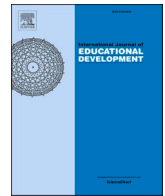




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Effects of remote learning during COVID-19 lockdown on children's learning abilities and school performance: A systematic review

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ABSTRACT

This systematic review describes the effects of COVID-19 lockdowns on children's learning and school performance. A systematic search was conducted using three databases. A total of 1787 articles were found, and 24 articles were included. Overall, academic performance was negatively affected by COVID-19 lockdowns, with lower scores in standardized tests in the main domains compared to previous years. Academic, motivational, and socio-emotional factors contributed to lower performance. Educators, parents, and students reported disorganization, increased academic demands, and motivational and behavioral changes. Teachers and policymakers should consider these results in developing future education strategies.

1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has had severe global impacts, from the deaths of millions of people to worldwide economic crises. The spread of this unprecedented disease has forced communities into social isolation, changing the ways we relate and socialize with others. Since March 11, 2020, when the World Health Organization declared a global pandemic, the world has increasingly transitioned toward remote communication, placing a virtual interface between human interactions (Cucinotta and Vanelli, 2020). Children have been profoundly affected by this sudden lifestyle change. With the closure of schools and colleges, learning and education have increasingly become screen-dependent, impacting children's cognitive, social, and emotional development (Alban Conto et al., 2021; Haleemunnissa et al., 2021).

Although remote learning benefits disease control, it has augmented socioeconomic inequalities regarding access to technological resources (Hossain, 2021). During the pandemic, low-income families tended to have less access to reliable internet and devices compared with high-income families in the same city (Francis and Weller, 2022). Consequently, children from less privileged households spent fewer hours learning and were more likely to drop out of school (The Lancet, 2021; Zagalaz-Sánchez et al., 2021). Indeed, UNICEF reports that the impacts of the COVID-19 pandemic on children's education in Ghana

were marked by a lack of access to essential tools and learning materials (such as computers and textbooks) and inadequate conditions for effective learning (overcrowded households, poor or no access to electricity, and improper space for learning). These circumstances were more common in children living in rural and remote areas. Children with disabilities and physical or learning impairments were also affected (Karpati et al., 2021). Furthermore, a lack of high-quality education impacts individuals' health and income, as well as professional opportunities in the future, because of the bidirectional links between health and education (The Lancet, 2021).

Moreover, several adverse effects of remote learning on children's mental health have been identified, mostly related to the excessive use of electronic devices and lack of in-person contact with school classmates and teachers. These reported effects include disturbed sleep patterns, attention deficits, frustration, stress, depression, and boredom (Xie et al., 2020). However, positive effects of distance learning have also been reported, such as improved competitive and motor skills (Sundus, 2017). Therefore, the overall impact of school closures and remote learning remains controversial.

Remote learning has also negatively affected children's cognitive and academic performance throughout all age groups (Colvin et al., 2022). Standardized assessments during and after obligatory confinement have revealed students' difficulties meeting grade expectations, particularly in schools with less in-person class time (Colvin et al.,

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2022). Specific academic difficulties have been reported in mathematics, language, and reading skills. More than 1.5 million students from across the United States exhibited worse performance in mathematics and reading scores compared with the previous academic year (Colvin et al., 2022).

As the death rate from COVID-19 slows, people have gradually returned to in-person businesses, and schools have begun to reopen. Current evidence still needs to be more consistent regarding the effect of remote learning on academic performance. Although remote tools may facilitate access to education and allow the development of additional learning skills, the consequences of screen-dependent learning during confinement are likely to affect children in the post-COVID-19 era, and the long-term impact remains to be seen. Therefore, the current systematic review sought to describe the effects of COVID-19 lockdowns on children’s learning abilities and school performance.

2. Materials and methods

A systematic literature search was conducted on September 24,

2021, and February 3, 2023, to identify experimental, observational, or analytical studies. The search was performed in three online databases. The following terms were used in a search of PubMed (<https://pubmed.ncbi.nlm.nih.gov/advanced/>): (((((((virtual) OR (virtually)) AND (learning)) AND (learning disorders)) AND (distance learning[MeSH Terms])) OR (distance education[MeSH Terms])) AND (pandemic [MeSH Terms])) OR (confinement)) AND (School children) AND (COVID-19)). For searching the Scopus database (<https://www.scopus.com>), we used the following terms: ALL (virtual OR virtually AND learning AND learning AND disorders AND (“distance” AND “learning”) AND (“distance” AND “education”) AND (pandemic OR confinement) AND (“school” AND “children”) AND covid-19) AND (LIMIT-TO (SUBJAREA, “MEDI”) OR LIMIT-TO (SUBJAREA, “PSYC”) OR LIMIT-TO (SUBJAREA, “HEAL”) OR LIMIT-TO (SUBJAREA, “NEUR”)). Finally, for searching the Science Direct database (<https://www.sciencedirect.com/search>), we used the following terms: (((((((virtual) AND (learning)) AND (learning disorders)) AND (distance learning[MeSH Terms])) OR (distance education[MeSH Terms])) AND (pandemic [MeSH Terms])) OR (confinement)) AND (school children) AND COVID-

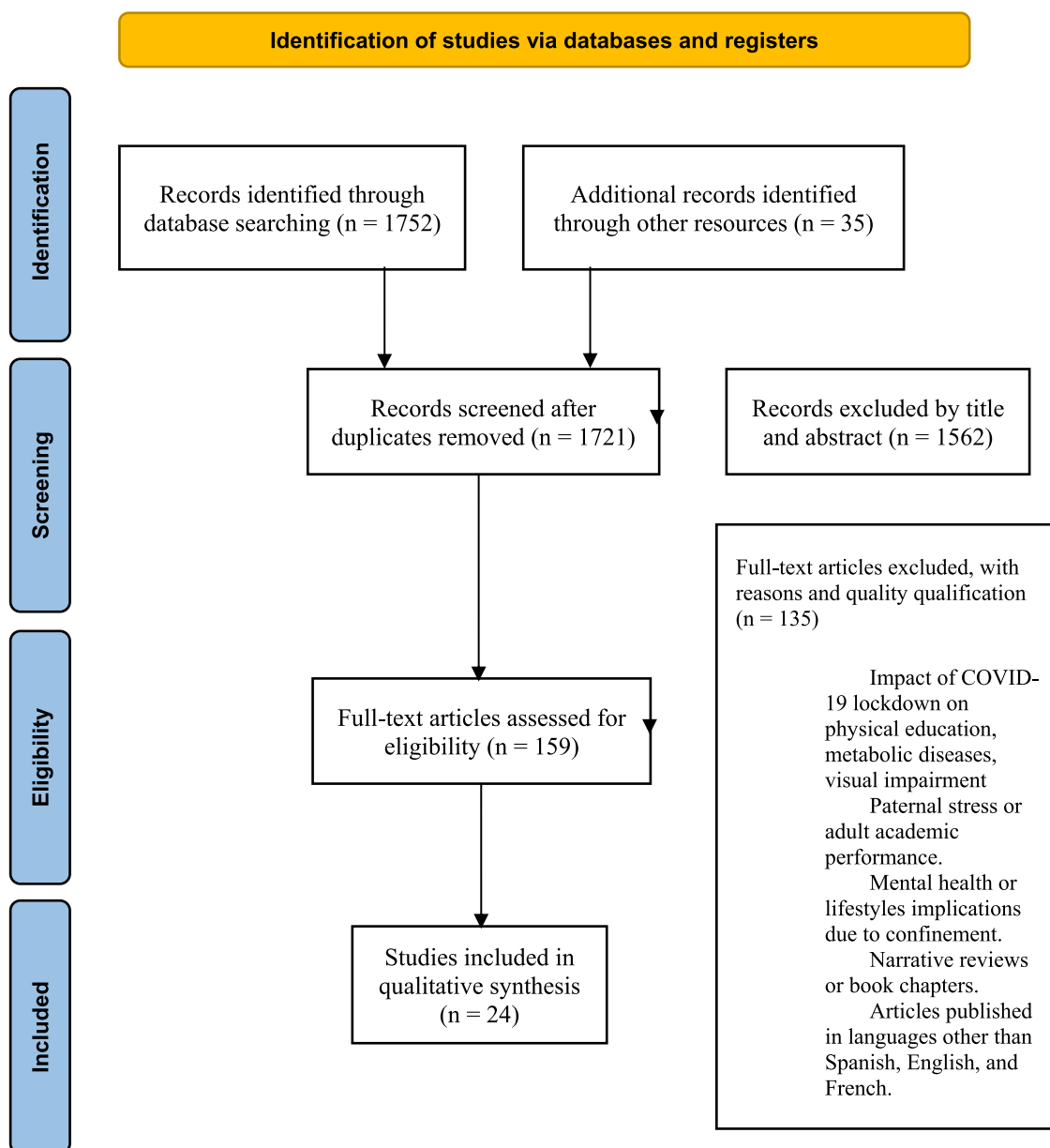


Fig. 1. Preferred reporting items for systematic reviews and meta-analyses flow diagram.

19. The ID 290696 was generated in the International Prospective Register of Systematic Reviews.

We found 1787 articles, removed duplicates, and filtered the remaining articles by title and abstract following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Fig. 1). Articles were excluded if they: (I) assessed the impact of COVID-19 lockdown on physical education, metabolic diseases, or visual impairment; (II) focused on paternal stress or adult academic performance; (III) focused on mental health or lifestyle implications caused by confinement without analyzing the association with learning abilities; (IV) were book chapters or narrative reviews; or (V) were published in languages other than Spanish, English, and French. Consequently, we selected 24 articles. All included articles were evaluated using the Joanna Briggs checklist to guarantee quality (<https://jbi.global/critical-appraisal-tools>). Finally, we extracted the following information: title, year of publication, authors, digital object identifier number, objectives, period of the study, period of confinement in the country of the study, evaluated learning area, population and sample, tests implemented for learning assessment, and overall results. In addition, a final question was answered for each study: “Did learning improve, stay the same, or worsen after lockdown?” All investigators participated in the data collection process and the preparation for data presentation and synthesis.

3. Results

Articles included in the review were grouped based on the primary domain of children’s learning performance examined during COVID-19 lockdowns. First, children’s academic performance was clustered in mathematics, reading, language, and biology. Second, we grouped articles that examined emotional and behavioral impacts on academic performance, and those that focused on children’s, parents’, and teachers’ recollections regarding perceptions of learning (Table 1). Twelve studies were conducted in Europe (Álvarez-Guerrero et al., 2021; Chambonnière et al., 2021; Engzell et al., 2020; Giménez-Dasí et al., 2020; Haelermans et al., 2022; Korzycka et al., 2021; Maldonado and Witte, 2021; Rose et al., 2021; Scarpellini et al., 2021; Spitzer and Musslick, 2021; Tomasik et al., 2021; Zagalaz-Sánchez et al., 2021), followed by four in Asia (Cui et al., 2021; Sakarneh, 2021; Zhang et al., 2020; Zhao et al., 2020), seven in North America (Domingue et al., 2022; Gaudreau et al., 2020; Goldhaber et al., 2022; Kuhfeld et al., 2022, 2020; Maulucci and Guffey, 2020; Relyea et al., 2023), and one in South America (González et al., 2022) (Supplementary table). Regarding evaluation methods, fifteen papers used standardized tests or formative assessment, eight studies used online questionnaires or surveys, and one study used an evaluation scale. Overall, we found that worsening learning outcomes were reported in 16 studies, whereas four studies reported improvements in children’s performance in mathematics, biology, and cognitive abilities, using adaptable teaching strategies for online classes. Finally, four studies reported stable learning performance. Further discussion of each study and the results is presented below.

4. Discussion

4.1. Effects of COVID-19 Lockdowns on Children’s mathematics performance

Six of the 24 studies evaluated differences in mathematical performance before and after lockdowns (Cui et al., 2021; Engzell et al., 2020; Goldhaber et al., 2022; Kuhfeld et al., 2020; Rose et al., 2021; Tomasik et al., 2021). Of these, only one study reported improved children’s academic outcomes, comparing the relative error and absolute error rates in mathematical problem sets in 2500 German students from grades 4–10 before and during school closures (Spitzer and Musslick, 2021). The results revealed a positive effect of remote learning during

Table 1

Articles examining the impact of remote learning during the COVID-19 pandemic.

Impact of remote learning during COVID-19 lockdowns	Domains	References
Academic performance	Mathematics	(Engzell et al., 2020; Goldhaber et al., 2022; González et al., 2022; Haelermans et al., 2022; Kuhfeld et al., 2020; Maldonado and Witte, 2021; Rose et al., 2021; Spitzer and Musslick, 2021; Tomasik et al., 2021)
	Reading	(Domingue et al., 2022; Engzell et al., 2020; Gaudreau et al., 2020; Goldhaber et al., 2022; Haelermans et al., 2022; Kuhfeld et al., 2022, 2020; Maldonado and Witte, 2021; Rose et al., 2021)
	Language and spelling	(Engzell et al., 2020; González et al., 2022; Haelermans et al., 2022; Maldonado and Witte, 2021; Tomasik et al., 2021)
Emotion and behavior	Biology	(Maulucci and Guffey, 2020)
	Resilience	(Zhang et al., 2020)
	Emotional regulation	(Chambonnière et al., 2021; Giménez-Dasí et al., 2020; González et al., 2022; Zhao et al., 2020)
	Attention	
	Inhibition	
Population perception	Mood disorders	
	Willingness to study	
Population perception	Children with intellectual disabilities	(Álvarez-Guerrero et al., 2021; Cui et al., 2021; Rose et al., 2021; Zhao et al., 2020)
	Children with neurotypical development	(Cui et al., 2021; González et al., 2022; Korzycka et al., 2021; Sakarneh, 2021; Scarpellini et al., 2021; Zagalaz-Sánchez et al., 2021)

COVID-19 lockdowns compared with the results from the previous year, particularly in students with previous lower academic achievement (Spitzer and Musslick, 2021).

The other studies that evaluated students using standardized math tests in American, Swiss, Dutch, Flemish, and British schools reported mainly lower primary school scores during and after lockdowns (Engzell et al., 2020; Goldhaber et al., 2022; Kuhfeld et al., 2020; Maldonado and Witte, 2021; Rose et al., 2021; Tomasik et al., 2021). Differences in school performance varied among primary and secondary Swiss students, with the former being the most affected group (Tomasik et al., 2021). Overall academic achievement was reduced in both groups, whereas only primary school students exhibited delayed learning with a distance learning system (Tomasik et al., 2021). The authors proposed that cognitive, motivational, and socio-emotional effects were contributing factors (Spitzer and Musslick, 2021). These findings align with projections of slower academic development after school closures in the United States (Goldhaber et al., 2022; Kuhfeld et al., 2020). A Policy Analysis for California Education report found that by the time students completed interim winter assessments in the 2020–21 school year, they had experienced a learning lag of approximately 2.6 months in English language arts (ELA) and 2.5 months in math (Pier et al., 2021). Moreover, economically disadvantaged students, English learners, and students of color experienced a more significant learning lag than students not in these groups (Goldhaber et al., 2022; Pier et al., 2021).

4.2. Effects of COVID-19 Lockdowns on Children’s reading performance

Several studies in the United States, Netherlands, and England evaluated the effects of COVID-19 lockdowns on reading abilities in children (Domingue et al., 2022; Engzell et al., 2020; Gaudreau et al.,

2020; Goldhaber et al., 2022; Kuhfeld et al., 2020; Rose et al., 2021; Tambyraja et al., 2021). Engzell et al. analyzed performance in reading and comprehension of factual and literary subjects among 350,000 primary school students in national exams before and after an 8-week lockdown during the COVID-19 pandemic (Engzell et al., 2020). The results revealed a post-pandemic decrease in reading performance of more than 3 % compared with pre-pandemic test results (Engzell et al., 2020). Similar unfavorable results were reported by Rose et al.'s study in England during the spring and summer of 2020 (Rose et al., 2021), which followed 6000 pupils for two years and evaluated learning performance using National Foundation for Educational Research standardized tests. The results revealed significantly lower reading performance in 2020 compared with a 2017 sample, with 5.2 % of students scoring two marks fewer. Moreover, reading assessments revealed a 7-month progress delay in 2020, compared with a 2019 sample (Rose et al., 2021).

In the United States, Kuhfeld et al. proposed several projections regarding the impact of COVID-19 on learning patterns in 5 million students (Kuhfeld et al., 2020). Data were extracted from Measures of Academic Progress Growth assessments in the previous two years. The authors made various predictions regarding best-case scenarios through to worst-case scenarios. Projections in a partial absenteeism scenario were predicted to result in 63–68 % of the expected annual learning gains in reading, whereas full absenteeism was predicted to result in less than 30 % of learning gains in reading. In addition, variability between students' reading performance was estimated to be 1.2 times the standard deviation normally expected (Kuhfeld et al., 2022).

Several studies reported that students' socioeconomic status was a determinant factor for negative impacts on reading performance caused by COVID-19 lockdowns (Domingue et al., 2022; Engzell et al., 2020; Kuhfeld et al., 2020; Rose et al., 2021; Tambyraja et al., 2021). In the United States, studies reported that students who attended high socioeconomic-status schools achieved better academic performance and had a more robust growth level than those who attended low socioeconomic-status schools or had reduced-price lunches (Domingue et al., 2022). In the Netherlands, the decrease in reading learning performance was reported to be 60 % greater in children from disadvantaged homes (Engzell et al., 2020; Haelermans et al., 2022). Moreover, in England, Rose et al. reported that the gap between disadvantaged and non-disadvantaged students was 8.28 standardized points in the test, corresponding to an 8-month learning gap between the two groups (Rose et al., 2021).

However, Gaudreau et al. proposed that during the COVID-19 pandemic, children's remote vocabulary learning, and comprehension could be supported with virtual strategies designed to contribute to the educational progress of young students (Gaudreau et al., 2020). The researchers evaluated reading comprehension and vocabulary learning in 58 4-year-old children under three different storytelling format conditions: live, video chat, and prerecorded storytelling. The results revealed that reading in all three formats positively stimulated verbal learning compared with children not exposed to reading, with more significant responses reported in the live and video chat conditions (Gaudreau et al., 2020).

In addition, absenteeism significantly impacts students' reading performance, indicating greater variability between children's academic skills (Kuhfeld et al., 2020). Some reading strategies used in remote learning environments may be beneficial for reading and could be implemented by teachers (Gaudreau et al., 2020). Furthermore, social, and economic inequalities may contribute to gaps in reading performance between students that could last for years, requiring substantial mitigation efforts from schools and governments.

We found only a few studies conducted in other countries. Angrist et al. estimated learning losses in terms of oral reading fluency in sub-Saharan Africa from half a year to over one year in the short term, which can accumulate over time, and children might be unable to catch up. Their estimates suggest that short-term learning deficits for a child in

grade 3 could accumulate to the equivalent of 2.8 years of lost learning by grade 10 (Angrist et al., 2021).

4.3. Effects of COVID-19 Lockdowns on Children's language performance

School closures caused by COVID-19 lockdowns have been reported to affect language learning negatively. Three of the 17 included studies reported reduced performance in language standardized tests compared with previous test results (Engzell et al., 2020; Maldonado and Witte, 2021; Tomasik et al., 2021). Maldonado et al. evaluated mathematical and language scores in a Flemish school and reported lower Dutch and French learning results than in mathematics (Maldonado and Witte, 2021). The authors proposed that the lack of Dutch speaking at home contributed to lower language performance. However, this difference was not found by Engzell et al., who evaluated reading, spelling, and mathematics scores in a Dutch school and reported lower scores in all three subjects than the previous year (Engzell et al., 2020; Maldonado and Witte, 2021). Children who relied on speech and language therapy faced a more significant challenge after school closures. The lack of access to in-person therapy and the shift to newly established teletherapy modalities contributed to therapy dropout and were likely to have decreased academic achievement in this population (Tambyraja et al., 2021).

4.4. Effects of COVID-19 Lockdowns on Children's biology performance

Biology and science performance was also assessed during COVID-19 lockdowns, and different virtual strategies have been proposed by researchers (Maulucci and Guffey, 2020). Maulucci et al. examined the effects of Bybee's 5E virtual academic model in biology lessons among 71 high school students. Bybee's 5E model was integrated into a remote biology school curriculum, following two standard courses: The Alabama Course of Study and the Next Generation Science Standards. The authors examined responses to two biology pretest questions to assess misconceptions and evaluate students' progress. The course involved several engaging, exploring, explaining, extending, and evaluating virtual activities. Analysis of the course dynamics revealed that students who attended live lessons benefited from discussion and feedback opportunities. This finding indicates that increasing live lessons and real-time participation may increase engagement, using tools like Nearpod, Zoom, and bio-interactive platforms. Overall, the results suggest that teachers' and students' technology skills must be developed quickly to enable new virtual strategies that guarantee the best learning environments for students (Maulucci and Guffey, 2020).

4.5. Children's, parents, and teachers' perceptions of learning during COVID-19

Multiple investigators have studied the perceptions of students, parents, and teachers regarding the changes in education caused by COVID-19 (Álvarez-Guerrero et al., 2021; Cui et al., 2021; Korzycka et al., 2021; Sakarneh, 2021; Scarpellini et al., 2021; Zagalaz-Sánchez et al., 2021; Zhang et al., 2020). Here we discuss the perceptions reported in these studies, emphasizing those that involve academic performance and learning skills. We will also review how students perceive their learning process and how parents and teachers perceive it from their perspectives.

4.5.1. Perceptions of parents' and teachers of children with special needs

Regarding students with intellectual disabilities, five studies have been conducted so far (Álvarez-Guerrero et al., 2021; Averett, 2021; Sakarneh, 2021; Scarpellini et al., 2021; Tellier, 2022). Some studies revealed negative perceptions and challenges of remote learning (Álvarez-Guerrero et al., 2021; Averett, 2021; Sakarneh, 2021). In Jordan, Sakarneh interviewed ten parents of children with special needs about their perceptions regarding the use of online platforms, behavioral

changes caused by lockdowns, and the level of inclusion of education (Sakameh, 2021). Parents reported two main issues regarding remote learning adaptation: first, the lack of motivation to complete tasks individually, and second, the use of conventional teaching techniques that were not adaptable to children's particular needs because of strict schedules and inadequate learning material (Sakameh, 2021). Studies conducted in Spain, Italy, and the US highlighted the lack of virtual accommodations for the special needs population and the lack of social skills development due to virtual interactions (Álvarez-Guerrero et al., 2021; Averett, 2021; Scarpellini et al., 2021).

On the contrary, some parents and teachers in the US and Canada shared positive experiences with remote learning in children with disabilities. They expressed stress relief, control of mood swings, time flexibility, increased accessibility, and support due to the hard work of school staff (Averett, 2021; Pellicano and Stears, 2020; Tellier, 2022).

Several strategies have been proposed. Utilization of concept maps, prolonged work times, and decreases in the number of tasks as well as encouraging children to ask for help, promoting the preparation of the class materials, stimulating peer discussion, familiarization with the learning platform, and using an individualized student center method (Cui et al., 2021; Tellier, 2022; Zhao et al., 2020). In Spain, Álvarez-Guerrero et al. analyzed the Dialogic Literary Gatherings responses of five children with moderate to severe intellectual disabilities (Álvarez-Guerrero et al., 2021). Teachers' and parents' perceptions were also examined. Two teachers directed the meetings once a week for six months. Visual aids, such as photographs and drawings related to the literary content, facilitated children's comprehension. In addition, the role of families in learning interaction during gatherings was essential for the transition from face-to-face to virtual dynamics. Teachers perceived the benefits of debate and discussion in cognitive and behavioral processes. Moreover, Dialogic Literary Gatherings were reported to promote children's vocabulary, comprehension, and reading abilities and enhance their interactions with society (Álvarez-Guerrero et al., 2021).

4.5.2. Perceptions of parents and teachers of neurotypical children

In neurotypical children, further studies were carried out that reflected essential concerns, which can be grouped into the following clusters: perception of virtual learning disorganization, increased academic demands, motivational and behavioral changes, and particular academic impact in rural areas (Sakameh, 2021; Scarpellini et al., 2021; Zagalaz-Sánchez et al., 2021).

First, the overall results reported a perception of the disorganization of distance learning. In Italy, 1601 mothers were interviewed to explore their perceptions of primary and middle school children's experiences with remote learning during COVID-19 lockdowns. The results revealed that 1.5 % of children lacked access to technology, particularly primary school students who were often exposed to less structured routines. Furthermore, the results revealed diminished teacher feedback and contact compared with face-to-face teaching formats. Regarding learning assessments, primary school students performed less than in the previous academic year. In contrast, middle school grades remained consistent because of better planning of tests and oral exams (Scarpellini et al., 2021). In a survey conducted in Poland, school children's concerns were regarding the lack of feedback from teachers, unclear evaluation parameters for older students, and an absence of academic progress comparison with peers among younger students (Korzycka et al., 2021).

Second, the curriculum structure was a perceived concern, particularly increased academic demands. A national survey in Poland assessed adolescents' perceptions of remote learning and performance during COVID-19 lockdowns (Korzycka et al., 2021). For older students, curriculum structure was identified as a difficulty, particularly increased academic demands (Korzycka et al., 2021). In China, Cui et al. conducted a questionnaire with 1008 elementary school children and parents, distributed in two data collection periods, one at the beginning and the other at the end of 40 days during China's COVID-19 lockdown (Cui

et al., 2021). According to the results, parents agreed that the lecture format was inadequate, surpassing students' capacities and potentially promoting emotional and behavioral disturbances (Cui et al., 2021).

Third, a lack of motivation and behavioral problems were commonly raised in surveys. A survey by Cui et al. revealed that a trend for decreased motivation was reflected in uncompleted homework assignments and dissatisfaction with online lessons (Cui et al., 2021). Moreover, Korzycka et al. reported that lack of motivation was thought by children to be secondary to the lack of a school environment and extracurricular activities (Korzycka et al., 2021). Furthermore, Italian mothers also reported behavioral changes, such as reduced attention span (< 20 min), an increased need for breaks (every 10 min), restlessness in younger children (69.1 %), and anxiety in older children (34.2 %) (Scarpellini et al., 2021). In addition, living conditions during COVID-19 lockdowns significantly affected children's motivation, and the degree of happiness and fatigue were related to the size of housing (Zagalaz-Sánchez et al., 2021). Specifically, larger house environments were associated with greater happiness and less fatigue, while participants that lived in rural areas had increased levels of physical activity and reading (Zagalaz-Sánchez et al., 2021). A survey performed in India regarding the perception of teachers and students towards online classes reported generalized negative feedback and overall preference for regular classes and highlighted the influence of learning environments on the quality of online learning and teaching (Selvaraj et al., 2021).

Finally, specific academic impacts in rural areas were also reported in three studies (Korzycka et al., 2021; van Cappelle et al., 2021; Zagalaz-Sánchez et al., 2021). In Spain, a 45-day cross-sectional study was performed to analyze the effects of living conditions during COVID-19 on educational activities and learning processes. A sample of 837 0–12-year-old children and their families responded to a validated questionnaire, and daily life activities were compared between children from urban and rural areas. Regarding technological devices, children with higher usage tended to live in apartments, followed by children without gardens in their houses, who mostly lived in urban areas (Zagalaz-Sánchez et al., 2021). In addition, students in rural areas faced significant tech-support challenges in remote learning compared with students from large cities (Korzycka et al., 2021).

Similarly, a study reflecting on the findings from a UNICEF survey in India found several factors related to adolescents' perception of their learning. The frequency of teacher contact and live video classes had a positive impact. However, time spent on domestic chores significantly decreased reported levels of perceived learning (van Cappelle et al., 2021).

Overall, the authors proposed that the multiple stimuli involved in remote learning can overload children's integrating learning abilities (Korzycka et al., 2021). The lack of appropriate cognitive stimulation and social interaction caused by COVID-19 lockdowns might affect learning performance, particularly in young children (Scarpellini et al., 2021). Further institutional efforts should focus on comprehending social determinants to improve interventions and academic conditions for children.

4.6. Emotional and behavioral impacts on academic performance

Some previous studies have focused on understanding the emotional and behavioral factors regarding learning and academic environments during the COVID-19 pandemic. However, only three studies have sought to relate these factors to children's school performance and learning abilities (Giménez-Dasí et al., 2020; Zhang et al., 2020; Zhao et al., 2020). For example, resilience, emotional regulation, psychiatric disorders, and behavioral changes have been examined in various studies. In Spain, Giménez-Dasí et al. evaluated psychological and behavioral effects in 167 3-to-11-year-old children and their families (Giménez-Dasí et al., 2020). The System of Evaluation of Children and Adolescents questionnaire was assessed twice: before and after 4–6 weeks of lockdown. The results were divided between older

(6–11-year-olds) and younger (3-year-olds) children. Older children exhibited the worst emotional regulation, attention, self-control, and willingness to study. In addition, younger children's parents reported worsening psychological states (55 % in early Childhood and 64 % in Primary education), whereas 36 % reported no change, and 17 % felt that their child's psychological state had improved (Giménez-Dasí et al., 2020). Similar results were reported by Zhao et al. in 2010 school-aged children, parents, and teachers, using online questionnaires for seven days in China (Zhao et al., 2020). Overall, participants reported that homeschooling methods were acceptable, whereas teachers mentioned a possible decline in children's academic performance, motivation, and focus. In addition, the results revealed that 17.6 % of respondents suspected emotional and behavioral problems in children, and 68.8 % of parents reported that their children had more than 3 h of screen time per day, which exceeds the recommendations of the American Academy of Pediatrics (Committee on Public Education, 2001; Zhao et al., 2020). Another study conducted in Spain found that online digital storytelling activity during the pandemic crisis provided primary school cognitive, emotional, and social support (Alonso-Campuzano et al., 2021).

In China, Zhang et al. evaluated emotional resilience and its effects on learning skills in 896 12–14-year-old middle school children (Zhang et al., 2020). In addition, different questionnaires were implemented in seventh and eighth graders during the first lockdown period. The results revealed that greater resilience contributed to a better time, environment, and resource management abilities. However, the authors reported that the follow-up duration was short and suggested further studies examining other factors, such as academic performance, family support, and technology habits (Zhang et al., 2020).

5. Limitations

The number of studies selected for qualitative analysis is low, which impedes significant overall conclusions of the effects of lockdowns on academic outcomes. Although studies analyzed in this review provide general conclusions about the impact of remote learning on children's school performance, additional studies are required to further evaluate the potential moderators of learning. Furthermore, articles included in this study are heterogeneous in terms of the number of subjects, study design, and evaluation methods, which makes results difficult to compare one to another, thereby reaching subjective conclusions rather than quantitatively significant results. We also acknowledge an important geographic bias since most of the studies with significant results in academic performance were conducted in selected regions, and we found less evidence from Latin America, Africa, and other developing countries.

6. Conclusions

A relatively small number of studies examining the impact of COVID-19 lockdowns on academic performance and learning abilities have been published to date. Our analysis suggested several negative consequences of lockdowns and the shift to virtual learning schemes for children's academic performance in different knowledge areas. However, in about 35 % of the studies included, no learning loss was reported; therefore, the negative impact of academic performance during lockdown should be tempered. Some contributing factors were identified: socioeconomic status (type of household and family income), access to technology, learning environment, quality of innovative remote resources, and teachers' feedback.

Furthermore, remote learning has increased the learning gap between students, including those with intellectual disabilities who face a more significant challenge. New learning strategies have been developed to improve assessment and interactive pedagogical tools for improving children's attention, motivation, and willingness to study. In addition, psychological support for the behavioral and emotional consequences of COVID-19 is needed to facilitate children's transition back

into in-person learning routines. Further research should focus on the long-term learning impact on school performance after lockdown to establish truthful conclusions.

Preparation for a possible new emergency is deemed necessary. Consideration of flexible learning modalities and standardized tests for performance monitoring could help overcome language, geography, and disability barriers. In addition, psychological support for the behavioral and emotional consequences of COVID-19 is needed to facilitate children's transition back into in-person learning routines. Further research should focus on the long-term learning impact on school performance after lockdown to establish truthful conclusions.

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María C. Cortés-Albornoz: Conceptualization, Methodology, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing. **Sofía Ramírez-Guerrero:** Conceptualization, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing. **Danna P. García-Guáqueta:** Conceptualization, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing. **Alberto Vélez-Van-Meerbeke:** Conceptualization, Investigation, Resources, Writing – review & editing. **Claudia Talero-Gutiérrez:** Conceptualization, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Supervision.

Conflicts of interest statement

The authors declare that they have no competing interests.

Data Availability

Not applicable.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ijedudev.2023.102835](https://doi.org/10.1016/j.ijedudev.2023.102835).

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