Taylor & Francis
Taylor & Francis Group

Global Public Health

An International Journal for Research, Policy and Practice

ISSN: 1744-1692 (Print) 1744-1706 (Online) Journal homepage: www.tandfonline.com/journals/rgph20

Child labour in cocoa growing regions of Ghana and Côte d'Ivoire: an analysis of academic attainment in children engaged in hazardous labour.

Lucy Pirkle, Cathy Zimmerman, Santadarshan Sadhu, Kareem Kysia & Meghna Ranganathan

To cite this article: Lucy Pirkle, Cathy Zimmerman, Santadarshan Sadhu, Kareem Kysia & Meghna Ranganathan (2024) Child labour in cocoa growing regions of Ghana and Côte d'Ivoire: an analysis of academic attainment in children engaged in hazardous labour., Global Public Health, 19:1, 2320860, DOI: 10.1080/17441692.2024.2320860

To link to this article: https://doi.org/10.1080/17441692.2024.2320860

Published online: 23 Feb 2024.

GLOBAL PUBLIC HEALTH
2024, VOL. 19, NO. 1, 2320860
https://doi.org/10.1080/17441692.2024.2320860

Child labour in cocoa growing regions of Ghana and Côte d'Ivoire: an analysis of academic attainment in children engaged in hazardous labour.

Lucy Pirkle[a], Cathy Zimmerman[b], Santadarshan Sadhu[c], Kareem Kysia[a] and Meghna Ranganathan[a]

[a]Department of Brain Sciences, Imperial College London, London, UK; [b]Gender, Violence and Health Centre, London School of Hygiene & Tropical Medicine, London, UK; [c]Vulnerable Populations Research Area, NORC at the University of Chicago, Chicago, IL, USA

ABSTRACT

This paper examines the relationship between child labour and educational attainment and explores the distinction between harmful and non-harmful agricultural cocoa work. We conduct a secondary analysis of data on 3,338 children who reported attending school in 2018 across cocoa growing regions of Ghana and Côte d'Ivoire. To address differences between harmful and non-harmful child labour, we differentiated work completed by a child by hazardous activity engagement. These groups of child labour were then modelled against educational attainment, defined by a whether or not the child needed to repeat a class. We then conducted mediation analysis to assess whether injury mediates this relationship. Our results show that hazardous child labour increases the odds of repeating a class and work-related injury compared to non-hazardous labour. The effect of hazardous child labour on academic attainment was also found to be mediated by work-related injuries by 14%. Educational attainment is associated with hazardous labour activities and the odds of injury and not the act of participation in agricultural labour alone. Programmes based on strong measures of harmful work will foster better protection for children who are most at risk and may inform global debates around the benefits versus the risks of child labour.

ARTICLE HISTORY
Received 3 June 2023
Accepted 14 February 2024

KEYWORDS
Educational attainment; harmful child labour; non-harmful child labour; work-related injury; hazardous child labour

1. Introduction

Child labour, defined by the International Labour Organisations (ILO) as 'work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development', is one of the most significant global challenges of the twenty-first century (IPECL, 2004, p. 16). Although full eradication of child labour is set out in the Sustainable Development Goals (SDGs), the statistics remain alarming; figures suggest an estimated 1 in 10 children worldwide are child labourers (ILO, 2017). Child labour has been found to be particularly prevalent in cocoa growing regions of the countries of Ghana and Côte d'Ivoire, with an estimated 45% of children living in agricultural households in these regions participating in child labour in cocoa production (Sadhu et al., 2020). There are, however, significant variations in prevalence estimates. The reasons for these

CONTACT Meghna Ranganathan meghna.Ranganathan@lshtm.ac.uk

variations include the lack of a clear universal definition of child labour (Edmonds, 2008). Broadly, all definitions of child labour aim to discern between work that is beneficial or those than are harmful for children. However, so far there is no clear consensus on what makes child labour harmful.

This challenge is complicated further by cultural differences between countries. For example, evidence has shown that parents within Ghana believe that children's participation in economic activities is beneficial to the child's future. This viewpoint stems from the notion that child labour is fundamental to the child's social education, thereby helping them learn essential life skills, such as a strong work ethic (Adonteng-Kissi, 2021). In some cases, it is believed that this socialisation ensures children become worthy successors to their parents (Adonteng-Kissi, 2021). Similar findings have also been reported elsewhere, including Nigeria (Omokhodion, 2010) and Asia (Nengroo & Bhat, 2015) suggesting that this viewpoint may be shared across other contexts. These cultural differences and parental viewpoints suggest one challenge to achieving the full eradication of child labour, as set out in the SDGs. This challenge does not negate the need to protect children from the harms of child labour. However, it is an important consideration to be included within policy discussions. Policy must ensure children across the world are protected from the dangers of child labour without unduly impeding their life chances and career prospects. To achieve this, there must be a clear understanding of what makes child labour harmful.

A common outcome measure reported in the literature for measuring harm to the child, is the impact on their education and more specifically educational attainment. Educational attainment is defined as the highest level of schooling a child has successfully completed. This is an important outcome measure of harm as individual impacts of lower educational attainment include worse long-term health outcomes (Zajacova & Lawrence, 2018). Lower educational attainment has also been shown to reduce economic development through contributing to the persistence of poverty and the intergenerational cycle of child labour that have widespread societal costs (Roggero et al., 2007). Historically, the explanation for lower educational attainment within child labourers was lower school attendance. This is because there is a trade-off between child labour and schooling (Basu & Ban, 1998; Baland & Robinson, 2000; Dunne et al., 2021). A child who works will have less time to spend on other activities during the day than non-working children, including their education. However, it has been reported that a child working alongside school still has lower educational attainment compared to non-working peers (Heady, 2000; Khanam & Ross, 2011; Pellenq et al., 2021). Therefore, this indicates that school attendance alone is insufficient to explain the causal mechanisms responsible for lower educational attainment in child labourers.

There are several other potential factors that could contribute to lower educational attainment amongst child labourers. For example, psychosocial effects of work and working conditions of child labourers have also been explored (Fanton d'Anton et al., 2022). A study conducted in Ethiopia found that the working conditions of children were intrinsically linked to wellbeing, particularly socioemotional development. Additionally other factors such as physical fatigue from working have also been explored (Fanton d'Anton et al., 2022). Work-related injury is among other possible work-related influences on academic performance that has the potential to help differentiate between harmful and non-harmful work. Research on work-related health outcomes in child labourers is limited but is growing. A study conducted in Ghana showed that children engaged in cocoa production are involved in activities with health risks, such as, exposure to poisoning, acute injuries, and musculoskeletal ailments (Mull & Kirkhorn, 2005). The severe injury rate among child labourers was also estimated by the ILO as 4% yearly, accounting for around 11.8 million children, indicating child labourers are at a high risk of injury (Thi et al., 2022).

These findings are meaningful as evidence suggests that childhood health issues are linked to educational outcomes, such as the need to repeat classes due to poor performance (Behrman, 1996). However, causal mechanisms explaining the link between work-related injury due to child labour and lower educational attainment are still absent in the literature. One potential mechanism is mental ill-health driven by work-related injury. Although no direct link has been made between mental health, child labour and academic attainment, several studies have identified separate

associations between child labour and poor mental health outcomes and between mental health and academic performance (Gao et al., 2020; Fekadu et al., 2006; Yu et al., 2019). Additionally, evidence suggests that injuries can affect children's brain development leading to poor performance at school (Rzucidlo & Campbell, 2009). Alterations in the Hypothalamic–Pituitary–Adrenal (HPA) axis have been linked with injury-related stress (Agorastos et al., 2019). These alterations have been identified separately as risk factors for poor school performance through stress-related deficits of memory and learning (Heissel et al., 2017). Both poor mental health and impeded brain development resulting from work-related injury could help explain the correlations of poor academic performance in children who work in harmful child labour alongside school.

Work-related injury is also an area of focus for child labour research due to the potential to differentiate between the harmful nature of the different forms of child labour. One study by Mavrokonstantis (2011) found an educational attainment gap between children who work in dangerous environments compared to safer environments. In this study, this was between children working in rural versus urban areas, thought to be due to the differences in work completed in the different areas. Although potentially helpful for policy discussions, research on the clear distinctions between safe and dangerous environments and educational attainment remains limited. Current literature lacks direct evidence of correlations between child labour, injury, and educational attainment. An understanding of relationships between these factors could help construct clear definitions on what constitutes harmful child labour, thus protecting children from the dangers of child labour and allowing children to help families engaging non-hazardous work. This paper aims to add to the evidence base by examining relationships between child labour, work-related injury and poor educational attainment, specifically examining school going children engaged in agricultural work in the cocoa growing regions of Ghana and Côte d'Ivoire.

2. Methods

2.1. Research design and study setting

The data used in this paper were collected by researchers at the National Opinion Research Center (NORC) at the University of Chicago and can be found in this NORC Report (Sadhu et al., 2020).

The survey was designed to be representative of all children aged 5–17 living in agricultural households in the cocoa growing areas during the 2018/19 main cocoa harvest season in Côte d'Ivoire and Ghana. This was achieved through the completion of a multi-stage stratified cluster sampling technique. Extensively trained local enumerators conducted a pre-interview developmental assessment using a child questionnaire to ensure robustness in data collection. The aim was to determine the cognitive capacity of the child and therefore an ability to understand what was being asked of them. If the assessment concluded that the child would not understand the majority of the survey questions, parents were asked to support the child in the interview. Children were asked directly about their experiences with child labour, as this has been found to yield more accurate information than asking parents (Lichand & Wolf, 2023).

This work aimed to develop population estimates for the prevalence of child labour and hazardous child labour in those regions. An agricultural household was defined by a minimum of one adult or child occupant being involved in work within agriculture within the past 12 months. Extensive stakeholder engagement, local enumerator training and rigorous data collection oversight were included within the study design to ensure high quality data was collected and the precision of the data collected. The research looked specifically at cocoa growing regions in Côte d'Ivoire and Ghana as these regions have a high prevalence of child labour and are the largest producers of cocoa in the world, accounting for around 63% of global cocoa bean production. This analysis looks specifically at data collection between November 2018 to January 2019 in Ghana and February 2019 to March 2019 in Côte d'Ivoire. These dates were chosen as they fall within the main harvest season within both countries (Sadhu et al., 2020).

This current paper presents secondary analysis of these data.

2.2 Definitions

Sadhu et al. (2020) used a 'common definition' of child labour. The definition was formulated by identifying overlaps between the Ghanaian and the Ivorian legal definitions of child labour (Sadhu et al., 2020).

- ***Hazardous child labour*** was defined as a child who performed any of the five types of hazardous work activities related to cocoa agriculture (land clearing, carrying heavy loads, exposure to agro-chemicals, handling sharp tools, undertaking night work) within the 12 month period before the survey or worked long hours (more than 42 h) during the reference week.
- ***Non-hazardous child labour*** was defined as a child working below minimum age (if they are under 12) or a child above 12 years who exceeded age-related maximum legal working hours but did not perform any of the five hazardous work activities defined above. Examples of this include gathering, drying and breaking cocoa pods (without sharp tools), weeding (without sharp tools), fermentation of cocoa pods, preparing seedlings, watering and packing.

2.3. Conceptual framework

Our conceptual framework (Figure 1) drew on the child labour literature. The framework depicts if and how child labour impacts academic performance measured by the need to repeat a class. Within the framework, we hypothesise that hazardous child labour impacts a child's educational attainment with work-related injuries mediating this relationship. Thus, we hypothesise it is the labour conditions and odds of injury that impacts educational attainment in child labourers.

Our conceptual framework aims to differentiate between the impact of no labour, hazardous and non-hazardous child labour on educational attainment.

The framework also recognises potential confounders in these relationships, including:

1. ***Age:*** This was included as a potential confounder as there may be differential impacts on the child depending on their age (Ibrahim et al., 2019).

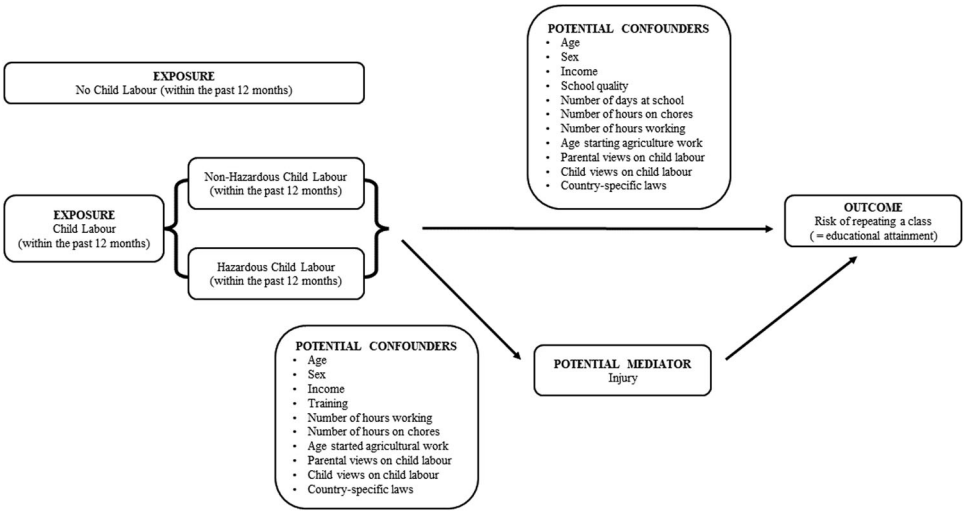

Figure 1. Conceptual framework.

2. ***Sex:*** This was included as a potential confounder as boys have been found to have a higher chance of working in agriculture than girls (Kembou et al., 2022).
3. ***Time spent working (both on household chores and outside the home):*** This was included as a potential confounder as the greater the time spent working the less time the child has to dedicate to school work (Basu & Ban, 1998; Baland & Robinson, 2000; Dunne et al., 2021) and also they greater the chances for injury.
4. ***Age started on agricultural work:*** This was included as a potential confounder as the longer and earlier the child is in work the greater the potential for harm due to the developmental processes of the brain and potential stressors the child is exposed to.
5. ***School quality (measured by student to teacher ratio being above the median):*** This was included as a potential confounder as it has previously been reported that school quality is linked to a child's educational attainment (The World Bank, 2022). Student to teacher ratio is often cited as an important contributing factor to school quality as students at schools with lower student to teacher ratios have greater opportunities to engage with teachers and educational resources (Fomba et al., 2023; Rawlings et al., 2023).

We selected work-related injury as a potential confounder in this relationship due to injury-causing pathological stress responses (Gustafsson, 2008; Irfan et al., 2012) and potential mental health problems. These impacts are linked to lower school performance (Sabia & Hupbach, 2020; Gao et al., 2020).

2.4. Variables

2.4.1. Outcome variables:

- ***Educational attainment*** – The primary outcome measure is whether a child needs to repeat a class. This outcome is recorded as a measure of educational attainment as repeaters are at an increased risk of leaving school early and therefore the highest level of schooling the child has completed will be lower (UNESCO, 2012). The child was asked whether they had repeated a class.
- ***Agricultural Injury*** – The secondary outcome measure is whether the child had been injured at work within the past 12 months. For the child to be considered having been injured within agriculture, she/he would have been injured and worked either directly in cocoa farming or off-farm cocoa processing within the past 12 months. The child was asked whether they had been injured in the past 12 months.

2.4.2. Exposure variable:

- ***Child Labour*****:** The main exposure variable is whether the child was participating in hazardous or non-hazardous agricultural child labour or no labour specifically within agriculture. For the purposes of this research, agricultural work was defined as 'work on own or the household's plot or any other farm, food garden, or help in growing farm produce or in looking after animals for the household' (Sadhu et al., 2020, p. 3). Using the definition of child labour stated in Section 2.2, children were asked whether they had engaged in different types of agricultural work in the past 12 months. This then enabled researchers to split into no child labour, hazardous or non-hazardous child labour depending on their involvement in specified hazardous activities.

Potential Confounding Variables: The following variables from the conceptual framework were analysed as potential confounders based on the literature:

a. ***age;*** the child was asked what their age at time of interview was. This has been included as a linear variable.
b. ***sex;*** the child was asked what their sex was.
c. ***school quality;*** school quality was linked to a questionnaire completed by the child's school. The measure chosen for this was student to teacher ratio (measured by student to teacher ratio being above the median). ***any formal or informal training;*** the child was asked whether they had been given any formal or informal training.
d. ***the hours spent working (economic, non-economic and household chores);*** the child was asked to estimate the number of hours spent working each day of the week. Details of this work were also captured.
e. ***cocoa strata;*** The cocoa stratum is a measure of high, medium and low cocoa production rates in the child's area, with these data extracted from COCOBOD in Ghana and the Coffee–Cocoa Council in Côte d'Ivoire (Sadhu et al., 2020).
f. ***the age starting agriculture work;*** the child was asked what ages they started completing agricultural work (Sadhu et al., 2020).

Where available, we used variables where the child was asked about the past 12 months to eliminate the risk of seasonal variations in work patterns affecting the outcomes of the analysis. We have not included a number of confounders and have not accounted for differences in country laws between Ghana and Côte d'Ivoire, within the analysis. We, however, acknowledge the importance of these variables and have included them as and included as part of the conceptual framework.

2.5 Data analysis

This data analysis was completed using Stata BE 17.0. Before analysis, missing data and children not attending school were excluded. Children not attending school were excluded to focus on casual mechanisms contributing to relationships between child labour and educational attainment in children working alongside school. Analysis was completed on the data collected in 2018.

We used descriptive statistics to gain an overview of the population characteristics. We then used bivariate logistic regression (LR) to identify factors which are significantly associated with both academic attainment and work-related injury. All significant confounders identified in the bivariate analysis were then included in an initial multivariate LR model. Using reverse stepwise LR, we then fit adjusted models where the final model included all confounders that showed a p value of less than 0.1, indicating a significance at 10% or lower. This significant level was chosen to ensure all variables with a confounding effect were included in the final model. The significance level in the final model was set at 5% or lower ($p \leq 0.05$). The odd's ratio (OR) and confidence interval (CI) were reported. Reverse stepwise LR was chosen for this exploratory analysis as it is efficient at simplifying the model, maximising predictive accuracy and reducing the risk of overfitting.

We then used mediation analysis to identify whether work-related injury is one mechanism through which child labour causes poor educational attainment. For this analysis, hazardous child labour (using non-hazardous work as the reference) was used as the exposure variable and repeating a class as the outcome variable. The mediator was agricultural injury within the past 12 months. To complete the analysis, the Stata BE 17.0 statistical package medsem was utilised (Mehmetoglu, 2018) that works by the Baron and Kenny (1986) mediation method with Iacobucci, Saldanha, and Deng (2007) adjustment. Partial or complete mediation was determined by LR. With age being the only confounder significant in each pathway, the regression analysis for mediation was adjusted by the child's age. A Sobel's z-test was then conducted to look at whether the addition of injury into the regression model significantly reduced the direct effect of hazardous labour on educational attainment. A ratio of the indirect to total effect (RIT) and ratio of indirect to direct effect (RID), were then calculated to determine the size of this mediation.

3. Results

3.1. Socio-demographic characteristics of the respondents

A total of 5,543 children across Ghana (n = 2809) and Côte d'Ivoire (n = 2724) completed the survey in 2018 (see Appendix, Table A). 87.6% (n = 4854) of these children, were attending school and 67.1% (n = 3718) had worked in agriculture in the past 12 months. For the purposes of this analysis that aimed to assess children who work alongside school, all children not attending school were then excluded from further analysis, leaving 3,338 children.

Analysis on the remaining children showed 12.1% (n = 586) of the children performed non-hazardous work and 56.7% (n = 2752) were exposed to hazardous work alongside their studies (Table 1). Most children attending school were aged between 5 and 11 (52.4%; n = 1747), followed by children aged between 12 and 14 (30.7; n = 1023) and children aged between 15 and 17 (16.9%; n = 565). This population also was 43.8% (n = 1462) female and a slightly higher percentage (56.89%; n = 1899) of children lived in Ghana.

3.2. Hazardous child labour is associated with the need to repeat a class

Unadjusted analysis-factors associated with academic attainment: We first conducted bivariable analysis using LR to identify factors influencing repeating a class (Table 2). This showed that the age of the child (the older the child the greater the odds of repeating a class), country, student–teacher ratio above the median, number of days considered school days, hours spent in agricultural labour and hours spent on chores were associated with repeating a class. There was no evidence of an association between gender, age started agricultural work and hours spent in economic activities other than agriculture and repeating a class.

Multivariable analysis-hazardous child labour increases odds of repeating a class: The effect of completing hazardous and non-hazardous child labour on need to repeat a class was then assessed after adjusting for statistically significant confounders in a reverse stepwise LR (Table 3). This showed that in comparison to not participating in any child labour, non-hazardous child labour did not show evidence of increasing the odds of repeating a class (OR: 0.98; CI 95% 0.76-1.27, $p > 0.05$). However, hazardous child labour significantly increased the odds of repeating a class

Table 1. Socio-demographic characteristics of children who attend school and engaged in child labour in agriculture in the past 12 months.

Characteristics	Ghana Freq (%)	Côte d'Ivoire Freq (%)	Total Freq (%)
Child Age Range			
5–11 y.o.	936 (49.29)	811 (56.48)	1747 (52.38)
Non-Hazardous	265	192	457
Hazardous	671	619	1290
12–14 y.o.	596 (31.38)	427 (29.47)	1023 (30.67)
Non-Hazardous	68	36	104
Hazardous	528	391	919
15–17 y.o.	367 (19.33)	198 (13.79)	565 (16.94)
Non-Hazardous	17	8	25
Hazardous	350	190	540
Gender			
Female	844 (44.44)	618 (42.95)	1462 (43.80)
Non-Hazardous	189	138	327
Hazardous	655	480	1135
Male	1055 (55.55)	821 (57.05)	1876 (56.20)
Non-Hazardous	161	98	259
Hazardous	849	768	1617
County			
Ghana			1899 (56.89)
Côte d'Ivoire			1439 (.11)

Table 2. Bivariable analysis showing the association between potential confounding variables and outcome (need to repeat a class).

Unadjusted	Odds Ratio (95% CI)	Sig.
Age	1.20 (1.17-1.22)	***
Gender (base = female)	1.07 (0.95-1.21)	n.s.
Country (base = Ghana)	1.72 (1.52-1.95)	***
Student teacher ratio above the median (poor school quality)	1.33 (1.18-1.50)	***
Number of days in the past 7 days that were school days	0.95 (0.92-0.98)	**
Age started agricultural work	1.04 (1.00-1.09)	n.s.
Hours spent on agricultural work (past 7 days)	1.00 (1.00-1.00)	***
Hours spent on economic activities other than agriculture (past 7 days)	1.00 (1.00-1.00)	n.s.
Hours spent on household chores other than agriculture (past 7 days)	1.01 (1.00-1.02)	***

Significance level: *** = $P < 0.001$, ** = $P < 0.01$, n.s. = $P > 0.1$. Sig. = significance level.

Table 3. Reverse stepwise LR showing association between child labour and need to repeat class after adjusting for confounders.

	Step 1		Step 2		Step 3 (Final Model)	
No Agriculture	OR (95% CI) Ref	Sig. Ref	OR (95% CI) Ref	Sig. Ref	OR (95% CI) Ref	Sig. Ref
Non-Hazardous	0.93 (0.70-1.24)	0.605 n.s.	0.93 (0.69-1.23)	0.599 n.s.	0.98 (0.76-1.27)	0.896 n.s.
Hazardous	1.25 (1.01-1.55)	0.039 *	1.25 (1.01-1.55)	0.038 *	1.24 (1.02-1.50)	0.033 *
Age	1.15 (1.12-1.18)	0.000 ***	1.15 (1.12-1.18)	0.000 ***	1.17 (1.14-1.20)	0.000 ***
Country	0.53 (0.43-0.65)	0.000 ***	0.55 (0.47-0.65)	0.000 ***	0.56 (0.48-0.64)	0.000 ***
No. School Days	0.97 (0.93-1.01)	0.190 n.s.	0.97 (0.93-1.01)	0.183 n.s.	0.96 (0.93-1.00)	0.043 *
No. Hours in Agriculture	1.00 (1.00-1.00)	0.119 n.s.	1.00 (1.00-1.00)	0.118 n.s.	1.00 (1.00-1.00)	0.074 n.s.
No. Hours Chores	1.00 (1.00-1.01)	0.401 n.s	1.00 (1.00-1.01)	0.404 n.s.		
Student: Teacher > median	0.94 (0.78-1.14)	0.532 n.s				

Significance level: *** = $P < 0.001$, ** = $P < 0.01$, n.s. = $P > 0.1$. Sig. = significance level.

by 1.24 times (95% CI: 1.02-1.50; $p < 0.05$). Further, in comparison to non-hazardous child labour, hazardous child labour significantly increased the odds of repeating a class by 1.32 times (CI 95%: 1.05-1.66; $p < 0.05$) (Table 4). This effect was also seen when the same analysis was completed for each country independently.

3.3 Hazardous child labour is associated with work-related injury

As the analysis showed that hazardous child labour increased the odds of repeating a class above non-hazardous child labour, we then examined whether this relationship could be explained by work-related injury. As the variable of work-related injury only includes injury during work, a relationship between no agricultural labour and injury could not be assessed.

Injury demographics: For the children engaged in child labour in agriculture, we looked at a breakdown of the injuries and consequence of the injuries to the children broken down by type of labour completed (Table 5). This showed that the most common injury reported by the child completing hazardous labour was wounds and cuts (n = 954; 80.9%). The most common consequences of exposure to the hazardous labour included being in bad pain (n = 582; 36.1%), tiredness/exhaustion (n = 672; 41.6%) and feeling very sick (n = 451; 26.4%).

Unadjusted analysis-factors associated with injury: We then aimed to look at whether injury acts as a mediator in this relationship. To do this, we first completed unadjusted bivariable analysis using LR to identify factors influencing injury while performing hazardous and non-hazardous agricultural work (Table 6). This showed that age (the older the child the higher the odds of repeating a class), gender, whether a child received training, age of starting agricultural work and hours spent in agricultural labour were statistically associated with work-related injury. Cocoa strata, and country were not statistically associated with injury.

Table 4. Reverse stepwise LR showing association between non-hazardous child labour and hazardous child labour and need to repeat class after adjusting for confounder.

	Step 1		Step 2		Step 3 (Final Model)	
Non-Hazardous	OR (95% CI) Ref	Sig. Ref	OR (95% CI) Ref	Sig. Ref	OR (95% CI) Ref	Sig. Ref
Hazardous	1.41 (1.10-1.80)	0.007 **	1.40 (1.09 −1.80)	0.008 **	1.32 (1.05-1.66)	0.018 *
Age	1.13 (1.10-.16)	0.000 ***	1.13 (1.10-1.16)	0.000 ***	1.14 (1.11-1.17)	0.000 ***
Country	0.59 (0.47-0.74)	0.000 ***	0.57 (0.48-0.68)	0.000 ***	0.57 (0.48-0.67)	0.000 ***
No. School Days	0.97 (0.92-1.01)	0.146 n.s.	0.97 (0.92-1.01)	0.153 n.s.	0.96 (0.92-1.00)	0.039 *
No. Hours in Agriculture	1.00 (1.00-1.00)	0.086 n.s.	1.00 (1.00-1.00)	0.087 n.s.	1.00 (1.00-1.00)	0.045 *
No. Hours Chores	1.00 (1.00-1.01)	0.164 n.s	1.00 (1.00-1.01)	0.596 n.s.		
Student: Teacher > median	1.06 (0.86-1.31)	0.596 n.s.				

*Significance level: *** = P < 0.001, ** = P < 0.01, * = P < 0.05, n.s. = P > 0.05.*

Table 5. Injury-related summary statistics.

Demographic	Freq. (n%)
Total	1179 (42.84)
Injury	
Wounds/Cuts	954 (80.92)
Broken Bones	16 (1.36)
Snake Bites	17 (1.44)
Back Pains	253 (21.46)
Muscle Pains	254 (21.54)
Other Pains	153 (12.98)
Burns	52 (4.41)
Skin Itchiness	215 (18.24)
Other	116 (9.94)
Consequence	
Was in bad pain	582 (36.06)
Felt very sick	451 (26.42)
Felt very tired or exhausted	672 (41.64)
Did not feel well for a long time	214 (13.26)
Had to receive traditional treatment	258 (15.99)
Had to receive treatment at hospital/health center	194 (12.02)
Could not continue working	188 (11.65)
Could not go to school	107 (6.63)
Other	342 (21.19)

Table 6. Unadjusted bivariable analysis showing effect of variables on odds of injury.

Unadjusted	Odds Ratio (95% CI)	Sig.
Age	1.13 (1.10-1.16)	***
Gender (base = female)	1.31 (1.13-1.51)	***
Country (base = Ghana)	0.99 (0.86 −1.15)	n.s.
Child received training	1.19 (1.03-1.38)	*
Cocoa Strata		
Medium	1.00 (0.86-1.18)	n.s.
Low	0.89 (0.72-1.11)	n.s.
Age started agricultural work	0.96 (0.91-1.00)	*
Hours spent on agricultural work (past 7 days)	1.00 (1.00-1.00)	***

Significance level: *** = $P < 0.001$, * = $P < 0.05$, n.s. = $P > 0.05$. Cocoa stratum is a measure of high, medium and low cocoa production rates in the child's area, with these data extracted from COCOBOD in Ghana and the Coffee- Cocoa Council in Côte d'Ivoire (Sadhu et al., 2020). Sig. = significance level.

Table 7. Reverse stepwise LR showing association between child labour and injury after adjusting for confounders.

	Step 1		Step 2		Step 3	
	OR (95% CI)	Sig.	OR (95% CI)	Sig.	OR (95% CI)	Sig.
Non-Hazardous	Ref	Ref	Ref	Ref	Ref	Ref
Hazardous	13.32 (4.07-43.55)	0.000 ***	13.25 (4.06-43.27)	0.000 ***	12.92 (3.97-42.04)	0.000 ***
Age	1.11 (1.02-1.21)	0.013 *	1.11 (1.02-1.21)	0.013 *	1.11 (1.02-1.21)	0.012 *
Age started work	0.9565339 (0.91-1.00)	0.053 n.s.	0.96 (0.91-1.00)	0.053 *	0.96 (0.91-1.00)	0.052 *
Sex	0.93 (0.71-1.22)	0.595 n.s.	0.93 (0.71-1.21)	0.590 n.s.		
Training	0.97 (0.75-1.25)	0.807 n.s.				

Significance level: *** = $P < 0.001$, * = $P < 0.05$, n.s. = $P > 0.05$.

Multivariable analysis-hazardous child labour increases odds of injury: After adjusting for the significant confounders, we found that that compared to non-hazardous child labour, there was strong evidence of an association between engaging in hazardous child labour and an increase in injury by 12.9 times (95% CI: 3.97-42.04; $p < 0.001$) (Table 7).

3.4. Injury acts as a mediator between hazardous child labour and poor academic attainment

Finally, noting that hazardous child labour increases the odds of both injury and poor academic attainment, we then assessed the role of injury as a mediator in the casual pathway linking hazardous child labour to increased odds of repeating a class (Table 8). Using the Baron and Kenny (1986) mediation technique adjusted by Iacobucci et al. (2007), we showed through LR analyses that the relationships between hazardous labour and injury, injury and repeating a class and hazardous labour and repeating a class were all statistically significant. Sobel's z-test, used to test significance of the mediation, also returned a significant result. As both the direct relationship between injury and repeating a class and Sobel's z-test returned a significant result, partial mediation is indicated. Using all the regression coefficients to calculate the indirect, direct, and total effects, we computed the ratio of indirect to total (RIT) score. This showed that 14% of the effect of hazardous child labour on repeating a class is mediated by injury. The ratio of indirect to direct (RID) score showing the effect of injury was 0.2 times as large as the impact of hazardous child labour on this measure of educational attainment. When single country analysis was completed, complete mediation was found in Ghana but not in Côte d'Ivoire.

4. Discussion

Low educational attainment in children results in negative consequences for children and the wider society, such as lowering the child's long-term health outcomes and contributing to persistent poverty (Rashmi et al., 2015). Therefore, it is vitally important that the factors that lead to it are fully elucidated so that policies and programmes to address this global challenge can be developed.

Table 8. Mediation analysis showing injury is a partial mediator in the relationship between hazardous labour and educational attainment.

	Coefficient	Significance
STEP 1: hazardous labour => injury	0.267	0.000 ***
STEP 2: injury => repeating a class	0.041	0.024 *
STEP 3: hazardous labour => repeating a class	0.004	0.004 **
Sobel's z-test		0.026 *
	Effect Size	
RIT (Indirect/Total)	0.138	
RID (Indirect/Direct)	0.161	

Significance level: *** = $P < 0.001$, ** = $P < 0.01$, * = $P > 0.05$. RIT = ratio of indirect to total effect, RID = ratio of indirect to direct effect. All pathways were adjusted for age of child.

Additionally, better understanding of the causal factors can aid in prioritising policies and programmes for the most hazardous aspects of child labour.

4.1. Differential impact on educational attainment: hazardous vs non-hazardous child labour

The study findings contribute to the field as it shows that in cocoa growing regions of Ghana and Côte d'Ivoire, children's engagement in agricultural hazardous labour is associated with increased odds of repeating a class compared to non-hazardous labour. The practical distinction between hazardous and non-hazardous child labour is in the types of tasks or activities the child participates in. Therefore, it appears that educational attainment is associated with *labour conditions, not just the act* of participating in agricultural work. This finding is consistent with a report by Mavrokonstantis (2011) who found that in rural areas of Vietnam, child labour did not impact school performance. Explanations for those findings were linked to children mainly working on family farms with limited exposure to hazardous work. At the same time, children's work in urban areas of Vietnam, thought to be more hazardous, was significantly associated with negative educational outcomes.

Together, these findings highlight the importance of making a clear distinction between hazardous and non-hazardous child labour while assessing the impact of child labour on educational attainment. An understanding of when child labour can be deemed 'non-hazardous' is particularly important in low-income countries where there are high rates of poverty and cultural differences suggest child labour can provide positive impacts to a child's future and career prospects (Aufseeser et al., 2018; Adonteng-Kissi, 2021; Miller, 2023). It has been documented that one of the main causes of child labour in cocoa farming on smaller farms is children are needed as 'helping hands' as they cannot afford to hire wage labour (ILO, 2017). Without children filling these gaps, smaller firms may not be operational. If farmers cannot work for income, the family may be pushed further into poverty and therefore their basic needs may not be met (Radfar et al., 2018). Pushing children further into poverty can have severe negative consequences, such as child malnutrition, which is a recognised determinant of school performance (Rashmi et al., 2015). Further, there remains evidence on other benefits of child labour in certain cases, including on future career prospects and income contributions as a source of pride for children (Heissler & Porter, 2013).

Therefore, eradication of 'all forms of child labour' as outlined in the SDGs, must be met with adequate social protection mechanisms to ensure this aim does not do more harm than good (Patrinos & Psacharopoulos, 1997). Our results suggest looking at ways to prioritise eradication of the most hazardous child labour and most common hazardous tasks first to protect children at the greatest risk of harm, whilst providing the time and resources to effectively implement these policies.

4.2. Injury as a potential mediator in this relationship

Given these distinctions between the effects of hazardous and non-hazardous child labour, it is important for child protection schemes to have a greater understanding of what causes these harmful impacts of hazardous labour. This is particularly important given our findings that poor educational attainment persists in hazardous child labourers who attend school. Our analysis of injuries related to child labour showed that hazardous child labour significantly increased the odds of injury compared to non-hazardous labour.

Possible explanations for this link are that injury causes pathological stress responses and potential mental health problems. Irfan et al. (2012), for example, reported that through the hyperactivation of the cortisol response hormone (CRH) following extensive physical stress due to child labour, children had elevated cortisol levels. Chronic elevation of cortisol can lead to chronic stress that has

been linked to lower school performance (Sabia & Hupbach, 2020). These responses are related to cortisol or CRH leading to damage to the hippocampus, that is responsible for learning and memory (Brunson et al., 2002). Decreased hippocampal function due to high CRH or cortisol from injury-mediated stress could help explain low educational attainment in hazardous child labourers. Elevated cortisol is also linked to poor mental health, including development of anxiety disorders and depression (Gustafsson, 2008). Poor mental health has repeatedly been linked to lower school attainment (Gao et al., 2020). However, many of these papers look specifically at severe or traumatic injury. Further research is needed to conclusively identify which mechanisms are responsible for work-related injury causing lower academic attainment following hazardous labour.

However, given the mediation effect was only found to be 14% for work-related injury, these findings signal further research is needed to look at what is causing the correlation between hazardous child labour and lower academic attainment. This could include assessing which of the hazardous activities contribute to the lower academic attainment, either in isolation, or in combination with another component. For example, night work may make children too tired to stay awake in class the following day or the strenuous nature of carrying heavy loads could lead to the child becoming too fatigued to concentrate. As the impact of individual hazardous activities or combination of more than one hazardous activities on educational attainment has not been assessed in the paper, we cannot comment further on these potential mechanisms. There may also be a greater mediator effect if mental and psychological health were included as mediators. However, due to data availability this was not considered in this paper.

Further, our findings provide useful insights into the most common types of injuries to children and offer practical information for policy or programme interventions. We found that 80% of the children reported that they had suffered wounds and cuts related to their work in agriculture. Considering only 20% of children did not report an injury, these findings indicate that there is an urgent need for occupational health and safety programmes that can reduce the risk of injuries, especially age-appropriate approaches to training and personal protective gear. Other studies have indicated that agricultural work exposes workers, regardless of age to significant risk of wounds and cuts due to the nature of the work, but it remains unclear the differences in risks by age (Parvez & Shahriar, 2018). Yet, these studies indicate that with adequate protective equipment, the risk of injury is reduced (Garrigou et al., 2020). By implementing programmes, such as providing farms with subsidies for protective equipment, risk of injury to a child may be reduced, possibly lowering the negative effects on school performance.

4.3 Limitations

Although our analysis has contributed to the body of knowledge on child labour, there are some limitations. Given the complexity of the issue of child labour and academic performance, it is not possible to confirm all confounding variables have been included in our analysis. It is possible that important confounders have been excluded from the analysis due to limitations in the wider literature. Further, a major problem in the literature on academic attainment following child labour is the endogeneity of child labour (Mavrokonstantis, 2011). To help account for this in this research, we included confounders that address how the children split their time, including how much time the children spent on chores, agricultural work as well as non-agricultural work. However, other endogenous factors such as the child's wages, child employment rates were not included due to lack of data.

Additionally, where possible we included potential confounders which assessed the patterns over the past 12 months rather than past week to prevent seasonal variations in working patterns affecting the findings in our study. However, this was not always possible. Therefore, where variables have been included which look at work patterns over the past week, there is a risk that the results may be skewed depending on the time of year the survey was conducted. Similarly, there is debate on the most accurate way to assess academic attainment amongst child labourers. In this paper we

use grade repetition. This is a common measure used in the literature and has been regularly reported as an indicator of the level of education obtained (educational attainment) (UNESCO, 2012). However, recent research has indicated that it is high grade repetition rather than repeating a single year that is indicative of lower educational attainment. Therefore, we propose this research is repeated when data on the number of grades repeated by the child becomes available.

Another limitation concerns our mediation analysis. In this research, we utilised the Baron and Kenny (1986) adjusted by Iacobucci et al. (2007) method. Although the model does utilise the standard errors of the mean for path coefficients presented by Iacobucci et al. (2007), there are concerns that Sobel's test used to determine significance of the mediation, has low statistical power (Zhao et al., 2010). Therefore, larger sample sizes may be needed to increase the confidence in this finding.

Finally, this paper uses data collected as part of a large cross-sectional study conducted by NORC at the University of Chicago (NORC). NORC is known for adopting the highest standards for ensuring data quality of the surveys it undertakes. Based on the information documented by NORC in the report we believe that these data are of high quality as NORC used validated tools and conducted extensive local enumerator training and stakeholder engagement as part of data collection efforts. However, our study analysis is for 2018 data only. Therefore, it provides evidence of the findings within a snapshot in time and we cannot comment on the dependability and stability of these findings over time.

Additionally, due to this analysis being purely quantitative, the data has not been triangulated with qualitative data. The results have been assessed against the literature and analysed within a conceptual framework. Qualitative data would offer further insights into pathways and can ensure us that that results have been triangulated.

4.4 Implications

Overall, this research emphasises a need to understand the heterogeneity of child labour and how this can be used to improve policy to protect child labourers worldwide. As this research does not indicate negative outcomes on education for children with non-hazardous labour, there is an implication that the elimination of hazardous labour could be prioritised above that of eliminating all types of agricultural child labour.

Although we showed a distinction between hazardous versus non-hazardous work, this is only one potential method to segment work types. This definition of the children considered to complete non-hazardous labour still exceeded the maximum hours set by international laws (ILO, 1999). Therefore, it is important that the impact of non-hazardous work on this group of children is examined more closely. Non-hazardous work in this report cannot be decisively ruled as synonymous with non-harmful with these findings alone and we cannot speak to other potential negative or positive outcomes of non-hazardous child labour. By defining harmful child work comprehensively, the types of child work that are most harmful to the child can be targeted in ways that will be more effective. Well-targeted programmes that are based on good measures of potential harm will foster better protection for those children who are most at risk and may help inform global debates around the benefits versus risks of child labour.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Adonteng-Kissi, O. (2021). Parental Perceptions of the Nature of Child Labour in Rural and Urban Ghana: Cultural Versus Economic Necessity. Child Care in Practice: Northern Ireland Journal of Multi-Disciplinary Child Care Practice. ahead-of-print (ahead-of-print), 1-21.

Agorastos, A., Pervanidou, P., Chrousos, G. P., & Baker, D. G. (2019). Developmental trajectories of early life stress and trauma: A narrative review on neurobiological aspects beyond stress system dysregulation. *Frontiers in Psychiatry*, *10*, 118. https://doi.org/10.3389/fpsyt.2019.00118

Aufseeser, D., Bourdillon, M., Carothers, R., & Lecoufle, O. (2018). Children's work and children's well-being: Implications for policy. *Development Policy Review*, *36*(2), 241–261. https://doi.org/10.1111/dpr.12215

Baland, J. M., & Robinson, J. A. (2000). Is child labor inefficient? *Journal of Political Economy*, *108*(4), 663–679. https://doi.org/10.1086/316097

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. http://doi.org/10.1037/0022-3514.51.6.1173

Basu, K., & Ban, P. H. (1998). The economics of child labour. *American Economic Review*, *88*(3), 412–427.

Behrman, J. R. (1996). The impact of health and nutrition on education. *The World Bank Research Observer*, *11*(1), 23–37. https://doi.org/10.1093/wbro/11.1.23

Brunson, K. L., Grigoriadis, D. E., Lorang, M. T., & Baram, T. Z. (2002). Corticotropin-Releasing hormone (CRH) downregulates the function of Its receptor (CRF1) and induces CRF1 expression in hippocampal and cortical regions of the immature Rat brain. *Experimental Neurology*, *176*(1), 75–86. https://doi.org/10.1006/exnr.2002.7937

Dunne, M., Humphreys, S., & Szyp, C. (2021) Education and work: Children's lives in rural Sub-saharan Africa. ACHA working paper 9. Brighton: Action n Children's harmful work in African agriculture, IDS.

Edmonds, E. (2008) *Defining child labour: A review of the definitions of child labour in policy research*. *International Labour Organisation.*

Fanton d'Anton, C., Greene, C., Pellenq, C., Melese Yilma, T., Champy, M., Canaver, M., & Pasquini, C. (2022). Child labor and psychosocial wellbeing: Findings from Ethiopia. *International Journal of Environmental Research and Public Health*, *19*(13), 7938. https://doi.org/10.3390/ijerph19137938

Fekadu, D., Alem, A., & Hägglöf, B. (2006). The prevalence of mental health problems in Ethiopian child laborers. *Journal of Child Psychology and Psychiatry*, *47*(9), 954–959. https://doi.org/10.1111/j.1469-7610.2006.01617.x

Fomba, B. K., Talla, D. F., & Ningaye, P. (2023). Institutional quality and education quality in developing countries: Effects and transmission channels. *Journal of the Knowledge Economy*, *14*(1), 86–115. doi:https://doi.org/10.1007s13132-021-00869-9

Gao, Y., Hu, D., Peng, E., Abbey, C., Ma, Y., Wu, C., Chang, C., Hung, W., & Rozelle, S. (2020). Depressive symptoms and the link with academic performance among rural Taiwanese children. *International Journal of Environmental Research and Public Health*, *17*(8), 2778. https://doi.org/10.3390/ijerph17082778

Garrigou, A., Laurent, C., Berthet, A., Colosio, C., Jas, N., Daubas-Letourneux, V., Jackson Filho, J., Jouzel, J., Samuel, O., Baldi, I., Lebailly, P., Galey, L., Goutille, F., & Judon, N. (2020). Critical review of the role of PPE in the prevention of risks related to agricultural pesticide use. *Safety Science*, *123*, 104527. https://doi.org/10.1016/j.ssci.2019.104527

Gustafsson, P. E. (2008) *Psychosocial stress, mental health and salivary cortisol in children and adolescents*. [dissertation/master's thesis]. Linköping University, Linköping.

Heady, C. (2000). What is the effect of child labour on learning achievement? *Evidence from Ghana: Innocenti Working Papers*, *79*, 40.

Heissel, J. A., Levy, D. J., & Adam, E. K. (2017). Stress, sleep, and performance on standardized tests: Understudied pathways to the achievement Gap. *AERA Open*, *3*(3). https://doi.org/10.1177/2332858417713488

Heissler, K., & Porter, C. (2013). Know your place: Ethiopian children's contributions to the household economy. *The European Journal of Development Research*, *25*(4), 600–620. https://doi.org/10.1057/ejdr.2013.22

Iacobucci, D., Saldanha, N., & Deng, X. (2007). A meditation on mediation: Evidence that structural equations models perform better than regressions. *Journal of Consumer Psychology*, *17*(2), 139–153.

Ibrahim, A., Abdalla, S. M., Jafer, M., Abdelgadir, J., & de Vries, N. (2019). Child labor and health: A systematic literature review of the impacts of child labor on child's health in low- and middle-income countries. *Journal of Public Health*, *41*(1), 18–26. https://doi.org/10.1093/pubmed/fdy018

International Labour Organisation. (1999). Ilo: Convention concerning the prohibition and immediate elimination of the worst forms of child labour. *International Legal Materials*, *38*(5), 1207–1210. https://doi.org/10.1017/S0020782900020027

International labour organisation. (2017). *Global estimates of child labour: Results and trends, 2012-2016*. ILO.

IPECL. (2004). *Child labour: A textbook for university students*. International Labour Organisation.

Irfan, M., Raja, G. K., Murtaza, S., Mansoor, R., Qayyum, M., & Rizvi, S. S. R. (2012). Physical stress may result in growth suppression and pubertal delay in working boys. *Journal of Medical Hypotheses and Ideas*, *6*(1), 35–39. https://doi.org/10.1016/j.jmhi.2012.03.006

Kembou, S., Wolf, S., & Ogan, A. (2022). *Child labor activities and schooling decisions in rural côte d'Ivoire*. RTA-HTRI Conference.

Khanam, R., & Ross, R. (2011). Is child work a deterrent to school attendance and school attainment? *International Journal of Social Economics*, *38*(8), 692–713. https://doi.org/10.1108/03068291111143901

Lichand, B., & Wolf, S. (2023). Measuring Child Labor:the Who's, the Where's, the When's, and the Why's Research Square.

Mavrokonstantis, P. (2011). *The impact of child labour on educational attainment: Evidence from Vietnam. Young lives student paper. [dissertation/ master's thesis]. [Oxford*. UK]. University of Oxford.

Mehmetoglu, M. (2018). Medsem: A stata package for statistical mediation analysis. *International Journal of Computational Economics and Econometrics*, *8*(1), 63–78. https://doi.org/10.1504/IJCEE.2018.088321

Miller, A. (2023). Child learning while earning: Barriers and pedagogies toward sustainable development goal 4, "quality education" for child street-sellers in Siem Reap, Cambodia. *Child Abuse & Neglect*, *139*, 105514. https://doi.org/10.1016/j.chiabu.2022.105514.

Mull, L. D., & Kirkhorn, S. R. (2005). Child labor in Ghana cocoa production: Focus upon agricultural tasks, ergonomic exposures, and associated injuries and illnesses. *Public Health Reports*, *120*(6), 649–655. https://doi.org/10.1177/003335490512000613

Nengroo, A. H., & Bhat, G. M. (2015). Opinion of parents about child labour and their education – A study. *Journal of Empirical Studies*, *2*(3), 40–46. https://doi.org/10.18488/journal.66/2015.2.3/66.3.40.46

Omokhodion, F. O. (2010). Perception and practice of child labour among parents of school-aged children in Ibadan, southwest Nigeria. *Child: Care, Health and Development*, *36*(3), 304–308. https://doi.org/10.1111/j.1365-2214.2009.00988.x

Parvez, M. S., & Shahriar, M. M. (2018). Agricultural farm-related injuries in Bangladesh and convenient design of working hand tools. *Journal of Healthcare Engineering*. https://doi.org/10.1155/2018/4273616

Patrinos, H. A., & Psacharopoulos, G. (1997). Family size, schooling and child labor in Peru - An empirical analysis. *Journal of Population Economics*, *10*(4), 387–405. https://doi.org/10.1007/s001480050050

Pellenq, C., Gunn, S., & Lima, L. (2021). The psychological health and well-being of children working in the brick industry: A comparative study. *Safety Science*, *140*, 105251. https://doi.org/10.1016/j.ssci.2021.105251

Radfar, A., Asgharzadeh, S., Quesada, F., & Filip, I. (2018). Challenges and perspectives of child labor. *Industrial Psychiatry Journal*, *27*(1), 17–20. https://doi.org/10.4103/ipj.ipj_105_14

Rashmi, M. R., Shweta, B. M., Fathima, F. N., Agrawal, T., Shah, M., & Sequeira, R. (2015). Prevalence of malnutrition and relationship with scholastic performance among primary and secondary school children in Two select private schools in bangalore rural district (India). *Indian Journal of Community Medicine*, *40*(2), 97–102. https://doi.org/10.4103/0970-0218.153871

Rawlings, B., Davis, H. E., Anum, A., Burger, O., Chen, L., Morales, J. C. C., Dutra, N., Dzabatou, A., Dzokoto, V., Erut, A., Fong, F. T. K., Ghelardi, S., Goldwater, M., Ingram, G., Messer, E., Kingsford, J., Lew-Levy, S., Mendez, K., Newhouse, M., … Legare, C. H. (2023). Quantifying quality: The impact of measures of school quality on children's academic achievement across diverse societies. *Developmental Science*, e13434. doi:https://doi.org/10.1111desc.13434

Roggero, P., Mangiaterra, V., Bustreo, F., & Rosati, F. (2007). The health impact of child labor in developing countries: Evidence from cross-country data. *American Journal of Public Health*, *97*(2), 271–275. https://doi.org/10.2105/AJPH.2005.066829

Rzucidlo, S. E., & Campbell, M. (2009). Beyond the physical injuries. *Journal of Trauma Nursing*, *16*(3), 130–135. https://doi.org/10.1097/JTN.0b013e3181b9e078

Sabia, M., & Hupbach, A. (2020). Stress-Induced increase in cortisol negatively affects the consolidation of contextual elements of episodic memories. *Brain Sciences*, *10*(6), 358. https://doi.org/10.3390/brainsci10060358

Sadhu, S., Kysia, K., Onyango, L., Zinnes, C., Monnard, A., & Arellano, I. R. (2020). Assessing Progress in Reducing Child Labor in Cocoa Production in Cocoa Growing Areas of Côte d'Ivoire and Ghana.

The World Bank, Implementation Completion Report (ICR) Review: Ghana Secondary Education Improvement. (2022). Available from: https://documents1.worldbank.org/curated/en/099140002222311308/pdf/P1457410276d560470ae3702a97efa81157.pdf.

Thi, A. M., Zimmerman, C., Pocock, N. S., Chan, C. W. & Ranganathan, M. (2022) Child domestic work, violence, and health outcomes: A rapid systematic review. *International Journal of Environmental Research and Public Health.* 19 (1), 427. https://doi.org/10.3390/ijerph19010427

UNESCO. (2012). *Opportunities lost: the impact of grade repetition and early school leaving*. United Nations Educational Scientific and Cultural Organization (UNESCO).

Yu, M., Linn, K. A., Shinohara, R. T., Oathes, D. J., Cook, P. A., Duprat, R., Moore, T. M., Oquendo, M. A., Phillips, M. L., McInnis, M., Fava, M., Trivedi, M. H., McGrath, P., Parsey, R., Weissman, M. M., & Sheline, Y. I. (2019). Childhood trauma history is linked to abnormal brain connectivity in major depression. *Proceedings of the National Academy of Sciences*, *116*(17), 8582–8590. https://doi.org/10.1073/pnas.1900801116

Zajacova, A., & Lawrence, E. M. (2018). The relationship between education and health: Reducing disparities through a contextual approach. *Annual Review of Public Health*, *39*(1), 273–289. https://doi.org/10.1146/annurev-publhealth-031816-044628

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering baron and kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206. https://doi.org/10.1086/651257

Appendix

Table A Socio-demographics of all children included in the study.

Characteristic	Ghana (n = 2809)	Côte d'Ivoire (n = 2724)	Total (n = 5543)
	Freq. (%)	Freq. (%)	Freq. (%)
School Attendance			
No	147 (5.23)	542 (19.82)	689 (12.43)
Yes	2662 (94.77)	2192 (80.18)	4854 (87.57)
Work in agriculture (past 12 months)			
No	809 (28.80)	1016 (37.16)	1825 (32.92)
Yes	2000 (71.19)	1718 (62.84)	3718 (67.08)
Do not attend school + type of child labour in agriculture (past 12 months)			
+ *No Labour*	46 (31.29)	263 (48.52)	309 (44.85)
+ *Non-Hazardous Labour*	10 (6.80)	54 (9.96)	64 (9.29)
+ *Hazardous Labour*	91 (61.90)	225 (41.51)	316 (45.86)
Attend school + type of child labour in agriculture (past 12 months)			
+ *No Labour*	763 (32.94)	753 (29.67)	1516 (31.23)
+ *Non-Hazardous Labour*	350 (15.11)	236 (9.30)	586 (12.07)
+ *Hazardous Labour*	1203 (51.94)	1549 (60.03)	2752 (56.70)
Attend school + type of hazardous labour (past 12 months) * (% of total number of children in hazardous labour)			
+ *Land clearing*	334 (12.55)	541 (24.68)	875 (18.03)
+ *Carrying heavy loads*	953 (35.80)	838 (38.22)	1791 (36.90)
+ *Exposure to agro-chemicals*	903 (33.92)	606 (27.65)	1509 (31.09)
+ *Handling sharp tools*	1301 (48.87)	1002 (45.71)	2303 (47.45)
+ *Long working hours*	13 (0.49)	22 (1.00)	35 (0.72)
+ *Working at night*	68 (2.55)	52 (2.37)	120 (2.47)