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Review article

Effects on children and adolescents' lifestyles after COVID-19 lockdown: A systematic review

[*Efectos en los estilos de vida de los niños y adolescentes después del confinamiento producido por el COVID-19: Revisión sistemática*]

[*Efeitos no estilo de vida de crianças e adolescentes após o confinamento devido à COVID-19: uma revisão sistemática*]

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ABSTRACT

Introduction: The lockdown measures caused by Covid-19 produced major changes in the lifestyles of children and adolescents.

Objective: To understand the effects of confinement following the COVID-19 pandemic on the lifestyles of children and adolescents related to physical activity levels, fitness, eating habits, sleep patterns, and psychological factors.

Materials and methods: A systematic review was carried out following the guidelines established by *Preferred Reporting Items for Systematic Reviews and Meta- Analyses* (PRISMA). The electronic databases Medline, SportDiscus , Web of Science , Dialnet, and Scopus . The search terms used were Physical Activity, COVID-19, Adolescents or Children, and Post-Pandemic. A total of 17 studies published between 2020 and 2024 were selected.

Results and conclusions: The studies analyzed indicated a negative effect of confinement on health-related lifestyles, a decrease in physical activity levels, a deterioration in some physical activity skills, and a greater dependence on devices, among others, even months after confinement in children and adolescents.

Keywords: physical activity, COVID-19, children, adolescents, post-pandemic.

RESUMEN

Introducción: las medidas de confinamiento provocadas por el Covid-19 produjeron grandes cambios en el estilo de vida de niños y adolescentes.

Objetivo: conocer los efectos del confinamiento tras la pandemia producida por COVID-19 en los estilos de vida de niños y adolescentes relacionados con los niveles de actividad física, la condición física, los hábitos alimenticios, los patrones de sueño y los factores psicológicos.

Materiales y métodos: se llevó a cabo una revisión sistemática atendiendo las directrices establecidas por *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA). Se utilizaron las bases de datos electrónicas Medline, SportDiscus, Web of Science, Dialnet y Scopus. Se utilizaron los términos de búsqueda, Actividad Física, COVID-19, Adolescentes o Niños y Postpandemia. Se seleccionaron un total de 17 estudios de publicados entre los años 2020 y 2024.

Resultados y conclusiones: los trabajos analizados indicaron un efecto negativo, una disminución en los niveles de actividad física, un deterioro de algunas aptitudes de la actividad física y una mayor dependencia a los dispositivos entre otros, del

confinamiento en los estilos de vida relacionados con la salud incluso meses después del confinamiento en niños y adolescentes.

Palabras clave: actividad física, COVID-19, niños, adolescentes, postpandemia.

RESUMO

Introdução: As medidas de lockdown causadas pela COVID-19 produziram mudanças significativas no estilo de vida de crianças e adolescentes.

Objetivo: Compreender os efeitos do lockdown após a pandemia de COVID-19 no estilo de vida de crianças e adolescentes, relacionados aos níveis de atividade física, aptidão física, hábitos alimentares, padrões de sono e fatores psicológicos.

Materiais e métodos: Uma revisão sistemática foi conduzida seguindo as diretrizes estabelecidas pelo Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Foram utilizadas as bases de dados eletrônicas Medline, SportDiscus, Web of Science, Dialnet e Scopus. Foram utilizados os termos de busca Atividade Física, COVID-19, Adolescentes ou Crianças e Pós-pandemia. Foram selecionados 17 estudos publicados entre 2020 e 2024.

Resultados e conclusões: Os estudos analisados indicaram um efeito negativo do lockdown nos estilos de vida relacionados à saúde, diminuição dos níveis de atividade física, deterioração de algumas habilidades de atividade física e aumento da dependência de dispositivos, entre outros, mesmo meses após o lockdown em crianças e adolescentes.

Palavras-chave: atividade física, COVID-19, crianças, adolescentes, pós-pandemia

INTRODUCTION

The COVID-19 pandemic has changed people's lifestyles worldwide. This situation affects daily habits related to physical activity levels, diet, sleep habits, and screen use, among others (Miranda-Contreras *et al.,* 2023).

Governments in different countries around the world began to implement strict containment measures with the aim of preventing the spread of the virus (Di Nucci *et al.,* 2022; Lai The introduction of lockdown measures and physical and social distancing, along with school closures and mobility restrictions, profoundly altered the daily routines of children and adolescents (Di Renzo *et al.,* 2020; Magaz -González *et al., 2022*), with a significant impact on daily movement, directly affecting physical and psychological health (Di Nucci *et al.,* 2022; Brooks *et al.,* 2020).

Different scientific studies have documented notable changes in the levels of physical activity, diet, sleeping habits and lifestyles of children and adolescents (Chaabane *et al.,* 2021; Magaz -González *et al.,* 2022; Teixeira *et al.,* 2021; Wingerson *et al.,* 2023).

In terms of physical activity, scientific evidence suggests a widespread decrease in physical activity levels among children and adolescents during the pandemic (Neville *et al.,* 2022; Rodríguez-Núñez *et al.,* 2022). A longitudinal study evaluating over 3,000 adolescents found that physical inactivity increased significantly during the first months of confinement (Kiss *et al.,* 2021). This decline in physical activity is largely attributed to the reduction in structured physical activity, such as physical education classes in schools and recreational and organized sports activities, as well as an increase in screen time and sedentary behaviors (López-Iracheta *et al.,* 2024; Tapia-Serrano *et al.,* 2022).

Regarding eating habits, changes in eating patterns have also been observed in children and adolescents. The adoption of these behaviors has negative consequences for the health and well-being of this group. One of the most notable effects has been the increase in the consumption of provocado ultra-processed foods rich in sugars and fats (Surekha Several studies have shown that pandemic-induced stress and anxiety, coupled with

increased time at home, led to an increase in the consumption of unhealthy foods such as snacks and fast food (Adams *et al.,* 2020; Jansen *et al., 2021* ; Ruíz-Roso *et al.,* 2020). This change in diet is associated with an increased risk of obesity, metabolic diseases, and other conditions that can have long-term consequences for the health of young people (Brambilla *et al.,* 2022). In addition, the lockdown has impacted the availability and access to fresh and nutritious foods. Supply chain disruptions and economic hardship have limited many families' ability to purchase fruits, vegetables, and other healthy foods (Paslakis *et al.* , 2022). *et al.,* 2021).

With school closures and the transition to online learning, many children and adolescents have lost access to balanced school meals, which are often a crucial source of nutrition. Furthermore, the lack of daily school meal routines has contributed to irregular eating patterns, such as an increase in meals and snacks outside of regular schedules (Saals *et al.,* 2022). This shift to online education has also led to an increase in the time spent using screens. This results in the adoption of more sedentary behaviors and a reduction in social interactions, aspects that can put the social and emotional development of children and adolescents at risk, with the possibility of sleep disorders (Mangué *et al.,* 2020; Pardhan *et al.,* 2022).

It's worth mentioning that online education isn't the only factor that has contributed to the growing use of screens. Recent research has shown an increase in screen time during the pandemic (Çakıroğlu *et al.,* 2021; Nilsson *et al.,* 2022). To this fact, it is necessary to add the frequency with which social networks have been used during confinement, resulting in the addiction generated by their use (Alimoradi *et al.,* 2022; Luo *et al.,* 2021).

Changes in young people's daily routines have also had a considerable impact on their sleep habits (Bruni *et al.,* 2021). Delayed bedtimes and decreased sleep quality are risk factors experienced during the pandemic, with a negative effect on the emotional development and mental health of children and adolescents (Panchal et al., 2021). *et al.,* 2023).

Regarding emotional state, it has been observed that the lockdown period has had a notable impact on anxiety levels and the manifestation of irritable behavior in young people (Pizarro-Ruiz and Ordóñez- Clambor , 2021). These authors determined that it is not possible to specify the long-term effects that may be triggered as a result of this situation. Likewise, the increase in stress, social isolation, and low self-esteem has also contributed to young people being more vulnerable during the pandemic (Vicario-Molina *et al.,* 2023).

Considering the effects of confinement on children and adolescents, a systematic review is needed to analyze the consequences after the confinement period on changes in physical activity levels, physical fitness, eating habits, sleep patterns, and psychological factors.

This systematic review was conducted following the guidelines established by *Preferred Reporting Items for Systematic Reviews and Meta- Analyses* (PRISMA) (Page *et al.,* 2021).

The electronic databases Medline, SportDiscus , Web of Science , Dialnet , and Scopus . The search was conducted between March and May 2024. The search terms physical activity, Covid-19, adolescents or children, and post-pandemic were used, as well as combinations of these terms and their synonyms. The search was conducted in both Spanish and English. The Boolean operators used in the search strategy were "OR" and/or "AND" and "NOT." In addition, the asterisk " * " was used at the end of some of the terms to find variations of these terms. The search strategy is described below . complete :

(Physical Activity OR Physical Exercise) AND (Covid 19 OR Coronavirus OR SarsCOV19) AND (Child* OR Teen* OR Adolesc *) AND (Post Pandemic OR After Pandemic) NOT (Obesity) NOT (During Pandemic).

In addition, a manual search of the scientific articles found in the reference section of the included articles was performed to obtain additional relevant information.

Inclusion and exclusion criteria:

The articles included in this review were original studies published in peer-reviewed journals. The following inclusion criteria were applied: (i) objective: scientific articles containing data related to lifestyle, diet and/or physical activity levels in children or adolescents after the pandemic; (ii) study time: articles published between 2020 and 2024; (iii) sample: children or adolescents aged 8–17 years; (iv) methodology: cross-sectional, longitudinal, narrative or systematic reviews.

The exclusion criteria were (i) language: articles not written in Spanish, English, Portuguese, or Galician; (ii) objective: works with objectives other than those of the present review; (iii) sample: children or adolescents with illnesses or disabilities; (iv)

Selecting sources of evidence

The selection process, following the application of the inclusion and exclusion criteria, yielded a total of 17 records. Figure 1 shows the PRISMA 2020 flowchart describing the search process and reasons for exclusion in this review.

The three authors (BMS, EJVC, and AMV) first independently reviewed all titles and abstracts. Disagreements were then discussed, and the selection was jointly reviewed. Each author reviewed one-third of the full-text articles assessed for eligibility, then jointly reviewed them, resolving any disagreements through discussion and consensus.

Quality assessment, data analysis and synthesis

All included articles were extracted under a structured framework in which they were classified: study design, sample size, participant selection, measurements, key findings, limitations and implications (Figure 1).

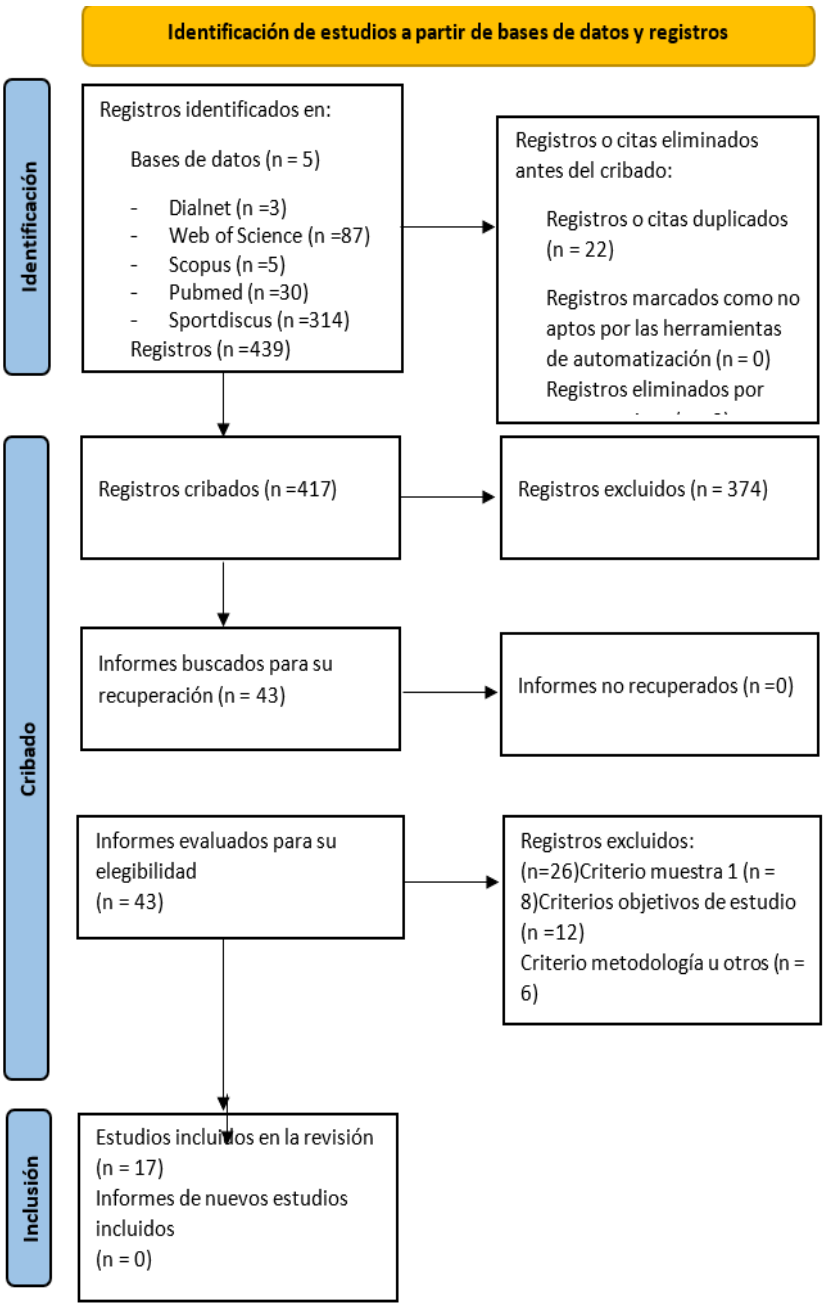

Fig. 1. - *PRISMA 2020 flowchart*

DEVELOPMENT

Seventeen scientific articles were selected, the main results of which focused on the effects of lockdown on variables related to physical fitness and activity levels, diet, psychological factors, screen use, and sleep.

Of the total number of studies analyzed, 16 of them focused on the effects on physical condition, anthropometric data and levels of physical activity (Béghin *et al.,* 2022; Bustos-Arriagada *et al.,* 2021; Carcamo -Oyarzun *et al.,* 2023; Carriedo *et al.,* 2022; Drenowatz *et al.,* 2023; Gómez Sagasti and Barrutia Sarasua, 2022; Hnízdil *et al.,* 2022; Horii *et al.,* 2023; Jang *et al.,* 2023; Lin *et al.,* 2024; Mahfouz *et al.,* 2023; Martínez -Córcoles *et al.,* 2022; Paterson *et al.,* 2021; salway *et al.,* 2022; Tapia-Serrano *et al.,* 2022; Walker *et al.,* 2023). Regarding the studies that analyzed eating-related behaviors, a total of three articles were found (Bustos-Arriagada *et al.,* 2021; Di Nucci *et al.,* 2022; Gómez Sagasti and Barrutia Sarasua, 2022). On the other hand, five articles focused on the study of other psychological factors after confinement (Gómez Sagasti and Barrutia Sarasua, 2022; Jang *et al.,* 2023; Lin *et al.,* 2024; Mahfouz *et al.,* 2023; Walker *et al.,* 2023). Finally, four articles focused on analyzing the results of these effects on screen use and sleep habits (Bustos-Arriagada *et al.,* 2021; Gómez Sagasti and Barrutia Sarasua, 2022; Paterson *et al.,* 2021; Tapia-Serrano et al., 2022; Walker *et al.,* 2023).

Table 1 shows the most relevant results of each of the studies analyzed (Table 1).

Table 1. *- Effects of confinement on different variables related to lifestyle habits in children and adolescents.*

REFERENCE	AIM	SAMPLE	METHODOLOGY	RESULTS AND CONCLUSIONS
Béghin et al. (2022).	To assess the impact of lockdown on the fitness levels of French adolescents.	Students (n=1231). Before lockdown, 532 (318 boys, 214 girls) and after lockdown, 699	Anthropometric characteristics and physical condition were measured. Cross-sectional design.	NS changes in body composition. Physical Condition: ↓($p<0.05$) fitness levels in both sexes between before and after confinement, except

		(325 boys, 374 girls).	Two independent groups of students were compared (before and after confinement) They measured each other. - anthropometric data - Physical fitness test.	cardiorespiratory fitness (boys) and flexibility (girls). ↓: overall level of physical fitness between pre- and post-confinement samples for boys (−9.8%; $p < 0.01$) and girls (−16.2%; $p < 0.01$), respectively. ↓ ($p<0.05$) overall fitness score, boys (−9.8%, $p < 0.01$) and girls (−16.2%; $p < 0.01$). The greatest difference in the body speed displacement test (−30%) in boys was 12.8% and in girls 25%. The capacity that changed the least was cardiorespiratory fitness (−4.2%). The smallest difference in girls was in cardiorespiratory fitness (−4.8%); and in boys, in upper limb muscle strength and endurance (−3.9%).
Bustos-Arriagada et al. (2021).	To understand the effects of COVID-19 on the eating behavior and lifestyles of children and adolescents one year after the lockdown in Chile.	Families (n=1083) of students aged between 2 and 18 years old in Chile.	Cross-sectional quantitative study. Questionnaire It was measured: -physical activity -screen time —-socio-demographic variables -eating habits	**Compliance with healthy lifestyle recommendations** : Less than 70%, except for "eat breakfast every day" and "sleep hours" in children and adolescents. Higher adherence to healthy behaviors in preschoolers compared to school-age children and adolescents ($p<0.05$). **Sleep hours:** ↑ ($p<0.05$) in adolescents. **Eating habits:** Greater compliance in all age groups: "Eat breakfast daily" (89.2%), "eat at

				night" (69.9%) and "do not eat fast food" (66%). Compliance less than 50%: Intake of dairy products (28.6%), fruits (44.8%), vegetables (46.9%), fish (21.2%) and legumes (31.7%). **Screen Time and Physical Activity Guidelines** : **Physical activity:** ↑ ($p<0.05$) in preschoolers. **Screen time:** ↑ ($p<0.05$) in schoolchildren. **Healthy lifestyle:** 23.4% AF and a healthy lifestyle, similar proportions in both sexes.
Carcamo - Oyarzun et al. (2023).	To analyze the secular effects of COVID-19 lockdown measures on the actual motor competence (AMC) and perceived motor competence (PMC) of Chilean students.	Schools (n=9), students (n=523), 46.8%, girls, age (11.11 ±0.66) in Chile. Pre-lockdown cohort n=265. Post-lockdown cohort n=258. All schools are considered highly vulnerable.	Quantitative with a sequential cohort design. Pre-lockdown cohort in the 2018-2019 academic year Post-confinement cohort started in 2022. Motor competence was measured: -MOBAK 5-6 Test, consisting of analyzing the eight motor tasks of the test (items of object control and self-movement). And perceived motor competence: -SEMOK questionnaire, perception of motor competence of the eight items aligned with the MOBAK 5-6 test.	**Object control: Similar values between the** pre- and post-lockdown NS cohorts . BMI ↑ and gender ↑ significantly, but not age. **Self-Movement Domain :** Greater motor competence pre-lockdown vs. post-lockdown . Significant effect of the covariates age ↑ and BMI ↑, but not of sex ($p = 0.066$). **Object control:** Similar values between pre- and post-confinement (NS). Significant effect of BMI ↑ and sex ↑, but not of age. **Self-movement :** Lower values in post-confinement compared to pre-confinement .

				Significant effect of the covariates sex ↑ and BMI ↑, but not of age.
Carriedo et al. (2022).	To analyze changes in physical activity between the start of the first academic year after a lockdown and the start of the second academic year after the "new normal" lockdown in a cohort of adolescents living in a rural population in Spain.	Secondary school students (n=687), 375 men and 312 women, aged between 11 and 19 years (15.35±1.77) in Spain.	Intrasubject quantitative . It was measured: -Physical activity levels -physical form -socio-demographic information Two measurement points (T1 and T2). T1: Start of the first academic year after a lockdown (November 2020). T2: Start of the second academic year post-confinement (November 2021). EuroFit Fitness Tests . Sociodemographic Questionnaire and Physical Activity	**Changes in physical activity levels:** Vigorous physical activity and resting metabolic rate: Significantly reduced. Moderate and low physical activity: Remained stable. **Evolution of physical fitness:** Components of physical fitness: ↑ significant. **Gender differences:** Men: Scored significantly higher than women in all tests except flexibility at both T1 and T2. **Impact of social distancing measures:** Moderate to vigorous physical activity: significantly ↑. **Fitness capabilities:** ↑ significantly **Explanatory factors:** Membership of a sports club and commitment to training, muscle strength and cardiovascular fitness. Mitigation of negative effects: Membership in a sports club and vigorous physical activity.
Di Nucci et al. (2022).	To assess whether lifestyle and eating habits changes resulting from COVID-19 have influenced the post-pandemic	Students (n=106), aged 2 to 11 in Italy.	Retrospective study. Self-administered questionnaire The following were measured: -eating habits	Selective food rejection did not change during the pandemic period (97%). 70% of participants did not change their eating habits, and some subgroups reported a ↑ in the consumption of

	level of food neophobia in children living in a central Italian region.		-lifestyle indicators -food neophobia: Children's Food Neophobia Scale (CFNS).	fruits (22.2%), vegetables (19.2%) and legumes (21.2%). Sedentary behavior increased from 25.3% to 70.7% during the pandemic. Neophobia was not associated with weight status (p=0.5), high prevalence of intermediate level neophobia in children with normal weight (78.4%). 39.4% of children participated in meal preparation during lockdown. There was a ↑ in the proportion of children who shared all meals with their family (32.3% vs. 78.8%). Non-coercive parental behaviors in reaction to food rejection were associated with low levels of neophobia (p < 0.05).
Drenowatz et al. (2023).	To explore differences in children's physical fitness development following movement restrictions implemented to mitigate the spread of COVID-19 in Austria.	Schools (n=200), students (n=24,571) aged 6-11 in Austria . Before confinement (n=18,168) and after confinement (n=6,403).	State Project "How fit is you ?" Quantitative with sequential cohort design. The following were measured: -Physical fitness (muscle power, speed, agility, cardiorespiratory endurance, flexibility and object control) -Body Mass Index	-The BMI percentile ↑ significantly in post-pregnancy boys, with a more pronounced ↑ in girls. -Cardiorespiratory endurance, agility and flexibility: significantly ↓ compared to the years prior to restrictions. -Linear speed and ball handling skills: ↓ already visible before the implementation of COVID-19 policies. -Absolute strength (medicine ball push): significantly ↑

				compared to previous years. Sex differences: Cardiorespiratory endurance and agility: ↓ comparable in boys and girls. Muscle power: ↓ consistently only in girls. Flexibility: Consistently ↓ in children only after COVID-19 compared to years prior to the implementation of COVID-19 policies.
Gómez Sagasti and Barrutia Sarasua (2022).	To study the evolution of students' conceptions of "health" and "illness" before and nine months after the declaration of the COVID-19 pandemic.	Students (n=12) 33.3%, girls, 8-9 years old in Spain. Before confinement and after confinement.	Exploratory-descriptive qualitative. Mixed method (questionnaire and drawing) The following were measured: -ideas about health -ideas about the disease	**Concept of health:** Before confinement: something exclusively physical (44%) and with an existential concept (25%), ignoring determinants of health as important as the environment. After confinement: Health as absence of disease (50%) and exclusively physical condition (40%). **Healthy habits:** related to diet (38%), physical activity (24%) and oral and hand hygiene (24%) at both times. **Unhealthy habits:** related to diet (57% before confinement, 36% after) and lack of physical activity (32% after confinement). **Drawings after confinement:** More happy faces (+17%) and from abroad (+8%). **Physical changes:** Body fat decreased by

				64.23%. BMI decreased by 10.91%. Significant decrease in endurance running by 14.6%. Significant decrease in flexibility test by 250%. Physical performance: Standing long jump and shuttle run: Absolute improvements. Abdominal test: Performance did not change significantly.
Hnízdil et al. (2022).	To describe specific changes in performance and body composition following long-term mobility restrictions due to COVID-19 in young school-aged children in the Czech Republic.	First grade students (n = 52). Before and after confinement.	Longitudinal study in an identical group. The following were measured: -physical performance -anthropometric measurements	↑ (p>0.05) body fat by 64.23% ↑ (p>0.05) BMI values of 10.91% ↓ (p < 0.05) endurance running by 14.6% ↓ (p < 0.05) flexibility by 250% ↑ (p>0.05) absolute performance for the long jump and cardiorespiratory capacity (around the average of the population in the given category). ↑ (p>0.05) sit-up test (below the average of the population in the given category).
Horii et al. (2023).	To investigate the incidence of knee pain and changes in physical activity after the spread of COVID-19 among elementary and middle school students in Japan.	Schools (n=399), students (n=1767) 49.8%, girls, 8-14 years old in Japan. Before confinement n=886 and after confinement n=881.	Prospective cohort study. Self-reported questionnaires at the end of each month The following were measured: -knee pain -physical activity	↑ (p < 0.05) prevalence of knee pain after confinement ↓ (p < 0.05) physical activity after confinement ↓ (p < 0.05) physical activity and prevalence of knee pain in the fourteen years after confinement.

Jang et al. (2023).	To examine the association between changes in depressive mood after the COVID-19 pandemic and physical activity among South Korean adolescents.	Stratified cluster random sampling. Schools (n=399), students (n=54848), 48.3%, girls aged 11-18 in South Korea.	Descriptive quantitative. The following were measured: -health behavior -sociodemographic information -physical activity -emotional state	Improving health through physical activity may be a protective factor against depressed mood. Associations between changes in depressed mood and physical activity of ≥60 min or vigorous-intensity physical activity. ↓ ($p < 0.05$) depressed mood after confinement in relation to muscle strengthening exercises (after adjusting for pre-existing depression). ($p>0.05$) aerobic exercise was not related to changes in depression in adolescents
Lin et al. (2024).	To examine the association between physical activity and interpersonal adjustment in adolescents through self-esteem and psychological resilience after the coronavirus pandemic.	Students (n=542) 55.35% girls aged 13-18 in China.	Descriptive quantitative. Validated questionnaires. The following were measured: -physical activity -self-esteem -resilience -interpersonal adaptation	Positive correlation ($p < 0.05$) physical activity with self-esteem Positive correlation ($p < 0.05$) between psychological resilience and interpersonal adaptation. Indirect effect ($p < 0.05$) of physical activity on interpersonal adaptation, through the serial mediating roles of self-esteem and psychological resilience (physical activity may improve levels of interpersonal adaptation indirectly through self-esteem and psychological resilience).

Mahfouz et al. (2023).	To assess students' physical activity, mental health, and quality of life after two years of distance learning in Saudi Arabia.	Students (n=642) 41.12% girls aged 17-18 in Saudi Arabia.	Descriptive quantitative. Cross-sectional observational survey. The following were measured: -pediatric quality of life -depression, anxiety and stress scales -physical activity	Moderate level of physical activity ↓ HRQoL Symptoms of mental health problems ($p < 0.05$) Pediatric Quality of Life (81.4 ± 16.4 for sex, age groups and grade levels Negative correlation ($p>0.05$) between general quality of life and mental health domains. Negative correlation ($p>0.05$) between sport and symptoms of mental illness. Positive correlation ($p < 0.05$) between sport and pediatric quality of life. Positive regression model ($p < 0.05$) stress was a predictor for the quality of life of adolescents of both sexes
Martínez-Córcoles et al. (2022).	To analyze balance performance after the COVID-19-induced quarantine, considering the type of sport practiced by Spanish children.	Schools (n=2), students (n=150) 54% girls 10.02 ± 1.15 years in Spain. Before confinement and after confinement.	Observational and longitudinal study. The following were measured: -low postural control under different balance conditions -physical activity -type of footprint	↓ ($p < 0.05$) equilibrium after quarantine. ($p>0.05$) postural control was not influenced by the type of sport practiced, nor by the surface on which the test was performed. ↓ ($p>0.05$) balance among those who practiced intense or moderate physical activity before quarantine ↓ ($p>0.05$) results for physically active

				people than for inactive people ↓ ($p < 0.05$) balance in children who performed high and moderate physical activity
Paterson et al. (2021).	To investigate the relationships between the pandemic and movement behaviors (physical activity, sedentary behavior, and sleep) in school-aged children and young adults during the first year of the COVID-19 outbreak.	Systematic review. Students between 5 and 17 years old.	Systematic Review: Articles were included that examined: -physical activity -sedentary behavior -screen time -dream	↓ ($p>0.05$) frequency and duration of physical activity ↑ ($p>0.05$) sedentary behaviors ↑ ($p<0.05$): recreational and school use of digital technology and screens. ↓ ($p>0.05$) duration and quality of sleep
Salway et al. (2022).	To understand the activity level of children in the United Kingdom after lockdown restrictions were lifted.	Schools (n=50), students (n=1689) aged 10-11 and their families in the UK. Before confinement n=1296 and after confinement n=393.	Active-6 Project. Cross-sectional design. Two independent groups of students. (before and after confinement) Accelerometer and comparison using multilevel linear models. The following were measured: -average minutes of physical activity	**Students:** ↓ ($p>0.05$) MVPA on weekdays and weekends in 2021 post-COVID than in 2018 before the pandemic (7.7 min = 95% CI: 3.5 to 11.9 and 6.9 min = 95% CI: 0.9 to 12.9). ↓ ($p>0.05$) MVPA on weekdays and weekends in 2021 post-COVID than in 2018 pre-pandemic (7 and 8 minutes per day). ↑ ($p>0.05$) Sedentary time in 2021 post COVID than in 2018, before the pandemic (25.4 min = 95% CI: 15.8 to 35.0 and 14.0 min = 95% CI: 1.5 to 26.5). = Gender and home education.

				Families: ↓ (p>0.05) MVPA on weekdays and weekends in 2021 post-COVID than in 2018 pre-pandemic (7 and 8 minutes per day). = MVPA = sedentary time
Tapia-Serrano et al. (2022).	To examine changes in movement behaviors (physical activity, screen time, and sleep duration) and academic performance before and after 1 year of COVID-19.	Students (n=844) 42.7% girls from 11-12 to 16-17 years old. Before confinement n=343 and after confinement n=501.	Cross-sectional design. Two independent groups of students. (before and after confinement) Valid and reliable questionnaire. They measured each other. -sociodemographic data -Physical activity levels - Recreational screen time - sleep duration - Academic performance -anthropometry	1) 24-hour movement behaviors appear to have worsened among young people 1 year after the Covid-19 pandemic compared to pre-pandemic; 2) Compliance with the three 24-hour Movement Guidelines appears to be significantly lower among Spanish adolescents 1 year after the Covid-19 pandemic, especially for sleep duration recommendations. 3) The positive relationship between physical activity and academic performance appears to have disappeared 1 year after the Covid-19 pandemic. (4) The non-significant relationship between recreational screen time and academic performance and the positive relationship between sleep duration and academic performance do not appear to have changed 1 year after Covid-19.
Walker et al. (2023).	To analyze children's physical activity patterns in the United Kingdom	Families (n = 22), school staff (n = 9) and six focus groups with children	Part of the Active-6 Project. (after confinement)	Five themes emerged. Theme 1: Increased screen use within the home, while activities outside the home continued to feel less

	beyond the short-term periods following pandemic lockdowns.	in primary education aged 10 to 11 years (n = 45) in the United Kingdom.	- Qualitative (2022). -individual interviews with families (n = 22) and individual interviews with school staff (n = 9) -six focus groups of students (n = 45) They measured each other. -changes in physical activity -sedentary behavior patterns - factors that influence any change	spontaneous. Theme 2: Disrupted development of social, emotional, and physical skills among students compared to what would have been expected before the pandemic. Theme 3: Increased mental health challenges among families, which created complex barriers to students' physical activity. Theme 4: A new normal for children's physical activity was evoked and explored, with an increased reliance on structured and organized activities. Topic 5: Students with lower socioeconomic status may be especially at risk for decreased physical activity.

Note *: ↓ decrease, ↑ increase; NS not significant, PA physical activity, BMI body mass index, HRQOL health-related quality of life, MVPA moderate-vigorous physical activity, MVPA moderate-vigorous physical activity*

Physical Activity

The different studies analyzed showed that the confinement associated with the COVID-19 pandemic significantly altered the lifestyles of children and adolescents, especially in their levels of physical activity (Bustos-Arriagada et al., 2021; Horii *et al.*, 2023; Martínez -Córcoles *et al.*, 2022; Paterson *et al.*, 2021; Salway *et al.*, 2022; Tapia-Serrano *et al.*, 2022). Several of these studies showed a widespread negative impact on physical activity levels during and after lockdown in children and adolescents. Regarding physical activity guidelines, Bustos-Arriagada *et al.* (2021) observed low compliance, even one year after lockdown. Similarly, Paterson *et al.* (2021) and Tapia-Serrano *et al.* (2022) identified an overall decrease in the frequency and duration of physical activity, accompanied by an

increase in sedentary behavior and a decrease in the quantity and quality of sleep. These findings are in line with those obtained in other studies that analyzed the effects exclusively on lockdown (López-Bueno *et al.,* 2020; Moore *et al.,* 2020; Pietrobelli *et al.,* 2020) who observed that, during this period, children and adolescents reduced their levels of physical activity and increased the time spent using screens.

Regarding the intensity of physical activity performed, a study conducted in the United Kingdom highlighted that, even after confinement restrictions, moderate to vigorous physical activity in children decreased significantly compared to pre-pandemic levels (Salway *et al.,* 2022). In addition, sedentary time increased considerably, possibly influenced by limitations in participation in organized activities (Walker *et al.,* 2023). Likewise, Carriedo *et al.* (2022) highlighted that sports club membership and vigorous physical activity played a crucial role in mitigating the negative effects of social distancing on the physical fitness of Spanish adolescents. On the other hand, Martínez-Córcoles *et al.* (2022) reported greater impairment in balance in children who engaged in moderate or intense physical activity before quarantine, which could be attributed to the disruption of regular sports activities. These findings have already been demonstrated in studies analyzing the confinement period (Dunton *et al.,* 2020) who reported a decrease in high-intensity physical activity and an increase in sedentary behavior during the pandemic. In this sense, Oñate Navarrete *et al.* (2023) found that participation in organized sports activities before the lockdown, such as membership in sports clubs, was positively associated with higher levels of moderate-to-vigorous intensity physical activity during confinement. On the other hand, in relation to the negative effects of a sedentary lifestyle, the study by Horii *et al.* (2023) observed a reduction in the incidence of physical activity and an increase in knee pain in Japanese children after lockdown, highlighting the physical implications of prolonged inactivity.

The established relationship between health perception and the lifestyle habits of Spanish children in primary education is noteworthy. Gómez Sagasti and Barrutia Sarasua (2022) demonstrated that, after the pandemic, the perception of lack of physical activity as an unhealthy habit increased. This change suggests greater awareness of the

importance of physical exercise for health, possibly influenced by the restrictions of confinement and its impact on daily routines. These results align with other studies that have associated physical activity with better mental health and quality of life in students (Jang *et al.,* 2023; Lin *et al.,* 2024; Mahfouz García *et al. (* 2024), in line with what has already been established in the literature, recently demonstrated the inversely proportional relationship between physical activity and anxiety and stress.

According to Walker *et al.* (2023), the socioeconomic environment during lockdown also had an impact on the decrease in physical activity. Along these lines, linked to educational level, Casado *et al.* (2009) found that young people whose parents had higher levels of education practiced more physical activity than those whose parents had lower levels of education.

Physical condition

Prolonged restrictions led to a significant deterioration in the physical condition of children and adolescents (Béghin *et al.,* 2022; Carcamo -Oyarzun *et al.,* 2023; Drenowatz *et al.,* 2023; Hnízdil *et al.,* 2022; Martínez -Córcoles *et al., 2022). In* Béghin 's study *et al.* (2022) reported a significant decline in the physical fitness of French adolescents four months after lockdown, especially in walking speed. Similarly, Drenowatz *et al.* (2023) identified significant decreases in cardiorespiratory endurance, agility, and flexibility in Austrian children three months after restrictions. These changes reinforce the relationship between sedentary time and physical decline, as indicated by Caracuel Cáliz *et al.* (2024).

Martínez- Córcoles *et al.* (2022) analyzed balance performance in Spanish children after lockdown and found a significant decline, suggesting a need for recovery in specific motor skills. Additional research by García-Tascón *et al.* (2024) supports the hypothesis that the lack of dynamic physical activities during lockdown contributed to the deterioration of postural control. Carcamo -Oyarzun *et al.* (2023) despite the observation of some stability in the domains of object control and self-movement, the analysis of variance indicated that the perception of motor competence was lower after lockdown.

This may be explained by the lack of social interactions and opportunities for group physical activities, which are essential for the development of motor skills, as suggested by Burgos Angulo *et al.* (2023).

In contrast, some of the studies analyzed found improvements in certain physical abilities. For example, Carriedo *et al.* (2022) found that upper body power, muscular endurance, and hand-eye coordination significantly increased at the beginning of the second year after lockdown. Similarly, Hnízdil *et al.* (2022) reported absolute improvements in long jump performance and cardiorespiratory fitness. In line with these results, García-Tascón *et al.* (2021) established that certain types of physical activity benefited from adaptations even under conditions of prolonged restrictions. These improvements could be explained, in part, by the natural increase in physical capacities associated with growth and maturation during childhood and adolescence, which is supported by Armstrong and Van Mechelen (2023).

Feeding

Regarding nutrition, Bustos-Arriagada *et al.* (2021) identified an improvement in specific habits such as eating breakfast daily and a reduction in fast food consumption among Chilean children and adolescents after the lockdown. However, less than half of those surveyed reported consuming healthy foods such as dairy products, fruits, vegetables, fish, and legumes. Likewise, Di Nucci *et al.* (2022) found that greater participation in food preparation and increased family meals after lockdown favored vegetable consumption and mitigated food rejection. This trend aligns with research suggesting that children's active participation in cooking reinforces the acceptance of healthy foods (James *et al.*, 2021).

On the other hand, Gómez Sagasti and Barrutia Sarasua (2022) documented an evolution in children's perceptions of health and illness before and after confinement, observing a stronger relationship between eating habits and unhealthy habits. This change may reflect a greater understanding of other factors that affect health, such as physical activity, which also gained relevance and has been analyzed in the first section of this

discussion. Along these lines, Reyes Ramos and Meza Jiménez (2021) established that prolonged exposure to familiar environments during confinement allowed for greater reflection on issues related to health and well-being, which could have contributed to a positive change in children's perceptions of healthy habits. Di Nucci *et al.* (2022) observed increased frequency of family meals and participation in cooking, stating that these could be viable strategies for promoting healthy habits and improving family bonding. Furthermore, collaboration between parents, teachers, and health professionals in school-based programs can be crucial for generating significant and lasting changes in children's eating and physical activity habits (Gámez-Calvo *et al.,* 2022; García-Cruz *et al.,* 2024).

Regarding the variables related to body composition, Hnízdil *et al.* (2022) reported a significant increase in body fat and body mass index (BMI), accompanied by a decrease in strength and flexibility test results in children from the Czech Republic. This deterioration in body composition may be related to changes in dietary patterns and an increase in the consumption of ultra-processed foods (Pietrobelli *et al.,* 2020).

Screens

Excessive screen use was another of the most notable effects of lockdown. The studies analyzed showed a consistent trend toward increased screen time, related to changes in family, school, and social dynamics brought about by lockdown (Bustos-Arriagada *et al.,* 2021; Paterson *et al.,* 2021; Tapia-Serrano *et al.,* 2022; Walker *et al.,* 2023). In line with this increase, De Armas-Mesa *et al.* (2023) observed that screen time also increased as a psychological adaptation mechanism to cope with social isolation.

Among the results analyzed, the study by Bustos-Arriagada *et al.* (2021) revealed that compliance with guidelines on screen time and physical activity was low one year after the lockdown in Chile. This finding coincides with that reported by Paterson *et al.* (2021), who in a systematic review highlighted that, globally, pandemic restrictions significantly increased the recreational and school use of digital technology. This increase was visible across all devices and media.

Tapia-Serrano *et al.* (2022) examined changes in movement behaviors in Spanish youth, concluding that the relationship between recreational screen time and academic performance did not change significantly one year after the pandemic. These authors also observed a sustained increase in screen use, suggesting that the routines established during lockdown persisted despite the gradual reopening of activities.

Additionally, Walker *et al.* (2023) described a similar phenomenon. Their qualitative analysis indicated that habits related to increased screen use at home remained unchanged, while activities outside the home continued to be less spontaneous. This points to a lasting transformation in schoolchildren's behavioral patterns, likely linked to a greater reliance on electronic devices for both educational and recreational reasons.

Dream

The lockdown also impacted schoolchildren's sleep patterns, affecting their quality and duration (Paterson *et al.*, 2021; Tapia-Serrano *et al.*, 2022). Changes in bedtime and wake-up times, as well as increased screen time, may have contributed to these disturbances (Paterson *et al.*, 2021). Tapia-Serrano *et al.* (2022) found that, although compliance with sleep recommendations decreased, the positive relationship between sleep duration and academic performance remained stable. In line with these results, Medina-Ortiz *et al.* (2021) highlight that disruptions in daily routines and decreased physical activity may have reinforced sleep disturbances. Therefore, promoting physical activity habits can counteract the negative effects of excessive screen time on sleep patterns, according to Farias and Miranda (2021).

Psychological factors

Jang *et al.* (2023) identified that physical activity has a protective role against depressed mood in South Korean adolescents, although the specific relationship varies according to the type of exercise, with muscle strengthening exercises being the most beneficial in reducing depression. In line with this, recent studies have highlighted that regular

physical activity during and after confinement contributes significantly to adolescents' emotional resilience (Farias and Miranda, 2021).

In the context of interpersonal adaptation, the study by Lin *et al.* (2024) showed that physical activity indirectly influenced the improvement of self-esteem and psychological resilience in Chinese adolescents. The integration of physical activity programs that promote self-esteem and resilience can, therefore, play a key role in the social development of schoolchildren, especially after a period of isolation such as that experienced during the pandemic (Varea and González-Calvo, 2021).

Mahfouz 's work *et al.* (2023) observed an inverse correlation between stress levels and quality of life in Saudi schoolchildren after lockdown. Meanwhile, Walker *et al* .'s (2023) study reported disrupted development of emotional, social, and physical skills in British children, resulting in barriers to physical activity. Both studies highlight the importance of addressing mental health as an integral part of promoting physical activity in the school population. Along these lines, other studies establish that engaging in 4 to 5 hours of physical activity per week is associated with higher scores on self-esteem levels, demonstrating its psychological benefits (Franco Gallegos *et al.* 2024).

The results of the study by Gómez Sagasti and Barrutia Sarasua (2022) showed that, although conceptions of health among Spanish children evolved after confinement, they maintained a predominantly physical-focused view of health, without integrating psychological or social well-being. This finding aligns with the egocentric developmental stage typical of childhood, but also reflects a possible limitation in comprehensive health education, which does not sufficiently emphasize psychological and social components. This point underscores the need for educational programs that promote a more holistic view of health in schoolchildren (Wilcock and Hocking, 2024).

CONCLUSIONS

The COVID-19 lockdown impacted the lifestyles of children and adolescents.

Physical activity levels decreased after the lockdown, even months after the measures were relaxed for children and adolescents. Moderate-to-vigorous physical activities were the most affected, and a decline was also observed in some fitness skills such as cardiorespiratory endurance, agility, flexibility, and balance.

Improvements were found in certain eating habits, such as the incorporation of daily breakfast, a reduction in fast food consumption, and a greater acceptance of healthy foods.

After the lockdown, the increase in recreational and school screen use continued, and greater dependence on devices was observed among children and adolescents.

The lockdown and the COVID-19 pandemic led to a positive shift in children and adolescents' perceptions of health, although psychological and social well-being were not sufficiently integrated.

Study limitations

Regarding the limitations of the study, the following are noted:

- The studies included in the review have different methodologies, which makes it difficult to compare results.
- The quality of the included studies is variable, making it difficult to generalize the results.
- The number of articles selected makes it difficult to ensure representativeness and generalization of the results.
- The studies analyzed come from different countries and contexts, which influences the variety of results and the difficulty of generalization.

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The authors have participated in the writing of the work and analysis of the documents.