



THE LINK BETWEEN HEALTH ISSUES AND LEARNING DYNAMICS AMONG LATVIAN STUDENTS

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Abstract

The contagion of COVID-19 and its resulting health consequences, combined with the rapid and unplanned shift to online teaching and learning, profoundly affected various aspects of students' personal and academic lives worldwide. The pandemic disrupted traditional educational systems, altering the way students learn and interact, while also influencing their mental and physical well-being. These changes have raised concerns about the long-term impact on students' academic performance, engagement, and overall learning outcomes, especially in the context of health challenges exacerbated by the pandemic. Therefore, the aim of this study is to explore the link between COVID-19-related health problems and student learning dynamics. The study found that health indicators have generally worsened during COVID-19 and have significantly worsened for students who contracted COVID-19. However, this difference is statistically significant only for the health factor "nervousness." The study also indicates that the overall deterioration of health does not significantly affect academic performance. A total of 106 students participated in the study, with 60 participants from grade 8 and 46 participants from grade 9. Of these, 59 were male and 47 were female. Among the participants, 81 contracted COVID-19, while 25 did not. Although many studies suggest that the consequences of COVID-19 negatively impact health and potentially affect academic achievement, these effects have not been found to be statistically significant. Therefore, further research is needed to identify specific cases where the spread of the disease could have a statistically significant impact on academic performance.

Keywords: COVID-19, learning dynamics, learning outcomes, quantitative research, self-assessment survey

Introduction

The provision of education is influenced by various local, national, and global events, one of which was the COVID-19 pandemic that began in early 2020. When the transition to remote learning started, the education system had to adapt immediately, and the consequences of these changes also needed to be considered and analysed, particularly in relation to students' learning dynamics and academic achievements. Various research studies identified the profound and multifaceted impact of pandemics on global society, with the education sector being one of the most affected areas (Medne et al., 2024; Pokhrel & Chhetri, 2021). The swift and unplanned transition from traditional classroom instruction to online learning environments was necessitated by efforts to curb the spread of the virus (Easop, 2022; Viner et al., 2020). While essential for maintaining social distancing, this shift introduced significant challenges for students, educators, and families (Supratiwi et al., 2021). According to UNICEF, over 1.6 billion children experienced educational disruptions due to school closures, underscoring the widespread nature of this crisis (UNICEF, 2021).

Beyond these educational disruptions, the pandemic significantly impacted students' mental and physical health. Research shows that COVID-19 and its associated stressors

exacerbated symptoms of anxiety, depression, and other forms of distress-related psychopathology in children and adolescents (Blendermann et al., 2024; Madigan et al., 2023; Sun et al., 2023). Among university students and other age groups, these psychological effects have been linked to increased anxiety and depression, further compounded by disrupted academic processes and inadequate social support (Cao et al., 2020; Capone et al., 2020; Kohls et al., 2020; Wang et al., 2020;). Consequently, these mental health challenges have been associated with heightened stress, decreased self-efficacy, and a reduced sense of belonging among students (Essadek & Rabeyron, 2020; Stathopoulou et al., 2020; Van de Velde et al., 2020). In addition to these mental health impacts, significant learning losses have been documented, with primary school children experiencing declines in academic performance equivalent to several months of learning (Moscoviz & Evans, n.d.). Studies by Moscoviz and Evans (2022) and Patrinos et al. (2022) have reported average learning losses across different settings, though much of this evidence has come from high-income countries and has been based on school-based assessments. While severe cases of COVID-19 are less common among children and young people compared to adults, some may still experience long-term symptoms after contracting the disease (Lopez-Leon et al., 2022; Malone et al., 2022; NIHR, 2021). Academic achievement, and its prediction in relation to other psychological aspects, has been a subject of research for over a century. The strong relationship between cognitive abilities and academic achievement is well-established (Tikhomirova et al., 2020). Given this relationship, there is concern that the spread of COVID-19 and the conditions it created could affect the learning process and students' academic achievements not only in the short term but also in the long term (Molteni et al., 2021). While there are contradictions in studies regarding the severe course of COVID-19 and its impact on cognitive abilities in children and youth, it is emphasized that any disease with prolonged symptoms can adversely affect school attendance. Some European countries are already grappling with the consequences of the pandemic in their education systems (Blasko et al., 2022).

To date, most studies have focused on the impact of pandemic conditions on health, while relatively little emphasis has been placed on academic achievements. Although children are less likely to experience severe cases of COVID-19, the pandemic's conditions significantly affected the learning processes of 58 million students across Europe. The crisis created by COVID-19 poses serious risks to academic achievements and future opportunities, necessitating further research (Patrinos et al., 2022). In Latvia, research conducted between autumn 2019 and spring 2021, when face-to-face learning was shifted to remote learning, revealed a general trend of increasing average grades among students (Hačatrjana & Graustiļa, 2022). These grades continued to show a significant relationship with cognitive ability. However, there is a limited number of studies on the long-term physical and cognitive symptoms of COVID-19 in children and young people and their effects on academic achievement (Borel et al., 2022). Thus, there is a need for additional studies, particularly longitudinal ones, that monitor not only physiological but also psychological factors in relation to students' academic achievements after contracting COVID-19.

Research Problem

After contracting COVID-19, many people recover fully within a few days to a few weeks (NIHR, 2021). In most cases, COVID-19 presents as a mild or asymptomatic illness; however, recovery is not always swift or without complications (Lopez-Leon et al., 2022; Malone et al., 2022). An increasing number of studies indicate that patients continue to experience impaired cognitive abilities and mental health issues several months after an acute COVID-19 infection (Davis et al., 2021; Hampshire et al., 2022). These lingering symptoms are commonly referred to as "long COVID" or long-term complications of COVID-19 (Davis et al., 2021; Lopez-

Leon et al., 2022; Zimmermann et al., 2021). Research has identified more than 200 long-term symptoms of COVID-19, and the nature and severity of these symptoms can vary significantly over time within a single patient (Hughes et al., 2022; UK National Institute for Health and Care Excellence, 2022). Despite growing awareness of “long COVID,” there is still a notable lack of research on the cognitive difficulties experienced by children and young people who have had COVID-19, both during the illness and during the following recovery, as highlighted by studies conducted globally and in Latvia (Gardovska et al., 2022). This research gap underscores the need for further exploration to better understand and address these cognitive challenges.

Research Focus

This study focuses on examining the link between COVID-19-related health issues and student learning dynamics among school students in Latvia. It specifically aimed to explore how physical and mental health conditions resulting from the pandemic, such as cognitive impairments, anxiety, nervousness, and other long-term symptoms, impact academic performance, engagement, and learning outcomes. The study further researches whether these health factors have a statistically significant effect on the dynamics of academic achievements in different subjects and to what extent these impacts differ between students who contracted COVID-19 and those who did not.

This research addresses the gap in the current literature regarding the cognitive and psychological effects of “long COVID” on young students and their educational progress, both during the illness and after their recovery. It also seeks to contribute to the broader understanding of how pandemic-related health challenges influence learning dynamics, potentially guiding future educational and health interventions.

Research Aim and Research Questions

Given these challenges, this study aimed to research the link between COVID-19-related health problems and student learning dynamics, with a focus on how physical and mental health conditions resulting from the pandemic influence academic performance, engagement, and learning outcomes. Specifically, the research aimed to answer two key questions:

1. To what extent did the physical and mental health of students deteriorate during the COVID-19 pandemic, and how did contracting COVID-19 specifically affect their health?
2. Which specific health factors (e.g., mental health, physical health, or COVID-19-related conditions) affect students' dynamic of academic performance?

By examining these questions, the study aims to provide valuable insights and to identify areas where further research and intervention may be needed to support student well-being and learning outcomes.

Research Methodology

General Background

This study examines whether students' health factors influence their learning achievements. The study analyses the experience of students from general education schools. Students from grades 8 and 9 of the general education schools who were involved in the study attended a computer class (available at the school), where they completed a self-assessment survey on the QuestionPro site. School personnel (teachers and school psychologists were involved) helped to gather and merge students' learning dynamics with questionnaire answers,

and all the participants' responses were anonymized. Health factors, student learning dynamics and demographic data were gathered from 13.02.2023.-25.04.2023.

Sample

The convenience sampling method was used for the study. Invitation to participate in the research was sent to 20 general education schools. In total, 106 students chose to participate: 60 from grade 8 and 46 from grade 9. Students were between 14 and 16 years old. Of these students, 59 were male and 47 were female, while 81 contracted COVID-19 and 25 did not. All participants studied in general education schools.

Instrument and Procedures

Data on student health changes were collected using a questionnaire. All factors except working memory were self-assessed by students on a 4-point Likert scale (0 = none, 1 = mild, 2 = moderate, 3 = severe). Working memory was determined with a working memory test (based on the methodology of the Symmetry Span Task; SPT) (Kane et al., 2004), adapted by Bartušēvica, Laboratory for Perceptual and Cognitive Systems, University of Latvia. This measured students' visuospatial working memory. The test was specifically designed to be filled in on a computer screen without any time limit. The task shows a grid displaying a sequence of red squares, followed by a picture with an ornament. The participant must remember the exact location of each red square and specify them at the end. The participant must also indicate whether the ornament is symmetrical along the vertical axis or not.

Students' learning dynamics were defined as the difference between the mean values of all grades acquired in the year when the research was conducted and the previous year and compared across five subjects: mathematics, Latvian language, literature, English as a second language, and biology.

Data Analysis

Descriptive statistics (mean, median, standard deviation) were used to describe students' health factors. Data were non-parametric, therefore, Mann-Whitney *U* tests were carried out to determine whether the results differed between students who contracted COVID-19 and those who did not. Spearman's rank correlation tests were also carried out to determine the correlation between health factors and students' learning dynamics.

Data were analysed using SPSS Statistics 29, Microsoft Excel, and JASP 0.14.1. This study followed all ethical research standards in accordance with the General Data Protection Regulation (GDPR). Approval for conducting this research was obtained from the Research Ethics Committee of Social Sciences and Humanities of the University of Latvia (21.02.2023. Nr.30-47/4).

Research Results

Health factors considered typical for COVID-19 patients were compared to determine the extent to which health factors have changed. The comparison was made between students who had previously contracted COVID-19 and students who had not (Table 1).

Table 1
Changes in Health Factors

Health factor	Students who did not contract COVID-19			Students who contracted COVID-19		
	<i>M</i>	<i>Mdn</i>	<i>SD</i>	<i>M</i>	<i>Mdn</i>	<i>SD</i>
Fatigue	1.20	1	1.08	1.31	1	0.90
Headaches	0.84	0	1.03	1.05	1	1.02
Insomnia	1.00	1	1.19	1.01	1	0.98
Fragility	0.76	0	0.93	0.85	1	0.92
Hearing loss	0.28	0	0.54	0.48	0	0.81
Eyesight loss	0.40	0	0.71	0.40	0	0.63
Anhedonia	1.16	1	1.18	1.11	1	1.04
Mood	0.92	0	1.12	1.11	1	1.02
Long-term memory	0.60	0	0.87	0.80	0	0.98
Concentration	1.08	1	1.22	1.30	1	0.94
Nervousness	0.76	0	1.05	1.25	1	1.10
Working memory (time)	115.08	106	39.63	117.54	108	32.93

This comparison allows us to conclude that some health factors deteriorate more after contracting COVID-19. Students who contracted COVID-19 self-assessed changes in hearing loss, nervousness, and long-term memory higher compared with students who did not, while fatigue, insomnia, fragility, eyesight loss, anhedonia, and working memory times were assessed similarly. However, a lot of students who did not contract COVID-19 have been faced with deteriorating health. The mean and median values for fatigue, insomnia, anhedonia, and concentration are over 1, indicating that at least half of the students have been at least mildly affected by health issues. It should be noted that the data were collected at the end of the COVID-19 pandemic in Latvia; therefore, changes in health can be attributed to general public sentiment, which was not good, and the long period of distance learning, which heavily affected students' learning influencing socialization, motivation, and mental issues.

Mann–Whitney *U* tests were carried out to determine whether there is a statistically significant difference between students who contracted COVID-19 and those who did not (Table 2).

Table 2*Comparison of Students' Health Factors (Mann–Whitney U test)*

Health factor	Group	N	MR	Sum of Ranks	U	Z	p
Fatigue	Did not contract	25	50.8	1271	946.00	-0.52	.604
	Contracted	81	54.3	4400			
Headaches	Did not contract	25	48.6	1215	889.50	-0.97	.333
	Contracted	81	55.0	4457			
Insomnia	Did not contract	25	51.6	1290	964.50	-0.38	.707
	Contracted	81	54.1	4382			
Fragility	Did not contract	25	51.2	1280	954.50	-0.47	.642
	Contracted	81	54.2	4392			
Hearing loss	Did not contract	25	49.5	1237	912.00	-0.93	.354
	Contracted	81	54.7	4434			
Eyesight loss	Did not contract	25	52.6	1314	989.00	-0.22	.830
	Contracted	81	53.8	4357			
Anhedonia	Did not contract	25	53.8	1344	1006.00	-0.05	.960
	Contracted	81	53.4	4327			
Mood	Did not contract	25	48.6	1215	890.00	-0.96	.338
	Contracted	81	55.0	4456			
Long-term memory	Did not contract	25	49.2	1231	906.00	-0.87	.383
	Contracted	81	54.8	4440			
Concentration	Did not contract	25	47.7	1192	867.00	-1.13	.260
	Contracted	81	55.3	4479			
Nervousness	Did not contract	25	43.2	1080	755.00	-2.01	.044
	Contracted	81	56.7	4591			
Working memory (time)	Did not contract	25	52.0	1301	975.50	-0.28	.783
	Contracted	81	54.0	4371			

The results indicate almost no statistically significant differences between the health factor self-assessments of students who contracted COVID-19 and those who did not. There is a statistically significant difference only for the health factor “nervousness.” This indicates that contracting COVID-19 did not affect research participants’ health factors. Therefore, to determine whether the deterioration of these health factors influences students’ learning dynamics, both groups were merged for further analysis.

There is a statistically significant correlation between learning dynamics in mathematics and working memory (Table 3). However, the correlation should be considered weak. No other aspect has a statistically significant correlation with learning dynamics in mathematics.

Table 3
Spearman's Rank Correlation Between Health Factors and Learning Dynamics in Mathematics

Health factor	Fatigue	Headaches	Insomnia	Fragility	Hearing loss	Eyesight loss
r_s	.041	-.032	-.149	-.144	.068	.074
Health factor	Anhedonia	Mood	Long-term memory	Concentration	Nervousness	Working memory (time)
r_s	-.054	-.043	-.081	-.081	-.020	.196*

*. Correlation is significant at the .05 level (2-tailed).
**. Correlation is significant at the .01 level (2-tailed).

There is a statistically significant correlation between learning dynamics in Latvian language and fatigue, fragility, concentration, and working memory (Table 4). All correlations should be considered weak. Fatigue, fragility, and concentration determination have a negative effect on students' grades, while a longer working memory allows students to get higher grades in Latvian language.

Table 4
Spearman's Rank Correlation Between Health Factors and Learning Dynamics in Latvian Language

Health factor	Fatigue	Headaches	Insomnia	Fragility	Hearing loss	Eyesight loss
r_s	-.216*	-.155	-.100	-.218*	-.072	-.028
Health factor	Anhedonia	Mood	Long-term memory	Concentration	Nervousness	Working memory (time)
r_s	-.174	-.174	-.141	-.194*	-.043	.289**

*. Correlation is significant at the .05 level (2-tailed).
**. Correlation is significant at the .01 level (2-tailed).

There are no statistically significant correlations between learning dynamics in literature and health factors (Table 5). Furthermore, nearly all correlation r_s values are positive, indicating that deteriorating health improves students' grades. Further research should be conducted to find connections between literature and students' health issues.

Table 5
Spearman’s Rank Correlation Between Health Factors and Learning Dynamics in Literature

Health factor	Fatigue	Headaches	Insomnia	Fragility	Hearing loss	Eyesight loss
r_s	.119	.001	-.041	.072	.100	.036
Health factor	Anhedonia	Mood	Long-term memory	Concentration	Nervousness	Working memory (time)
r_s	.055	.059	.099	.129	.162	.167

*. Correlation is significant at the .05 level (2-tailed).
**. Correlation is significant at the .01 level (2-tailed).

There are no statistically significant correlations between learning dynamics in English as a second language and health factors (Table 6), indicating that these health factors do not affect learning dynamics in English as a second language.

Table 6
Spearman’s Rank Correlation Between Health Factors and Learning Dynamics in English as a Second Language

Health factor	Fatigue	Headaches	Insomnia	Fragility	Hearing loss	Eyesight loss
r_s	.045	.005	-.063	-.082	.072	.004
Health factor	Anhedonia	Mood	Long-term memory	Concentration	Nervousness	Working memory (time)
r_s	.041	-.026	-.078	.051	-.039	-.018

*. Correlation is significant at the .05 level (2-tailed).
**. Correlation is significant at the .01 level (2-tailed).

There are no statistically significant correlations between learning dynamics in biology and health factors (Table 7). It indicates that health factors are not connected to the dynamics of students’ academic performance in the subject of biology.

Table 7
Spearman's Rank Correlation Between Health Factors and Learning Dynamics in Biology

Health factor	Fatigue	Headaches	Insomnia	Fragility	Hearing loss	Eyesight loss
r_s	.080	-.007	-.036	.001	.120	.056
Health factor	Anhedonia	Mood	Long-term memory	Concentration	Nervousness	Working memory (time)
r_s	.006	.047	.171	.158	.108	.025

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

Therefore, only students' academic performance is affected by health factors in mathematics and Latvian language subjects.

Discussion

The findings of this study indicate a general deterioration in students' health during the COVID-19 pandemic, with those who contracted COVID-19 experiencing worse health outcomes, particularly in terms of nervousness. However, apart from nervousness, no other health factors were found to affect learning dynamics statistically significantly. Despite these health deteriorations, no significant impact on learning outcomes was observed in subjects such as literature, English as a second language, and biology. In contrast, weak correlations between some health factors and learning outcomes were identified in mathematics and Latvian language.

It is important to note that this study defined learning dynamics as changes in students' grades, which may also have been influenced by external factors, including the shift from face-to-face to remote learning (Lāma & Lāma, 2020). Teachers' attitudes and possible adjustments in testing practices may have facilitated higher grades for students who contracted COVID-19, potentially leading to grade inflation. Therefore, further studies are needed to isolate the specific impact of health factors on academic achievement and to assess whether these impacts are more pronounced in other contexts. The pandemic-induced shift to remote learning likely affected both students' health and academic performance. Research showed that digital competence and readiness for remote learning varied significantly among students, affecting how well they adapted to online learning environments (Slišāne et al., 2021; Slišāne et al., 2022).

The results align with previous studies that have documented the mental health challenges experienced by students during the pandemic (Blendermann et al., 2024; Lāma, 2021; Madigan et al., 2023). However, the weak influence of health factors on academic outcomes contrasts with prior research that highlights stronger connections between cognitive impairments and learning performance (Hampshire et al., 2022). This discrepancy may be attributed to the limitations of this study's methodology, particularly the reliance on self-reported data, which can be prone to biases.

The reliance on self-assessment surveys to evaluate cognitive symptoms presents a significant limitation. As noted in the literature, younger students in particular may struggle to recognize, identify, and describe the symptoms they experience (Davis et al., 2021; SCCM, n.d.). With over 200 known long-term COVID-19 symptoms (Malone et al., 2022), many symptoms may have been either underreported or misinterpreted. Moreover, the pandemic's conditions may have exacerbated symptoms equivalent to "long COVID," complicating accurate self-assessment. Future research should incorporate objective health measurements and investigate how cognitive impairments influence academic achievement over longer periods.

Additionally, the lack of a global consensus on how to assess long-term COVID-19 symptoms (NICE, 2022) limits the comparability of findings across different studies. The use of various screening instruments worldwide contributes to the variability of results, making it challenging to generalize outcomes from this study. Standardizing symptomatology assessment methods would help ensure reliability and comparability across research efforts (O'Connor et al., 2021; Hughes et al., 2022).

Despite the weak correlation between health factors and academic performance, the fact that health deterioration was observed in both students who contracted COVID-19 and those who did not underscore the need for targeted interventions. Schools and educators should develop support programmes for students with long-term health issues, particularly in subjects like mathematics and Latvian language, where weak but notable correlations were found. Such interventions could include personalized learning plans, cognitive remediation programs, and enhanced mental health support. Given the limited scope of this study, future research should focus on longitudinal studies to better understand the long-term effects of COVID-19-related health issues on learning outcomes. Tracking students over multiple years could provide a clearer picture of how health and academic performance evolve over time. Moreover, future studies should involve larger and more diverse sample sizes and account for other potential confounding factors, such as socioeconomic status, access to learning resources, and the quality of remote learning environments.

The self-assessment approach to identifying symptoms, particularly cognitive symptoms related to “long COVID,” can be problematic as students may not fully recognize or accurately report their symptoms. This aligns with findings that self-assessment can introduce biases or inaccuracies in evaluating one’s abilities, as highlighted by Slišāne et al. (2021) regarding the challenges of accurately self-assessing competences during remote learning. This can be linked to the difficulty students face in recognizing “long COVID” symptoms.

Another important direction for future research is to examine the differences between health impacts and learning outcomes across different age groups, school levels, or even countries. Comparative studies could help identify whether certain demographics are more vulnerable to long-term health impacts and how educational systems might adapt to mitigate these effects. Additionally, it is essential to investigate the cognitive and psychological impacts of “long COVID” more thoroughly, particularly regarding its effects on specific academic subjects and learning processes.

While this study provides insights into the general deterioration of students’ health during the COVID-19 pandemic, it raises important questions about the complex relationship between health factors and academic achievement. The importance of long-term research into the effects of health on learning is reinforced by studies that highlight the lasting impact of crises on competences and professional readiness (Lāma & Lāma, 2020; Slišāne et al., 2021). The findings suggest that while nervousness was a health factor statistically significantly affected by contracting COVID-19, overall health deterioration did not significantly affect learning outcomes in most subjects. Nevertheless, the study emphasizes the need for further investigation into how specific health factors, such as cognitive impairments, may impact learning outcomes over the long term, particularly in the context of evolving educational environments and policies.

Limitations

This study involved students from grades 8 and 9. Grade 9 is the final grade of primary school, after which students move into secondary school. Some of the positive learning dynamics observed may be attributed to the additional motivation of students, as their grades can influence their chances of being accepted into a better school. Furthermore, it should be

noted that the number of study participants is insufficient to generalize the results to a broader population and should be considered alongside similar studies.

Conclusions and Implications

This study has confirmed that the COVID-19 pandemic significantly impacted students' health, affecting both those who contracted the virus and those who did not. Among students who contracted COVID-19, hearing loss, nervousness, and long-term memory were self-assessed as more severely affected compared to those who did not. However, no statistically significant differences were found for other health factors such as fatigue, insomnia, fragility, eyesight loss, anhedonia, and working memory times. Notably, many students who did not contract COVID-19 also reported deteriorating health, with at least half experiencing mild issues in fatigue, insomnia, anhedonia, and concentration. These findings suggest that the widespread health challenges experienced by students were not limited to those infected with COVID-19 but were also influenced by the prolonged period of distance learning, reduced social interaction, and the overall negative public sentiment during the pandemic.

Despite the health challenges reported, this study found limited statistically significant relationships between health factors and academic performance across subjects. Nervousness emerged as the only health factor that differed significantly between students who contracted COVID-19 and those who did not. Weak correlations were observed between working memory and academic performance in mathematics, as well as between fatigue, fragility, concentration, and working memory and learning dynamics in Latvian language. Fatigue, fragility, and concentration had a negative effect on learning dynamics in Latvian language, while stronger working memory was associated with better performance in both subjects. In contrast, no statistically significant correlations were found between health factors and learning dynamics in literature, English as a second language, and biology. This suggests that health deterioration did not substantially impact academic performance in these subjects, which may have lower cognitive demands or rely on different types of student engagement and assessment.

This study demonstrates that the pandemic's impact on health was uneven, with cognitive domains, such as working memory and concentration, playing a more critical role in subjects with higher cognitive demands like mathematics and Latvian language. The widespread deterioration of health among students, regardless of whether they contracted COVID-19, highlights the far-reaching effects of the pandemic and the need for targeted support to mitigate its long-term consequences.

The findings underscore the importance of implementing targeted interventions to support students in coping with the cognitive and emotional challenges resulting from the pandemic. Schools should prioritize strategies that enhance working memory and concentration, particularly in cognitively demanding subjects, while also providing robust mental health resources to address anxiety, nervousness, and other psychological challenges. Personalized learning plans tailored to students' individual needs can help mitigate the negative effects of health issues, especially for those struggling with fatigue and concentration difficulties.

Further research is essential to explore the subject-specific impacts of health deterioration. While this study found no significant correlations for literature, English as a second language, and biology, future investigations should examine whether other factors, such as student motivation or teacher-student interactions, contribute to performance in these subjects. Longitudinal studies tracking students over multiple years are needed to better understand the long-term effects of health challenges on academic outcomes. Moreover, future research should incorporate objective measures of health factors, such as standardized cognitive tests, to complement self-assessment data and enhance the reliability of findings. Comparative studies across different educational systems and cultural contexts could also shed light on how various factors mediate the relationship between health and academic performance.

Policymakers must recognize the lasting impact of the pandemic on students' learning and well-being. Increased funding for mental health programs and cognitive development initiatives in schools is critical to supporting students' recovery. Flexibility in academic assessment and curriculum design during crises can further reduce stress and foster resilience among students. This study provides valuable insights into the relationship between health challenges and learning dynamics during the COVID-19 pandemic. By identifying the critical role of cognitive functions in academic performance, it highlights the need for adaptive educational strategies and targeted interventions to support students' well-being and academic success. These findings contribute to a growing understanding of how health crises affect learning and underscore the importance of building resilience within educational systems to address future challenges.

Declaration of Interest

The authors declare no competing interest.

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