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Healthy habits in children. Before, during and after confinement due to COVID-19
Hábitos saludables en niños. Antes, durante y después del confinamiento por COVID-19

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Abstract. Adequate physical activity (PA) engagement and Mediterranean diet (MD) adherence are important for improving health. Children's lifestyles have been affected by lockdown due to the COVID-19 pandemic. It is also possible that the initial detrimental impact of the pandemic on children's health continues beyond the period in which confinement was imposed. Thus, the aim of the present study was to analyze PA engagement, MD adherence and screen time in children during confinement and compare findings with data gathered during pre- and post-confinement periods. The initial sample included 55 children aged 10-12 years. Of these, eighteen could not be followed up. The final sample was composed of 37 children aged 12-13 years. All were primary school students in the province of Granada, Spain. Validated questionnaires were administered to evaluate PA (PAQ-C) and Mediterranean diet adherence (KIDMED). The FAS III test was used to evaluate socioeconomic status and an ad-hoc questionnaire was developed to collect sociodemographic data and evaluate screen time. Children exhibited worse PA levels and screen time during confinement when compared with pre-confinement and post-confinement periods. Screen time habits acquired during confinement continued afterwards. In contrast, PA levels were higher following confinement than both during and afterwards.
Keywords: Health, confinement, COVID-19, longitudinal, children.

Resumen. La práctica adecuada de actividad física (AF) y la adherencia a la dieta mediterránea (DM) son importantes para mejorar la salud. Los estilos de vida de los niños se han visto afectados por el confinamiento debido a la pandemia de COVID-19. También es posible que el impacto perjudicial inicial de la pandemia en la salud de los niños continúe más allá del periodo en el que se impuso el confinamiento. Por lo tanto, el objetivo del presente estudio fue analizar el compromiso con la AF, la adherencia a la DM y el tiempo de pantalla en los niños durante el confinamiento y comparar los hallazgos con los datos recopilados durante los períodos previos y posteriores al confinamiento. La muestra inicial incluyó 55 niños de 10-12 años. De ellos, dieciocho no pudieron ser objeto de seguimiento. La muestra final estaba compuesta por 37 niños de 12-13 años. Todos eran alumnos de primaria de la provincia de Granada, España. Se administraron cuestionarios validados para evaluar la AF (PAQ-C) y la adherencia a la dieta mediterránea (KIDMED). Se utilizó el test FAS III para evaluar el estatus socioeconómico y se desarrolló un cuestionario ad-hoc para recoger datos sociodemográficos y evaluar el tiempo de pantalla. Los niños mostraron peores niveles de AF y tiempo frente a la pantalla durante el confinamiento en comparación con los periodos previo y posterior al confinamiento. Los hábitos de tiempo frente a la pantalla adquiridos durante el confinamiento continuaron después. Por el contrario, los niveles de AF fueron más altos después del confinamiento que durante y después del mismo.
Palabras clave: Salud, confinamiento, COVID-19, longitudinal, niños.

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Introduction

The COVID-19 pandemic represents a serious health crisis. COVID-19 is characterized by severe respiratory syndrome which can cause death (Alonso-Martínez et al., 2021). In Spain, the government decreed, on March 14th 2020, general restrictions including the closure of schools and the establishment of mandatory home confinement for children. Even though children seem to be at a lower risk of severe infection, their lifestyle may have been severely impacted by these measures (Medrano et al., 2021). Lockdown mayh have had a particularly strong influence on the lifestyles of children with regards to levels of physical activity (PA) and eating habits (Woo-Baidal et al., 2020).

PA pertains to any bodily movement produced by the skeletal muscles that requires energy expenditure. According to World Health Organization (WHO) recommendations (2022), children and adolescents should engage in at least 60 minutes of moderate-to-vigorous intensity, mostly aerobic, PA per day, whilst also engaging in vigorous-intensity aerobic activity at least 3 days a week. According to several studies, individuals who engage in daily PA throughout childhood and adolescence tend to continue to do so throughout adulthood, making childhood PA engagement an indirect predictor of good future health (Azevedo et al., 2007; Black et al., 2019). Furthermore, there is overwhelming evidence associating PA with a reduction in cardiovascular diseases, hypertension, different cancers, etc. (Warburton et al., 2017). Likewise, PA enhances the efficacy of vaccines (Pascoe et al., 2014).

Further, a Mediterranean diet (MD) is characterized by low intake of saturated fat and a high consumption of plant-based foods (fruits, vegetables, whole grains, nuts and seeds), olive oil, dairy products (cheese and yoghurt) and eggs, with low-moderate amounts of fish and poultry, and a low consumption of red meat and wine (Willet et al., 1995). Adequate MD adherence leads to important health benefits (Cani et al., 2020) including the prevention of cardiovascular disease, obesity (Estruch et al., 2018, Estruch et al., 2020), cancer, etc. (Schwingshackl et al., 2017). It is also associated with an improved body composition, immunity and quality of life (Muros et al., 2017, Serra-Majem et al., 2019).

Likewise, adequate PA levels and the avoidance of sedentary habits are positively related with following a healthy diet, such as a MD (Muros et al., 2017). Both have been

shown to enhance the immune system and are effective in the prevention of many chronic conditions that increase the risk of severe COVID-19 infection (Nieman & Wentz, 2019; Detopoulou et al., 2021).

However, others studies among children from different countries with similar approaches to containment of the outbreak showed that during the current COVID-19 pandemic, PA levels decreased and screen time increased (Xiang et al., 2020). At the same time, the consumption of calorie dense foods increased due to anxiety, stress and boredom (Ruiz-Roso et al., 2020). Specifically, children belonging to low socioeconomic status families were most adversely affected (Guan et al., 2020, Van-Lancker et al., 2020). This is likely to be mainly due to decreased daily PA, the loss of opportunities to be active (Guan et al., 2020) and limited access to high quality food (British Dietetic Association, 2020).

Furthermore, prior to the pandemic, more than 81% of the child and adolescent population was already inactive worldwide (WHO, 2022). In addition, 73.9% of the child Spanish population spent more than one hour per day in front of the screen on weekdays with 82.6% doing so at weekends (Ministerio de Sanidad, 2017). Further, 64.1% of the Spanish child population failed to follow a MD in 2019 (Estudio Pasos, 2022).

Thus, lower levels of PA and diet quality have been associated with a higher body mass index (BMI) (Robinson et al., 2021), increased risk of mortality and chronic diseases (Biswas et al., 2015).

In this way, the maintenance of a healthy lifestyle was of vital importance during confinement and may be even more important now as we continue to navigate life afterwards. It is possible that the initial detrimental impact of the pandemic on children's health have continued beyond the period of confinement (Salway et al., 2022), potentially leading to an increase in the above mentioned percentages. Consequently, the scientific community must strive to examine whether the aforementioned lifestyle habits have continued to be affected following confinement and analyze the influence of this on children's health.

To the best of our knowledge, at the time of writing a few longitudinal studies have been conducted in Spain to examine the effects of the COVID-19 pandemic and changes following confinement on lifestyle behaviors in adults, however, such studies are more limited in children. Knowledge of the effects of the pandemic on lifestyle behaviors would be of prime interest for future pandemic strategies, especially in terms of identifying vulnerable groups and targeting responses to their realities (Woolf et al., 2020).

Thus, the aim of the present study was to analyze PA engagement, MD adherence and screen time in children during confinement. The study also aims to study whether habits adopted during confinement continued post-confinement and compare findings with information gathered in relation to a pre-confinement period.

Methodology and method

Participants

A non-experimental, descriptive, longitudinal, analytical, retrospective and correlational study was designed. In the first evaluation, fifty-five children were recruited. Students were undertaking the fifth year of primary school education and were aged between 10 and 12 years. All participants attended a mixed funding school in the province of Granada, Spain. The total sample was made up of 19 boys (34.5%) and 36 girls (65.5%). Of these, eighteen dropped out of follow-up. With regards to the final evaluation, participants were undertaking the sixth year of primary school education and were aged between 11 and 13 years. This sample was made up of 13 boys (35.1%) and 24 girls (62.8%).

Sampling was not random with participants being selected according to convenience. The first evaluation was conducted in February 2021. In this period restrictions were still in place for open access to some schools. The second evaluation was conducted in May 2022. In this period, no strict restrictions were in place in Spain, with only face masks being required for use of public transport and in hospitals. Nonetheless, only 37 students agreed to continue to be evaluated. In both evaluations, all students participated voluntarily after gaining the prior consent of their parents or legal guardians. Participating schools and their corresponding parents' associations authorized the study. Ethical approval was granted by the Ethics Committee of the University of Granada. First evaluation (1230/CEIH/2020) and second evaluation (2796/CEIH/2022).

Instruments

PA engagement was evaluated using a validated Spanish translation of the Physical Activity Questionnaire for Older Children (PAQ-C) aged between 8 and 14 years (Crocker et al., 1997; Manchola-González et al., 2017). It has been shown to be valid and reliable, producing an intraclass correlation coefficient (ICC) greater than 0.73 and an internal consistency of $\alpha = 0.86$. This questionnaire consists of 10 items designed to measure moderate and vigorous PA engagement over a period of seven days. The PAQ-C is a self-administrated questionnaire consisting of ten items. A higher score indicates more active children. Item number ten examined whether students had been impeded from carrying out their usual PA during the week prior to questionnaire completion. Questionnaires were to be excluded in cases in which this was reported to have occurred, however, none of the participants marked this item affirmatively.

A Spanish adapted version of the KIDMED test was used to evaluate MD adherence (Serra-Majem et al., 2004; Altavilla et al., 2020). This test consists of 16 items designed to measure levels of MD adherence in children. Items must be answered affirmatively (yes) or negatively (no). Four of the items are negatively framed, with positive responses being scored -1. In contrast, positive responses to positively

framed items are scored +1. Negative responses have a score of 0. Thus, possible overall scores range from -4 to 12. From this, MD adherence is categorized along the following continuum: Poor quality (≤ 3); Needs improvement (4-7); Optimal quality (≥ 8).

The Spanish adapted version of the family affluence scale (FAS III) was used to evaluate socioeconomic status (Hobza et al., 2017). It has been shown to be valid and reliable, with an internal consistency of between α= 0.76 and 0.91. This scale is made up of 6 items designed to evaluate family purchasing power based on material goods and is scored between 0 and 3. Individual score are summed, giving a maximum possible score of 13 and a minimum possible score of 0. Scores are categorized as being "Low (0-2)", "Medium (3-5)" or "High (≥ 6)".

An ad hoc questionnaire was used to collect the sociodemographic data of sex, date of birth, height and weight. BMI was calculated from height and weight [BMI = weight [kg] / (height [m])2]. Age and sex standardized classifications of normal weight, overweight and obese were calculated according to international cut-points defined by Cole et al. (2000) for boys and girls aged between 2 and 18 years. Moreover, height and weight were measured using standard Alpha protocol (Ruiz et al., 2011) during the third measurement time-point (post-confinement).

In addition, two items were added to examine screen time on both weekdays and at weekends. Both items evaluated the number of hours spent engaged in screen-based leisure activities (watching television, playing video games, using a mobile phone, using a computer, etc.). E-learning was not included.

Procedure

Two information packs were prepared to obtain informed consent prior to data collection. These included information on all the characteristics and conditions of the study. The first was addressed to the director of the educational center. The second was addressed to the parents or legal guardians of the students. Students completed questionnaires individually during school hours in the presence of a researcher. The purpose of this was to ensure that procedures were conducted in an appropriate legislative and ethical manner. In order to evaluate the influence of COVID-19 on examined variables, participants completed the same questionnaire on two separate occasions. On the first occasion, 55 participants were asked to consider the overall period of confinement or lockdown (March 15th 2020-June 21st 2020). These were then asked to respond to the same questions in relation to a time immediately prior to the onset of COVID-19 (weeks before March 14th 2020). Both of these first two questionnaires were completed on the same day. This data was collected during the month of February 2021. This method has been used in other previous studies (Ammar et al., 2020). On the second occasion, eighteen participants dropped out of follow-up. Thus, 37 students agreed to continue to be evaluated. These were asked to respond according to their reality at the time of completion. This data was collected during the month of May 2022.

Data Analysis

Data were analyzed using the IBM SPSS 25.0 statistical software. Qualitative variables (sex, socioeconomic status and BMI categories) are presented as percentages. Quantitative variables are presented as means and standard deviations.

First, data were analyzed in order to observe the behavior of variables during the confinement period. Initial sample distribution (n=55) was analyzed using the Kolmogorov-Smirnov test. After verifying that data followed a normal distribution, analysis was conducted using student's T-test to compare two unrelated groups. The magnitude of change for each outcome measure was reported using Hedge's g and interpreted as small (g = 0.2), moderate (g = 0.5), or large (g = 0.8) (Cohen, 2013).

Secondly, data were analyzed in order to compare data collected during confinement with pre-confinement and post-confinement periods. 18 participants dropped out of follow-up. Sample distribution (n=37) was analyzed using the Shapiro-Wilk test. After verifying that data followed a normal distribution, analysis of variance (ANOVA) and Tukey post-hoc analysis was also used to conduct between-variable analysis and compare between the three data collection periods.

Sex-adjusted correlations were performed using Pearson's test. Significance was set at p=.05.

Results

Table 1 presents sample characteristics corresponding to the confinement period according to sex, socioeconomic status and BMI.

During confinement due to COVID-19, students reported mean scores of 2.51±0.64 on the PAQ-C and 7.53±2.41 on the KIDMED. In addition, participants reported spending an average of 3.60±2.12 hours per day in front of a screen.

Of the overall sample, 34.5% of participating students were boys and 65.5% were girls. With regards to socioeconomic status, 10.9% of participants came from families with a medium socioeconomic status and 89.1% came from families with a high socioeconomic status. In addition, 12.7% of students were overweight or obese.

With regards to sex, statistically significant differences were found for MD adherence (p=.024; Hedge's g=0.661) and screen time (p=.001; Hedge's g=1.148). Specifically, boys were observed to engage in more screen time (5.01±2.38 vs 2.86±1.55 hours) and showed less MD adherence (6.53±1.77 vs. 8.06±2.55 points) than girls.

With regards to BMI, statically significant differences were found for PA engagement (p=.006; Hedge's g=0.583). Overweight/Obese participants had higher PA engagement scores than healthy weight participants (2.83±0.21 vs 2.46±0.67 points).

Table 1.
Sample characteristics corresponding to confinement, according to sex, socioeconomic status and BMI.

Characteristics		N	%	PA	*p.*	*H*	MD	*p.*	*H*	ST	*p.*	*H*
TOTAL		55	100%	2.51±0.64			7.53±2.41			3.60±2.12		
Sex	*Boys*	19	34.5%	2.44±0.59			6.53±1.77			5.01±2.38		
	Girls	36	65.5%	2.55±0.67	0.537	0.171	8.06±2.55	0.024	0.661	2.86±1.55	0.001	1.148
SES	*Medium*	6	10.9%	2.52±.0.90			7.83±2.56			5.12±2.56		
	High	49	89.1%	2.51±0.61	0.969	0.016	7.49±2.41	0,745	0.140	3.42±2.01	0.064	0.823
BMI	*Normal*	48	87.3%	2.46±0.67			7.58±2.35			3.41±1.99		
	Overweight / Obesity	7	12.7%	2.83±0.21	0.006	0.583	7.14±2.97	0.656	0.181	4.90±2.68	0.082	0.716

p<0.05. *Notes:* PA: Physical activity, MD: Mediterranean diet, ST: Screen time, SES: Socioeconomic status, BMI: Body mass index, H: Hedge's

Table 2 presents sample characteristics overall and compares data collected during the period of total confinement with the pre-confinement and post-confinement periods.

Statistically significant differences were observed in relation to the variables of PA (p<.05) and screen time (p<.05).

Participants reported engaging in less PA during confinement than both before (2.78±0.70 vs 3.16±0.56; p=.049; Hedge's g=0.599) and after confinement (2.78±0.70 vs 3.88±0.79; p=.000; Hedge's g=1.473). Likewise, participants reported engaging in more PA following confinement than both during (3.88±0.79 vs 2.78±0.70; p=.000; Hedge's g=1.473) and before confinement (3.88±0.79 vs 3.16±0.56; p=.000; Hedge's g=1.052).

On the other hand, both boys and girls spent more hours in front of screens during confinement than prior to (3.61±1.97 vs 1.69±0.87; p=.000; Hedge's g=1.261) and after this period (3.61±1.97 vs 2.59±1.60, p=.016; Hedge's g=0.568). Thus, they spent fewer hours in front of screens prior and following confinement (1.69±0.87 vs 2.59±1.60; p=.040; Hedge's g=0.698).

Table 2.
Differences in sample characteristics between the period of confinement, pre-confinement and post-confinement.

Physical activity			*p*	*Hedge's*
Before	3.16±0.56	During	0.049	0.599
		After	0.000	1.052
During	2.78±0.70	After	0.000	1.473
After	3.88±0.79	.	.	
Mediterranean diet			*p*	*Hedge's*
Before	6.86±2.37	During	0.948	0.080
		After	0.506	0.247
During	7.05±2.36	After	0.330	0.317
After	6.19±3.02	.	.	
Screen time			*p*	*Hedge's*
Before	1.69±0.87	During	0.000	1.261
		After	0.040	0.698
During	3.61±1.97	After	0.016	0.568
After	2.59±1.60	.	.	

p<0,05

Table 3 presents the sex-adjusted correlation coefficients produced between the study variables pertaining to the confinement period.

A positive correlation was observed between MD adherence and age (r=.298; p=.028). No correlations were observed between the other variables.

Table 3.
Sex-adjusted correlations between study variables pertaining to the confinement period.

	Physical activity	Mediterranean diet	Socioeconomic status	Age	Body mass index
Screen time	-0.078	-0.178	-0.164	0.017	-0.004
Physical activity	.	0.137	-0.038	-0.029	-0.055
Mediterranean diet	.	.	-0.236	0.298*	0.039
Socioeconomic status	.	.	.	0.002	-0.173
Age	.	.	.	.	-0.077

p<0.05*

Discussion

The change of circumstances imposed by confinement due to COVID-19 increased exposure to unhealthy habits and there is a risk that this continued following the end of confinement. One of the aims of the present study was to analyze PA engagement, MD adherence and screen time in children during confinement period.

In the present study, boys specifically reported spending more time in front of the screen during confinement than girls. According to Esposito et al. (2020), boys usually are more inclined to play video games and use the PC for leisure. These same authors also observed that girls are more likely to spend their free time with friends or members of their peer group but, despite this, they often failed to achieve sufficient PA engagement.

Finally, with regards to MD adherence, girls reported higher MD adherence during confinement than boys. One study conducted in Spain reported that the consumption of fruits, vegetables, legumes and eggs increased, whilst red meat consumption decreased (Rodríguez-Pérez et al., 2020). Ventura et al. (2021) observed that longer meal preparation times and reduced exposure to fast food stores led to greater consumption of fruits, vegetables and legumes. Similarly, spending more time with one's family promoted MD adherence (Rodríguez-Pérez et al., 2020). Further, cooking at home with one's parents reduced boredom and the number of visits reported to fast food restaurants (Ruiz-Roso et al., 2020). It is possible that larger differences were found in girls because of the existence of specific characteristics related to identity and gender roles. As older generations associate girls with reproductive activities such as "keeping house", such customs may have continued during confinement, with girls spending more time cooking with their parents. Another explication could also be that, upon entering adolescence, children begin to show more concern for their body image. Other studies (Bergier et al., 2017) have observed that girls are more concerned with losing weight and engaging in better nutritional behaviours. This may also explain the positive correlation between MD adherence and age in the present study.

In the same way, children with body image concerns probably spent more time working on their body image. In the present study, it wais even observed that those who were overweight or obese were more physically active than those who had a healthy weight.

The present study also aimed to study whether habits adopted during confinement continued post confinement. The final study aim was to compare findings with

information gathered in relation to a pre-confinement period.

Findings of the present study established that children exhibited worse levels of PA and screen time during confinement due to COVID-19 when compared with pre-confinement and post-confinement periods. With regards to screen time, children's habits continued following confinement, with participants spending more time in front of a screen than they did prior to confinement. In contrast, PA levels were higher following confinement than both during and afterwards.

In the present study, a decrease in PA levels was observed during confinement in both boys and girls. These findings are not surprising given that COVID-19 restrictions impeded access to opportunities to be active, such as sports clubs, active travel to school and school break times for children and adolescents (Hurter et al., 2022). Other studies have also observed an overall decrease in PA engagement during confinement. For example, ten Velde et al. (2021) used questionnaires and accelerometers to measure PA levels in 102 Dutch children of similar ages and found total PA to decrease by 51 minutes per day and sedentary time to increase by 45 minutes per day. In addition, a study conducted using the Global Physical Activity Questionnaire developed by the Word Health Organization in Chinese children (Xiang et al., 2020) found that the mean time spent in PA decreased from 77 to 15 minutes per day during confinement.

In contrast, the present study found an increase in PA levels in both boys and girls following confinement. These findings differ from other studies which have observed that, despite the removal or relaxation of lockdown measures, PA levels remained low following confinement in Dutch children (ten Velde et al., 2021). However, the present study collected data when there were no restrictions. Data collection was not conducted immediately after confinement, with some restrictions, as it was in the aforementioned study. Nonetheless, Shneor et al. (2021) reported that 19 Israeli students aged between 8 and 12 years resumed PA engagement following confinement to meet daily recommendations of 60 min. This may have been due to the reopening of parks, sports centers and (Chen et al., 2020) greater commitment to engage in health promotion. Research such as that conducted by Ventura et al. (2021) has also reported that Spanish children who tended to report engaging often in PA after lockdown were those who did so with other relatives in the household. Similarly, another study indicated that parental support was a key correlate in the promotion of PA during the COVID-19 pandemic, making it a potential promoter of children's health (Guerrero et al., 2020). It is also possible that parental support may have continued to be a factor following confinement. Specifically, participants in the present study attended a mixed funding school and came from families with a medium-high socioeconomic status. This type of family tends to be characterized by parents with more stable and regular jobs (McKibbin & Fernando, 2021) with better established timetables. This may, therefore, have enabled these parents to devote more attention to their children and participate in health promotion activities at their children's school following confinement.

With regards to screen time, both boys and girls spent more hours in front of a screen during confinement than both prior to and following confinement. Xiang et al. (2020) also reported an increase of up to 4-5 hours a day in the time spent interacting with screens in Chinese children. Confinement contributed to greater idleness and the subsequent need for distraction via electronic devices (Teixeira et al., 2021). This being said, screen time was still higher following confinement than it was prior to confinement. ten Velde et al. (2021) also observed in Dutch children that lockdown may have a lasting impact on PA and screen time and that these unhealthy behavioral adaptations in children may lead to a 'new normal'. Another reason may be that after 2 years between pre-confinement period and post-confinement period, increasing aged may have influenced the results.

The maintenance of such habits may be dangerous because high screen time has been associated with a higher snacking frequency, especially when it comes to energy-dense snacks, fast foods and fizzy beverages, and promotes over-consumption during subsequent meals (Boulos et al., 2012). Thus, parents should supervise screen time and limit access to digital content, whilst also encouraging their child's engagement in offline activities that require movement both during and following confinement. Wong et al. (2021) has described this as a "digital detox".

The observation of an increase in PA following confinement alongside high levels of screen time may seem counterintuitive. However, this finding may be explained by the fact that PA may have being encouraged through electronic devices, resulting in a relative increment of entertainment screen time with respect to active time (Constandt et al., 2020). Another reason may be that the 2 year difference between the pre-confinement and post-confinement period will have entailed changes for the adolescents which may have influenced outcomes. At the adolescent stage, both boys and girls begin to worry about their body image. Bergier et al. (2017) observed a positive and significant correlation between the use of exercise to improve body shape and PA engagement in both European adolescent boys and girls.

After discussing the results, it is necessary to highlight that the educational community is calling for the need to include training in Information and Communication Technologies (ICTs), both for teachers and students (Quilindo et al., 2023). During the period of confinement for COVID-19, difficulties were encountered in adapting physical education classes to an online format (González-Rivas et al., 2021). Physical education is a fundamental area in which the promotion of healthy habits such as physical activity and healthy eating is a key part of the curriculum. Therefore, it is necessary to establish re-adaptation systems to work on curricular content through the use of ICTs. Thus, their use will be normalised and will no longer be a

problem in a situation similar to that of COVID-19 confinement (Castillo-Retamal et al., 2023).

The present study has several limitations, which will not be discussed below.

The first limitation pertains to the small sample size. The first evaluation was conducted in February 2021. In this period, restrictions were still in place for open access to some schools. For this reason, only 55 participants could be evaluated. The second evaluation was conducted in May 2022. During this period, no strict restrictions were in place in Spain, with face masks only being required for use of public transport and in hospitals. Nonetheless, only 37 students agreed to continue to be evaluated. Further, another similar public study of 19 Dutch children (ten Velde et al., 2021) justified recruitment of a small sample with the same logical reasons of difficult access. Thus, findings should always be interpreted with caution.

Likewise, another limitation pertains to the timing of data collection. The time elapsed between the first and final evaluations may have influenced outcomes. For example, biological variables were not considered. A random sample of children should have been noted prior to overall confinement due to COVID-19, with the aim of evaluating the same participants at three different time points. This is necessary to be able to make generalized conclusions regarding the impact of lockdown on children's health behaviours. This being said, confinement due to COVID-19 was unexpected. Further, this method has been used in other previous public studies (Ammar et al., 2020).

Finally, questionnaires were used to measure study variables which increase measurement error. However, PAQ-C, KIDMED and FAS III questionnaires have shown sufficient reliability and validity for use in the present study population. Little impact is therefore foreseen on final conclusions. We could use technological instruments such as pulsometers or accelerometers like alternatively, to record more accurate data on PA frequency and intensity over given time-points.

Conclusions

Findings of the present study established that children exhibited worse PA levels and screen time during confinement due to COVID-19 when compared with pre-confinement and post-confinement periods. With regards to screen time, children's habits continued following confinement, with participants spending more time in front of a screen than they did prior to confinement. In contrast, PA levels were higher following confinement than both during and afterwards.

Lockdown influenced changes in children's habits. It is, therefore, necessary that scientific and educational communities establish or improve strategies to install scheduled physical activities and limit screen time as a means to encouraging adequate PA engagement and MD adherence. In addition, such strategies should also be developed to encourage an appropriate responses to uncertain situations, such as that generated by the current COVID-19 pandemic, or any other similar pandemic that could occur in the future.

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