

# School Closures During Social Lockdown and Mental Health, Health Behaviors, and Well-being Among Children and Adolescents During the First COVID-19 Wave

## A Systematic Review

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**IMPORTANCE** School closures as part of broader social lockdown measures during the COVID-19 pandemic may be associated with the health and well-being of children and adolescents.

**OBJECTIVE** To review published reports on the association of school closures during broader social lockdown with mental health, health behaviors, and well-being in children and adolescents aged 0 to 19 years, excluding associations with transmission of infection.

**EVIDENCE REVIEW** Eleven databases were searched from inception to September 2020, and machine learning was applied for screening articles. A total of 16 817 records were screened, 151 were reviewed in full text, and 36 studies were included. Quality assessment was tailored to study type. A narrative synthesis of results was undertaken because data did not allow meta-analysis.

**FINDINGS** A total of 36 studies from 11 countries were identified, involving a total of 79 781 children and adolescents and 18 028 parents, which occurred during the first wave of the COVID-19 pandemic (February to July 2020). All evaluated school closure as part of broader social lockdown during the first COVID-19 wave, and the duration of school closure ranged from 1 week to 3 months. Of those, 9 (25%) were longitudinal pre-post studies, 5 (14%) were cohort, 21 (58%) were cross-sectional, and 1 (3%) was a modeling study. Thirteen studies (36%) were high quality, 17 (47%) were medium quality, and 6 (17%) were low quality. Twenty-three studies (64%) were published, 8 (22%) were online reports, and 5 (14%) were preprints. Twenty-five studies (69%) concerning mental health identified associations across emotional, behavioral, and restlessness/inattention problems; 18% to 60% of children and adolescents scored above risk thresholds for distress, particularly anxiety and depressive symptoms, and 2 studies reported no significant association with suicide. Three studies reported that child protection referrals were lower than expected number of referrals originating in schools. Three studies suggested higher screen time usage, 2 studies reported greater social media use, and 6 studies reported lower physical activity. Studies on sleep (10 studies) and diet (5 studies) provided inconclusive evidence on harms.

**CONCLUSIONS AND RELEVANCE** In this narrative synthesis of reports from the first wave of the COVID-19 pandemic, studies of short-term school closures as part of social lockdown measures reported adverse mental health symptoms and health behaviors among children and adolescents. Associations between school closure and health outcomes and behaviors could not be separated from broader lockdown measures.

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JAMA Pediatr. doi:10.1001/jamapediatrics.2021.5840  
Published online January 18, 2022.

**N**early every country implemented full or partial school closures during 2020 as part of social distancing and lockdown efforts to reduce the transmission of SARS-CoV-2 during the COVID-19 pandemic. Globally, an estimated up to 1.5 billion children and adolescents younger than 20 years were out of school<sup>1</sup> in early 2020 during the first COVID-19 wave (February/March to May/June 2020). Some countries did not return fully to in-person learning during 2020, and many closed schools again in early 2021 in response to new SARS-CoV-2 variants.

School closures are designed to reduce social contacts between students and disrupt transmission of SARS-CoV-2 between students and thereby reduce introduction of the virus by children into households.<sup>2</sup> In most countries, school closures were instituted as part of local or national lockdown measures involving the whole of society, meaning that the effectiveness of school closures as a standalone measure for reducing community transmission remains unclear.<sup>3</sup>

Theory and evidence suggest that closure of schools and restrictions on social interaction between children and adolescents have the potential to be related to harms for students through a number of mechanisms.<sup>4-6</sup> Among children and adolescents, school closures reduce access to services delivered in schools, such as school meals, school health services, and provision of supplies, eg, menstrual hygiene.<sup>7</sup> Schools are also part of the safety net provided around children, and loss of this may also be associated with reduced surveillance for child abuse or neglect. Other mechanisms are associated with the reductions in social contacts between children and adolescents and with significant adults such as teachers; this isolates adolescents and social support and reduces opportunities for cognitive and social development.<sup>8,9</sup> In addition to associations with mental health and well-being through reductions in social contacts,<sup>9</sup> there may be direct associations such as anxiety due to loss of known and valued activities<sup>5</sup> and loss of the protective effects of connection with school.<sup>10</sup> There may also be a range of associations owing to the loss of physical activity gained from active transport to school as well as from school sports.

School closures during the COVID-19 pandemic have occurred primarily within broader social lockdowns. While some mechanisms are associated with school closure (eg, pathways through loss of learning or loss of health goods delivered through schools), pathways associated with reduction in social contacts and loss of physical activity are common to school closures and broader social lockdowns, although schools form the major part of social mixing in the lives of children and adolescents.<sup>11</sup>

International reports have highlighted concerns about the potential harms to children and adolescents associated with school closures during COVID-19,<sup>12</sup> yet the literature has not been systematically evaluated. We present here a narrative synthesis summarizing the available evidence from the first COVID-19 wave on school closures during broader social lockdown and physical and mental health among children and adolescents.

## Methods

We undertook a systematic review and narrative synthesis to answer what the associations of school closures with the health, well-being, and educational outcomes of children and adolescents are.

### Key Points

**Question** Is there an association between school closure during broader social lockdown measures during the COVID-19 pandemic and mental health symptoms, health behaviors, and well-being of children and adolescents, aged 0 to 19 years?

**Findings** In this systematic review of 36 studies from 11 countries, school closures and social lockdown during the first COVID-19 wave were associated with adverse mental health symptoms (such as distress and anxiety) and health behaviors (such as higher screen time and lower physical activity) among children and adolescents. The effects of school closures could not be assessed separately from broader social lockdown measures.

**Meaning** The potential epidemiologic benefits of school closures during broader social lockdown measures for controlling infectious diseases should be balanced with the potential for adverse mental health symptoms and health behaviors among children and adolescents.

We excluded associations of closure with transmission of infection. We followed the relevant requirements of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline,<sup>13</sup> and our protocol was prospectively registered with PROSPERO (CRD42020181658).

### Search Strategy

We searched 11 electronic databases (PubMed, PsycInfo, Web of Science Social Citation Index, Australian Education Index, British Education Index, Education Resources Information Centre, WHO Global Research Database on COVID-19, MedRxiv, PsyArXiv, Research Square, and COVID-19 Living Evidence) from inception to September 1, 2020. We used a combination of free-text controlled terms to identify citations containing children and adolescents and concepts of either school closure, restricted access to education, or social distancing/lockdown measures (eTable 1 in the [Supplement](#)). We screened the reference list of included articles and asked experts in the field for additional studies.

Inclusion criteria included any children and adolescents aged 0 to 19 years and school closure (any duration) in response to any nonroutine event, whether together with broader nonpharmaceutical interventions (ie, lockdown) or alone; higher education and school absences, truancy, and holidays were excluded. Controlled studies (open schools or regions without lockdowns), uncontrolled pre-post studies (change from before closure), and cross-sectional studies (comparison with reference data) were included. Observational, cohort, uncontrolled pre-post, modeling, and cross-sectional published or preprint studies and reports with prespecified outcomes in English were included.

We initially sought to identify data on school closures before COVID-19 as well as during the current pandemic. Given that school closures during the COVID-19 pandemic very frequently occurred as part of broader social lockdown, our initial search strategy was broad to capture a range of outcomes in the contexts of school closures with and without co-occurring lockdowns. The available literature from before COVID-19 was sparse and related only to very brief school closures and was therefore not included in this review. Following a published logic model,<sup>5</sup> we also restricted this review to health and well-being outcomes that were potentially associated with

school closures whether isolated or as part of broader lockdown, ie, mental health and well-being, sleep, physical activity, and other health behaviors including diet and with child protection actions (eTable 2 in the Supplement). Additional identified data on health service use outcomes, associations with health conditions, educational attainment, and parent/caregiver outcomes will be published elsewhere.

We adopted a machine learning approach<sup>14</sup> for screening titles/abstracts, developed by the EPPI-Centre and using EPPI-Reviewer 4 software (EPPI).<sup>15</sup> The machine learning was trained through the initial screening of 1500 articles by the researchers. Using these screening decisions, a classifier model was developed to rank the remaining unscreened studies and identify a threshold below which studies were highly likely to not be relevant. Two researchers (S.R., H.C., J.P.) independently screened identified records on the title/abstract, and potentially relevant studies were acquired in full text and independently assessed for inclusion by 2 researchers (H.C., S.R., S.H., and J.P.). Further screening on the title only was then conducted by 1 reviewer (S.R.) to a lower threshold than the machine learning used, which assured the accuracy of the model. Decisions about inclusion were independently reassessed by 2 authors (R.V. and S.M.).

### Data Extraction and Quality Assessment

Two authors (S.M. and R.S.) independently extracted outcome data that were checked independently by 1 author (R.V.). Evidence was ranked by type of study and quality and risk of bias were independently rated by 2 authors (S.M. and R.S.) using the Newcastle-Ottawa Scale-Cohort studies for cohort studies,<sup>16</sup> modified Newcastle-Ottawa Scale for cross-sectional studies,<sup>17</sup> National Heart, Lung, and Blood Institute tool for pre-post studies,<sup>18</sup> and a modified checklist for modeling studies.<sup>19</sup> Across checklists, studies were categorized as high quality if they met 90% or more of criteria, medium if 50% or more but less than 90%, and low if less than 50%.

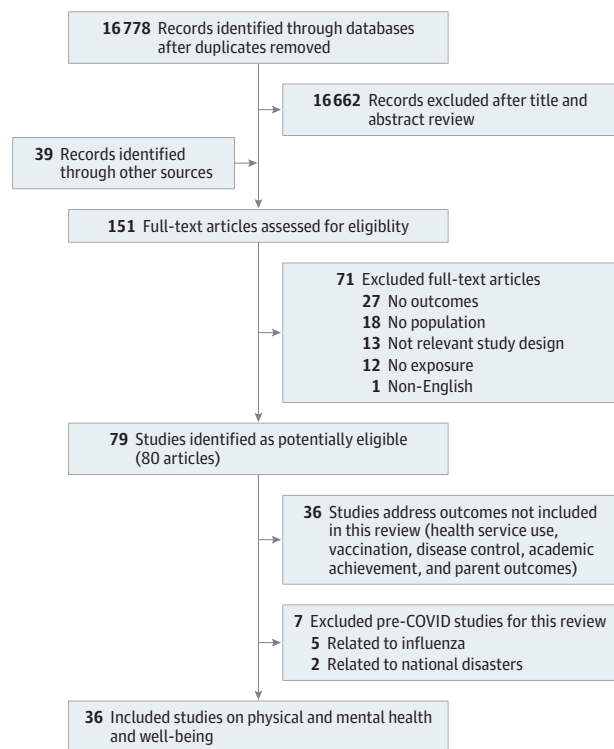
### Data Synthesis and Analyses

Owing to heterogeneity of designs and measures, meta-analysis was not possible. We performed a narrative synthesis of the results, grouping studies according to the type of outcome. Findings were reported by study quality and type (eg, longitudinal or cross-sectional) and interpretation was then weighed qualitatively giving greater emphasis to longitudinal and higher-quality studies and less to cross-sectional or low-quality studies. We did not conduct a formal assessment of reporting bias or publication bias.

## Results

The Figure shows the search flow. A total of 16 817 records were retrieved after removing duplicates, of which 151 were reviewed in full text, and 79 studies (reported in 80 publications) were judged to be potentially relevant. Here we report findings from 36 studies reporting children and adolescents' health and well-being outcomes (Table).<sup>20-55</sup> Studies involved a total of 79 781 children and adolescents and 18 028 parents and related to school closures and lockdown during the first wave of the pandemic from February to July 2020.

Figure. PRISMA Flow Diagram



Five (14%) were cohort studies (4 used an external historical/retrospective comparison group<sup>34,35,40,56</sup> and 1 was a parallel comparison group<sup>24</sup>), 9 (25%) were uncontrolled pre-post studies (8 included 1 measurement pre- and postexposure<sup>22,26,32,39,41-43,49</sup> and 1 was a repeated measures time-series study<sup>21</sup>), 21 (58%) were cross-sectional,<sup>25,27-31,33,36-38,44-48,50-55</sup> and 1 (3%) was modeling study.<sup>20</sup>

Thirteen (36%) were high quality (eTables 3-6 in the Supplement), 17 (47%) were medium quality, and 6 studies (17%) were low quality. Thirteen studies were from low- and middle-income countries (8 from China, 2 from Turkey, and 1 each from Brazil, Bangladesh, and India); 11 studies were from the UK, 4 from the US, 5 from Italy, and 1 each from Canada, Japan, and Spain. Twenty-three studies (64%) were published in peer-reviewed journals, 8 (22%) were online reports from institutions or academic collaborations, and 5 (14%) were preprints.

The exposure in all studies was school closure together with broader social lockdown during the first COVID-19 wave from February to July 2020. No studies reported on school closures without broader lockdown. Changes reported below refer to comparisons with either historical control periods (cohort studies), data collection prior to lockdown (pre-post studies), or, for cross-sectional studies, either comparison with historical reference data or retrospective recall of the period before school closure and lockdown (Table).

### Mental Health and Well-being

A total of 25 studies (69%) were focused on mental health and well-being (eTable 7 in the Supplement). Studies originated from Japan,<sup>35</sup> UK,<sup>25,37,40-42,48,49</sup> US,<sup>46</sup> China,<sup>24,28,44,50,52-54</sup> Italy,<sup>27,39,47</sup> Turkey,<sup>36</sup>

Table. Characteristics of Included Studies<sup>a</sup>

Source	Study design	Quality	Period of reference	School closure /lockdown duration	Source of data	No. of individuals enrolled	Age, y	% Male	SES reported
An, <sup>20</sup> 2020; United States	Modeling study	High	April 2020-March 2021	Scenario 1: April-May 2020 nationwide school closure Scenario 2: scenario 1 + 10% reduction in daily physical activity (June-August) Scenario 3: scenario 2 + September-October school closure Scenario 4: scenario 3 + November-December school closure	Early Childhood Longitudinal Study, kindergarten class of 2010-2011	15 631 Children	5-6 Up to 10-11 t the end of follow-up	NR	Yes
Baron et al. <sup>21</sup> 2020; United States	Time series analysis	High	January 2004 to March-April 2020	1.5 mo	Florida Department of Children and Families	13 132 County-by-month observations	<18	NR	Yes
Baysun and Akar, <sup>22</sup> 2020; Turkey	Uncontrolled pre-post	Low	Pre: March 2020; post: May 2020	3 mo	NR	4 Children	14-30 mo	50	No
Bhopal et al., <sup>23</sup> 2021; United Kingdom	Cohort with external historical/retrospective control	High	March 2020 compared with same period in 2018-2019	1 mo	Child protection medical examination services database	107 Children	0-16	NR	No
Chen et al., <sup>24</sup> 2020; China	Parallel comparative study	Low	February 22-March 8, 2020	1 mo	Online survey	7772 Students	12-18	47.7	No
Children's Society, <sup>25</sup> 2020; United Kingdom	Cross-sectional survey	Low	April-June 2020	2 mo	Online survey	> 2000 Households and 150 children	10-17	NR	Yes
Dellagiulia et al., <sup>26</sup> 2020; Italy	Uncontrolled pre-post	Low	February 25-March 25, 2020	1 mo	Questionnaire	37 Mothers	Mean (range), 3.81 (3-6)	51	No
Di Giorgio et al., <sup>27</sup> 2021; Italy	Cross-sectional survey	Medium	April 1-9, 2020	1 mo	Online survey	245 Parents	Mean (SD), 4.10 (0.92)	53	No
Duan et al., <sup>28</sup> 2020; China	Cross-sectional survey	Medium	NR	NR	Online survey	3613 Children and adolescents	7-18	50.2	No
Dunton et al., <sup>29</sup> 2020; United States	Cross-sectional survey	Medium	April 25-May 16, 2020	1-2 mo	Online survey	211 Parents	Mean (SD), 8.73 (2.58)	47	Yes
Ellis and Dumas, <sup>30</sup> 2020; Canada	Cross-sectional survey	Medium	April 1, 2020	3 wk	Online survey	1316 Adolescents	16.7	21.9	No
Falkingham et al., <sup>31</sup> 2020; United Kingdom	Cross-sectional survey	High	April 2020	1 mo	Understanding Society COVID-19 Study	895 Adolescents	16-24	NR	Yes
Gallagher et al., <sup>32</sup> 2020; United Kingdom	Uncontrolled pre-post	Medium	April 10-May 22, 2020 baseline survey; 1 mo later first follow-up	3 mo	Online survey	194 Parents and 58 adolescents	11-18	9.30	Yes
García de Avila et al., <sup>33</sup> 2020; Brazil	Cross-sectional survey	Medium	April-May 2020	1-2 mo	Online survey	289 Children	8.8	45.7	Yes
Garstang et al., <sup>34</sup> 2020; United Kingdom	Cohort with external historical/retrospective control	High	Late February-late Jun 2020 compared with same period in 2018 and 2019	3 mo	Electronic patient records from Child Protection Medical Examination database	200 Referrals	Median (IQR), 69 (85) mo	63.5	No
Isumi et al., <sup>35</sup> 2020; Japan	Cohort with external historical/retrospective control	High	March-May 2020, compared with same period in 2018-2019	2 mo	Public data on suicide statistics, Ministry of Health, Labour and Welfare	NR	<20	NR	No
Kılınçel et al., <sup>36</sup> 2020; Turkey	Cross-sectional survey	Medium	NR	NR	Online survey	745 Adolescents	Mean (SD), 16.83 (1.66)	30.5	Yes

(continued)

Table. Characteristics of Included Studies<sup>a</sup> (continued)

Source	Study design	Quality	Period of reference	School closure /lockdown duration	Source of data	No. of individuals enrolled	Age, y	% Male	SES reported
Levita et al., <sup>37</sup> 2020; United Kingdom	Cross-sectional survey	Medium	March 23-28 and April 22-May 1, 2020	1 mo	Online survey	546 Parents	13-18	NR	No
López-Bueno et al., <sup>38</sup> 2020; Spain	Cross-sectional survey	High	March 22-May 10, 2020	2 mo	Online survey	860 Parents	Mean (SD), 9.6 (3.9)	50.8	Yes
Nastro et al., <sup>39</sup> 2020; Italy	Uncontrolled pre-post	Medium	Pre: March 9, 2020; post: April 20, 2020	1 mo	Online survey	71 Parent or adolescents	1-18	NR	No
Odd et al., <sup>40</sup> 2020; United Kingdom	Cohort with external historical/retrospective control	High	January 1-March 23, 2020, compared with March 24-May 17, 2020. April 1-May 17, 2020, compared with same period 2019	2 mo	National Child Mortality Database	51 Children	<18	58	Yes
Pearcey et al., <sup>41</sup> 2020; United Kingdom	Uncontrolled pre-post	Medium	April 17-June 22, 2020, baseline survey; first follow-up: 1 mo later	NR	Online survey	972 Parents	2-5	NR	Yes
Pearcey et al., <sup>42</sup> 2020; United Kingdom	Uncontrolled pre-post	Medium	March 30-May 31, 2020, baseline survey; first follow-up: 1 mo later	NR	Online survey	2890 Parents and 572 adolescents	13	NR	Yes
Pietrobelli et al., <sup>43</sup> 2020; Italy	Uncontrolled pre-post	Medium	Pre: May-June 2019; post: March 2020	3 wk	Telephone interview	41 Parents	Mean (range), 13.0 (6-18)	53.6	No
Qi et al., <sup>44</sup> 2020; China	Cross-sectional survey	Medium	February 2020	1 wk	Online survey	9954 Adolescents	11-20	NR	No
Roy et al., <sup>45</sup> 2020; India	Cross-sectional survey	High	NR	NR	Online survey	1065 Adolescents	Mean (SD), 19.9 (3.5)	NR	No
Russell et al., <sup>46</sup> 2020; United States	Cross-sectional survey	Medium	April 27-28, 2020	1 mo	Online survey	420 Caregivers	0-18	NR	Yes
Segre et al., <sup>47</sup> 2020; Italy	Cross-sectional survey	Medium	May 18-June 7, 2020	3 mo	Survey via video-meeting platform	82 Children and adolescents	Mean (range), 10.4 (6-14)	53.7	Yes
Watson et al., <sup>48</sup> 2020; United Kingdom	Cross-sectional survey	Low	June 22-July 6, 2020	2.5 mo	Online survey	11 228 Parents	2-7	50	No
Widhall et al., <sup>49</sup> 2020; United Kingdom	Uncontrolled pre-post	Low	Apr/May 2020; compared with pre-COVID-19 survey in October 2019	1.5 mo	Online survey	721-770 Adolescents	13-14	NR	No
Xie et al., <sup>50</sup> 2020; China	Cross-sectional survey	Medium	End of February-early March 2020	1 mo	Online survey	1784 Children	7-12	56.7	No
Yeasmin et al., <sup>51</sup> 2020; Bangladesh	Cross-sectional survey	High	April-May 2020	1 mo	Online survey	384 Parents	5-15	NR	Yes
Zheng et al., <sup>52</sup> 2020; China	Cross-sectional survey	Medium	February 2020	1 mo	Online survey	1620 Children	Mean (SD), 10.10 (1.63)	52.2	No
Zhou et al., <sup>53</sup> 2020; China	Cross-sectional survey	High	February 2020	1 wk	Online survey	4085 Adolescents	Mean (range), 15 (11-18)	0	No
Zhou et al., <sup>54</sup> 2020; China	Cross-sectional survey	High	March 2020	3 wk	Online survey	8079 Adolescents	16	46.5	No
Zhou et al., <sup>55</sup> 2020; China	Cross-sectional survey	High	March 2020	3 wk	Online survey	7736 Adolescents	12-18	46.5	No

Abbreviations: NR, not reported; SES, socioeconomic status.

<sup>a</sup> The reason for all school closures was the COVID-19 pandemic.



Ireland,<sup>32</sup> India,<sup>45</sup> Canada,<sup>30</sup> Brazil,<sup>33</sup> and Bangladesh.<sup>51</sup> Five (3 cohort, 2 cross-sectional) studies reported broadly representative data.<sup>25,35,37,40,49</sup> The remainder were longitudinal studies or cross-sectional convenience samples.

### Suicide

Two high-quality cohort studies found no significant increase in national suicide rates during school closure and lockdown compared with historical control periods in England (daily death rates for age <18 years, 0.32 vs 0.45; relative risk, 1.41 [95% CI, 0.80-2.46])<sup>40</sup> and Japan (incidence rate ratio for age <20 years, 1.15 [95% CI, 0.81-1.64]).<sup>35</sup> In the sample from England, factors associated with COVID-19 and lockdown were judged by the investigators to have contributed to 48% of the 26 suicide deaths during lockdown.<sup>40</sup>

### Mental Health Symptoms

A high-quality cross-sectional UK population-based study during school closure and lockdown found that 53.3% (326 of 612) of girls and 44.0% (171 of 389) of boys aged 13 to 18 years had symptoms of anxiety and trauma above population threshold, with 47.4% (290 of 612) of girls and 59.6% (232 of 289) of boys reporting anxiety, while depressive symptoms were reported in 19.4% (119 of 612) of girls and 21.9% (85 of 389) of boys.<sup>37</sup>

A low-quality pre-post survey of adolescents in South West England found reductions in proportions with anxiety symptoms in boys and girls compared with October 2019, noting that mean anxiety scores fell among those with high scores before lockdown but changed little in those with previously normal scores. Proportions with depressive symptoms rose slightly in girls and fell slightly in boys, with mean scores falling in those with preexisting high scores but rising in those with previously normal scores.<sup>49</sup> There were increases in adolescents' sense of connection with school but no change in peer or family connection scores. Those with low pre-COVID-19 school connection showed greater reduction in anxiety scores but little change in depression scores. Anxiety and depression scores increased most in those with poorer connection with family and peers before COVID-19.<sup>49</sup>

A series of large cross-sectional surveys of mixed quality in Chinese school-aged children and adolescents and a high-quality cohort study<sup>24</sup> found high levels of symptoms reaching clinical thresholds on self-report screening tools and higher than recent reference data. Estimates for significant anxiety ranged from 10% to 19%.<sup>24,44,52,54</sup> Estimates for depressive symptoms ranged from 17% to 39%,<sup>28,50,53,54</sup> although 1 study reported only 6.3% (102 of 1620).<sup>52</sup> One cohort<sup>24</sup> and 1 cross-sectional<sup>50</sup> study found symptoms greater in Wuhan, China, than other cities, consistent with greater exposure to lockdown.

Higher proportions of children and adolescents with problems than in reference populations were seen in large cross-sectional studies from other countries. Depressive symptoms were reported in 28.6% (301 of 1054) of Canadian adolescents<sup>30</sup> and 26.5% (102 of 384) of children from Bangladesh.<sup>51</sup> Anxiety symptoms were reported in 19.4% (56 of 289) to 21.8% (63 of 289) of Brazilian children.<sup>33</sup> Suicidal ideation was only reported in 1 medium-quality cross-sectional Canadian study, which found that 17.5% (184 of 1054) of individuals aged 16 to 18 years reported suicidal ideation in the past week, compared with 6% in pre-COVID-19 estimates.<sup>30</sup>

A large low-quality Scottish cross-sectional study of children aged 2 to 7 years found that 47% of 9621 parents reported worsening of their child's behavior and 47% of 9608 parents reported worsening of their child's mood, with proportions of 4276 four- to 7-year-old children with borderline or high scores being 37% for emotional difficulties, 43% for conduct problems, and 41% for hyperactivity/inattention, approximately double that expected.<sup>48</sup>

Smaller cross-sectional studies of mixed quality from a range of countries reported high levels of stress,<sup>46</sup> anxiety,<sup>27</sup> behavioral difficulties,<sup>27</sup> and hyperactivity/inattention<sup>27</sup> in younger children and stress,<sup>45</sup> anxiety,<sup>36</sup> and depressive symptoms in adolescents.<sup>47</sup> Problems appeared greatest in those with previous mental health problems<sup>36</sup> and where parents had poorer mental health.<sup>46</sup>

Change in psychological function was examined by 3 medium-quality pre-post studies using national convenience samples to examine change throughout 1 month during lockdown. An Irish study identified no changes in function in primary- or secondary-aged children and adolescents.<sup>32</sup> UK studies found no changes in emotional difficulties but restlessness/inattention difficulties reduced, while behavioral difficulties reduced significantly in boys aged 2 to 5 years but not girls<sup>42</sup>; increases in emotional, behavioral, and restlessness/inattention difficulties in primary school children<sup>41</sup>; and increases in restlessness/inattention difficulties and decreases in emotional difficulties by parent report in 11- to 16-year-old children (children and adolescents themselves reported no change).<sup>41</sup> Parents of children and adolescents with preexisting mental health problems reported a significant reduction in their child's emotional difficulties during lockdown in both the Irish and UK studies.<sup>32,41</sup>

### Well-being

A large broadly representative but low-quality cross-sectional study from England found increased low life satisfaction (18% of 2001) and low well-being scores (26.9% of 1201).<sup>25</sup> A broadly representative low-quality pre-post survey from South West England reported minor worsening of well-being scores.<sup>49</sup>

### Child Abuse

Three studies focused on child abuse (eTable 8 in the [Supplement](#)). A high-quality time series study from Florida estimated that the number of notifications of child abuse in the state decreased by 15 000 bimonthly notifications (27%) during lockdown, using school staffing and spending data to conclude this resulted primarily from lack of referrals during school closures.<sup>21</sup> Two large high-quality UK regional cohort studies estimated that child protection medical referrals fell by 36% (156 per quarter in 2019 to 99 in 2020)<sup>56</sup> to 39% (incidence rate ratio for 2020 compared with 2018/2019 was 0.61 [95% CI, 0.43-0.86])<sup>34</sup> with one estimating that the proportion of referrals originating from schools approximately halved.<sup>34</sup>

### Sleep

Ten studies assessed sleep (eTable 9 in the [Supplement](#)). A high-quality nationally representative UK cohort study found that 25% of 895 individuals reported new onset of sleep problems owing to worrying.<sup>31</sup> A large low-quality cross-sectional convenience study of Scottish children aged 2 to 7 years found that proportions sleeping through the night (32% of 5287 two- to 4-year-old children and 50% of 5055 5- to 7-year-old children) were lower than pre-COVID-19 national data (38% and 60%, respectively), with 33% of 9610

parents reporting worse sleep since COVID-19 and only 7% sleeping better.<sup>48</sup> Cross-sectional convenience studies in Italian<sup>27</sup> and Spanish<sup>38</sup> children reported no changes in sleep duration or quality; however, a small pre-post study of Italian preschool children found a decrease in sleep duration early during lockdown,<sup>26</sup> and a cross-sectional Italian study found 61% (50 of 82) reported difficulties falling asleep and fragmented sleep.<sup>47</sup>

Two cross-sectional convenience studies of Chinese children and adolescents reported increased sleep problems; 1 study reported that 63.9% (3072 of 4805) slept for 8 hours or fewer per night,<sup>53</sup> while the second found a prevalence of insomnia symptoms of 23.2% (2747 of 11 835).<sup>55</sup> In contrast, increased sleep duration was reported by a cross-sectional study of individuals aged 13 to 25 years in India<sup>45</sup> and a small pre-post study of adolescents with obesity in Italy.<sup>43</sup>

## Health Behaviors

### Physical Activity and Sedentary Behavior

In cross-sectional convenience samples from the US, Scotland, and India, 36% to 47% of children and adolescents experienced falls in physical activity,<sup>29,45,48</sup> while 24% to 24.4% undertook more physical activity.<sup>45,48</sup> A Spanish study reported that mean daily physical activity fell 52% (weekly minutes pre: 198.6; post: 95.5).<sup>38</sup> A medium-quality Italian pre-post study of children and adolescents with obesity found a decrease in physical activity of 2.3 hours per week (64% relative decrease).<sup>43</sup> In a medium-quality cross-sectional convenience study, 41% of 211 parents reported their child had done much more sitting compared with recall of the period before lockdown (eTable 10 in the [Supplement](#)).<sup>29</sup>

### Screen Time and Social Media

Two cross-sectional convenience studies reported increases in screen time, although they did not separate recreation from online learning; a Spanish study found that mean daily screen time rose by 2.9 hours per day (245% increase), greatest among teenagers,<sup>38</sup> while an Indian study found mean screen time was 5.1 hours during lockdown, more than 70% higher than previous national data.<sup>45</sup> A medium-quality pre-post study in Italian children and adolescents with obesity found a significant increase of 4.9 hours per day (296% increase).<sup>43</sup>

Increases in social media use were reported in 2 studies. A Canadian medium-quality cross-sectional convenience study found the proportion of older teenagers using social media more than 3 hours per day more than doubled (31.9% to 77.2%).<sup>30</sup> A broadly representative low-quality English pre-post study of 770 adolescents found an association with an increase in weekday high social media use ( $\geq 3$  hours per day) among girls (42% before COVID-19, 55% during lockdown) but not boys (29% before COVID-19, 30% during lockdown) but no change during weekends (eTable 10 in the [Supplement](#)).<sup>49</sup>

### Eating and Diet

A large low-quality cross-sectional convenience study of Scottish children aged 2 to 7 years found little evidence of change in diet<sup>48</sup>; however, cross-sectional convenience studies from India, Spain, and Italy suggested an association with increased overall levels of consumption,<sup>45,47</sup> particularly of unhealthy food,<sup>45,47</sup> and a reduction in fruit and vegetable consumption.<sup>38</sup> A medium-quality pre-post study in Italian children and adolescents with obesity found an

association with an increase in the number of meals eaten per day (4.2-5.3), with increased intake of potato chips and sugary drinks.<sup>43</sup> We identified no studies of eating behaviors (eTable 10 in the [Supplement](#)).

## Overweight

A high-quality US microsimulation study estimated that 2 months of school closure would result in a 11.1% rise in childhood obesity in young children throughout the following year, with larger rises if social distancing reduced physical activity or there were additional school closures throughout the following year.<sup>20</sup> A low-quality pre-post study from Turkey reported that weight percentile increased in young children from 25th to 50th percentile to 50th to 75th percentile (eTable 11 in the [Supplement](#)).<sup>22</sup>

## Associations With Socioeconomic Status

Few studies considered how socioeconomic status modified outcomes. A cross-sectional study from Brazil found greater anxiety in children and adolescents from families with lower education levels.<sup>33</sup> Pre-post UK<sup>41,49</sup> and Irish<sup>32</sup> studies found few differences by parental income in change in psychological function over a month in lockdown.

## Discussion

We present a detailed systematic review of the association of school closures as part of broader social lockdown with children and adolescents' health and well-being during the first COVID-19 wave. While 39% of studies were cohort or longitudinal designs providing a higher quality of evidence, 58% of included studies were cross-sectional studies that used pre-COVID-19 population norms to identify change and many used convenience samples. However, there was consistency in findings across studies, particularly for mental health, with almost all studies documenting poorer mental health and well-being.

All included studies were of school closures enacted within broader lockdown in the first COVID-19 wave. Therefore, these data do not allow us to separate the associations of school closures from broader social lockdown. It is likely that a range of factors during lockdown contributed to the harms documented here, with school closures playing a role alongside social isolation, family stresses, and broader pandemic fears.

However, there are strong theoretical reasons to suggest that school closures may have contributed to a considerable proportion of the harms identified here, particularly mental health harms, through reduction in social contacts with peers and teachers.<sup>9</sup> Schooling occupies the greater part of students' awake time during the week, and social mixing studies show that social contacts are higher during the week than on weekdays, most social contacts of children and adolescents are with same-age peers with a smaller degree with family, and that social mixing is reduced during school holidays.<sup>57,58</sup> During the first-wave lockdowns, reductions in same-age social mixing was greater among children and adolescents than other ages.<sup>59</sup> These data show that school closure is responsible for a large proportion of the social mixing reductions among children and adolescents seen during lockdown and therefore may have contributed to a high proportion of the harms resulting from reduced social mixing, although this cannot be quantified.

Many studies concerned mental health. Representative and large convenience studies from high-income countries and low- and middle-income countries found that 18% to 60% of children and adolescents scored above thresholds for risk of psychological difficulties, proportions higher than before COVID-19. While convenience samples are likely to inflate estimates of distress, findings were largely consistent across study types. There were suggestions that the association was greater where lockdown was more prolonged but less in students who had poorer pre-COVID-19 connection with their schools.

These rises in psychological distress are made more concerning by other evidence that presentations to or access to health care facilities were markedly reduced internationally during the first wave, with 50% to 65% reductions reported in presentations for self-harm<sup>60,61</sup> and 40% reductions in psychiatric admissions.<sup>60</sup> The contrast of rises in distress with decreases in presentations suggests that there was an escalation of unmet mental health need during lockdowns in already vulnerable children and adolescents. More troubling still is evidence of a reduction in the ability of the health and social care systems to protect children in many countries, as shown by the large falls in child protection referrals seen in high-quality cohort studies. These studies<sup>21,34,56</sup> identified school closures as a major contributor to falls in child protection referrals.

High-quality UK and Chinese studies suggested around one-quarter of children and adolescents developed significant sleeping difficulties, consistent with and potentially contributing to the psychological problems found in other studies and potentially reflecting the loss of physical activity and routine because of school closures and lockdown. It is equally possible that for some adolescents, school closure represented an opportunity to experience more natural sleep patterns.

Findings on more behavioral outcomes were of lower quality and potentially biased<sup>62,63</sup> and may reflect differing responses to school closure and lockdown across families or social groups. However, together the data suggest that closures during lockdown predominantly decreased healthy behaviors, such as physical activity, and increased less healthy diet and screen time behaviors. While some of the increase in screen time noted may reflect online learning, children and adolescents themselves are concerned about the effect of high amounts of screen time on their well-being.<sup>64</sup>

Our data do not allow us to examine whether provision of online schooling mitigated some of the associations of school closures as some have hypothesized.<sup>9</sup> Online schooling does provide a level of social interaction and may act to mitigate some harms resulting from the reduction of social mixing. However, evidence that online learning does little to mitigate the learning losses associated with school closures even in high-income countries<sup>65</sup> suggests further study is required of its relationship with mental health and well-being.

We are not aware of other similar systematic reviews conducted with high quality. Our findings of high levels of psychological distress are consistent with a systematic review of the associations of isolation with children and adolescents, which included some COVID-19 studies,<sup>66</sup> and with longitudinal studies published after our search dates.<sup>67-69</sup> Data suggest that distress associated with social isolation may persist in the longer term,<sup>9,66</sup> emphasizing the potential for long-term sequelae in those distressed by lockdowns including school closures.

### Strengths and Limitations

Strengths of the study were the use of a large number of educational as well as health electronic databases and preprints and independent assessment of study eligibility, data extraction, and quality. This review also has several limitations. First, we were unable to study the influence of school closure distinct from broader social lockdown, and thus our findings relate to lockdowns including school closures. Second, machine learning enabled a broad search across multiple databases but may have missed studies. Third, approximately 60% of the studies were cross-sectional, providing weak evidence. Many publications included only simple analyses that did not take account of potential confounders. Fourth, studies using parent report may have been biased by greater amounts of time spent by parents with their children and adolescents compared with before COVID-19. Fifth, no data were identified on the association of the degree of school closures nor on whether associations differed by age. In addition, no studies were included on a number of important outcomes or vulnerable groups, including studies of children with learning difficulties or autism or studies of eating disorders or substance use. Sixth, because of heterogeneity of study designs and measures, it was not possible to conduct a meta-analysis; rather, the results were summarized with a narrative synthesis. Seventh, the findings apply primarily to the first COVID-19 wave when schools in most countries were closed, and the duration of most school closures was of relatively limited duration. Other work is needed to examine associations of partial school closures or hybrid learning systems that occurred in later waves. Eighth, publication bias was not formally assessed in this systematic review.

### Conclusions

In this systematic review of reports from the first wave of the COVID-19 pandemic, studies of short-term school closures as part of broader social lockdown reported adverse mental health symptoms and health behaviors among children and adolescents. The available data did not allow for distinguishing associations between school closure and health outcomes and behaviors from those of broader lockdown measures.

#### ARTICLE INFORMATION

**Accepted for Publication:** November 2, 2021.

**Published Online:** January 18, 2022.  
doi:10.1001/jamapediatrics.2021.5840

**Author Contributions:** Drs Viner and Minozzi had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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**Conflict of Interest Disclosures:** None reported.



**Additional Contributions:** We are grateful to members of the World Health Organization Research Advisory Group on COVID-19 in Education Settings for suggestions on the work. We are also grateful to Alexandra Jamieson (UCL) for helping with screening of abstracts; compensation was not received.

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