

Medium-term protective effects of quality early childhood education during the COVID-19 pandemic in Ghana

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Abstract

The COVID-19 pandemic led to extended school closures globally. Access to remote learning opportunities during this time was vastly unequal within and across countries. Higher-quality early childhood education (ECE) can improve later academic outcomes, but longer-term effects during crises are unknown. This study provides the first experimental evidence of how previously attending a higher-quality ECE program affected child engagement in remote learning and academic scores during pandemic-related school closures in Ghana. Children ($N = 1668$; 50.1% male; $M_{\text{age}} = 10.1$ years; all Ghanaian nationals) who attended higher-quality ECE at age 4 or 5 years had greater engagement in remote learning ($d = .14$) in October 2020, but not better language and literacy and math scores. Previous exposure to higher-quality ECE may support educational engagement during crises.

INTRODUCTION

The COVID-19 pandemic led to historically unparalleled global school closures, increasing risks to child development through inadequate access to learning at school and increased poverty and food insecurity (Egger et al., 2021). Global estimates suggest that disruption of access to early childhood education (ECE) translated to 53% of learning days lost (McCoy et al., 2021). Little rigorous evidence exists on how to support learning during crises, let alone on how to ensure equitable educational experiences during crises (Aber et al., 2021). Robust evidence shows that attending high-quality ECE improves short- and longer-term outcomes for vulnerable children

in the United States (Gray-Lobe et al., 2021; McCoy et al., 2017), with similar relations emerging in low- and middle-income countries (LMICs; Wolf, 2019). However, the short- and medium-term effects of high-quality ECE during crises remain unknown.

Ghana has the highest ECE enrollment rates in sub-Saharan Africa (SSA) but also has challenges with ECE quality (UNICEF, 2019). During the pandemic, schools were closed between March–December 2020. The Ministry of Education designed and rapidly implemented educational TV and radio programming for primary-school students, but children faced large difficulties in accessing remote learning (RL) due to lack of learning materials or devices (Wolf et al., 2021).

Abbreviations: ECE, early childhood education; LMIC, low- and middle-income countries; MAR, missing-at-random; QP4G, quality preschool for Ghana; RL, remote learning; SES, socioeconomic status; SSA, sub-Saharan Africa; TTPA, teacher training plus parental awareness; TT, teacher training; WWC, What Works Clearinghouse.



Overcrowded households, no access to electricity (especially in rural areas), and limited learning space and parental and teacher support were additional challenges (UNICEF, 2021).

This study provides the first experimental evidence of how previously attending higher-quality ECE affected engagement in RL and scores in language/literacy and math during the pandemic in Ghana. Our results suggest that higher-quality ECE was a protective factor for children's educational engagement in a context where prepandemic learning outcomes were among the lowest globally (Angrist et al., 2021).

Medium and long-term ECE effects

Experimental studies examining longer-term ECE—specifically preschool—impacts come predominantly from high-income countries. They show mixed results, ranging from no detectable persistent impacts (e.g., Hill et al., 2015; Magnuson et al., 2007) to small, continued benefits into middle childhood, adolescence, and adulthood (e.g., García et al., 2020; Gormley et al., 2018; Gray-Lobe et al., 2021; Vandell et al., 2016). A meta-analysis across 22 experimental and quasi-experimental studies found strong support for sustained ECE gains on outcomes, including reduced grade retention and increased high-school graduation rates (McCoy et al., 2017). Importantly, as children in comparison groups often attended alternative ECE programs, the qualities of those alternative programs are key to understanding differences across studies (Duncan & Magnuson, 2013; Morris et al., 2018).

Longer-term academic gains might be due to improved nonacademic skills from preschool exposure, including self-regulation and executive function (Blair & Cybele Raver, 2015; Diamond et al., 2007). Therefore, children who received high-quality ECE could be more engaged in classroom processes. Findings that ECE can increase long-term school persistence such as high school graduation supports this notion (McCoy et al., 2017). Importantly, medium- and longer-term ECE impacts on broader nonacademic pathways—such as academic engagement and motivation—have not been examined yet.

During school closures and in times of crisis, these factors might be particularly important for children to persist in learning activities at home and maintain engagement in education amidst severe macro- and micro-level challenges. Primary-school-aged children's motivation decreased during the pandemic (Zaccoletti et al., 2020), and school engagement varied widely by gender and socioeconomic strata in both high- and low-income settings (Bacher-Hicks et al., 2021; Tembey et al., 2021). Prolonged school closures and inequities in exposure to risk and protective factors characterize the COVID-19 pandemic as well as other crises (e.g., Steimle et al., 2021; Wolf et al., 2021). Preschool enrollment

has been shown to improve especially the outcomes of vulnerable children in the United States (Yoshikawa et al., 2013). Whether ECE has differential impacts in LMICs, and during crises, remains unknown.

The Quality Preschool for Ghana interventions

Quality Preschool for Ghana (QP4G) was a partnership between Ghana's Ministry of Education, Innovations for Poverty Action, Sabre Education, and academic researchers. The goals were to improve preprimary school quality—measured by teacher–child interactions—and children's school readiness. Program details are reported elsewhere (Wolf, Aber, Behrman, & Tsinigo, 2019). The primary component (teacher training [TT]) targeted teachers through in-service training and coaching that aimed to increase child-centered activity-based learning opportunities, positive behavior management, and the quality of teacher–child interactions. The secondary component targeted parents through three Parent–Teacher Association meetings offered to all parents with enrolled preschool children and was implemented with the TT program. Each meeting consisted of viewing videos developed for the intervention followed by discussions led by district educational coordinators; the content included play-based learning, parents' roles in children's learning, and encouraging parent–teacher communication. QP4G was evaluated through a school-randomized trial where schools were assigned to: (a) TT, (b) teacher training plus parental awareness (TTPA), and (c) “ECE business as usual” control.

Both treatment conditions led to medium-sized reductions in teacher burnout and improved several dimensions of observed classroom quality (increased emotional support and positive behavior management). TT (but not TTPA) also increased support for student expression (Wolf, Aber, Behrman, & Tsinigo, 2019). Furthermore, both treatment conditions increased the number of developmentally appropriate activities teachers used.

Importantly, while both TT and TTPA treatments improved classroom quality, TTPA counter-acted some improvements in quality as well as impacts on child outcomes. For children, during the implementation year TT significantly improved outcomes in three of four domains: early numeracy ($d_{wt} = .11$), early literacy ($d_{wt} = .11$), and social-emotional skills ($d_{wt} = .18$), but not executive function. There were no significant impacts of TTPA on children's outcomes, indicating that the parental component counter-acted the positive effects of the teacher training program. A second follow-up study (Wolf, Aber, Behrman, & Peele, 2019) found that 1 year later, impacts of TT were sustained only for social-emotional skills ($d_{wt} = .13$). Finally, a third follow-up study two years after the intervention ended (Wolf, 2019) found that impacts of TT were sustained for children's social-emotional

and executive-function outcomes ($d_{wt} = .11-.15$). These findings corroborate previous studies suggesting that higher-quality ECE improves nonacademic outcomes that could increase future engagement in learning and school persistence (Blair & Cybele Raver, 2015).

The current study

This study examined medium-term impacts of previous QP4G exposure on RL engagement and learning outcomes during school closures due to the COVID-19 pandemic for Ghanaian children aged 10–12 years. Previous follow-up studies with this sample showed persistent impacts of the TT intervention on children's social-emotional and executive function skills 1- and 2-years after the intervention (Wolf, 2019; Wolf, Aber, Behrman, & Peele, 2019). Our current study was exploratory given the lack of evidence of medium-term ECE impacts during times of crisis, though we were investigating if there were continued benefits for that same group of children. Thus, we addressed three exploratory research questions: (1) Does previous QP4G exposure increase engagement in educational activities during school closures? (2) Does previous QP4G exposure improve children's test scores during school closures? And (3) do impacts vary by child sex and household socioeconomic status (SES)?

METHODS

Participants and procedures

Two-hundred and forty representative schools were recruited from six districts in the Greater Accra Region of Ghana in 2015 and were randomly assigned to TT, TTPA, or Control, as described previously. Preschool children were randomly sampled from class rosters totaling 15 per school ($N = 3435$). Previous data collection included in-person child assessments and phone surveys with caregivers in September–October 2015 (baseline), May–June 2016 (follow-up 1), May–June 2017 (follow-up 2), and May–June 2018 (follow-up 3). A phone-based study with children and their caregivers was conducted in October–December of 2020 (follow-up 4). The present study uses data collected at baseline and follow-up 4. At follow-up 4, we attempted to reach all the children and caregivers who were recruited in 2015 (2026 child–caregiver pairs were tracked pre-pandemic). We were able to reach 48.6% ($N = 1668$; $M_{age} = 10.1$ years) of the original 3435, or 83.4% of those tracked pre-pandemic.

The Greater Accra Region is the most developed region in Ghana, has the smallest share of socioeconomically disadvantaged citizens, and considerable ethnic diversity (Owusu & Agyei-Mensah, 2011). Variation in SES across districts and neighborhoods is substantial. For example, for the six districts included in this study,

rankings on “disadvantage” ranged from 93 to 187 (average 139) among 216 districts in Ghana (UNICEF, 2015). Half of children in our sample lived in households that were at-risk of living below the poverty line. All children in our sample were Ghanaian nationals. We did not collect data on ethnic groups, but children spoke a range of local languages at home including Twi/Fante, Ewe, Ga, Dangme, and Hausa.

Following verbal consent, caregivers participated in phone surveys covering topics related to their economic situations and their children's education, administered in English or their preferred local language.¹ For children, phone surveys included questions on their involvement in educational activities during the pandemic and assessment of their language/literacy, and math skills. Following best practices for phone-based child assessments (Angrist et al., 2020), enumerators asked children to locate quiet and comfortable seats while engaging in the phone surveys, as well as to gather materials to solve math problems; caregivers were asked to give children privacy while they were engaging in the surveys. Enumerators informally spoke with the children to help them feel at ease and emphasized that tests were low-stakes before administering the survey in the language with which the child was most comfortable.

Measures

Engagement in RL

Children and caregivers were asked, separately, the same five items to assess the various modes in which children were engaged in RL since schools closed in mid-March, adapted from the Gender and Adolescent Global Evidence Core Respondent survey module (Baird et al., 2020): whether the child had pursued: (i) independent study (without direction from teachers/caregivers); (ii) exercises assigned by teachers; (iii) educational television or radio programming; (iv) online courses; and (v) private tutoring. Sum scores were generated for the child ($M = 1.91$, $SD = 1.12$, range = 0–5) and caregiver-reported items ($M = 2.20$, $SD = 1.08$, range = 0–5; $r = 0.42$).

Child learning

To assess children's *language and literacy* and *math* abilities over the phone, we adapted modules from the Early Grade Reading Assessment (RTI International, 2016a), Early Grade Mathematics Assessment (RTI International, 2016b), and Young Lives (Boyden, 2018). In Ghana, by grade 4, schools shift to English-only instruction, following national policy. All child assessments were therefore conducted in English.



Language and literacy included three sub-tasks including one oral vocabulary task (list words that began with the letter “B” up to a maximum of 10), 10 spelling words adapted from the EGRA oral vocabulary and Young Lives reading tasks (spell words such as “flower,” “sun,” “frog,” and “trousers”), and oral comprehension (a brief passage was read followed by six comprehension questions [17 items total; $\alpha = .68$; $M = 0.53$, $SD = 0.23$, range = 0–1]). *Math* included two sub-tasks measuring number discrimination (identifying the larger number of pairs), and operations and numbers (solving for mathematics problems including addition, subtraction, and multiplication [16 items total; $\alpha = .78$; $M = 0.64$, $SD = 0.20$, range = 0–1]). For both language/literacy and math, the percentages correct were calculated for each of the individual sub-tasks and the average scores subsequently calculated across the sub-components. Both composite variables were standardized for analysis.

Baseline learning outcomes

Children were assessed in-person using the International Development and Early Learning Assessment (IDELA; Pisani et al., 2018). Emergent math was assessed using 39 items grouped into eight subtasks that covered number knowledge, basic addition and subtraction, one-to-one correspondence, shape identification, sorting based on color and shape, size and length differentiation, and completion of simple puzzles ($\alpha = .72$). Emergent language/literacy was measured using 38 items grouped into six subtasks that covered constructs of print awareness, letter knowledge, phonological awareness, oral comprehension, emergent writing, and expressive vocabulary ($\alpha = .74$).

Covariates

Baseline covariates included: private-sector status of baseline preschools, district dummies, child sex, age, KG level at baseline, and standardized emergent language/literacy and math baseline scores. We also included baseline household wealth measured by the Ghana Poverty Scorecard (Schreiner & Woller, 2010).

Analytic approach

Differential attrition

Baseline equivalency across treatment arms was established and reported in Wolf, Aber, Behrman, and Tsinigo (2019). Given the longitudinal nature of this 5-year study, a large portion (51.4%) of the sample

from baseline was not found for the phone-based follow-up. We conducted attrition analysis using 2015 baseline data. Children present in follow-up 4 had higher baseline SES ($b = .002$, $SE = .001$), were more likely to attend private preschools at baseline ($b = .06$, $SE = .03$), and less likely to be from the Ga South district ($b = -.10$, $SE = .04$). Variables for which there were no significant relations to attrition included: baseline parental education, cognitive stimulation, books in the home, emergent language/literacy, emergent math, social-emotional, executive function, and approaches to learning.

Children in both treatment groups were more likely to be in the sample compared to the control (5.2% for TT vs. control, 6.7% for TTPA vs. control, $p < .01$). We consider standards developed by the What Works Clearinghouse (WWC; Institute of Education Sciences, 2020) that classify evaluation studies as having either “high” or “low” attrition based on a combination of overall and differential attrition. In this case, overall and differential attrition rates suggest that there is an “unacceptable threat of bias under both optimistic and cautious assumptions.” Therefore, we conduct additional sensitivity analyses to understand how different approaches to handling missing data affect our impact estimates.

Multiple imputation

Following WWC Version 4.1 Standards Handbook (Institute of Education Sciences, 2020), we used multiple imputation to address missing data for all missing cases, including dependent variables and treatment status, using all five data rounds. While data were not missing completely at random, if variables that strongly predict attrition are incorporated into the missing-data strategy, the plausibility of the missing-at-random (MAR) assumption increases (Young & Johnson, 2015). In other words, by using large sets of covariates in estimating multiple chains of models, including those that predict differential attrition, assumptions of MAR have been shown to be robust. Impact estimates were computed using 100 imputed datasets; the final analytic sample included all 3435 children from baseline.

To examine the sensitivity of results to the multiple imputation, we: (i) conducted all impacts using list-wise deletion, and (ii) used inverse-probability weighting as an alternative approach to tackle differential attrition (Wooldridge, 2007). For the latter, we predicted probabilities of successfully tracking control-group respondents using logistic regressions on baseline characteristics that predicted attrition. We then used these probabilities as inverse weights for each individual in regression models as an alternative specification.

Impact estimates

Multilevel regression models were used to address the nested, nonindependent nature of the data with children sampled at baseline from schools and classrooms. We employed two-level models to estimate impacts on all outcomes and included a select set of covariates. To examine impact heterogeneity by child sex and SES (baseline household wealth), we added interaction terms at the child-level. The multiply imputed datasets were analyzed using Rubin's combining rules to compute pooled coefficients and standard errors (Royston et al., 2009).

RESULTS

Table 1 presents sample descriptives. Half (50.1%) of children were male and 55.6% attended private schools. A majority (68.5%) of caregivers had not completed secondary school, and one-fifth (20.8%) had not completed primary school. On average, children scored 53% and 64% of items correct on literacy/language and math assessments, respectively. More specifically for literacy, 64.3% of children could spell at least five of ten grade-appropriate words correctly. After having listened to a simple story, 65.7% of the sample answered all three questions about the story's content correctly. For math, 45.2% of children could correctly answer two-integer addition or subtraction problems (i.e., $38 + 26$) and 56.4% could solve a simple multiplication item (i.e., 9×2). In

addition, half (51.4%) of the sample correctly answered the number of minutes in 1 hour.

Table 2 presents impact estimates. Children randomly assigned to the TT condition in 2015 were more likely to engage in RL activities during school closures based on both caregiver and child reports ($b = .15$, $SE = .07$, $p < .05$; $b = .17$, $SE = .05$, $p < .01$, respectively). There were no statistically significant impacts on language/literacy or math scores. There was no evidence of heterogeneous impacts by child sex or baseline household wealth (results not shown).

Given the large attrition rates, we re-ran treatment impacts using two different methods to address missing data—list-wise deletion and inverse-probability weighting. Results are presented in Table A1. Impacts did not differ substantially, with one exception: using inverse-probability weights, TT impacts on caregiver-reported engagement in RL activities were smaller ($b = .09$) and not statistically significant.

To assess how caregiver's support during the child assessment may have impacted the results, we re-ran the impact analysis for language/literacy and math scores in two ways: (1) including a dummy variable for whether children reported receiving help during the assessment, and (2) dropping the 192 and 193 kids who reported receiving help on language/literacy and math tests, respectively. The results were nearly identical. Finally, we tested for whether results were sensitive to children's home language by re-running our models controlling for home language spoken, as well as by interacting treatment status with home language; results were very similar and did not differ by language groups.

TABLE 1 Child sample characteristics

	Observed <i>N</i>	<i>M</i> or %	<i>SD</i>
Child male	3435	50.1%	—
Age (in years) at follow-up 4	1632	10.07	1.25
Baseline household wealth ^a	2115	60.81	13.64
Caregiver education (baseline)	2129		
Less than primary school		20.8%	—
Primary school		7.3%	—
Junior high school		40.4%	—
Senior high school (SHS)		12.2%	—
More than SHS		18.3%	—
Private school (vs. public) at follow-up 4	1544	55.6%	—
Child-reported RL activities	1668	1.91	1.12
Caregiver-reported RL activities	1732	2.20	1.09
Language and literacy score (mean % correct)	1668	0.53	0.22
Math score (mean % correct)	1668	0.64	0.20

^aHousehold wealth is measured using the Ghana Poverty Scorecard (Schreiner & Woller, 2010), which ranges 0–100, with higher scores indicating a lower likelihood of living in poverty. A score of 60 or below indicates a high probability that households fall below the national poverty line.

Abbreviation: RL, remote learning.

DISCUSSION

The COVID-19 pandemic led to school closures globally, leaving children across diverse contexts without formal education for nearly a year. Evidence is growing that higher-quality ECE can improve children's short- and longer-term educational outcomes in stable times, including in LMICs. Yet the protective role of higher-quality ECE in crises—when schools are closed, for example—is not known. High-quality ECE can improve future learning-related outcomes, such as self-regulation and school persistence (e.g., McCoy et al., 2017), which may be particularly important for schooling outcomes during times of crisis given its centrality in other important outcomes including mental and physical health, schooling, and employment (e.g., Diamond, 2013).

This study provides among the first evidence that higher-quality ECE can lead to sustained school engagement when children reach primary school, even when schools are closed, as during the COVID-19 pandemic. One possible explanation could be attributed to the sustained impacts on children's social-emotional and executive function outcomes (Wolf, 2019), which perhaps

TABLE 2 Treatment impacts on remote learning activities and language/literacy and math scores 5 years after program implementation

	<i>b</i> (<i>SE</i>)	<i>p</i> -value
Child-reported RL activities		
TT	.14 (.06)*	.031
TTPA	.00 (.06)	.958
Caregiver-reported RL activities		
TT	.15 (.06)*	.020
TTPA	.03 (.06)	.543
Language/literacy		
TT	.02 (.06)	.753
TTPA	-.07 (.06)	.207
Math		
TT	.07 (.05)	.169
TTPA	.02 (.05)	.622

Note: All impact estimates computed from 100 multiply imputed datasets using two-level models with children nested in baseline schools and a set of baseline covariates. Sample size for TT versus control = 2268 children nested in 161 schools. Sample size for TTPA versus control = 2255 children nested in 158 schools.

Abbreviations: RL, remote learning; TT, teacher training condition; TTPA, teacher training plus parent-awareness training condition.

* $p < .05$.

provided children with transferable skills that helped them navigate and respond to schooling and other challenges during the pandemic. This result highlights that evaluations examining medium- and longer-term ECE impacts should broaden the nonacademic outcomes examined. Nevertheless, the effect sizes were small: on average, children engaged in 0.15 more activities on a scale of five ($d = .14 SD$). Planned longer-term follow-ups will shed light on implications of increased RL engagement for children's later educational outcomes.

Children who were randomly assigned to the TTPA treatment did not have significantly higher engagement in RL activities, despite teachers having the same training as the TT treatment. Parents were critical supports for children to participate in RL activities while schools were closed. Previous studies of QP4G have documented adverse, counter-acting effects of the parental-awareness intervention on child outcomes in earlier years, and that less-educated parents were resistant to the “modernist” educational approaches promoted by QP4G (Wolf, 2020; Wolf, Aber, Behrman, & Peele, 2019). That persistent impacts of the teacher training were not observed in this treatment group speaks to the strong influence of families on children's education (Schoellman, 2016).

Despite increased engagement in RL activities for the TT treatment group, we did not find improvements in children's language/literacy and math scores for either treatment arm. One possible explanation is that our learning assessments were brief, administered over the phone, and consequently only provided very cursory estimates of children's abilities (i.e., oral reading

assessments were not possible). Phone-based learning assessments are new and best practices are still being developed (Angrist et al., 2020). In our sample, 14% of children reported that someone in their households helped them during the phone-based assessments. Thus, interpreting the findings related to learning outcomes should consider these key measurement challenges, which have been also observed elsewhere (Crawford et al., 2021). A second explanation is that small increases in engagement are not enough to translate into improved language/literacy and math skills. A third possibility is that while children's RL involvement increased, the qualities of activities were poor and children did not gain academic skills despite their engagement. Alternatively, it is possible that there simply were no sustained impacts of ECE on children's academic skill levels. Importantly, the language/literacy and math measures were not specifically aligned with Ghana's grade-level curriculum, making it impossible to draw inferences about protective effects for grade-level learning and progression. As schools reopened in Ghana in January 2021, children were again tracked in schools and direct assessments were conducted. These additional data will allow us to assess sustained impacts on children's re-enrollment in school, as well as a broader set of learning and developmental outcomes.

Finally, despite magnified inequalities documented by household SES and child sex in educational engagement during school closures in other contexts (Vegas & Winthrop, 2020), we did not find differential persistent effects for either subgroup. This lends additional support to previous studies suggesting that the TT intervention had uniform effects on subgroups of children (Wolf, Aber, Behrman, & Tsinigo, 2019). Importantly, in our sample, SES was positively associated with RL ($r = .26$, $p < .001$), and boys were less likely to engage than girls ($r = -.08$, $p < .01$).

LIMITATIONS AND CONCLUSIONS

While higher-quality ECE has been shown to support children's schooling and development years later in both high-income (Yoshikawa et al., 2013) and low-income countries (Yoshikawa & Kabay, 2014), little is known about how ECE may support children in the medium-term during crises. This study provides some of the first evidence of how experimental higher-quality ECE may have shaped children's learning experiences during school closures. We focus on Ghana and contribute to limited evidence on the impacts of ECE on children in SSA.

There are important limitations to consider when interpreting the results. First, our measures of RL engagement were limited to child and caregiver reports. Second, our learning assessments were administered by phone and did not represent the whole of children's skills and

may suffer from other measurement error. Third, our sample focused on children in the Greater Accra Region who were enrolled in preprimary school in the 2015–2016 school year. This sample is not nationally representative, and likely represents a more advantaged population than the overall Ghanaian population.

Finally, we had significant attrition, with half of the baseline sample not found for the current study. Mobility and school dropout are common challenges in Ghana and many other LMICs, with disadvantaged children experiencing both at higher rates (Kamanda & Sankoh, 2015). Our sample for this study likely represents a more advantaged sub-sample within the broader study given that children were able to be tracked and surveyed. While we address missing data using multiple imputation and our sensitivity tests suggest that our data were missing at random, there are important implications for how the results may apply to other crises. For example, it is plausible that impacts on increased engagement occurred only among the more advantaged children (as they were less likely to drop out from the sample), and that if the full sample were tracked the overall impacts would be null. Alternatively, early education interventions have been shown to be especially effective among the most deprived learners, so there may be even larger impacts if the full sample would have been tracked. Thus, there is uncertainty on the overall effect of attrition on our results.

Despite these limitations, the findings suggest that higher-quality ECE can have some protective effects for children's later education during crises. The results point to several areas for future research. First, studies assessing longer-term impacts of ECE may consider broader outcomes, including academic motivation, engagement, and time use. Second, there is some evidence that children's subsequent classroom and school contexts matter for whether gains from preschool last into elementary school, what some have called “sustaining environments” (Bailey et al., 2017). These studies have focused exclusively on school and classroom contexts. However, when schools are closed, other contexts—including homes and neighborhoods—may become more important in supporting sustained impacts. The COVID-19 pandemic and related economic downturns increased parental stress, food insecurity and poverty, all of which may shape longer-term impacts of ECE (Egger et al., 2021). Future research in both stable and crisis contexts should consider a broader set of proximal settings when examining sustaining environments. Finally, future research should examine factors associated with fadeout of treatment impacts, in this case on learning outcomes. As quality education is increasingly recognized as an important component of humanitarian responses to crises (Murphy et al., 2018), more studies examining children's ECE experiences and educational transitions across diverse contexts are needed.

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ENDNOTE

¹ Mobile phone penetration is very high in Ghana; all parents from the original sample had mobile phones.

REFERENCES

- Aber, J. L., Tubbs Dolan, C., Kim, H. Y., & Brown, L. (2021). Children's learning and development in conflict- and crisis-affected countries: Building a science for action. *Development and Psychopathology*, 33(2), 506–521. <https://doi.org/10.1017/S0954579420001789>
- Angrist, N., Bergman, P., Evans, D. K., Hares, S., Jukes, M. C., & Letsomo, T. (2020). Practical lessons for phone-based assessments of learning. *BMJ Global Health*, 5(7), e003030.
- Angrist, N., Djankov, S., Goldberg, P. K., & Patrinos, H. A. (2021). Measuring human capital using global learning data. *Nature*, 1–6, 403–408. <https://doi.org/10.1038/s41586-021-03323-7>
- Bacher-Hicks, A., Goodman, J., & Mulhern, C. (2021). Inequality in household adaptation to schooling shocks: Covid-induced online learning engagement in real time. *Journal of Public Economics*, 193, 104345.
- Bailey, D., Duncan, G. J., Odgers, C. L., & Yu, W. (2017). Persistence and fadeout in the impacts of child and adolescent interventions. *Journal of Research on Educational Effectiveness*, 10(1), 7–39. <https://doi.org/10.1080/19345747.2016.1232459>
- Baird, S., Małachowska, A., & Jones, N. (2020). *Covid-19 phone survey (round 1)|Core respondent module*. <https://www.gage.odi.org/publication/covid-19-phone-survey-round-1/>
- Blair, C., & Cybele Raver, C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology*, 66, 711–731. <https://doi.org/10.1146/annurev-psych-010814-015221>
- Boyden, J. (2018). *Young lives: An international study of childhood poverty: Rounds 1–5 constructed files, 2002–2016* [data collection] (3rd ed.). <https://doi.org/10.5255/UKDA-SN-7483-3>

- Crawford, L., Evans, D., Hares, S., & Sandefur, J. (2021, September). *Teaching and testing by phone in a pandemic*. Working paper 591. Center for Global Development, Washington, DC.
- Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, 64, 135–168. <https://doi.org/10.1146/annurev-psych-113011-143750>.
- Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, 318(5855), 1387–1388. <https://doi.org/10.1126/science.11511>
- Duncan, G. J., & Magnuson, K. (2013). Investing in preschool programs. *Journal of Economic Perspectives*, 27(2), 109–132. <https://doi.org/10.1257/jep.27.2.109>
- Egger, D., Miguel, E., Warren, S. S., Shenoy, A., Collins, E., Karlan, D., Parkerson, D., Mobarak, A. M., Fink, G., Udry, C., Walker, M., Haushofer, J., Larreboure, M., Athey, S., Lopez-Pena, P., Benhachmi, S., Humphreys, M., Lowe, L., Meriggi, N. F., ... Vernot, C. (2021). Falling living standards during the COVID-19 crisis: Quantitative evidence from nine developing countries. *Science Advances*, 7(6), eabe0997. <https://doi.org/10.1126/sciadv.abe0997>
- Garcia, J. L., Heckman, J. J., Ermini, L. D., & José, P. M. (2020). Quantifying the life-cycle benefits of an influential early-childhood program. *Journal of Political Economy*, 128(7), 2502–2541.
- Gormley, W. T., Phillips, D., & Anderson, S. (2018). The effects of Tulsa's pre-K program on middle school student performance. *Journal of Policy Analysis and Management*, 37(1), 63–87. <https://doi.org/10.1002/pam.22023>
- Gray-Lobe, G., Pathak, P. A., & Walters, C. R. (2021). *The long-term effects of universal preschool in Boston*. Nber working paper series, 28756(May), 951–952.
- Hill, C. J., Gormley, W. T., & Adelstein, S. (2015). Do the short-term effects of a high-quality preschool program persist? *Early Childhood Research Quarterly*, 32, 60–79. <https://doi.org/10.1016/j.ecresq.2014.12.005>
- Institute of Education Sciences. (2020). *What Works Clearinghouse™ standards handbook, Version 4.1. 1–5*. Institute of Education Sciences.
- Kamanda, M., & Sankoh, O. (2015). A systematic review of the status of children's school access in low- and middle-income countries between 1998 and 2013: Using the INDEPTH network platform to fill the research gaps. *Global Health Action*, 8, 28430. <https://doi.org/10.3402/gha.v8.28430>
- Magnuson, K. A., Ruhm, C., & Waldfogel, J. (2007). The persistence of preschool effects: Do subsequent classroom experiences matter? *Early Childhood Research Quarterly*, 22(1), 18–38. <https://doi.org/10.1016/j.ecresq.2006.10.002>
- McCoy, D. C., Cuartas, J., Behrman, J. R., Cappa, C., Heymann, J., López Bóo, F., Lu, C., Raikes, A., Richter, L., Stein, A., & Fink, G. (2021). Global estimates of the implications of COVID-19-related preprimary school closures for children's instructional access, development, learning, and economic wellbeing. *Child Development*, 92(5), e883–e899. <https://doi.org/10.1111/cdev.13658>
- McCoy, D. C., Yoshikawa, H., Ziol-Guest, K. M., Duncan, G. J., Schindler, H. S., Magnuson, K., Yang, R., Koeppe, A., & Shonkoff, J. P. (2017). Impacts of early childhood education on medium- and long-term educational outcomes. *Educational Researcher*, 46(8), 474–487. <https://doi.org/10.3102/0013189X1737739>
- Morris, P. A., Connors, M., Friedman-Krauss, A., McCoy, D. C., Weiland, C., Feller, A., Page, L., Bloom, H., & Yoshikawa, H. (2018). New findings on impact variation from the head start impact study: Informing the scale-up of early childhood programs. *AERA Open*, 4(2), 233285841876928. <https://doi.org/10.1177/2332858418769287>
- Murphy, K. M., Yoshikawa, H., & Wuerml, A. J. (2018). Implementation research for early childhood development programming in humanitarian contexts. *Annals of the New York Academy of Sciences*, 1419(1), 90–101. <https://doi.org/10.1111/nyas.13691>
- Owusu, G., & Agyei-Mensah, S. (2011). A comparative study of ethnic residential segregation in Ghana's two largest cities, Accra and Kumasi. *Population and Environment*, 32, 332–352. <https://doi.org/10.1007/s11111-010-0131-z>
- Pisani, L., Borisova, I., & Dowd, A. J. (2018). Developing and validating the International Development and Early Learning Assessment (IDELA). *International Journal of Educational Research*, 91, 1–15. <https://doi.org/10.1016/j.ijer.2018.06.007>
- Royston, P., Carlin, J. B., & White, I. R. (2009). Multiple imputation of missing values: New features for MIM. *The Stata Journal*, 9(2), 252–264. <https://doi.org/10.1177/1536867X0900900205>
- RTI International. (2016a). *Early grade Reading assessment (EGRA) toolkit*. RTI International.
- RTI International. (2016b). *Early grade mathematics assessment (EGMA): A conceptual framework based on mathematics skills development in children*. RTI International.
- Schoellman, T. (2016). Early childhood human capital and development. *American Economic Journal: Macroeconomics*, 8(3), 145–174.
- Schreiner, M., & Woller, G. (2010). *A simple poverty scorecard for Ghana*. The World Bank.
- Steimle, S., Gassman-Pines, A., Johnson, A. D., Hines, C. T., & Ryan, R. M. (2021). Understanding patterns of food insecurity and family well-being amid the COVID-19 pandemic using daily surveys. *Child Development*, 92(5), e781–e797. <https://doi.org/10.1111/cdev.13659>
- Tembey, L., Baier, J., Ogolla, C., & Mohan, P. (2021). *Understanding barriers to girls' access and use of EdTech in Kenya during Covid-19*. Working paper 37. https://doi.org/10.53832/edtec_hhub.0048
- United Nations Children's Fund (UNICEF). (2015). *Ghana's district league table 2014: Strengthening social accountability for national development*. UNICEF. https://www.unicef.org/ghana/District_League_Table_report_Edit_NEW_R3.pdf
- United Nations Children's Fund (UNICEF). (2019). *A world ready to learn: Prioritizing quality early childhood education*. UNICEF.
- United Nations Children's Fund (UNICEF). (2021). *Primary and secondary impacts of the Covid-19 pandemic on children in Ghana*. UNICEF.
- Vandell, D. L., Burchinal, M., & Pierce, K. M. (2016). Early child care and adolescent functioning at the end of high school: Results from the NICHD study of early child care and youth development. *Developmental Psychology*, 52(10), 1634–1645. <https://doi.org/10.1037/dev0000169>
- Vegas, E., & Winthrop, R. (2020). *Beyond reopening schools: How education can emerge stronger than before COVID-19*. <https://www.brookings.edu/research/beyond-reopening-schools-how-education-can-emerge-stronger-than-before-covid-19/>
- Wolf, S. (2019). Year 3 follow-up impacts of the 'quality preschool for Ghana' interventions on child development. *Developmental Psychology*, 55(12), 2587–2602. <https://doi.org/10.1037/dev0000843>
- Wolf, S. (2020). "Me I don't really discuss anything with them": Parent and teacher perceptions of early childhood education and parent-teacher relationships in Ghana. *International Journal of Educational Research*, 99, 101525. <https://doi.org/10.1016/j.ijer.2019.101525>
- Wolf, S., Aber, J. L., Behrman, J. R., & Tsiningo, E. (2019). Experimental impacts of the quality preschool for Ghana interventions on teacher professional well-being, classroom quality, and children's school readiness. *Journal of Research on Educational Effectiveness*, 12(1), 10–37. <https://doi.org/10.1080/19345747.2018.1517199>
- Wolf, S., Aber, J. L., Behrman, J. R., & Peele, M. (2019). Longitudinal causal impacts of preschool teacher training on Ghanaian

- children's school-readiness: Evidence for persistence and fade-out. *Developmental Science*, 22(5), e12878. <https://doi.org/10.1111/desc.12878>
- Wolf, S., Aurino, E., Suntheimer, N., Avornyo, E., Tsinigo, E., Jordan, J., Samanhyia, S., Aber, J.L., & Behrman, J.R. (2021). *Learning in the time of a pandemic and implications for returning to school: Effects of COVID-19 in Ghana*. CPRE Working Paper.
- Wooldridge, J. (2007). Inverse probability weighted estimation for general missing data problems. *Journal of Econometrics*, 141(2), 1281–1301. <https://econpapers.repec.org/RePEc:eee:econom:v:141:y:2007:i:2:p:1281-1301>
- Yoshikawa, H., & Kabay, S. (2014). *The evidence base on early childhood care and education in global contexts*. UNESCO.
- Yoshikawa, H., Weiland, C., Brooks-Gunn, J., Burchinal, M., Espinosa, L., Gormley, W., Ludwig, J., Magnuson, K. A., Phillips, D., & Zaslow, M. (2013). *Investing in our future: The evidence base on preschool education*. Society for Research in Child Development.
- Young, R., & Johnson, D. R. (2015). Handling missing values in longitudinal panel data with multiple imputation. *Journal of Marriage and Family*, 77(1), 277–294. <https://doi.org/10.1111/jomf.12144>
- Zaccoletti, S., Camacho, A., Correia, N., Aguiar, C., Mason, L., Alves, R. A., & Daniel, J. R. (2020). Parents' perceptions of student academic motivation during the COVID-19 lockdown: A cross-country comparison. *Frontiers in Psychology*, 11, 592670. <https://www.frontiersin.org/article/10.3389/fpsyg.2020.592670>

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APPENDIX

TABLE A1 Impact estimates using alternative models to address missing data

	Main results	Unimputed sample	Inverse probability weights
	b (SE)		
Engagement in RL—child report			
TT	.14 (.06)*	.14 (.07) ⁺	.15 (.07)*
TTPA	.00 (.06)	.04 (.07)	.05 (.07)
Engagement in RL—caregiver report			
TT	.15 (.06)*	.13 (.06)*	.09 (.08)
TTPA	.03 (.06)	.05 (.06)	-.08 (.08)
Language/literacy			
TT	.02 (.06)	.02 (.07)	.02 (.08)
TTPA	-.07 (.06)	-.10 (.07)	-.10 (.07)
Math			
TT	.07 (.05)	.08 (.07)	.07 (.08)
TTPA	.02 (.05)	-.03 (.07)	-.03 (.07)
N	3435	1668	1668

Abbreviations: RL, remote learning; TT, teacher training condition; TTPA, teacher training plus parent-awareness training condition.

⁺p < .10.

*p < .05.