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Research article

COVID-19 and child education outcomes in Southern Ghana

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ABSTRACT

This study analyses the effects of the COVID-19 pandemic on child education outcomes by providing evidence on the gendered dimension, determinants and coping measures of informal households in Southern Ghana. We rely on a face-to-face interview undertaken in January 2022 (i.e., approximately 2 years after the beginning of the pandemic) involving 761 students across basic and secondary schools from 10 metropolitan, municipality and district assemblies (MMDAs) in the Greater Accra region of Ghana. We document several disruptions to child education outcomes such as learning practices, school attendance, class participation and academic performance. The results also showed that per child education expenditure incurred due to the COVID-19 pandemic by the informal households was GHS305 (US$ 49). Additionally, we assess the correlates of the negative effects on academic performance and COVID-19 related education expenditure as a result of coping measures. Our results from Ordinary Least Squares (OLS) show strong association between participation in online classes, age of students, ownership of television and district of residence on COVID-19 related education expenditure. Results from Logit models show that self-reported negative effects of COVID-19 pandemic on academic performance are affected by gender and age of student, distance to market and location of residence. Interestingly, we also found considerable gendered heterogeneity for the predictors of the COVID-19 pandemic on child education outcomes. We conclude that the COVID-19 pandemic and the associated countermeasures had negative effects on child education outcomes, and that informal households incurred considerable costs in attempting to address the associated education challenges in Southern Ghana. The findings have implications on the design and implementation of educational policies and programs to address the long-term effects of the COVID-19 pandemic on child education outcomes in developing countries.

1. Introduction

On March 11, 2020, Coronavirus (COVID-19) was classified as a global pandemic by the World Health Organization (WHO) [1] due to the high number of recorded cases and deaths. The COVID-19 remains as one of the major public health epidemic and has brought about significant alteration in human history that will be remembered in the next years to come [2]. As of June 7, 2023, the total

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number of confirmed cases was 767,750,853 with 6,941,095 confirmed deaths [3]. In May 2023, the WHO declared the end of COVID-19 as a global pandemic but reiterated the possibility of new cases through new variants [4]. Therefore, despite the pandemic phase been declared over, it is expected that COVID-19 and the associated cost to socio-economic activities and human lives will remain a major public health issue in many developing countries in the next decade.

Without a doubt, the COVID-19 pandemic affected a number of human activities, including education [5]. Worldwide, governments provided policies to mitigate the adverse impact of the pandemic, and these transmission control measures included strict safety protocols such as handwashing with soap and detergent, spacing during gathering (i.e., social distancing), lockdowns (full or partial) and the closure of schools. Available estimates from 169 countries of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) show that during the early phase of the pandemic, school closures affected nearly 1.6 billion students [6].

The government of Ghana, as part of efforts to provide an integrated response similar to other countries, imposed a partial lockdown in many municipalities and districts in the Greater Accra and Greater Kumasi localities for two weeks in March–April 2020 which aimed at curbing the spread of the pandemic. This period of confinement was subsequently extended by another week-making a total of three weeks of partial lockdown in Ghana [7]. This partial lockdown was enforced to ensure adherence to personal preventive measures (social isolation, improved contact tracing, hand washing, utilization of hand sanitizers, and a strong media education) and safety measures (school closures, PPE for healthcare workers, quarantine, self-isolation, hospitalization, and treatment) [7].

In Ghana, the closure[1] of schools across the country commenced on March 16, 2020 until there was a partial lift in the middle of June 2020 to allow the final year students at the senior high and junior high schools to write their final exams (i.e., BECE and WASSCE) ([8]; [18]). The closure of schools affected about 9.2 million students in kindergarten, primary, lower and upper secondary schools. Similarly, the closure of the educational institutions affected about 500,000 students in tertiary education and 450,000 teachers in both public and private schools [9]. As a result, measures were implemented by the Ministry of Education (MoE) and the Ghana Education Service (GES) to ensure continuous teaching and learning during the closure of educational institutions. These include COVID-19 emergency support provision of distance and remote learning solutions. For example, there was a broadcast of educational lessons on Ghana learning television (GLTV) for about 1 million senior high school (SHS) students during the pandemic [6]. Whilst public and private sectors adopted several COVID-19 coping measures, the empirical evidence on the effect of COVID-19 pandemic on child education outcomes, especially on the cost of the coping measures remain scanty in the literature.

This study makes several important contributions to the empirical literature on the effect of COVID-19 on child education outcomes. First, we rely on face-to-face interview to survey informal households in the Greater Accra region - the region most affected by the pandemic in Ghana. We employed a rich dataset collected approximately 2 years after the beginning of the pandemic. We anticipate that the 2 years duration after the emergence of the pandemic should make the households more knowledgeable on the effects and coping strategies, and this should lead to more accurate responses on the pandemic compared to studies undertaken at the immediate aftermath of the pandemic. Second, we undertake gendered analysis to identify the potential heterogeneity of the COVID-19 pandemic on child education outcomes. We assume that the effect of the COVID-19 pandemic on child education outcomes will be uneven with potential gendered disparities. Lastly, we provide new evidence on the household coping measures, the associated expenditure incurred and the factors influencing the COVID-19 related education expenditure. This is important addition to the literature as previous studies [10–15] are dominated by those analyzing the effect of the pandemic on school attendance and academic performance with limited evidence on the cost of households' coping measures.

Addressing the long-term effects of the COVID-19 pandemic on child education outcomes requires understanding of the informal households' coping mechanisms in developing countries. In this study, we examined the correlates of COVID-19 induced education expenditure. The study also identified the socio-economic factors influencing the perceived negative effect of COVID-19 pandemic on students' academic performance. The findings provide important evidence on the coping mechanisms in addressing the effects of the COVID-19 pandemic among informal households in Southern Ghana. Specifically, designing and implementing educational measures to counter the long-term devastating effects of the COVID-19 pandemic require analysis of the socio-economic determinants.

Interestingly, previous studies [10,16,17] have analysed the effect of COVID-19 pandemic on child education outcomes. However, to the best of our knowledge, no known study has econometrically examined the determinants of COVID-19 related education expenditure in developing countries. Similarly, econometric modelling of the gendered dimension of the perceived negative effects on students' academic performance are few. Therefore, studies modelling the determinants of informal households' responses and strategies in dealing with a covariate shock (i.e., COVID-19 pandemic) and its effects on child education outcomes are relevant for designing and implementing education policies and programs in developing countries. In this study, we address three main objectives to expand the evidence on the medium-term to long-term effects of the COVID-19 pandemic on child education outcomes in the Greater Accra region (i.e., Southern Ghana). The objectives are to: (1) estimate COVID-19 related education expenditure incurred by informal households; (2) examine the factors influencing the reported negative effects of the COVID-19 pandemic on academic performance; and finally, (3) examine the socio-economic determinants of COVID-19 related education expenditure. This study, therefore, addresses an important lacuna in the COVID-19 literature by examining the factors influencing COVID-19 induced education expenditure as well as the correlates of the COVID-19 pandemic on students' academic performance.

The remaining parts of this paper is laid out in the following order: Section 2 provides a literature review of the relationship between COVID-19 and children's education as well the theoretical framework, while Section 3 provides information on the materials and methods including data and empirical strategy. Section 4 presents the results and discussion, and Section 5 provides conclusions.

[1] The closure of schools was done through a phased in approach while maintaining social distancing regulations.

2. Background

2.1. COVID-19 pandemic and child education

Globally, the COVID-19 pandemic has had a significant negative impact on child education. The impacts of the pandemic has led to economic downturns and humanitarian crises including closures of educational institutions, disruption of academic calendars, and eventually on learning outcomes [18]. In Ghana, the impact of the pandemic on children's access and quality of education were as a result of the school closure with inadequate alternative teaching and learning methods been made available to all school children [18]. Consequently, the pandemic has exacerbated already existing inequalities in access to quality education. Globally, the COVID-19 pandemic significantly transformed the normal sequential lives of students, teachers, and parents with the switching to teaching and learning remotely as the new norm compared to the traditional face-to-face approach [15,19,20].

The shift towards remote learning due to the closure of schools, presented many unique challenges for students, teachers, and families. In Ghana, the reported negative effects of the pandemic on the education of children were exacerbated by several challenges such as lack of access to digital technology, difficulty in adapting to remote learning, and increased household responsibilities [19,21,22]. These results have been corroborated in a report by [18], which revealed that although distance learning programmes were implemented across the nation,[2] these services were not accessed equitably. For instance, about 14–17 percent of the children in school-going age were without access to televisions, mobile devices, and internet. Similarly, large number of students were also without "station points" to access postal offices used in delivering remote learning materials. Interestingly, even for children who had access to distance and online learning programmes resources (i.e., those living in urban and rich households), their learning was significantly affected by difficulties in adapting to in-home tuition/education and poor mobile networks. Moreso, children staying in rural/remote areas and informal households were largely left out of the virtual learning platforms as a result of living in overcrowded houses, dwellings without electricity or proper lighting, having inadequate space for learning and inadequate support from parents and teachers. Therefore, this study seeks to provide further evidence of the negative medium-term effects of the COVID-19 pandemic on the academic performance of students in informal households in the Greater Accra region of Ghana.

In the pre-pandemic period, although boys were significantly less likely to be enrolled in schools [23], girls were at a much higher risk of dropping out of school due social and economic pressures. Previous studies have shown that these socio-economic pressures (such as sexual violence, early pregnancy and marriage) that occurred during the pandemic had the tendency to keep these affected girls from returning to school after the pandemic (see for example, [24–26]). Moreover, girls who became pregnant during the school closures may face a number of barriers to re-entry into schools including stigma, marital expectations, child care, and the increasing economic demands of parenting [20]. In addition to this, closure of schools due to the pandemic led to a decline in enrollment particularly in primary and junior high schools [19,20,27]. Girls were disproportionately affected by the pandemic, with many dropping out of school to help with household chores or care for family members [21,28,29].

A rapid response panel survey carried out in May 2020 by the Research for Effective COVID-19 Responses' (RECOVR), revealed that school closures led to 64 percent of primary and 57 percent of secondary school students spending time on education at home (Innovations for Poverty Action [31]). Unfortunately, the children spent only an average of 6 h per week learning which is woefully inadequate to achieve meaningful educational outcomes. A similar proportion of respondents (about 60%) indicated that children studied their own schoolbooks and less than 20 percent resorted to other educational materials (including contents from the internet and the government-provided GLTV). Furthermore, a monitoring data in June 2020 further highlighted the difficulties faced by children learning at home as a result of the school closures [30]. The report showed that 39.4 percent of households with children attending primary and junior high school indicated that they had inadequate access to basic logistics for learning such as computers or phones, and 33.2 percent had inadequate learning materials including textbooks. About 28 percent of the households further reported that there was lack of interest by the children in taking up the online lessons. For children attending senior high schools, the main learning difficulty for almost half of the households was the lack of access to basic logistics like computers or phones (45.3%) followed by inadequate materials for learning including textbooks (27.6%) and the lack of access to internet (25.6%) to read the learning materials.

In this regard, at the height of the pandemic in Ghana, many households' ability to provide financial resources on school-related expenditure such as kits for school, food, and learning materials was negatively affected [22]. Many families struggled financially due to the pandemic with parents/guardians reporting that they were unable to afford the cost of learning materials and other expenses associated with remote learning. In terms of changes in expenditure patterns and behaviour, a report by IPA [31] indicated that almost half of respondents said they had to exhaust their savings in order to make payments for food, healthcare, or other miscellaneous expenses. However, to the best of our knowledge few studies have been able to determine the additional educational expenditure due to the pandemic in Ghana.

Unsurprisingly, the COVID-19 pandemic had adverse effect on child education outcomes in Ghana. The household's coping mechanisms to the COVID-19 pandemic and the associated safety protocols have led to additional educational expenditure been incurred. Hence, the novelty of this paper lies in contributing to the literature by examining the extent of the negative effect of the pandemic. Furthermore, we analyse the correlates of perceived negative effects on academic performance of students in pre-tertiary

[2] On 5 May 2020, a TV timetable for distance learning was provided by the Ghana Education Service (GES) for children from kindergarten to secondary high schools. These included subjects such as Math, English and Science. Additionally, platforms for distance learning for children were also made available through mobile devices and physical packages especially for those with limited access to mobile devices.

schools and also the extra educational expenditure incurred by households in Southern Ghana.

2.2. Theoretical framework

The COVID-19 pandemic (i.e., the recent covariate shock) have induced preventive health and non-health related behaviours in low-income households in developing countries. For instance, households have undertaken several coping strategies to mitigate its effects on child education outcomes. Interestingly, several theoretical frameworks/models have been used to explain the welfare-enhancing behaviours and one of the widely used models is the "Theory of Planned Behaviour" (TPB) [32]. Similarly, other theories/models related to this study are cognitive theory of stress [33], The Protective Action Decision Model (PADM) [34], and Protection Motivation Theory (PMT) [35,36].

TPB has emerged as one of the theoretical frameworks employed in explaining the COVID-19 related preventive health behaviours [37–45]. Interestingly, whilst the application of the TPB model in the COVID-19 literature has mainly been used to explain the psychological correlates determining health seeking behaviours [37], the theory could be expanded to other COVID-19 welfare mitigating behaviours. Therefore, this study is embedded in the TPB and its extension is used to address the effect of the COVID-19 pandemic on child education outcomes in Southern Ghana. The broader appeal of this model has led to its wider application in the COVID-19 pandemic empirical literature.

The theory postulates that three key factors such as attitudes, subjective norms and perceived behavioural control accurately explains the behavioural intentions of individuals/households [32,37]. In this study context, the extended version of the TPB assumed that household demographic characteristics, and perceptions, knowledge and attitudes on COVID-19 pandemic influences perceived negative effects on academic performance and COVID-19 related education expenditure. The current study is related to education behaviours: (1) child participation in online classes; (2) non-school attendance to avoid social contacts with colleagues and teachers; and (3) expenses on COVID-19 safety protocols and other coping strategies. Therefore, households undertaking avoidance, preventive or coping behaviours are influenced by several factors including socio-economic status, demographics, access to infrastructure, location of residence, knowledge and perceptions on COVID-19 pandemic.

This study applies the extended theory of planned behaviour to explain the correlates of COVID-19 related education expenditure and perceived negative effects on academic performance. Specifically, the TPB model in this current context imply that household education behaviours could be explained by intentions, attitudes, social norms and behavioural controls [32,37]. We also expect gendered differences in intentions, attitudes, social norms, and behavioural controls in addressing the COVID-19 related education expenditure and perceived negative effects on academic performance. Interestingly, since the effect of the COVID-19 pandemic are not homogeneous across socio-economic groups, the study seeks to examine the correlates of COVID-19 pandemic on child education outcomes for informal households in the Greater Accra region of Ghana.

3. Materials and methods

3.1. Data

The study received ethical approval from two ethics review committees at the University of Ghana, Legon: (1) Ethics Committee of Humanities (ECH) in May 2021 (*ECH 126 20–21*) and (2) Ethics Committee of Basic and Applied Sciences (ECBAS) in August 2021 (*ECBAS 035/20–21*). All respondents signed and received copies of the consent forms. Based on the 2021 Population and Housing Census, the Greater Accra region has a population of 5,455,692. Furthermore, children (0–19 years) constitute over 45 percent of Ghana's population Ghana Statistical Service [46]. This study relied on a rich data collected using face-to-face interviews taking into account the existing COVID-19 safety protocols in January 2022. The semi-structured questionnaires were administered to respondents in 10 metropolitan, municipality and district assemblies (MMDAs) in the Greater Accra region-the epicentre of the pandemic in Ghana. COVID-19 safety protocols strictly followed during the data collection exercise include maintaining social distance of at least 1 m apart, wearing of nose masks, handwashing with soap and detergent.

The data collection targeted low-income settings of the MMDAs and also employed a systematic sampling procedure. Low-income communities in this study context are those areas with informal settlements in the study sites. We also expected that households mainly employed in the informal sectors such as farming, self-employment and apprenticeship were more likely to be negatively affected by the pandemic due to their limited coping strategies. Respondents from every fifth dwelling along the major principal streets in the selected communities were targeted for interviews. However, it is important to note that this sampling procedure was not strictly followed due to non-availability of household members, non-response to survey, among other factors.

The data collected may not be representative for the entire region as it targeted informal households. Nonetheless, this study provides a rich information for examining the gendered effect of COVID-19 pandemic on child education outcomes in Southern Ghana. The selected districts have been affected by the COVID-19 pandemic in diverse ways and the associated response have also differed. For instance, the Shai-Osudoku district which is a rural district was not affected by the government's COVID-19 lockdown implemented in March to April 2020. Therefore, the pandemic could have differential effects on child education outcomes. The semi-structured interviews were conducted in January to March 2022. At the end of the data collection exercise, we collected data from 707 households. Of these, about 360 households had children attending school at the various educational levels (i.e., basic to secondary schools). In total, the data collection involves 761 students-of which 406 were males and 355 were females.

As stated earlier, the sample may not be representative at the regional or national level due to purposive selection of the study sites. Besides, we concentrated on informal households based on anecdotal evidence that the negative effect on the COVID-19 pandemic

could be larger on low-income households compared to rich households (see for instance Ref. [16]). Despite these weaknesses, the datasets contain rich information on COVID-19 related expenses and other information that could be difficult to ascertain from other surveys. For instance, surveys estimating COVID-19 related expenses at the regional or national levels are extremely rare in Ghana. Similarly, the data contains near equal representation of male and female students and this support our gendered analyses, which is also limited in the empirical literature on COVID-19 pandemic. Therefore, the results obtained from this study provides useful evidence on the effect of COVID-19 pandemic on child education outcomes in the Ghanaian context.

3.2. Empirical models

This study provides answers to important policy questions on the effect of the COVID-19 pandemic on student academic performance and the coping measures undertaken by informal households in the Greater Accra region. We also provide further evidence on the estimated cost of the COVID-19 related education coping measures. Results obtained are important in guiding current and future policies on pandemic recovery in the education sector of Ghana. Whilst the pandemic was declared to be over by WHO in May 2023, its effects could be long-lasting due to weak education infrastructure in many developing countries.

In this study, we employed descriptive statistics and regression models to analyse the quantitative data collected from the respondents. Descriptive statistics such as average, frequency, standard deviation and *t*-test were performed to analyse the child characteristics including the education outcomes. We also used the logit regression model to estimate the correlates determining whether child's academic performance has been negatively affected by the COVID-19 pandemic. The basic regression model is stated as:

$$\text{Log}\left(\frac{p_i}{1-p_i}\right) = \propto + \beta X_i + \varepsilon_i \tag{1}$$

where p_i represents the probability that the COVID-19 pandemic had negative effect on child i academic performance and $1 - p_i$ indicates the probability that the COVID-19 pandemic did not have a negative effect on child i academic performance. Therefore, the dependent variable as stated in Equation (1) is the natural logarithm of the odds of the negative effect of COVID-19 pandemic on child i education performance. $\propto$ represents the constant term, X_i indicates a vector of independent variables such as gender of respondent and student, household size, age of student and respondent, dummies for the location of residence, among others. β represents the estimated coefficients and ε_i shows the error term. The standard errors are clustered at the 360 households to account for multiple children within the same household.

Furthermore, we employed the ordinary least squares (OLS) regressions to estimate the determinants of the COVID-19 related education expenditure (in GHS). The basic model specification is as follows:

$$E_i = \propto + \beta X_i + \varepsilon_i \tag{2}$$

where E_i is the dependent variable measured as natural logarithm of the COVID-19 related education expenditure incurred (GHS). The remaining symbols have the same meaning as stated in Equation (1). Similarly, we report clustered standard errors at the 360 households for the estimated regressions. We undertook gendered analyses where we run separate regressions for male and female students using the same independent variables stated in Equations (1) and (2). We assume that the reported negative effects of the COVID-19 pandemic and the associated education expenditure will differ based on the gender of the student.

4. Results and discussion

4.1. Descriptive statistics

The sample consisted of 761 students distributed within 10 MMDAs of the Greater Accra region of Ghana (refer to Table 1). A little more than 44 percent of the sampled students were observed in two (2) districts - Ga South (22.9%), and Ga East (21.3%). A similar proportion of students were observed in four other municipalities and districts ranging between 10.1% (Ashaiman municipal) and 13.9

Table 1
Distribution of sampled students by district.

District	Student	Percent
Ga South	174	22.86
Shai Osudoku	106	13.93
Ashaiman	77	10.12
Ayawaso West	83	10.91
La Nkwantanang - Madina	85	11.17
Korle Klottey	16	2.10
Ayawaso East	8	1.05
Accra Metropolis	32	4.20
Okaikwei North	18	2.37
Ga East	162	21.29
Total	**761**	**100.00**

Notes: *Results are reported for all students in the households.*

percent (Shai-Osudoku district). Also, Accra Metropolis, Okaikwei North, Korle Klottey and Ayawaso East, each recorded less than 5 percent of the total number of students that were interviewed. The results suggest considerable targeting of respondents depending on reported COVID-19 cases. For instance, Ga East municipal had a designated COVID-19 treatment center and this may have influenced the larger sample from this municipality. Additionally, respondents in Shai-Osudoku district were targeted for comparative purposes since it was the only rural district selected for the data collection.

The descriptive statistics by gender of the students from the survey are presented in Table 2. Of the 761 students that were sampled, slightly more than half (53.4%) were males with the rest being females. The mean age of all the students was 11.1 years with the mean age for males (11.3 years) relatively higher compared to the females (10.9 years). In terms of school attendance, more than 90 percent of all sampled students had either attended school in the last 12 months (males = 95.6%; females = 94.1%) or was still in school (males = 95.6%; females = 95.2%) prior to the survey. More than four-fifth of the students (males = 86.2%; females = 87.0%) were currently in basic school (i.e., either primary or JHS). By implication, this is reflected in the significantly lower number of students that were in secondary or tertiary schools at the time of the survey (secondary = 9.3%; tertiary = 4.1%).

Differences in learning outcomes between private and public students is well documented in the literature [47–49]. In Ghana, religion has played critical role in the educational sector through the establishment of schools and other educational infrastructure [50]. Religious institutions (such as the Catholic, Presbyterian, Methodist, as well as other Pentecostal and charismatic churches) as well as private investment complements government efforts in establishing schools and also supplying teaching and learning materials. Hence, the survey sought to segregate religious schools from the non-religious ones as well as whether they are publicly or privately managed/owned. The results in Table 2 show that about 8 out of 10 students attended a non-religious school (whether public or private) with more than half (about 52%) of the sampled students attending public non-religious schools. The proportion of the remaining students that attended religious schools was relatively higher for public religious schools (11.8%) than for private religious

Table 2
Summary statistics by gender of students.

Variable	Overall	Male	Female	Difference
	Mean (SD)	Mean (SD)	Mean (SD)	(SE)
Age of student (Years)	11.089 (5.373)	11.298 (5.583)	10.851 (5.119)	0.447 (0.400)
Child attended school/college during last 12 months (1 = Yes)	0.949 (0.221)	0.956 (0.206)	0.941 (0.236)	0.015 (0.015)
Child still attending school (1 = Yes)	0.954 (0.210)	0.956 (0.206)	0.952 (0.214)	0.004 (0.015)
Current grade/level is basic school (i.e., Primary and JHS) (1 = Yes)	0.866 (0.341)	0.862 (0.345)	0.870 (0.336)	−0.008 (0.026)
Current grade/level is secondary school (1 = Yes)	0.093 (0.291)	0.089 (0.285)	0.099 (0.299)	−0.010 (0.023)
Current grade/level is tertiary school (1 = Yes)	0.041 (0.198)	0.049 (0.217)	0.031 (0.174)	0.018 (0.015)
Public religious school (1 = Yes)	0.118 (0.323)	0.106 (0.308)	0.132 (0.339)	−0.026 (0.024)
Public non-religious school (1 = Yes)	0.518 (0.500)	0.530 (0.500)	0.504 (0.501)	0.025 (0.036)
Private religious school (1 = Yes)	0.041 (0.198)	0.030 (0.170)	0.054 (0.225)	−0.024* (0.013)
Private non-religious school (1 = Yes)	0.323 (0.468)	0.335 (0.473)	0.310 (0.463)	0.025 (0.033)
Student attends public school (1 = Yes)	0.636 (0.481)	0.635 (0.482)	0.637 (0.482)	−0.001 (0.034)
Student has used computer in the last 3 months (1 = Yes)	0.138 (0.345)	0.140 (0.348)	0.135 (0.342)	0.005 (0.025)
Number of computer-related activities undertaken in the last 3 months (#)	0.318 (0.981)	0.315 (0.961)	0.321 (1.005)	−0.006 (0.070)
Student has performed at least three computer-related activities in the last 3 months (1 = Yes)	0.043 (0.204)	0.047 (0.211)	0.039 (0.195)	0.007 (0.014)
Student has used internet in the last 3 months (1 = Yes)	0.137 (0.344)	0.150 (0.358)	0.121 (0.327)	0.029 (0.026)
Student used internet for educational purposes (1 = Yes)	0.122 (0.328)	0.133 (0.340)	0.110 (0.313)	0.023 (0.023)
Student used internet for academic work in 2020 and 2021 due to the COVID-19 pandemic (1 = Yes)	0.117 (0.321)	0.133 (0.340)	0.099 (0.299)	0.034+ (0.023)
Number of educational purposes that student uses internet (#)	0.250 (0.756)	0.271 (0.767)	0.225 (0.744)	0.046 (0.051)
Student participated in on-line classes through Zoom, Google Meet, etc during the COVID-19 pandemic (1 = Yes)	0.050 (0.218)	0.059 (0.236)	0.039 (0.195)	0.020 (0.016)
COVID-19 **positively** affect student's education/schooling (1 = Yes)	0.066 (0.248)	0.069 (0.254)	0.062 (0.241)	0.007 (0.018)
COVID-19 **negatively** affect student's education/schooling (1 = Yes)	0.682 (0.466)	0.695 (0.461)	0.668 (0.472)	0.027 (0.032)
Household incurred extra cost for student education due to the COVID-19 pandemic (1 = Yes)	0.470 (0.499)	0.475 (0.500)	0.465 (0.499)	0.011 (0.035)
Total extra cost on student education due to COVID-19 pandemic (GHS; including 0s)	304.704 (552.671)	321.062 (619.768)	286.042 (464.622)	35.019 (39.833)
Natural logarithm of extra cost on education	3.529 (2.846)	3.590 (2.841)	3.459 (2.854)	0.130 (0.209)
Overall effect of COVID-19 pandemic on school attendance is negative (1 = Yes)	0.524 (0.500)	0.527 (0.500)	0.521 (0.500)	0.006 (0.034)
Overall effect of COVID-19 pandemic on academic performance is negative (1 = Yes)	0.618 (0.486)	0.638 (0.481)	0.594 (0.492)	0.044 (0.035)
Number of observation (N)	**761**	**406**	**355**	-

Notes: Standard error adjusted for 360 households. Results are reported for all students in the households. The Oanda's exchange rate for January 31, 2022 was 1 US$ = 6.22387 GHS.

schools (4.1%). This is expected as successive governments over the years have made considerable efforts in transferring ownership and management of most religious educational institutions under the care of the state back to the religious organization. In this regard, we observed that most of the students (about 63.6%) were attending public schools.

A cross-country survey of educators and students across Ghana, Georgia and Pakistan shows the negative impact of the pandemic on education. This had led to digital transformation through the use of online classes and access to digital teaching and learning materials aimed at overcoming important educational challenges in developing countries [51]. The survey further analysed students' use of computer and internet in the past three months prior to the survey (Table 2). From the results, about 14 percent of the students had used a computer in the last three months prior to the survey. Unfortunately, only 4.3 percent of the students who used computers had performed at least three computer-related activities. For those who used the internet, only 12.2 percent had used internet for educational purposes in the same time period.

The government adopted remote teaching through the internet, television, and radios as a key medium in facilitating distance learning and online education [22]. From the survey, only 5 percent of students participated in online classes during the pandemic through media such as Zoom, Google Meet, among others, and this was more pronounced in males (5.9%) than females (3.9%). These results suggest that there are considerable challenges in ensuring the use of digital technologies for educational purposes among students in informal households in the Greater Accra region. The low adoption of digital technologies for educational purposes should be a key concern for the government and stakeholders in the educational sector of Ghana.

Results on the respondents' perspective on how the pandemic had affected students' education revealed that while only 6.6 percent asserted that the pandemic had a positive effect, about 68.2 percent of the respondents affirmed that the pandemic had negatively affected child school attendance. As a result, we also observed that about 47 percent of respondents indicated that the household incurred an average extra education cost of GHS305.00 (US$ 49) (GHS321.06 (US$ 52) for males and GHS286.04 (US$ 46) for females) for their children due to the COVID-19 pandemic. In effect, more than half of the respondents (52.4%) opined that the pandemic has had negative overall effect on student attendance, with most of them (about 61.8%) indicating that academic performance was negatively affected due to the pandemic.

Results in Table 3 shows that the average age of respondents was 42 years. About 8 out of every 10 household heads were either married or in consensual union with their partner(s). In terms of ethnicity, about a third of the households were Ewes with almost equal proportions for the other ethnic groups. In Ghana, a larger proportion of the population identify themselves as Christians and this was not different from the results in Table 3 as 7 out of every 10 respondent identifies as a Christian. In terms of household characteristics, the household size was 5.52 with about 8 out of every 10 households having television. However, only 13 percent of households have a computer and about 43 percent had internet access. About 30 percent of households indicated that their main road to the community is tarred or asphalted with the average distance to the nearest market from a typical household being 6.2 km (km).

The households adopted several coping strategies in addressing the pandemic (results available upon request) and the major ones based on qualitative interviews include "*employed a teacher to teach the children*"; "*watch educational shows*"; "*learning on their own in the house*"; "*online learning*"; "*attending private classes*"; "*bought tablet for children to use for studies*"; "*bought books for children to study*"; "*bought phone for children to learn*"; and "*increasing learning hours in the house*". These responses show that households in the informal sector employed diverse coping measures to deal with the COVID-19 pandemic and these include personal learning, watching educational programs on television and hiring of private teachers to cover for the loss of teaching and learning hours.

4.2. Econometrics results

4.2.1. Determinants of COVID-19 education expenditure

The regression analysis was conducted to examine the determinants of the extra cost to child education as a result of the COVID-19

Table 3
Summary statistics of households.

Variable	Mean	SD	Min	Max
Respondent Characteristics				
Gender of respondent (1 = Male)	0 0.458	0.499	0	1
Age of respondent (Years)	41.964	12.974	18	89
Respondent is married/consensual union (1 = Yes)	0.783	0.413	0	1
Ethnicity of the respondent is Akan (1 = Yes)	0.219	0.414	0	1
Ethnicity of the respondent is Ewe (1 = Yes)	0.317	0.466	0	1
Ethnicity of the respondent is Ga/Adangme (1 = Yes)	0.211	0.409	0	1
Ethnicity of the respondent is other ethnic group (1 = Yes)	0.253	0.435	0	1
Religion of respondent is Christian (1 = Yes)	0.719	0.450	0	1
Respondent has ever attended formal school (1 = Yes)	0.853	0.355	0	1
Household Characteristics				
Household size (Number)	5.522	2.168	2	22
Household has a television (1 = Yes)	0.822	0.383	0	1
Household has a computer (1 = Yes)	0.131	0.337	0	1
Household has internet (1 = Yes)	0.425	0.495	0	1
Main road to the community is tarred road/urban/asphalted roads (1 = Yes)	0.294	0.456	0	1
Distance to nearest market (Kilometers)	6.206	6.970	0	30
Number of oobservations (N)	**360**	———	——	———

Table 4
OLS correlates of COVID-19 education expenditure.

Variables	(1)	(2)	(3)
	Dependent variable: Natural logarithm of extra cost to education due to COVID-19 (GHS)		
Model	Overall	Male	Female
COVID-19 online classes	1.353*	1.214	1.926**
	(0.752)	(0.934)	(0.956)
Male student	0.007		
	(0.148)		
Age of student	0.350***	0.404***	0.231+
	(0.080)	(0.084)	(0.155)
Squared of the age of student	−0.013***	−0.015***	−0.008
	(0.004)	(0.003)	(0.008)
Male respondent	−0.061	−0.133	−0.047
	(0.212)	(0.231)	(0.311)
Age of respondent	0.017	−0.028	0.081*
	(0.034)	(0.040)	(0.044)
Squared of the age of respondent	−0.000	0.000	−0.001*
	(0.000)	(0.000)	(0.000)
Married respondent	0.316	0.540*	−0.037
	(0.237)	(0.294)	(0.327)
Respondent belongs to Ga ethnic group	0.062	0.050	0.033
	(0.279)	(0.262)	(0.388)
Natural log of per capita household expenditure	0.266+	0.087	0.591***
	(0.167)	(0.195)	(0.220)
Christian respondent	0.214	0.528**	0.018
	(0.206)	(0.231)	(0.297)
Respondent has ever attended school	−0.041	−0.217	0.060
	(0.273)	(0.261)	(0.449)
Tarred road community	0.082	0.792**	−0.766*
	(0.296)	(0.352)	(0.400)
Kilometers to nearest market	0.014	0.021	0.013
	(0.014)	(0.014)	(0.020)
Household size	0.036	0.022	0.095*
	(0.041)	(0.046)	(0.054)
Household owns a computer	0.134	0.000	0.452
	(0.431)	(0.526)	(0.569)
Household has access to internet	−0.055	−0.023	−0.179
	(0.224)	(0.241)	(0.320)
Household owns a television	−0.533**	−0.324	−0.760**
	(0.254)	(0.284)	(0.379)
Reference: Shai-Osudoku district			
Ga South municipal	4.467***	4.845***	4.125***
	(0.340)	(0.318)	(0.540)
Ashaiman municipal	−0.303	−0.287	−0.438
	(0.383)	(0.327)	(0.656)
Ayawaso West municipal	1.634***	1.889***	1.554**
	(0.523)	(0.595)	(0.754)
La Nkwantanang-Madina municipal	3.919***	4.072***	4.208***
	(0.584)	(0.597)	(0.770)
Korle Klottey municipal	4.018***	4.045***	4.110*
	(1.011)	(1.005)	(2.238)
Ayawaso East municipal	0.045	−0.558	1.310*
	(0.661)	(0.762)	(0.717)
Accra Metropolis	4.702***	4.895***	4.887***
	(0.544)	(0.606)	(0.732)
Okaikwei North municipal	−0.147	−0.160	0.298
	(0.545)	(0.700)	(0.661)
Ga East municipal	4.927***	5.334***	4.581***
	(0.373)	(0.361)	(0.540)
School grade of child is basic school	0.512+	0.369	0.236
	(0.353)	(0.473)	(0.654)
Public school	−0.193	−0.348+	0.071
	(0.206)	(0.240)	(0.275)
Constant	−3.897**	−2.593+	−6.688***
	(1.537)	(1.707)	(2.107)
Observations	730	386	344
R-squared	0.592	0.652	0.567
Prob > F	0.000	0.000	0.000

Notes: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1, and +<0.15. Reporting results with *p*-value closer to 10% is not uncommon in the literature (see for instance, Kremer et al. [52], p.171) reports results with "p-value = 0.101" and Liverpool-Tasie [53]; p.10-11) shows results of p-value of 15%). Regression results reported for only children attending up to secondary school.

pandemic across gender (Table 4). The models were statistically significant at 1 percent level (Prob > F (0.000)) and the independent variables accounted for 59.1 percent of the variation in the natural log of extra cost to education due to COVID-19. The results for all students reveal that participation in COVID-19 online classes, student's age, household's ownership of television, and the district location of the household are statistically significant correlates of pandemic-induced extra cost of education in southern Ghana.

An examination of the predictor variables in Table 4 shows that attending COVID-19 online classes increases the additional expenditure on child education. The plausible explanation is that parents/guardians had to spend additional income in securing online resources for the children to catch up with teaching and learning activities. Therefore, as [60] argue, the socioeconomic status of students can further explain the unequal impact of the pandemic on child education outcomes. Based on the gender disaggregated results, attending online classes was significantly associated with additional educational cost for female students. This result could be due to a previous study that found that females were more vulnerable to the COVID-19 pandemic [21,54] Therefore, enrolment of females into online classes increased the COVID-19 related education expenditure. These results are in consonance with Okyere [55]'s study on the positive effect of internet services on digital skills and literacy of school children in Kenya.

Another significant predictor of COVID-19-induced additional educational expenditure is the age of the student. This was highly significant for males (p = 0.01) compared to females (p = 0.15). An additional year to the child's age increases the extra cost of education due to the COVID-19 pandemic. However, the results further show that an increase in the squared age of the student is a significant predictor in reducing the extra cost to education. This shows that the relationship between the COVID-19 related education expenditure and age of students is not linear but convex. As age increases, the rate of increase of COVID-19 induced education expenditure decreases. In terms of gender, whereas the squared of the age of the student was statistically significant for males, the squared age of the respondent was statistically significant for females. Additionally, being a married respondent increases the additional education cost incurred due to the pandemic, and this was statistically significant for only male student households. This result points to a potential intrahousehold allocation bias in investing in education for male children compared to female children in Southern Ghana.

Interestingly, household ownership of television reduces the extra cost of education associated with the pandemic for both the overall model and that of female students. Possession of television as a proxy for alternative media was key in transmitting educational lessons during the pandemic, especially the government-led educational classes which were complemented by some other private media houses in Ghana [27]. Since the school children could watch the lessons on TV without necessarily buying data to use the internet, additional education-related expenditure was curtailed. For those children in households without television, buying it or using the internet for such purposes increases their educational expenditure due to the pandemic. These results are further corroborated in similar studies in literature ([59; 60]).

The results also indicate that household wealth (i.e., per capita consumption expenditure) is marginally associated with higher COVID-19 related education expenditure for students in Southern Ghana. Similarly, the results show a marginal increase in COVID-19 related expenditure associated with children attending basic schools compared to those at the senior secondary levels. Attending public school marginally decreases the COVID-19 related expenditure for male school children. These results have *p*-values closer to 10 percent.

The results in Table 4 further lends credence to the predictive power of respondent's district of residence associated with extra cost of education due to the pandemic. Compared to students who live in Shai-Osudoku, there was no statistically significant increase in additional cost of education for students who lived in Ashaiman and Okaikwei North municipals. However, living in districts such as Ga South, Ayawaso West, La Nkwatanang-Medina, Korle Klottey, Ayawaso East, Accra Metropolis and Ga East increases the additional cost incurred as a result of the pandemic. The results on the district dummies point to potential heterogeneity in the COVID-19 related education expenditure incurred and this support our earlier assertion that differences in COVID-19 severity at the location of residence could induce differences in coping measures. Comparing the location of residence to Shai-Osudoku (i.e., the only district not affected by the partial lockdown implemented in March to April 2020) present important policy evidence on the potential effect of the implementation of the strict lockdown on child education outcomes and the associated coping measures.

4.2.2. Determinants of negative effects of COVID-19 on academic performance

It is well documented in the literature that the COVID-19 pandemic led to adverse effect on student academic performance [10–15]. However, this study further sought to identify the correlates that predict the negative effects of the COVID-19 pandemic on students' academic performance in Southern Ghana (Table 5). The results reveal that being a male student and the age of the student significantly increases the probability of experiencing the negative effects of the pandemic on academic performance. However, the results on the squared age of the student suggest a non-linear relationship between age and perceived negative effects of COVID-19 pandemic on child's academic performance. Although gendered adverse effects of the COVID-19 pandemic is quite mixed [56,57], our study corroborates with Birkelund & Karlson [58] which showed that boys suffered more than girls due to school closures. We also found that compared to female respondents, households with male respondents are more likely to report of increases in the adverse effects of the pandemic on student academic performance. This is not surprising as males in many developing countries control the educational expenses and desired future outcome of children and therefore, may be more aware of these negative consequences of the COVID-19 pandemic.

The results also revealed that the probability of experiencing adverse effects of the pandemic on student academic performance is

Table 5
Logit model correlates of negative effects of COVID-19 on academic performance.

Variables	(1)	(2)	(3)
	Dependent variable: Negative Effects of COVID-19 on Academic Performance (1=Yes)		
Model	Overall	Male	Female
COVID-19 online classes	−0.828+	−0.730	−0.495
	(0.563)	(0.746)	(0.830)
Natural log of COVID-19 education expenses	0.054	0.108+	−0.005
	(0.058)	(0.070)	(0.089)
Male student	0.303*		
	(0.169)		
Age of student	0.473***	0.382***	0.611***
	(0.095)	(0.120)	(0.142)
Squared age of student	−0.016***	−0.012**	−0.022***
	(0.004)	(0.005)	(0.006)
Male respondent	0.333	0.718**	−0.147
	(0.291)	(0.358)	(0.375)
Age of respondent	0.042	0.021	0.102*
	(0.048)	(0.065)	(0.061)
Squared of the age of respondent	−0.001	−0.000	−0.001+
	(0.000)	(0.001)	(0.001)
Married respondent	−0.067	0.069	−0.359
	(0.314)	(0.414)	(0.404)
Respondent belongs to Ga ethnic group	0.327	0.641+	−0.136
	(0.347)	(0.405)	(0.427)
Natural log of per capita household expenditure	−0.262	−0.302+	−0.169
	(0.186)	(0.210)	(0.251)
Christian respondent	−0.390	−0.309	−0.596+
	(0.319)	(0.395)	(0.394)
Respondent has ever attended school	0.469+	0.223	0.881*
	(0.317)	(0.375)	(0.452)
Tarred road community	−0.410	−0.323	−0.782+
	(0.388)	(0.443)	(0.520)
Kilometers to nearest market	−0.041*	−0.065*	−0.020
	(0.024)	(0.034)	(0.026)
Household size	−0.054	−0.099	0.041
	(0.065)	(0.080)	(0.080)
Household owns a computer	−0.624	−1.064*	−0.121
	(0.511)	(0.552)	(0.682)
Household has access to internet	−0.087	−0.151	0.049
	(0.320)	(0.384)	(0.428)
Household owns a television	−0.574+	−0.610	−0.604+
	(0.353)	(0.462)	(0.416)
Reference: Shai-Osudoku district			
Ga South municipal	1.510***	1.592**	1.309*
	(0.566)	(0.740)	(0.781)
Ashaiman municipal	1.559**	1.759**	1.102
	(0.631)	(0.728)	(0.843)
Ayawaso West municipal	−0.584	−0.544	−0.652
	(0.541)	(0.658)	(0.723)
La Nkwantanang-Madina municipal	1.547**	1.159+	2.203**
	(0.667)	(0.794)	(0.929)
Korle Klottey municipal	0.812	0.285	1.517
	(0.782)	(0.900)	(1.785)
Ayawaso East municipal	–	–	–
	–	–	–
Accra Metropolis	2.580***	1.534	3.476***
	(0.747)	(1.189)	(1.033)
Okaikwei North municipal	0.153	0.360	−0.420
	(1.015)	(1.131)	(1.733)
Ga East municipal	0.743	0.519	0.766
	(0.595)	(0.717)	(0.827)
School grade of child is basic school	−0.203	−0.147	−0.264
	(0.431)	(0.633)	(0.597)
Public school	0.069	0.456	−0.256
	(0.258)	(0.322)	(0.399)
Constant	−1.368	0.338	−4.340*
	(1.773)	(2.142)	(2.585)
Observations	726	383	343
Pseudo R^2	0.194	0.208	0.227
Prob > chi^2	0.000	0.000	0.000

Notes: Robust standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1, and +<0.15. Refer to Table 4 for additional information.

positively influenced by a household respondent who has ever attended school. However, at the gender disaggregation level, this was statistically significant for female students. This is because females fall within the largest vulnerable group affected by the COVID-19 pandemic (Krywult-Albańska & Albański, 2021 [21]). Additionally, the distance of the household's residence to the nearest market is a significant predictor. That is, an increase in the distance to the nearest market by a kilometer lead to less likely of the household reporting negative effects on student performance as a result of the pandemic. Whilst this result may be counterintuitive, the possible explanation is related to safety guidelines outlined by WHO and the government to be observed, of which social distancing was key [8].

Further, the results in Table 5 also show that the ownership of computer is negatively associated with the perceived negative effects of COVID-19 pandemic on student's academic performance, and this was statistically significant for males. Ownership of computer provides students with alternative learning environment to disseminate teaching and learning lessons from the education curriculum during the pandemic. Students are therefore able to augment their classroom experiences at the comfort of their homes without being potentially exposed to crowds, among others. Furthermore, ownership of television led to marginal reduction in the perceived negative effects of the COVID-19 pandemic on academic performance. Results for location dummies show that compared to those in Shai-Osudoku district, the probability of experiencing the negative effects of COVID-19 on student academic performance was positively related to households that were in all the other municipalities except for Ayawaso West and Ayawaso East. This adverse effect was statistically significant for households that lived in Ga South, Ashaiman, La Nkwantanang-Madina and Accra Metropolis. These results are in consonance with those presented under Table 4 on the location heterogeneity of COVID-19 pandemic on child education outcomes.

The study also found marginal positive association of Ga respondents (i.e., natives of the study area) and perceived negative effect of COVID-19 on academic performance of male students. Additionally, increase in household per capita expenditure reduces the perceived negative effects of COVID-19 on academic performance of male students. Christian respondents were less likely to report perceived negative effects of COVID-19 pandemic on the academic performance of female students, albeit insignificant at the traditional confidence interval but it is closer to 10 percent. Similar results are found for access to tarred road and ownership of television on perceived negative effect of COVID-19 on female students' academic performance. These results show that negative effects of the COVID-19 pandemic had differential effects on diverse social groups, and this is one of the avenues for future research.

5. Conclusion and policy implications

This study analysed the effect of COVID-19 pandemic on child education outcomes in 10 MMDAs in the Greater Accra region of Ghana. The Greater Accra region-the location of the national capital-was the epicentre of the pandemic where the largest COVID-19 cases and deaths were reported. The study relied on a rich data from 761 students at different levels of education to provide important evidence on the medium-term implications of the COVID-19 pandemic on child education outcomes. The findings provide important evidence on the coping mechanisms adopted by households to limit the adverse effect of the COVID-19 (i.e., a covariate shock) pandemic on child education outcomes in Southern Ghana. The results also provide valuable evidence for the design and implementation of educational policies and programs in low-income setting of a developing country context.

Our results from the descriptive statistics show that the majority of the informal households reported that the COVID-19 pandemic had overall negative effect on child school attendance and academic performance. Moreover, informal households incurred about GHS 305 (US$ 49) extra education expenditure per child in coping with the COVID-19 pandemic in Southern Ghana. Furthermore, households employed several coping measures, including home tuition and virtual classes, in attempting to limit the adverse effect of the COVID-19 pandemic. Overall, our results show that informal households in Southern Ghana suffered considerable educational disruptions due to COVID-19 related countermeasures and safety protocols such as lockdown restrictions on school attendance, educational infrastructure and income generating activities.

Results from the regression models show that participation in online classes was positively associated with COVID-19 related education expenditure whilst ownership of television was negatively correlated with COVID-19 related education expenditure. These results imply that household incurred extra education expenditure by enrolling their children on virtual classes organized as coping measures for the COVID-19 pandemic. Furthermore, the results on ownership of television suggest that households relied on the mass media's teaching and learning programmes in coping with the disruption of the education calendar due to the COVID-19 pandemic. This also point to the fact that access to information and digital services serve as key strategies in addressing the effect of covariate shocks on the education sector. Additionally, the results show that male students were more likely to report of adverse effects of the COVID-19 pandemic on academic performance. Similarly, older students were more likely to be negatively affected in terms of academic performance and also more likely to incur extra cost for COVID-19 related expenses. Interestingly, the age of students exhibited non-linear relationship with negative academic performance and COVID-19 related education expenditure. Taken together, these results suggest that students at the higher level of education grade were more likely to be affected by the pandemic and this necessitated the need for households to incur extra cost as part of the coping measures. Our findings are in consonance with previous studies [16] in the empirical literature that showed that the effect of COVID-19 pandemic on child education outcomes was uneven with considerable socio-demographic differences.

Interestingly, the results show considerable heterogeneity based on the gender of the students. Whilst age and its squared, marital status, religion of respondent being Christian, access to tarred roads and location of residence positively influenced the COVID-19 related expenditure for male students, that of female students were positively influenced by location of residence, participation in

online classes, age of student and respondent, socio-economic status, location of residence and household size. Interestingly, household computer ownership and access to tarred road negatively influenced the COVID-19 related expenditure for female students. Unsurprisingly, similar results are found for the determinants of the negative effects on child academic performance. These results suggest that policy makers and stakeholders in the education sector should take into consideration the gender of students in addressing the negative effect of the COVID-19 pandemic and associated coping measures.

Our findings are relevant for the design and implementation of education policy and practice in addressing the medium to long-term effects of the COVID-19 pandemic on child education outcomes in Ghana and other developing countries. First, policy reforms in the education sector targeting poor households are urgently needed to mitigate the devastating effects of the COVID-19 pandemic on academic performance in Ghana. Second, the COVID-19 pandemic exposed the inadequacies of the teaching and learning methods employed in educational institutions in Ghana. Addressing such inadequacies requires proactive educational policies and programs through continuous improvement in the infrastructure and curriculum for students and teachers in low-income settings. There is the need to revisit the current pedagogical approaches in the primary and secondary education to make them easily adaptable to pandemic or emergency situations. This will require investment in new teaching and learning materials across primary and secondary schools in Ghana. Third, the extra education expenses incurred by the informal households serve as potential indication of low-income households' willingness to invest in child education. Therefore, a policy blend of "partial payment regime" could be pursued to enhance the delivery of educational materials in low-income communities during pandemic and emergency situations in Ghana. Fourth, policies and programs to support in-home education/tuition could be designed to enhance emergency preparedness in the education sector of Ghana. Fifth, it is important that policymakers and stakeholders continuously monitor children that were severely affected by the COVID-19 pandemic. Additional coping assistance could be targeted to children from low-income households to make up for the lost educational opportunities due to the COVID-19 pandemic. Therefore, policies and programs should be implemented to cater for the lost opportunities in teaching and learning for the severely affected students residing in informal households. Additional skills and training programs could be targeted to students graduating from the COVID-19 affected school calendars to enhance their employability and income opportunities. Targeting of recovery response programmes to different education levels should be considered in addressing the long-lasting impact of the COVID-19 pandemic in Ghana. Interestingly, promoting access to information, wealth and infrastructure for low-income communities could be useful in enhancing Ghana's education preparedness during pandemics and emergency situations.

Lastly, closing the e-learning gaps at different levels of education is urgently needed to improve the emergency preparedness of the education sector in Ghana. The government and non-governmental institutions should implement digitalization (e.g., TV and ICT programmes) to enable virtual classes that are responsive to the educational needs of students during pandemics and emergency situations as well as introduce the use of diagnostic assessments, needs-based assessments and other tools to ensure standardization of educational materials during pandemics. We also highlight the limitations of this study that could serve as avenue for future research. Given the study population, our sample size may not be nationally representative of Southern Ghana. Also, the cross-sectional nature of the study limits its generalizability and the extent of causality. Nonetheless, the study provides evidence to stair up policy discussion on the long-term effects of the COVID-19 pandemic on child education outcomes in Ghana.

Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Charles Yaw Okyere: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Frank Otchere:** Writing – review & editing, Writing – original draft, Validation, Methodology, Conceptualization. **Joseph Kujo Darko:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Conceptualization. **Christian Kwaku Osei:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Charles Yaw Okyere reports financial support was provided by Building a New Generation of Academics in Africa (BANGA-AFRICA) Project, University of Ghana, Legon. The other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e26238.

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