completing the questionnaire were that it be done in the computer room and individually, under the supervision of the physical education teacher. The first section of the questionnaire included a statement on data protection and usage, guaranteeing the anonymity of the responses based on Organic Law 3/2018. The research is approved by the research and doctoral commission of the Universidad Europea and complies with the Helsinki Protocol.

## Data Analysis

Data are presented as mean  $\pm$  standard deviation. The Kolmogorov-Smirnov test was used to check that the data distribution was normal. Subsequently, a repeated measures analysis of variance with one factor (ANOVA) was conducted. After obtaining a significant F value, a post-hoc analysis was performed to identify the differences between means using the Bonferroni procedure. The effect size was estimated by calculating partial eta squared ( $\eta^2 p$ ). A significance level of  $p \leq .05$  was set for all comparisons. Statistical procedures were performed using the SPSS statistical software (v24.0, IBM, USA).

## Results

As shown in Table 1, the data from the PAQ-C questionnaire indicate that in the academic years 18/19, 19/20, and 20/21, children engaged in less physical activity compared to the 21/22 academic year. Additionally, physical activity in the 19/20 academic year was greater than in the 20/21 academic year. Regarding the data obtained from the KIDMED questionnaire, adherence to the Mediterranean diet was lower in the 18/19 academic year compared to the other years, and it was also lower in the 19/20 academic year compared to the 20/21 and 21/22 academic years. From the results obtained and reflected in the PAQ-C and KIDMED tables for all children from the 18/19 to the 21/22 academic years, we can observe that, in the case of physical activity, the data reflect an increase except for the 20/21 academic year. It is worth noting that the results for the 18/19 and 20/21 academic years are very similar. The year with the lowest recorded physical activity for children was the 20/21 academic year (with greater restrictions due to COVID-19). However, regarding the KIDMED, the year with COVID-19 restrictions (20/21) surpassed the two previous years, indicating a growth over the four academic years, something not observed in the PAQ-C tables. Additionally, since the 18/19-year, adherence to the Mediterranean diet has significantly improved.

**Table 1**  
*PAQ-C and KIDMED results of all participating children from the 18/19 to 21/22 academic years*

	<b>N</b>	<b>18/19</b>	<b>19/20</b>	<b>20/21</b>	<b>21/22</b>	<b>F</b>	<b>p</b>	<b><math>\eta^2 p</math></b>	<b>Post Hoc</b>
PAQC	1016	2.94 $\pm$ 0.64	3.01 $\pm$ 0.69	2.92 $\pm$ 0.72	3.18 $\pm$ 0.60	31.06	0.000	0.030	19/20 > 20/21: ( $p = .032$ ) 21/22 > 18/19: ( $p < .001$ ) 21/22 > 19/20: ( $p < .001$ ) 21/22 > 20/21: ( $p < .001$ )
KIDMED	1016	6.77 $\pm$ 2.45	7.11 $\pm$ 2.58	8.32 $\pm$ 2.36	8.44 $\pm$ 2.27	124.77	0.000	0.109	19/20 > 18/19: ( $p = .017$ ) 20/21 > 18/19 ( $p < .001$ ) 20/21 > 19/20 ( $p < .001$ ) 21/22 > 18/19 ( $p < .001$ ) 21/22 > 19/20 ( $p < .001$ )

## Discussion

The purpose of this study was to evaluate the impact of the COVID-19 pandemic on physical activity and healthy eating habits based on the Mediterranean diet in Spanish schoolchildren during the 18/19 to 21/22 academic years and to compare the results of physical activity and healthy eating habits obtained before, during, and after the COVID-19 restrictions.

Our data revealed that, in the case of physical activity, significant differences were observed at different levels. The academic years 18/19 and 20/21 showed lower levels of physical activity compared to the academic years 19/20 and 21/22, respectively. Thus, the data obtained in the 18/19 academic year (the first year of our study) and the 20/21 academic year (with greater COVID-19 restrictions) showed very similar results, with the lowest physical activity values recorded in the 20/21 year. However, no statistically significant differences were found between the first year 18/19 and the 20/21 year. On the other hand, in the case of adherence to the Mediterranean Diet, the year with COVID-19 restrictions (20/21) reflected better adherence to the Mediterranean Diet than in the previous two years, showing a positive progressive increase over the four years analyzed. Moreover, it is noteworthy that in the years when restrictions were gradually lifted, the average values exceeded 8 points, indicating optimal diet quality levels (Serra-Majen et al., 2004).

In comparison with the above and with other studies conducted during the same period (Kovacs et al., 2021; López-Bueno et al., 2020; Schmidt et al., 2020), the impact of the lockdown on children's physical activity was more evident in this sample of Spanish schoolchildren. The data obtained showed that the number of schoolchildren who met the WHO PA recommendation decreased compared to what was observed in the year before and after the lockdown (Chaput et al., 2020; Kovacs et al., 2021). In this regard, the results obtained highlight the enormous impact that adequate PA measures have on the school population. A global concern is that the changes evidenced in behavior due to COVID-19 may continue to have a permanent impact. According to available data from various recent studies (García-Solano et al., 2021; Gasol

Foundation, 2019; Moreno et al., 2016; Ortiz-Marrón et al., 2016) the results are worrying and tend to show that fewer children meet the physical activity recommendations.

It is evident that the situation generated by COVID-19 is exceptional and unprecedented. Therefore, it may be extremely complex to determine the most effective option to address it with guarantees. However, what is known is the positive effect that adequate PA, diet, and a healthy lifestyle have in the prevention and treatment of COVID-19 (Hasson et al., 2022). In this regard, it is important to recognize the significance of healthy lifestyles and, therefore, to invest in optimal PA levels. Support from interested administrations, which must take responsibility for promoting healthy lifestyles, families, schools, and the community at large is fundamental to ensuring adequate PA levels in the school and leisure environments for children and to prevent the levels observed in the aforementioned studies from becoming the norm.

Regarding the impact of COVID-19 on adherence to the Mediterranean diet, the data from our study reflect a lower incidence and even an improvement during the lockdown compared to the previous two years, in contrast to what some studies indicate (Cifuentes-Faura, 2020) about the food insecurity children will be exposed to, resulting in an increase in unhealthy diets.

It is true that some studies (Gebremariam et al., 2016; Grao-Cruces et al., 2013) highlight that both parental guidance and example can positively influence children's behaviors regarding diet and physical activity habits, especially during the lockdown. Parents often remain the best resource (and the closest, due to the lockdown) for children to receive help. The data obtained in our study show a clear progressive improvement in the Mediterranean Diet over the course of the study and align with other studies during the same period. Notably, a recent survey among Spanish adults reported that most maintained a good diet during the first 5 weeks (Romeo-Arroyo et al., 2020). Additionally, another study shows data on an increased consumption of foods related to the Mediterranean Diet, such as olive oil, during this period (Tárraga Marcos et al., 2023). Furthermore, the decline in the consumption of food outside the home is linked to positive changes in diet quality (Altman et al., 2015).

The main limitations of this study include the high attrition rate of the sample and the absence of other anthropometric values or physiological parameters that could shed light on the true effect of lockdown on the health of the analyzed population. Similarly, other important values related to diet and exercise, such as variables related to mental health, could be included (Richard et al., 2023).

Among the main practical applications of this work, emphasis should be placed on obtaining valid and reliable measures that allow decision-making based on the information collected about the healthy lifestyles of schoolchildren. Similarly, it is necessary to delve into the development of education and awareness strategies on dietary and/or sports habits. Finally, based on the results obtained, the implementation of teaching strategies aimed at teaching the different possibilities of engaging in physical exercise in exceptional situations may allow an increase in activity in such particular contexts.

## Conclusions

In conclusion, the data provided by the study to evaluate the impact of the COVID-19 pandemic on physical activity and healthy habits in Spanish schoolchildren during the 18/19 to 21/22 academic years revealed lower physical activity values in two of the four school years studied (18/19 and 20/21). Thus, in the period with the most restrictions, a somewhat greater decrease was observed, although it is true that the data obtained in the 18/19 academic year were very similar. On the contrary, this did not occur in the case of healthy eating habits, which reflect better adherence to the Mediterranean Diet, progressively improving over the analyzed period. This study showed a greater impact of the lockdown on children's physical activity compared to others. Compliance with the WHO PA recommendations decreased. Regarding the Mediterranean Diet, an increase can be observed, likely due to eating within the family environment and awareness campaigns promoting healthy habits.

## Ethics Committee Statement

The research is approved by the Research and Doctoral Committee of the European University and complies with the Helsinki Protocol.

## Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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## Authors' Contribution

Conceptualization E.D., & P-G. B.; Methodology F-L. A., & B. P.; Formal Analysis I-B.I. & F-E. V.; Investigation E.D., & F-E. V.; Resources E.D. & F-E. V; Data Curation Analysis I-B.I. & F-E. V.; Writing – Original Draft E.D., & P-G. B.; Writing – Review & Editing F-L. A., & B. P. All authors have read and agree with the published version of the manuscript.

## Data Availability Statement

The data is not available due to its privacy policy.

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