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Impact of lockdown and school closure on children's health and well-being during the first wave of COVID-19: a narrative review

Luis Rajmil ,[1] Anders Hjern,[2] Perran Boran,[3] Geir Gunnlaugsson,[4] Olaf Kraus de Camargo,[5] Shanti Raman ,[6,7] and on behalf of International Society for Social Pediatrics & Child Health (ISSOP) and International Network for Research on Inequalities in Child Health (INRICH) COVID-19 Working Group

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For numbered affiliations see end of article.

Correspondence to
Dr Luis Rajmil; 12455lrr@comb.cat

ABSTRACT

Background In the context of containment measures against the COVID-19 pandemic, the aims were to examine the impact of lockdown and school closures on childs' and adolescents' health and well-being and social inequalities in health.

Methods Literature review by searching five databases until November 2020. We included quantitative peer-reviewed studies reporting health and well-being outcomes in children (0–18 years) related to closure measures' impact due to COVID-19. A pair of authors assessed the risk of bias of included studies. A descriptive and narrative synthesis was carried out.

Findings Twenty-two studies, including high-income, middle-income and low-income countries, fulfilled our search criteria and were judged not to have an increased risk of bias. Studies from Australia, Spain and China showed an increase in depressive symptoms and decrease in life satisfaction. A decrease in physical activity and increase in unhealthy food consumption were shown in studies from two countries. There was a decrease in the number of visits to the emergency department in four countries, an increase in child mortality in Cameroon and a decrease by over 50% of immunisations administered in Pakistan. A significant drop of 39% in child protection medical examination referrals during 2020 compared with the previous years was found in the UK, a decrease in allegations of child abuse and neglect by almost one-third due to school closures in Florida, and an increase in the number of children with physical child abuse trauma was found in one centre in the USA.

Interpretation From available reports, pandemic school closure and lockdown have adverse effects on child health and well-being in the short and probably long term. We urge governments to take the negative public health consequences into account before adopting restrictive measures in childhood.

What is already known

- School closure and lockdown were measures initially adopted almost worldwide in the first wave to fight the COVID-19 pandemic.
- Lockdown and school closure cause disproportionate impacts on the most vulnerable populations.
- Decisions on how to apply quarantine and school closures should be based on the best available evidence.

What this study adds

- The negative impact of school closures and lockdown has been felt by children across diverse geographies, involving high and low-income settings.
- Containment measures have produced a range of adverse effects including an increase in depressive symptoms, decrease in satisfaction with life, decrease in immunisation and an increase in unhealthy lifestyle.
- Along with a decrease in emergency presentations, there was also a significant decrease in the number of child abuse and neglect allegations and child protection medical assessments.

INTRODUCTION

The global COVID-19 pandemic caused by SARS-CoV-2 is the largest since the Spanish flu pandemic in 1918, with almost 100 million confirmed cases and over two million deaths.[1] This virus impacts relatively few children in terms of severe morbidity or mortality; however, they experience heightened adversity as governments intervene with drastic social control measures.[2] Over 1.5 billion children were out of school during the first peak, and economic insecurity has affected the most vulnerable, with several potential adverse effects.[3]

Governments around the world have reacted in variable ways with strategies to mitigate the pandemic. A review on the effect of school closure in the transmission of the SARS-CoV-2 in the general population predicted that school closures alone would prevent only 2%–4% of deaths, much less than other social

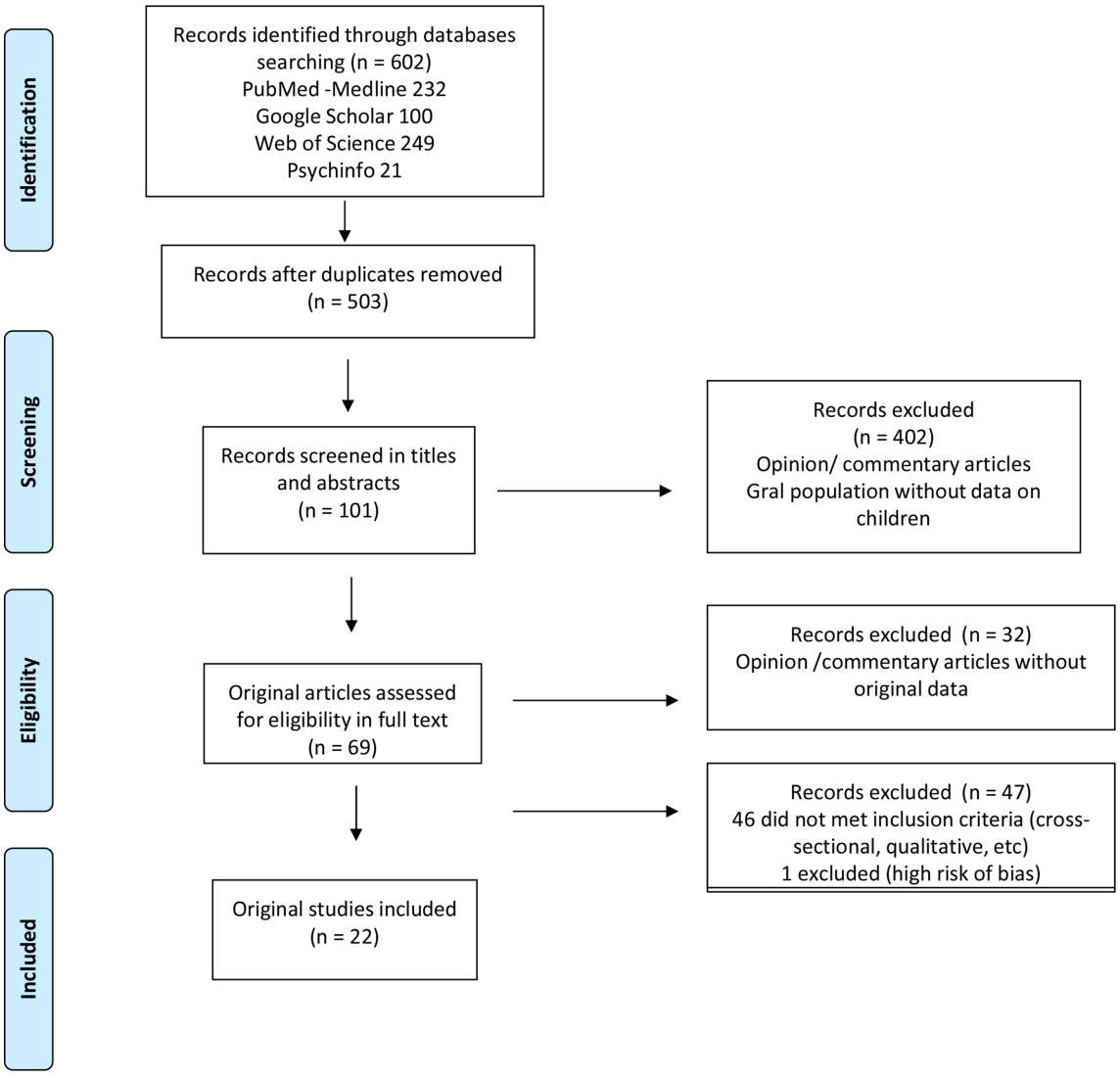

Figure 1 Sample.

distancing interventions.[4] On the other hand, school closures carry high social and economic costs for people across communities associated with interrupted learning, poor nutrition, gaps in childcare, the unintended strain on healthcare systems, rise in dropout rates from school and social isolation, among other effects.[5]

The pandemic is a universal crisis that has affected all population groups across the globe. For some children, the impact could be lifelong, particularly the most vulnerable groups and those with less economic, educational and social resources.[6] In response to school closures and depending on settings, online teaching accentuated the digital divides between those who have access and those without access.[7] Moreover, schools have health promotion potential by implementing diverse health interventions and opportunities to advocate for reforms and innovations to promote all students' health.[8] Arguments over whether to close schools or not to prevent transmission during a pandemic need to weigh in the potential health promotional benefits for children by attending school, in particular, those in vulnerable situations. This disconnect needs to be addressed with closer cooperation that would revitalise not only their educational potential but also child and adolescent health and well-being[9 10]

Large-scale 'lockdowns' as occurred with little warning in many countries, involving the complete shutting down of all economic activity, along with stringent travel bans, with punitive action for any violation, have been shown to cause

Box 1 Definitions of lockdown and school closure

- Although the term lockdown is not well defined, it is used to nominate any measure adopted to contain the pandemic employing social distancing measures.
- Lockdown measures range considerably, from mandatory total confinement in the home during prolonged periods to be only a recommendation to reduce social interactions and avoid nonessential work as much as possible.
- School closure and online classes or home schooling was the measure adopted in almost all cases during the first wave of the COVID-19 for primary and secondary schools in all included studies.

Table 1 Studies on mental health and general health

First author (journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
NR, *et al*. (J Youth Adolesc)	Australia (New South Wales)	Cohort study (Risks to Adolescent Wellbeing Project, the RAW Project)	Mental health, life satisfaction	To assess the impact of the COVID-19 pandemic on adolescents' mental health, and moderators of change, as well as assessing the factors perceived as causing the most distress.	13–16 years (response rate 53% at time T2 during lockdown, n=248)	T1=previous year (2019) T2=2 months after start lockdown) May 5 to May 14	Generalised Anxiety, Depressive symptoms, Student's Life Satisfaction Scale (SLSS)	Age, sex, schooling, peer and family relationships, social connection, media exposure, COVID-19 related stress, and adherence to government stay-at-home directives at T2	Significant increase in depressive symptoms and anxiety, and a significant decrease in life satisfaction from T1 to T2, higher among girls. Moderators were COVID-19-related worries, online learning difficulties, and increased conflict with parents as predictors of increases in mental health problems from T1 to T2. Adherence to stay-at-home and feeling socially connected during the lockdown protected against poor mental health.
Ezpeleta L, *et al*. (Int J Environ Res Public Health)[20]	Barcelona (Spain)	Cohort study (started 10 years ago)	Mental health	To assess life conditions during lockdown associated with mental health problems in children, and to analyse the mental health status of the population during the lockdown period.	226 parents (mainly mothers) answered the questionnaire (response rate 55%). Mean age=13.9 years	Lockdown March 13 to May 24. Questionnaires answered on June. Compare results with 2019	SDQ parent-proxy version	Physical environment, COVID-19 disease, the adults sharing the house, adolescents' relationships, activities, and feelings/behaviours	Total difficulties increased and peer, and prosocial, after adjusting for previous pathology. Effect size small to medium.

Continued

Table 1 Continued

First author (journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Zhang L, *et al*. (JAMA Net Open)[21]	China (Chizhou, Anhui Province)	Cohort	Mental health	To investigate psychological symptoms, nonsuicidal self-injury, and suicidal ideation, plans, and attempts among a cohort of children and adolescents	Age range 9:3–15.9. Mean age: 12.6 years fourth to eighth grades. N=1241 out of 1387 participants in two waves	Two waves: wave 1, early November 2019; and 2 weeks after school reopening (wave 2, mid-May 2020). After 3 months of lockdown, schools in Chizhou were reopened on April 26	Data on depressive and anxious symptoms (Mood and Feelings Questionnaire; MacArthur Health & Behavior Questionnaire), nonsuicidal self-injury, suicide ideation, suicide plan, and suicide attempt were collected in two waves	Adjusting for age, sex, body mass index, self-perceived household economic status, family cohesion, parental conflict, academic stress, parental educational level, family adverse life events, self-perceived health, sleep duration, and sleep disorders.	The prevalence of mental health outcomes among students in wave 2 increased significantly from levels at wave 1: depressive symptoms (24.9% vs 18.5%; adjusted OR (aOR), 1.50 (95% CI, 1.18–1.90); nonsuicidal self-injury (42.0% vs 31.8%; aOR, 1.35(95% CI, 1.17–1.55)°; suicide ideation (29.7% vs 22.5% aOR, 1.32(95%CI, 1.08–1.62); suicide plan (14.6% vs 8.7%; aOR, 1.71(95% CI, 1.31–2.24); and suicide attempt (6.4% vs 3.0% aOR, 1.74(95% CI, 1.14–2.67). No differences in anxiety symptoms.
Tromans S, *et al*. (Br J Psy Open)[23]	Leicester-UK	Electronic data register of aproximately 1 000 000 hab of the NHS	Mental health	To describe secondary mental health service utilisation prelockdown and during lockdown	Gral population. Children and adolescents' mental healthcare services (CAMHS)	January 27–March 22 compared with March 23–May 17 (lockdown)	Mental health admissions and referrals		Admissions pre-lockdown n=14; lockdown n=17, referrals pre-lockdown n=2193; lockdown n=1081.

Continued

Table 1 Continued

First author (journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Isumi A, *et al*. (Child Abuse Negl)[22]	Japan	Data on mortality by age in Japan	Suicides	To investigate the acute effect of the first wave of the COVID-19 pandemic on suicide among children and adolescents during school closure in Japan.	Total number of suicides among children<20 years	School closure March–May 2020. Compare March to May 2020 with the same data on 2018 and 2019	Suicide incidence rate ratio (IRR) by month		No change in suicide rates during the school closure (IIRR=1.15, 95% CI: 0.81 to 1.64) and no interaction with school closure.

disproportionate impact on the most vulnerable populations, for example, in India.[11] Decisions on how to apply quarantine and school closure should be based on the best available evidence. In situations where quarantine is deemed necessary, officials should quarantine individuals no longer than required, provide clear rationale for quarantine and information about protocols, and ensure sufficient supplies are provided.[12] In summary, during the fight against coronavirus in several countries, while adopting social distancing measures in order to reduce the spread of a disease that mainly causes direct harm to adults, children's needs have not been taken into due consideration.[13] For children, the risks of such measures might be greater and have a potential for short-term and long-term negative effect, mostly in low-income and middle-income countries and also in high-income countries, especially in the prenatal and in early childhood periods.[14]

At the current stage of the pandemic, it is important to summarise and compile existing information on the pandemic's impact on child health given the measures that have been taken. The aim of this narrative review is, therefore, to study the impact of COVID-19 lockdown measures and school closures on child's and adolescent's health and well-being. Our research questions were (a) What impact do lockdowns and closure of schools have on child health and well-being? and (b) to what extent do the effects of confinement increase social inequalities in child health?

METHODS

A literature review was carried out by search in PubMed, Medline, Psychinfo, Web of Science and Google Scholar, using the following terms: '(Lockdown OR School closure) AND (COVID-19 OR SARS-CoV-2) AND (children OR adolescent) AND (secondary effects OR physical OR mental)'. Secondary hand search also was done. The time period analysed was 1 December 2019 until 24 November 2020.

The research questions followed the Population Intervention Comparison Outcome tool[15]: p=0–18 years, I=school closures and/or lockdown due to COVID-19; C=a comparison group—could be compared with same population before or unexposed population as control, O=physical, developmental or mental health, psychosocial (would include child maltreatment, domestic violence, violence etc), access and use of healthcare services.

The Preferred Reporting Items of Systematic reviews Meta-Analyses (http://www.prisma-statement.org/) guideline was followed, although some items were not applicable given the characteristics of included studies.

The risk of bias of each included study was assessed by a pair of authors (PB, AH, LR) using the Mixed Methods Appraisal Tool[16] and was further stratified as low, intermediate or high risk by consensus of each pair of authors. In the first step, the risk of bias of each study was independently assessed, and in the second step, a consensus was achieved according to the number and characteristics of negative scores.

Table 2 Studies on physical activity/obesity studies

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown/ school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Zenic N, *et al*. (Appl Sci)[24]	Croatia	Follow-up	Physical activity (PA)	To evaluate the changes in PAL and factors associated with PALs	N=823; Mean age=16.5 years	'Social distancing measures': March 15. T1: October 2019 to March 2020 and T2 April 2020	Anthropometrics, physical fitness status, and evaluation of PALs (Physical Activity Questionnaire for Adolescents, PAQA) evaluated by an internet application	Urban vs rural	A decrease in PAL for the total sample (from 2.97 to 2.63, p<0.01) and mainly in urban adolescents (from 3.11 to 2.68, p<0.001). Significant differences between adolescents living in urban and rural environments were observed for baseline-PAL.
Gilic B, *et al*. (Child (Basel)[25]	Bosnia and Herzegovina	Follow-up pre and during pandemic	PAL	Changes in PAL among adolescents from Bosnia and Herzegovina and to evaluate sociodemographic and parental/familial factors, which may influence PAL before and during the COVID-19 pandemic and imposed lockdown.	N=688 adolescents (322 females), mean age 17 years at the baseline (15–18 years), attending high school. N=794 baseline F-up=695	Baseline January 6–12 Lockdown March 16 Follow-up April 20–26	The Physical Activity Questionnaire for Adolescents	Parental education level, income level, family conflicts	50% of adolescents underwent su fficient PAL at baseline, while only 24% of them were achieving suffi cient PAL at the time of follow-up measurement. Paternal level of education was associated to PAL during lockdown (OR: 1.33, 95% CI: 1.19 to 2.01).

Continued

Table 2 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown/ school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Pietrobelli A, *et al*. (Obesity Spring)[18]	Italy (verona)	Longitudinal observational study-OBELIX Study	Obesity	To analyse if youths with obesity, when removed from structured school activities and confined to their homes during the COVID-19 pandemic, will display unfavourable trends in lifestyle behaviours.	N=41 out of 50. Mean age 13.0±3.1 years	Children enrolled between 13 May and 30 July 2019. The interviews were conducted at the baseline visit and again 3 weeks following the mandatory quarantine starting on 10 March 2020.	Body weight, height, and waist circumference were measured at the baseline visit; BMI was calculated	Gender differences	The number of meals eaten per day increased by 1.15±1.56 (p<0.001). Sleep time increased significantly (0.65±1.29 hours/ day, p=0.003) and sports time decreased significantly by 2.30±4.60 hours/ week (p=0.003). Screen time increased by 4.85±2.40 hours/ day (p<0.001). There was an inverse correlation between change in sports participation and both a change in number of meals/ day and in screen time (r=–0.27, borderline significant at p=0.084). The number of meals eaten per day increased significantly more in the males than in females.

BMI, body mass index; PAL, physical activity level.

Inclusion criteria: all quantitative studies from peer-review literature describing studies that provided primary data about child (0–18 years) health and well-being related to the measures of school closure and any level of lockdown adopted regarding of COVID-19 and the impact on child health were included. Articles in Catalan, Danish, English, French, German, Icelandic, Italian, Norwegian, Spanish, Portuguese, Swedish and Turkish were included in the first screening. Following the initial screening, all included articles in the study were published in English-language journals. Original studies (cohort studies, repeated cross-sectional studies etc) were included if they reported children's data. We also included studies on changes in access/use of healthcare services during lockdown.

Exclusion criteria: studies that did not present separate data on childhood population, as well as commentaries, theoretical frameworks, without the analysis of empirical data, and preprint not peer-reviewed articles were excluded. Comments not based on specific empirical data (eg, opinion papers, protocols, letters without specific reviewed data) were also left out. Furthermore, articles regarding clinical manifestations and school transmission of COVID-19 impact on adults (ie, teachers, parents, except if it included specifically secondary impact on children) and cross-sectional studies analysing retrospective data without comparison or control group were also excluded.

Procedures: abstracts obtained by the initial search strategy were assessed for possible inclusion by at least two authors. Full-text papers of the studies were obtained in doubtful cases and independently evaluated by the authors. Differences of opinion on inclusion were decided by discussion and consensus among all authors (ie, one study that was initially included in the first screening was excluded by agreement of the authors due to a high risk of bias associated to the type of study and data collection; see the online supplemental material).

Data extraction: LR led data extraction that was checked initially by AH and PB, followed by a consensus with the rest of the authors. Data extraction included a summary of findings to answer the research questions and characteristics of the included studies: author; setting (country: international, national or regional study); type of study; age(s); lockdown (time in days/months); school closure and lockdown (time period); type of outcome; impact on child health and social inequalities.

Analysis: a meta-analysis was not possible to carry out given the nature of the study design and heterogeneity of the findings. Consequently, the authors carried out a descriptive and narrative synthesis of the results. First, studies were grouped according to their main subject and methodological similarities. LR, AH and PB identified the thematic content and described the results, followed by discussion among all the authors. The results were then analysed and summarised to distil out findings to subsequently integrate those with the rest of studies.

RESULTS

Study selection and risk of bias.

After excluding one study due to a high risk of bias,[17] 22 studies were included in the synthesis (figure 1). Included studies were from 15 countries, thereof 11 European. Eleven studies were a follow-up of children, while the rest of the studies analysed clinical databases, mortality registers or registries on child abuse and maltreatment.

Almost all of the included studies showed low to moderate risk of bias, except one study that was considered as moderate-high risk of bias; the sample was small, an unstructured questionnaire was administered, anthropometric measurements were taken at baseline only, and measures used were not appropriate for age (online supplemental Table 1).[18]

Exposure measure (box 1)

School closure was the most commonly adopted restrictive measure, although in most countries closure of schools and home confinement were both implemented at the same time; in some cases, the latter was established as a mandatory norm and especially for the child population, and in other cases, it was given as a general recommendation. The impact of school closure and lockdown or any measure of restriction such as stay-at-home, mandatory or recommended, was assessed between 2 weeks and 2–3 months after implementing these measures.

Outcome measures

Five studies addressed mental health,[19–23] three studies analysed physical activity and obesity,[18 24 25] three studies examined diabetes mellitus,[26–28] eight studies approached changes in the access and use of healthcare services,[29–36] while three studies analysed data regarding child abuse and violence.[37–39]

Mental health

One Australian study showed a significant increase in depressive symptoms and anxiety and a significant decrease in life satisfaction during school closure and lockdown, mainly in girls (table 1).[19] A Spanish study gave evidence to a worse total difficulty score of the Strengths and Difficulties Questionnaire according to parent-proxy responses.[20] A cohort of Chinese children and adolescents showed that all indicators of depressive symptoms (nonsuicidal self-injury, suicide ideation, a suicide plan and suicide attempt) deteriorated significantly during lockdown compared with previous baseline data.[21] No difference in the number of suicides was found in a Japanese study.[22] Referrals to the mental healthcare services for children and adolescents decreased during the lockdown in England compared with the previous year.[23]

Physical activity, obesity

A decrease in physical activity level (PAL) was found in a child cohort from Croatia (from 2.97 to 2.63, p<0.01) and significant differences were observed between adolescents living in urban and rural environments (table 2).[24] A study from Bosnia & Herzegovina found that 50% of

Table 3 Studies on diabetes mellitus

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown / school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Brener A, *et al*. (Acta Diabetol)[26]	Israel	Follow-up	Clinical control of T1D	To assess the impact of COVID-19 lockdown on the glycaemic control of paediatric patients with T1D.	102 T1DM patients (52.9% males), mean age 11.2 years, mean diabetes duration 4.2y	rom 23 February 2020 to 7 March 2020 and during the lockdown from 25 March 2020 to 7 April 2020.	Mean glucose level, time-in-range (TIR, 70–180 mg/dL; 3.9–10 mmol/L), hypoglycaemic (<54 mg/dL;<3 mmol/L), hyperglycaemic (>250 mg/dL;>13.3 mmol/L), coefficient of variation, and time CGM active before and during lockdown.	Age, sex, households (single/two parents), soicoeconomic position by home address SEP cluster and SEP index	In the younger age group, a multiple linear regression model revealed associations of age and lower SEP cluster with delta-TIR (F=4.416, p=0.019) and with delta-mean glucose (F=4.459, p=0.018). No significant correlations were found in the adolescent age group.
Christoforidis A, *et al*. (Diabetes Res Clin Pract)[27]	Greece	Follow-up	T1DM control	To monitor the effect of the lockdown in glycaemic variability, insulin requirements and eating portions and habits in children with T1DM wearing insulin pump equipped with a continuous glucose monitoring system	34 out of 250 children with T1DM, mean age=11.3y	3 weeks before and 3 weeks after March 10 (starting lockdown and school closure)	Control of insulin pump equipped and glucose metabolism		A higher CV indicating an increased glucose variability in the pre-lockdown period was observed (39.52% vs 37.40%, p=0.011). No significant difference was recorded regarding the total daily dose of insulin and the reported carbohydrates consumed, however, meal schedule has changed.

Continued

Table 3 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown / school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Di Dalmazi G, *et al*. (BMJ Open Diabetes Res Care)[28]	Italy (Orsola Policlinic, Bologna)	A cohort of DM-1	Clinical control in diabetics	To investigate continuous glucose monitoring (CGM) metrics in children and adults with T1D during lockdown and to identify their potentially related factors.	130 consecutive patients with T1DM (30 children (≤12 years), 24 teenagers (13–17 years),	Before the lockdown in Italy, from 20 February to 10 March 2020, and also January 30 to February 19 (pre-lockdown) and 20 days starting from that date, from 11 to 30 March 2020 (during lockdown).	Outcome measures: index of glucose control: GMI, LBG index, etc		In children, significantly lower (improvement) glucose SD (SDglu) (p=0.029) and time below range (TBR) <54 mg/dL (TBR2) (p=0.029) were detected after lockdown. CGM metrics were comparable in teenagers before and during lockdown.

GMI, glucose management indicator; LBG, low blood glucose index; SEP, socioeconomic position.

adolescents achieved sufficient PAL at baseline, while 24% at the time of follow-up measurement during lockdown; moreover, paternal education level was associated with PAL during lockdown (OR: 1.33, 95% CI 1.19 to 2.01).[25] The follow-up of Italian obese adolescents found that the number of meals per day increased by 1.15±1.56 (p<0.001) during the lockdown and also unhealthy food consumption and sedentary behaviours.[18]

Diabetes mellitus

Three studies on children with type 1 diabetes mellitus from Israel,[26] Greece[27] and Italy[28] showed no changes or improvements in glucose control indicators. However, in some cases, younger age and low family socioeconomic status were associated with worse control during the lockdown period (table 3).

Healthcare services access/use

There were no differences in the proportion of caesarean deliveries between the observation and control groups in a Chinese study. Furthermore, birth weight in the observation group during lockdown was higher than in the control group among infants born >34 gestational weeks (table 4).[29]

In Canada, the number of visits to the emergency department (ED) due to injuries in children decreased in 2 months in 2020 compared with the same period from 1993 to 2019.[30] An increase in the number of admissions due to seizures was found in an Italian children's hospital.[32] In another Italian study, the mean paediatric ED daily consultations decreased from 326.3 (95% CI 299.9 to 352.7) in March–May 2019 to 101.4 (95% CI 77.9 to 124.9) in the same period in 2020 (p<0.001).[34]

Similarly, a decrease in the number of visits by 63.8% to the ED was observed compared with the same period in 2019 in a German hospital except for malignant/neoplastic diseases.[33] An Australian study found a 47.2% decrease in total visits to the ED (26 871 vs 14 170), with a significant difference in daily mean. Conversely, there was a 35% (485 vs 656) increase in mental health diagnoses, while neonatal visits did not change significantly.[31]

There was a 52.5% decline in the daily average of the total number of vaccinations administered during lockdown than baseline data in Pakistan.[35] A study from Cameroon showed a drastic drop in hospitalisations, and child mortality rates doubled comparing with the previous year.[36]

Violence, abuse against children

Routinely collected clinical data on Child Protection Medical Examinations (CPME) from Birmingham (UK) showed a significant drop of 39% (95% CI 14% to 57%) in CPME referrals during 2020 compared with previous years, mainly associated with decreased school staff referrals.[37] A study from the US found an increase in the

Table 4 Studies on accessing healthcare services

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Li M, *et al*. (PlosOne)[29]	China (Wuhan)	Analysis of register of perinatal data	Perinatal services	To compare the indications for caesarean delivery (CD) and the birth weights of newborns during and pre-lockdown	N=3432 (out of 3,442) pregnant women who gave birth during lockdown and 7159 (out of 29,799) matched pregnant before lockdown.	On 23 January 2020, the municipal government of Wuhan announced the lockdown of the entire city. Data were collected until March 14. Control group: from 1 January 2019 to 22 January 2020.	Type of delivery. The neonates' data including birth weight, clinical symptoms, Apgar score, and outcomes		There was no differences in CD between the observation and control groups. Birth weight in the observation group was heavier than that in the control group among those with >34 gestational weeks ($p<0.05$). There was no significant difference in neonatal asphyxia between the two groups.
Keays G, *et al*. (Health Promot Chronic Dis Prev Can)[30]	Canada (Montreal Children's Hospital)	Data from the Canadian Hospitals Injury Reporting and Prevention Programme (CHIRPP)	Use of healthcare services (ED)	To evaluate if injury-related ED visits during the COVID-19 pandemic decrease.	General population stratified by age	Compare data from a 2 months period during the COVID-19 lockdown (March 16 to May 15) to the same period in previous years (1993–2019).	Visits to ED due to injuries: motor vehicle collisions, sports-related injuries and injuries that occurred during recreational activities.	No data	Compared with the 2015–2019 average, the decrease was smallest in children aged 2–5 years (35% decrease), and greatest in the group aged 12–17 years (83%). More children aged 6–17 years presented with less urgent injuries during the COVID-19 lockdown.

Continued

Table 4 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Cheek JA, *et al*. (Emerg Med Australas)[31]	Australia (four hospitals from Victoria)	Analysis of ED register	Use of healthcare services (ED)	To determine if changes to community-based services have affected paediatric ED attendances for mental health issues and neonates during the COVID-19 pandemic.	<18 years and neonatal visits	Closure of borders to non-residents on 20 March 2020.	Compare total visits to the ED, visits for mental health diagnoses and neonatal visits.		There was 47.2% decrease in total presentations (26 871 vs 14,170), with significant difference in daily mean. Conversely, there was a 35% (485 vs 656) increase in mental health, while neonatal presentations did not change (2% increase, 498 vs 507.
Palladino F, *et al*. (Neurol Sci)[32]	Italy. Santobono-Pausilipon Children's Hospital (Southern Italy)	Repeated cross-sectional study of clinical registers	Clinical health, seizures	To compare the 2020 admissions for seizures at the ED with previous year	Patients (4–14 years) attending the ED for seizures n=57 Median age: 8.03 years	Compare March 9 to up to May 4 and the same period for 2019	Diagnoses previous (epilepsy) or not	Use of devices, how contact with healthcare services	57 patients 20 of them new patients compared with 13 in 2019 and other differences.

Continued

Table 4 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Dopfer C, *et al*. (BMC Pediatr)[33]	Germany (Hanover)	Healthcare services. ED utilisation	Registry of paediatric ED	To investigate paediatric emergency Healthcare utilisation in a tertiary care centre	N=5424 visits in the study period. Mean age 7.1 years	School closures beginning on March 16, and an official lockdown of public life, on 23 March 2020. Analysis: March 18 to April 14 in 2019 and March 16 to April 12 in 2020.	Number of visits; ICD-10 diagnoses	Age, sex	In 2020, case numbers decreased by 63.8% compared with the same period of 2019. The % of visits to children<1 year increased in 2020. The disease category with increased daily ER visits after the lockdown began was malignant/ neoplastic disease.
Valitutti F, *et al*. (Front Pediatr)[34]	Italy (Campania region)	Healthcare services use before after	ED registry	To highlight the impact of the COVID-19 pandemic on ED consultation	Mean age=5.4 years in 2019 and 5.9 years in 2020	Registers of trimester March–May 2019 vs registers of trimester March–May 2020	Number of consultations, diagnoses, causes of emergency visits		Mean paediatric ED daily consultations were 326.3 (95% CI 299.9 to 352.7) in March–May 2019 and 101.4 (95% CI 77.9 to 124.9) in March–May 2020 (p<0.001).

Continued

Table 4 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Chandir S, *et al*. (Vaccine)[35]	Pakistan (Sindh)	Analysis of Electronic Immunisation Registry	Healthcare services. Preventive measures. Immunisation	To measure the reduction in daily immunisation rates in Sindh province, report antigen-wise coverage, and dropout rates for 0–23 month children, identify baseline characteristics associated with dropout, and observe the spatial distribution of immunisation activity.	0–23 month children	Lockdown starting on 23 March 2020, was initially extended to May 9,2020. It was a complete ban on movement, and exemptions were given only to essential service providers, including health (including immunisation), law enforcement, utility, and telecommunications.	Primary outcome of the analysis was the receipt of EPI recommended vaccinations (BCG, polio, penta, PCV10, rotavirus, and measles) during the COVID-19 lockdown period. Analysis of data from 23 September 2019 to 11 July 2020.		There was a 52.5% decline in the daily average total number of vaccinations administered during lockdown compared with baseline. The highest decline was seen for BCG (40.6% (958/2360) immunisation at fixed sites. Around 8438 children/day were missing immunisation during the lockdown. Enrolments declined furthest in rural districts, urban sub-districts with large slums, and polio-endemic super high-risk sub-districts.

Continued

Table 4 Continued

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Chelo D, *et al*. (Pediatr Pathol)[36]	Cameroon	Before after approach	Hospitalisation and mortality in the main paediatric hospital in Yaounde	To analyse the consequences of the pandemic on hospitalisation and on mortality in a paediatric hospital.	Children (age not specified) paediatric age	ockdown started on March 17. Analysis: 1 to 30 June 2020 and covered the period from 1 January 2016 to 31 May 2020.	Hospitalisation rates and mortality rates by periods		A drastic drop in hospitalisation was noted coinciding with partial lockdown. At the same time, the number of deaths per month doubled though the causes remained the same as in the past.

BCG, bacillus Calmette Guerin; ED, emergency department; EPI, expanded programme on immunization; ICD, International clasification of disease.

number of children with physical child abuse trauma,[38] and the Florida child abuse allegation data showed a decrease in 27% (n=15 000) in the number of allegations of child abuse and neglect comparing with the same 2 months of 2019 (table 5).[39]

DISCUSSION

This narrative review provides summaries of peer-reviewed published evidence on the impact of school closures and lockdown on child health, well-being and access to healthcare, during the first wave of COVID-19. The results show worse mental health status of children and adolescents from disparate geography and socio-economic background, reduced physical activity and increased sedentary behaviours. There were changes in the access and use of healthcare services as manifested by decrease in the ED visits, increased child mortality in a study from Cameroon and a reduction on immunisation coverage in Pakistan. Finally, an increased risk of child abuse and violence against children due to decreased access to general and specific care services during the period of lockdown and school closure was seen in the USA and UK. The effect of these measures of restriction indicates an increase in social inequalities. However, only a few of the studies focus specifically on analysing the impact on social determinants of child health. We found a significant negative effect in the most vulnerable groups (ie, higher mortality and less vaccination coverage in the studies from low-income and middle-income countries) and more significant negative impact on mental and physical health and child abuse and maltreatment in the most vulnerable child population in studies from high-income countries.

The results of this 'nonnatural experiment' are generalisable to most of the countries that applied any level of lockdown or confinement and closure of schools, although each country has different healthcare and education systems and social and redistribution policies. Confinement has produced an increase in previously existing inequalities with respect to access to basic living conditions and care services, with more difficulties in households with fewer resources.[40]

The results of the present study add to previous analyses on the impact of quarantine and school closure during previous epidemic outbreaks worldwide.[12] The latter analysed the impact and reported negative psychological effects including post-traumatic stress symptoms, confusion and anger. On the other hand, social isolation exacerbates personal and collective vulnerabilities while limiting accessible and familiar support options.[41] Many countries have seen an increase in demand for domestic violence services and reports of increased risk for children not attending schools, a pattern similar to previous episodes of social isolation associated with epidemics and pandemics.[42]

The results show an impact on mental health and physical activity mainly in the adolescent population. However, likely, these factors have also affected younger

Table 5 Studies on child abuse

First author (Journal)	Country (ies)	Type of study	Main subject	Objectives	Age (n)	Lockdown /school closure and time of data collection	Outcome measures	Other factors (inequalities)	Summary of results
Garstang J, *et al*. (BMJ Open)[37]	UK (Birmingham)	Registry of child protection	Routinely collected clinical data from Child Protection Medical Examination	To determine any change in referral patterns and outcomes in children referred for child protection medical examination (CPME) during the COVID-19 pandemic compared with previous years.	Children (0–18). N=200 CPME	Data were collected for all CPME for 18 week periods in 2018, 2019 and 2020, from the last week in February to the end of June	Incidence rate ratiosIRR of CPME comparing 2018–19 and 2020		A significant drop of 39% (95% CI 14% to 57%) in CPME referrals during 2020 compared with previous years. CPME 2018= 78; 2019=75; 2020=47. Associated mainly to a school staff decreased in referrals.
Kovler ML, *et al*. (Child Abuse Negl)[38]	USA (Maryland)	Clinical registry (Johns Hopkins Hospital of Maryland)	Child abuse and maltreatment	To assess the proportion of injuries secondary to physical child abuse (PCA) at a level I paediatric trauma centre during the COVID-19 pandemic.	Younger than 15 years	Childcare facilities closed on March 27. Analysis: March 28 to April 27 and compare with 2018 and 2019	PCA during lockdown	Age, race, severity, type of trauma	Eight patients (13% of total trauma) compared with 4 (2019, 4%) and 3 (2018, 3%).
Baron EJ, *et al*. (J Public Econ)[39]	USA (Florida)	Allegation data from the Florida DCF. County-level, monthly information on the total number of allegations of abuse, neglect or abandonment of children	Child abuse and maltreatment	To analyse the Florida child abuse Hotline reported cases and compare with previous years	Children (not specific age?)	Official statewide stay-at-home order in Florida was 3 April 2020. Compare from January 2004–2019 with March and April 2020 monthly allegations	Number of reported cases associated to schools opened	Ecological data on county level of economic condition	15 000 lower (27%) than expected for these 2 months.

DCF, Department of Children and Families.

children, a fact that needs to be assessed in future studies. Another review on the impact of COVID-19 on families and children found an increase in parental stress related to the suspension of classroom activities, social isolation measures, nutritional risks, children's exposure to toxic stress, depressive and anxiety symptoms, especially in previously unstructured homes, and a lack of physical activities.[43] Some cross-sectional reports found important differences between households of different socioeconomic status regarding home learning and with important potential implications for the long-term impact that the unprecedented circumstances.[44] Moreover, some studies carried out modelisations on the impact of inequalities and lost school learning. Christakis *et al*[45] compared the full distribution of estimated years of life lost (YLL) due to COVID-19 under both 'schools open' and 'schools closed' conditions and observed a 98.1% probability that school opening would have been associated with a lower total YLL than school closure. On the other hand, Azevedo *et al*[46] found that between 0.3 and 0.9 years of schooling losses adjusted for quality, bringing down the effective years of basic schooling that students achieve during their lifetime from 7.9 years to between 7.0 and 7.6 years. This would be associated with lost earnings in the amount between US$6472 and US$25 680 dollars over a typical student's lifetime, exacerbating inequalities.

Strengths and limitations

One of the strengths of this narrative review is the inclusion of peer-reviewed, longitudinal data or repeated cross-sectional data based on comparable measures. This makes the association between exposure to lockdown and school closure and outcome measures analysed more robust. Nonetheless, there are limitations. First, few of the studies analysed data from low-income and middle-income countries or social inequalities as independent factors, which should be addressed in future studies. Second, the exposure measures that we analysed, both school closure and lockdown, varied between countries and also the period from the beginning of the measures, and the time outcomes were assessed. This fact makes it difficult to evaluate the impact according to the level and duration of confinement and also to establish a clear association between exposure and outcomes. However, all the included studies present at least the timeline for initiating the measures adopted and evaluating the results. Third, educational, healthcare and redistributive policies before the pandemic conditioned each country's responses and results, and these factors must also be taken into account in future studies. Finally, the measures analysed here may have long-term effects and, therefore, future studies will need to factor in longer follow-up.

CONCLUSIONS

This narrative review attempted to provide the best available evidence on the impact of pandemic-related restrictive measures on child's and adolescent's health. The findings call for the attention of decision-makers to take into account the risks and benefits for children's health, with respect to public health measures that are adopted. Policymakers and researchers should look into other much less disruptive social distancing interventions given that lockdown measures greatly affect children and with more negative effects than benefits in the short and probably also in the long term. As other public health experts are urging,[47] we suggest that a comprehensive public health approach is needed in response to this pandemic with particular attention given to children. Social determinants and medical requirements should be addressed simultaneously, with equity and human rights as overarching principles.

Author affiliations
[1]Pediatric and Public Health Specialist, Retired, Barcelona, Spain
[2]Centre for Health Equity Studies, Stockholm University/Karolinska Institutet, Stockholm, Sweden
[3]Department of Pediatrics, Marmara University School of Medicine, Istanbul, Turkey
[4]Faculty of Social and Human Sciences, University of Iceland, Reykjavík, Iceland
[5]Department of Pediatrics, McMaster University, Hamilton, Ontario, Canada
[6]Department of Community Paediatrics, South Western Sydney Local Health District, Liverpool, New South Wales, Australia
[7]Women's & Children's Health, University of New South Wales, Sydney, New South Wales, Australia

Twitter Luis Rajmil @LuisRajmil

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ORCID iDs
Luis Rajmil http://orcid.org/0000-0002-6625-0649
Shanti Raman http://orcid.org/0000-0002-4546-3231

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