

Persistence and Fadeout of Preschool Participation Effects on Early Reading Skills in Low- and Middle-Income Countries

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Abstract

The adoption of the Sustainable Development Goals (SDGs) in September 2015 marked a new milestone for early childhood education, care, and development. For the first time in the framework of global goals, preschool education was described as integral to children's school readiness. Yet with few exceptions, much of the research on the impact of preschool has stemmed from high-income countries. Even fewer studies have examined preschool participation and later learning across multiple countries. This article helps fill this gap by connecting preschool participation to early primary reading outcomes, as measured by the Early Grade Reading Assessment. Drawing on a unique data set using student-level learning assessments from 16 countries, we use preprimary participation to explain primary school reading skills, including letter knowledge and oral reading fluency. We also model the influence of key demographic variables on these outcomes, including home language and classroom language of instruction (LOI). For a subset of six countries with exceptionally rich data, we examine national-level policy and practice to better understand what might explain the persistence or fadeout of the effect of preschool. Policy makers and practitioners alike will find these results useful in making cases for improving preschool experiences for children in low- and middle-income countries in the next decade of SDG-related efforts.

Key Words

Preschool, primary education, early childhood education, reading, school readiness, sustainable development goals, developing countries

Introduction

The adoption of the Sustainable Development Goals (SDGs) in September 2015 by the 193 member states of the United Nations signaled a new era for early childhood education, care, and development (UNESCO, 2015a). For the first time in the framework of global goals, early childhood education was described as integral to children's school readiness (Gove & Black, 2016; UNESCO, 2015b). Specifically, SDG target 4.2 requests countries to ensure that "all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education." But what does it mean to be "ready for primary education"? What do we know about how well preprimary programs are preparing children for later success? What evidence should practitioners and policy makers focus on to expand and improve early childhood experiences?

With few exceptions (Aboud & Hossain, 2011; Gertler et al., 2013), much of the published research on the impact of preprimary participation has stemmed from high-income countries (Campbell et al., 2014; Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010). Few studies have examined preschool and later learning across multiple countries (Raikes, Devercelli, & Kutaka, 2015). This article helps fill this gap by examining the relationship between preprimary participation and early primary reading outcomes, as measured by the Early Grade Reading Assessment (EGRA) (Dubeck & Gove, 2015; RTI International, 2016b). Drawing on a unique set of data using student-level learning assessments from 16 low- and middle-income countries, we use preprimary participation to explain primary reading outcomes and answer the research questions outlined above. These results should prove useful for practitioners and policy makers

seeking to understand the impact of preprimary participation on later learning levels in low- and middle-income country contexts.

Literature Review

With the focus on early learning expanding around the world, preschool participation has also increased, with the global gross enrollment ratio rising from 31 percent in 2000 to 49 percent in 2015 (UNESCO Institute for Statistics, 2016). As more countries begin to expand their early education programs, more research is being conducted to better understand the impact of preschool participation on student outcomes. Of particular interest is whether the impacts of these investments, including cognitive and noncognitive effects, persist or fade out over time.

Preprimary Participation and Later Learning Outcomes in High-Income Countries

In the United States, early childhood education, or preschool, has emerged as a focus for promoting children's learning and well-being. In discussions about the success of this aim, two longitudinal studies are often mentioned. The first, the High/Scope Perry Preschool Program, looked at at-risk children who participated in a preschool program in the 1960s, and followed them over time to look at how it impacted their lives. They found that those who attended preschool had significantly higher earnings and participated less in criminal activity compared to those who had not, thus repaying \$13 (USD) for each \$1 (USD) invested in their education (Belfield, Nores, Barnett, & Schweinhart, 2006). A second study, the Abecedarian Project, looked at the impact of child care and preschool on

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future outcomes and found that children who participated in their program subsequently attained significantly more years of education and were more likely to go to college (Campbell, Ramey, Pungello, Sparling, & Miller-Johnson, 2002). Subsequent follow-up studies of Abecedarian participants into their mid-30s revealed substantial health gains, including reduced cardiovascular and metabolic diseases, such as diabetes and obesity (Campbell et al., 2014).

However, these studies found inconsistent results when it came to sustained impact on cognitive skills. The Perry Preschool project found that the cognitive advantages of preschool tended to decline over time, with the control group generally catching up cognitively when they entered kindergarten (Barnett, 2008). The Abecedarian Project found similar declines in intelligence quotient over time, with effect sizes decreasing from 0.75 standard deviations (*SD*) at age 4 to 0.33 *SD* at ages 15 and 21 (Barnett, 2008). One possible explanation for why the cognitive effects of preschool may “fade out” is related to the quality of the schools that students attend as young children and adolescents. Using nationally representative data from the Early Childhood Longitudinal Study–Kindergarten Class, Magnuson, Ruhm and Waldfogel (2007) showed that the persistence of preschool effects was tied to both class size and the quality of instruction: Preschool gains were eliminated for children who attended kindergarten in small classrooms with high-quality learning experiences but persisted for those in larger classrooms with lower-quality instruction. Low-quality middle school experiences were also found to explain why the U.S. Department of Health and Human Services’ Head Start preschool program effects often fade out: Eighth-grade students who had participated in Head Start typically attended middle schools of significantly lower quality than their peers who

either did not attend preschool or who had been enrolled in other types of preschool programs (Lee & Loeb, 1995). The persistence or fadeout of the effect of preschool is a source of debate in the field, generating competing reviews of the evidence between proponents and opponents of the expansion of publicly funded early childhood programming (Bustamante, Hirsh-Pasek, Vandell, & Golinkoff, 2017).

Scaled-up preschool initiatives have shown similarly mixed academic effects in different states in the U.S. A recent study of children in Tennessee found that preschool actually had a small negative impact on academic achievement in third grade, particularly for English-language learners (Lipsey, Farran, & Hofer, 2015). Conversely, a study looking at the impact of full-day kindergarten on literacy skills found that students who attended the program showed significant gains in literacy, particularly Hispanic students and those who entered kindergarten with low-literacy skills (Gibbs, 2014). A study of the impact of Oklahoma’s universal preschool program found similar results, with children attending showing significant gains, particularly in letter-word identification, spelling, and applied programs, compared to the control group (Gormley, Gayer, Phillips, & Dawson, 2005).

Results in high-income countries outside of the U.S. are similarly mixed. In Uruguay, a study found small gains from preschool were magnified as children aged, with students 27 percent more likely to still be in school at age 15 (Berlinski, Galiani, & Manacorda, 2008). Conversely, a later study in Uruguay found that preschool had a short-term positive effect on student performance in the first year of school, but slightly weakened 6 years later (Aguilar & Tansini, 2012). Additionally, a longitudinal study done in the United Kingdom found that preschool led to large improvements in cognitive

assessments at age 7. Although these gains diminished over time, they remained significant to age 16 (Goodman & Sianesi, 2005). A longitudinal study in New Zealand also found that preschool had an impact on cognitive skills, particularly on numeracy and logical problem-solving skills (Hogden, 2007).

Many studies have indicated that early childhood education works better for those from high-risk backgrounds, such as minority students and those growing up in poverty. A study of the impact of preschool in Boston found that Hispanic students showed larger gains in cognitive skills than other students (Weiland & Yoshikawa, 2013). Additionally, an earlier study in Oklahoma indicated that Hispanic and African-American students showed significant gains as a result of preschool, while Caucasian students demonstrated little impact (Gormley & Gayer, 2005).

Preprimary Participation and Learning Outcomes in Low- and Middle-Income Countries

Internationally, studies suggest that attending a preprimary school or program is associated with better reading and math skills. Two studies on the impact of preschool in Bangladesh found that first-grade students who had attended preschool performed better than those who had not, particularly in the areas of reading, writing, and oral math (Aboud & Hossain, 2011; Aboud, Hossain, & O’Gara, 2008). In Cambodia, children with any preschool program experience (home-based, state-run, or community preschool) performed significantly better on developmental assessments than those who had not participated in any early education program (Rao et al., 2012). A study in Argentina found similar results, with one year of preprimary education equaling an 8 percent increase in mean Spanish and math test scores among third graders (Berlinski, Galiani, & Gertler, 2009). Similarly, the Young Lives study in Ethiopia found that preschool led to statistically significant increases in cognitive skills, which

remained at age 8 (Woldehanna, 2016; Woldehanna & Araya, 2017).

Other studies have shown that preschool leads to more consistent progression into later grades. In Mozambique, a randomized impact evaluation study found that, in addition to individual gains in cognitive, motor, and social-emotional skills, children who attended community preschools were 24 percent more likely than those who had not attended to be enrolled in primary school (Martinez, Naudeau, & Pereira, 2012). A study in Zambia found similar results, with a one-year follow-up revealing that 27 percent of students who had not attended preschool were still unenrolled in first grade, compared to only 11 percent of students who had attended (Zuilkowski, Fink, Moucheraud, & Matafwali, 2012). A subsequent study found that preschool participation resulted in improved learning outcomes, with an effect size of between 0.20 and 0.65 *SD* (McCoy, Zuilkowski, Yoshikawa, & Fink, 2017). In addition, a study in Uganda found that children exposed to preschool were more likely to be in school, and that children who enrolled in preschool at an earlier age were more likely to persist into higher grades than those who enrolled at a later age (Nyeko, Pence, & Barnes, 2015). Finally, a study in Ethiopia found that urban preschool attendees were 25.7 percent more likely to complete secondary school than their non-preschool-attending counterparts.

Similar to the studies in high-income countries, several studies in low- and middle-income countries also found higher gains among children with low socioeconomic status (SES). According to a study of early education in Ethiopia, while all children who attended preschool showed benefits, these gains were especially large for children from lower socioeconomic backgrounds (Dowd, Borisova, Amente, & Yenew, 2016). In addition to having a higher likelihood of primary school enrollment, students who attended preschool were also less likely to repeat first grade, as well as subsequent grades. In a study of preschool impact in rural

Nepal, researchers found that children who attended preprimary school were less likely to repeat first grade, or fail a grade (Jaganath, Khattri, Murray-Kolb, LeClerq, & Christian, 2015).

It is unclear what causes this variation of the impact of preschool, both within and across countries. Some surmise that preschool is just too late to intervene, given the fact that much of the brain develops before age 3, when many children are entering preschool (Richter et al., 2017). Others believe that this lack of consistent effects warrants a shift toward focusing on high-quality preschool, which would include small class sizes, experienced teachers, and age-appropriate instruction (Barnett, 2008). Regional variations in terms of enrollment rates and the quality of primary schools may also determine whether initial learning gains persist or fade out over time. Estimates of the economic returns to preschool expansion in sub-Saharan Africa are as high as \$33 (USD) for every dollar invested (Psacharopoulos, 2014), but this may be in part related to the current low levels of participation. Despite the potential solutions to persistent low learning levels offered through the expansion of preschool, the best ways to achieve long-term gains remain elusive.

Research Questions and Data

Given the apparent dearth of information on the contributions of preschool and the persistence of impact in low- and middle-income countries, the present article seeks to fill this gap. The research questions examined in this article are as follows: (1) Does participation in preschool improve later reading outcomes? (2) If so, why? What are the characteristics of preschool systems of the countries that seem to have persistent impact on student reading performance?

The databases analyzed for this article are populated with data from national and regionally representative EGRA surveys conducted between 2008 and 2016. Developed with United States Agency for International Development (USAID) support, EGRA is an open-source assessment of students' foundational skills in reading and is adapted to each language and country context (Dubeck and Gove, 2015); full instrument specifications and guidelines for implementation are documented in the second edition of the *EGRA Toolkit* (RTI International, 2016b). During a 15-minute, one-on-one oral interview, primary grade students were asked by a trained enumerator to identify letter names or letter sounds and read aloud common words and a brief grade-level passage. Most tasks were timed, with a one-minute limit. Students read from a paper stimulus sheet while the enumerator recorded their answers, either on a digital tablet or on paper using a clipboard. The assessment was almost always accompanied by a contextual questionnaire to allow the researchers to better understand the factors, such as home language and reading practices, affecting learning outcomes. Detailed information for each country-specific survey, including sampling frame and copies of the survey instruments and questionnaires, are available in data analysis reports for each country surveyed. Because the data were collected from students enrolled in primary grades, with the variable for preprimary participation based on student recall, we are unable to answer questions regarding the quality of the assessed students' preprimary experiences. Table 1 summarizes key characteristics of the data sets analyzed for this article, including references to the full reports.

Table 1.
Summary of Country Data Sets

Country	Level of Representation	Year	Grades	No. of Students	Report Reference
Ethiopia	Regional	2014	2 and 3	2,000	RTI International, 2014a
Ghana	National	2015	2	7,311	Ghana Education Service, RTI International, & Education Assessment and Research Centre, 2016
Indonesia	Project	2014	2	4,812	RTI International, 2015b
Iraq	National	2012	2 and 3	1,153	RTI International, 2012
Jordan	National	2014	2 and 3	2,935	Brombacher, Stern, Nordstrum, Cummiskey, & Mulcahy-Dunn, 2014
Kenya	Project	2013	1 and 2	4,222	Piper, King, & Mugenda, 2016
Malawi	National	2012	2 and 4	5,240	Pouezevara, Costello, & Banda, 2012
Mali	National	2015	2 and 4	2,393	RTI International, 2015a
Nicaragua	National	2008	2, 3 and 4	6,649	Castro, Laguna, Mayorga, & RTI International, 2009
Nigeria	4 States: Jigawa, Kaduna, Kano and Katsina	2014	2 and 3	2,531	RTI International, 2014b
Philippines	National	2013	3	2,463	Pouezevara, DeStefano, & Cummiskey 2013
Rwanda	National	2011	4 and 6	840	DeStefano, Ralaingita, Costello, Sax, & Frank, 2012
Senegal	National	2009	3	687	Pouezevara, Sock, & Ndiaye, 2010
Tanzania	National	2014	2	2,266	RTI International, 2016a
Uganda	Regional	2016	1 and 2	3,720	RTI International, 2016c
Zambia	National	2014	2	4,850	Brombacher, Bulat, King, Kochetkova, & Nordstrum, 2015

Results

The following pages seek to answer the research questions outlined above. For both questions, country-level EGRA data were included in the

analysis if the study included a variable on child-reported preprimary participation. If more than one EGRA was conducted in a country, the largest or most recent data set was used. The

EGRA data we studied were collected during 2008–2016 from children in first through sixth grade, with most of the data sets focusing on those in second and third grade.

To answer the first research question, about effects on later reading outcomes, we performed linear regressions for each country using both low- and high-level reading skills as the dependent variable. For low-level reading skills, we relied on either a letter task (scored in terms of correct letters per minute [CLPM] or correct letter sounds per minute [CLSPM]); for high-level skills, we used oral reading fluency (ORF; scored as correct words per minute). The

models controlled for all of the following student-level characteristics, if available: gender, geographic location of the school (urban/rural), language match of the child to the language of instruction (LOI), and socioeconomic status. SES was calculated by dividing the wealth index of child-reported articles in the home into quartiles (dividing all respondents into four roughly equal groups), with the highest SES compared with the lowest SES quartiles in the model. Table 2 provides descriptive statistics for each country for each of the variables used in the model.

Table 2.
Descriptive Statistics by Country (in Percent)

Country	Gender		Preprimary Experience?		Language		Socioeconomic Status		Location	
	Male	Female	No	Yes	Differ-ent	Same	Low	High	Urban	Rural
Ethiopia	51.7	48.3	39.1	60.9	13.6	86.4	32.9	27.9	33.9	66.1
Ghana	51.0	49.0	16.2	83.8	49.0	51.0	22.3	26.4	27.9	72.1
Indonesia	52.7	47.3	19.8	80.2	47.6	52.4	16.2	31.7		
Iraq	55.1	44.9	79.6	20.3			25.5	26.7		
Jordan	46.5	53.5	16.4	83.6			27.6	36.4	65.3	34.7
Kenya	49.5	50.5	7.5	92.5			23.2	25.8	82.8	17.2
Malawi	49.8	50.2	38.2	61.8	22.8	77.2	20.0	33.0	19.7	80.3
Mali	48.3	51.7	71.0	29.0	58.0	42.0	27.7	22.0		
Nicaragua	47.4	52.6	17.2	82.8			23.2	24.0	69.0	31.0
Nigeria	53.5	46.5	64.5	35.5	10.0	90.0	20.6	27.0		
Philippines	53.0	47.0	16.8	83.2	87.5	12.5	28.7	19.6		
Rwanda	48.4	51.6	61.3	38.7	4.8	95.2	24.3	20.2		
Senegal	52.6	47.4	56.6	43.4			18.1	34.2		
Tanzania	49.5	50.5	19.7	80.3			35.0	8.2	25.4	74.6
Uganda	51.1	48.9	23.6	76.4			27.4	25.1		
Zambia	49.5	50.5	71.8	28.2			26.8	21.8	25.5	74.5

Table 3.
Effect of Preschool Participation on Letter and Word Reading Skills

Country	CLPM [†] or CLSPM		Oral Reading Fluency	
	Attended Preschool	Intercept	Attended Preschool	Intercept
Ethiopia [†]	-2.68	24.94***	1.66	5.55
Ghana	1.80**	9.21***	1.44**	1.88*
Indonesia [†]	7.44***	53.24***	12.83***	18.60***
Iraq [†]	-0.03	11.08***	-2.40	5.71***
Jordan	4.78**	20.99***	6.23***	5.38**
Kenya	0.85	18.22***	0.20	7.53***
Malawi [†]	0.28	1.01	-0.86	-0.45
Mali [†]	1.68	10.36***	1.94	3.25***
Nicaragua [†]	-0.85	36.81***	-0.94	40.03***
Nigeria	1.21	1.13	1.13	0.30
Philippines	1.77	15.41***	8.80***	46.74***
Rwanda	-0.15	11.84***	3.87	10.15***
Senegal [†]	5.33*	25.59***	5.05	18.25***
Tanzania [†]	2.99***	1.45*	4.67**	8.23***
Uganda	0.93**	-0.08	0.19	-0.25
Zambia	1.99***	2.52***	0.64	1.24

Note. CLPM = Correct letters per minute; CLSPM = Correct letter sounds per minute.

[†] Values presented are denominated in CLPM.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3 presents regression results by country and early literacy measure, using the controls provided in Table 2. Letter identification (measured by CLPM) and letter sound identification (CLSPM) are lower-level literacy skills that develop before word reading. ORF measures the number of words read correctly in one minute from a narrative reading passage, typically developed for the expected reading level of a second-grade student. Due to differences in language structure, including word length, there is no universal definition of reading proficiency. In all countries, children were assessed in the official LOI, although children's home language or mother tongue did not always match that language.

The data in the "attended preschool" columns represent the difference in scores between students who reported attending

preschool with those who reported they did not attend preschool, in terms of the outcome measure of literacy. For example, in Indonesia, children who had attended preschool correctly identified 7.44 more letters per minute than a child who had not attended preschool. The "intercept" columns represent children's average score, holding all variables constant. For example, a child in Indonesia who was male, did not attend preschool, resided in a rural area, was from the lowest SES background, and did not speak the LOI as the mother tongue, correctly identified an average of 53.24 letters per minute. The intercept can also be viewed as an indication of the preliteracy or reading score of a child at the lowest end of the range.

To interpret the results, it is important to consider whether the impact was substantive in addition to statistically significant. For example,

in Zambia, children who had attended preschool scored significantly higher than those who had not. However, when we look at the measure of score difference, children with preschool experience correctly identified only two additional letter sounds per minute than a child who had not attended preschool, which is not considered a substantive gain. These results should be treated with caution as they do not account for either the quality of the child's preschool program or the subsequent primary school.

The results of the regression models showed that in half of the countries, preprimary experience had a sustained, significant, and substantive impact on literacy skills of students in second and third grade, even after controlling for gender, language match, SES, grade, and school location. Students in both Indonesia and Tanzania showed lasting impact of preprimary through second grade on correct letter identification, and students in Senegal showed impact through third grade. For example, students in Senegal with preprimary experience correctly identified 5.33 more letters per minute than students with no preprimary experience. Students in Ghana, Uganda, and Zambia showed lasting impact through second grade in identification of letter sounds per minute, and students in Jordan showed impact through third grade. For example, students in Uganda correctly identified 0.93 more letters per minute than students who had no preprimary experience. Countries that did not show a relationship between preprimary and letter identification were Ethiopia, Iraq, Malawi, and Nicaragua. Countries that did not show the relationship between preprimary and letter sound identification were Kenya, Nigeria, the Philippines, and Rwanda.

Additionally, the regression models showed that students with no preprimary experience in Malawi, Nigeria, Tanzania, and

Uganda had extremely low scores for letter and letter sound identification skills overall, meaning that students in these countries were not faring well in preliteracy skills in second and third grade. For example, second and third graders with no preprimary experience in Nigeria identified, on average, 1.13 letter sounds per minute. These same countries also had extremely low overall preliteracy scores among students in second and third grade even with preprimary experience. For example, students in Malawi with preprimary experience correctly identified, on average, only 1.29 letters per minute in second, third, and fourth grades. Students in Ghana, Indonesia, and Tanzania showed lasting impact of preprimary on second-grade assessment of reading fluency. Students in Jordan and the Philippines showed lasting impact of preprimary on third-grade assessment of reading fluency.

Countries that did not show a significant relationship between preprimary participation and ORF were Ethiopia, Iraq, Kenya, Malawi, Nicaragua, Nigeria, Rwanda, Senegal, Uganda, and Zambia. Additionally, the regression models showed that students with no preprimary experience in Malawi, Nigeria, and Uganda had extremely low scores for ORF overall, meaning that students in these countries were not faring well in literacy skills in second and third grade. For example, children in these grades with no preprimary experience in Nigeria were correctly reading, on average, 0.30 words per minute. These same countries also had extremely low overall preliteracy ORF scores among students in second, third and fourth grades, even with preprimary experience.

In addition to modeling the impact of preschool participation at the child level, we were interested in knowing whether the individual-level effect would be moderated by the prevalence of preschool participation; that is, would the effect of preschool be shaped by the

overall preprimary program participation rate in a given country? Figures 1 through 3 show scatterplots of the relationship between the impact of student participation in preprimary programs and the overall preprimary program participation rate. For each figure, we plotted the preschool enrollment rate of the study population against the effect of preschool participation on a child's literacy score for each of the tasks modeled in Table 3. For example, Figure 1 shows that Jordan had an 84 percent preprimary program participation rate and that students who had participated in preprimary programs were able to identify an additional five correct letter sounds per minute compared to students who had no preprimary experiences. For Figure 1, the relationship between the share

of students who had participated in preprimary programs and the effect of that participation on letter sound knowledge is neutral; with the exception of Jordan, most results hover around the horizontal axis. Both letter identification (Figure 2) and oral reading fluency (Figure 3) indicate a positive relationship between preprimary program participation rate and its effect on later learning outcomes; that is, countries with higher preprimary program participation rates tended to have a positive effect of that participation on later learning. Further research into the quality of the programming provided in both preprimary and primary schools is needed, however, before substantive conclusions can be drawn from these results.

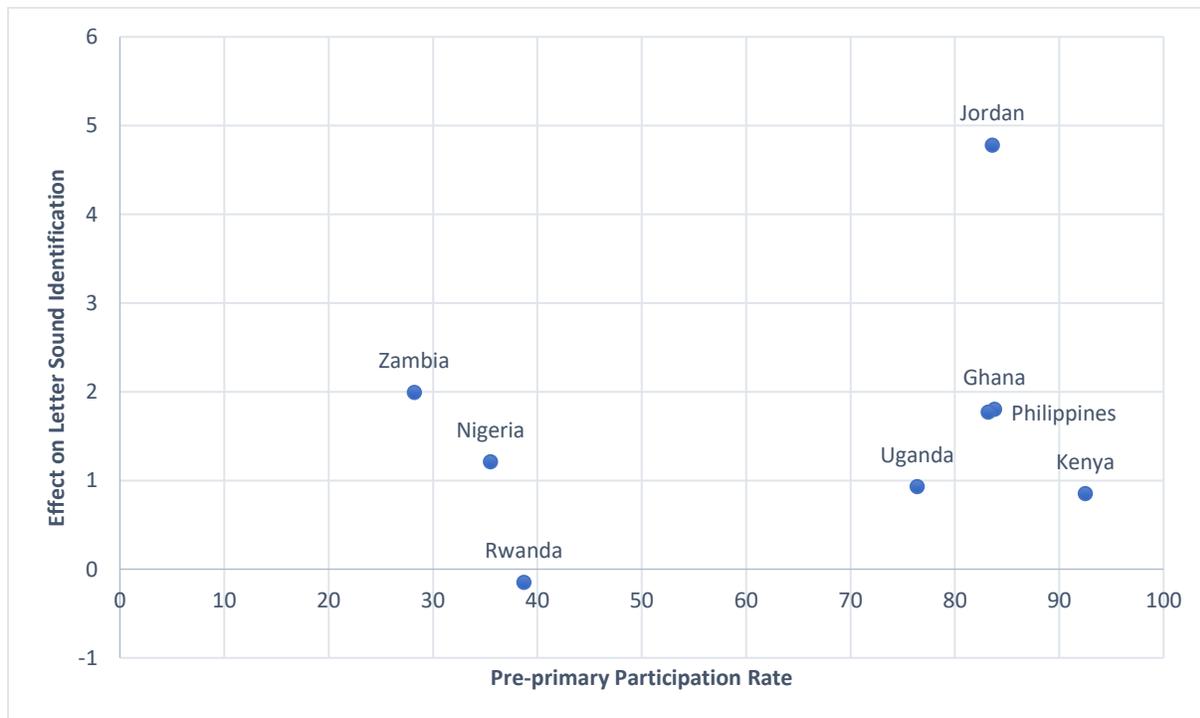


Figure 1. Relationship Between Preschool Participation Rate and Letter Sound Score Effect

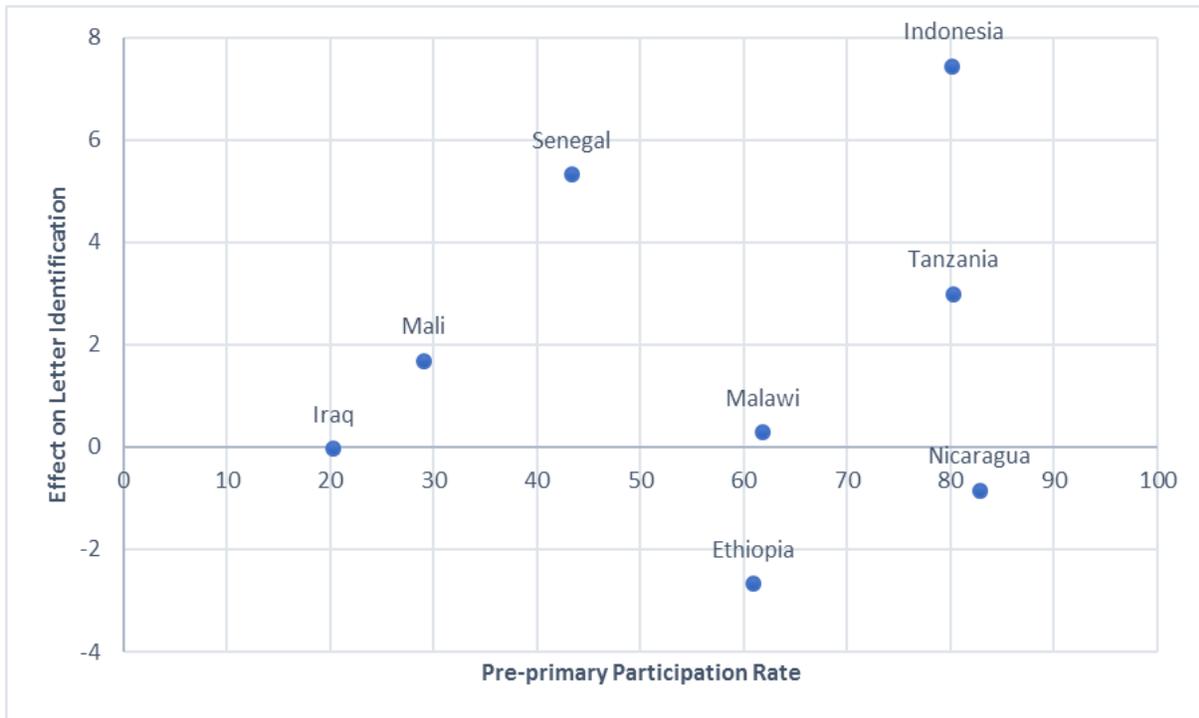


Figure 2. Preschool Participation Rate and Letter Identification Score Effect

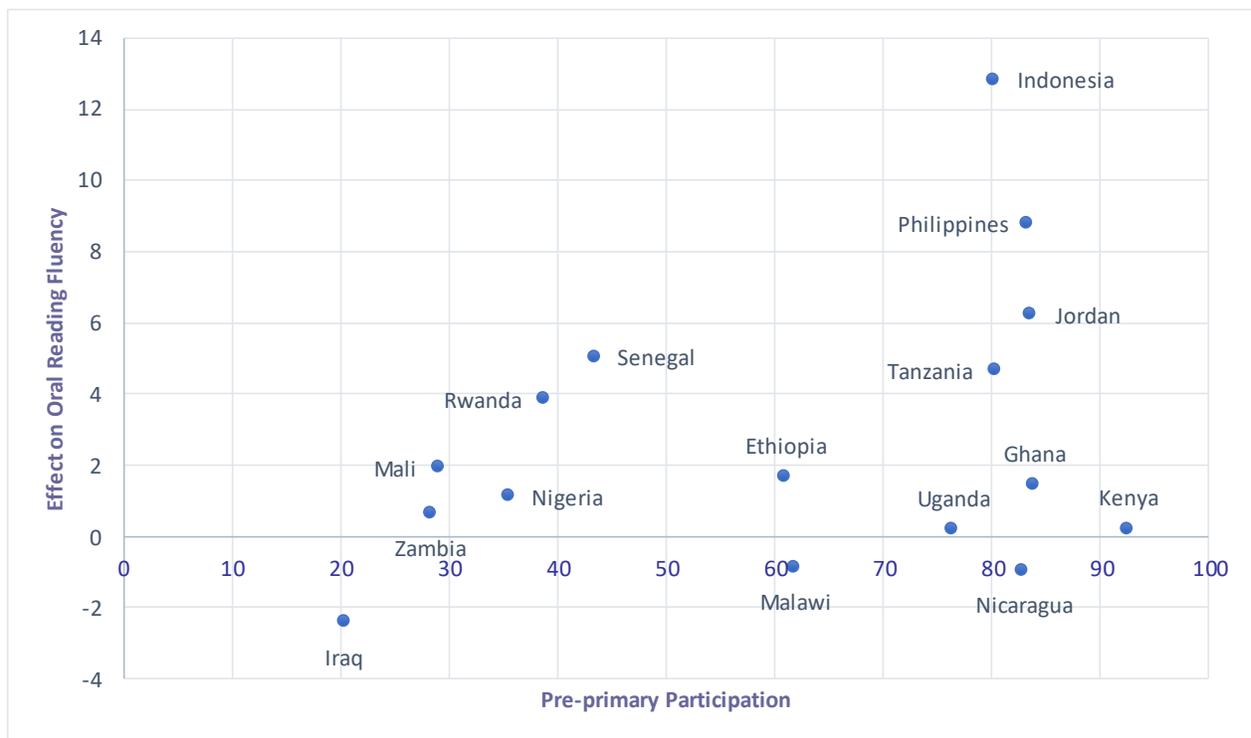


Figure 3. Preschool Participation Rate and Reading Fluency Score Effect

Country Case Studies

The results above show varied impact of preprimary programs on later literacy skills in primary school. Since countries vary in their levels of investment in early learning through policy and curriculum, as well as in other factors, including teacher–student ratio and LOI policies, in this section we take a closer look at six countries to better understand their respective results. As data were collected from students enrolled in first through fourth grade, we were not able to

assess the quality of their preprimary experiences; instead, we relied on system-level indicators to better understand the preprimary and early primary experiences of the population of study. Table 4 summarizes key country-level factors, including net enrollment rates and the presence of a national preschool curriculum, that may impact the quality of preprimary education, and thus later literacy outcomes.

Table 4.
Preschool Policy and Practice for Case Study Countries

Country	Government Established Preprimary or Kindergarten Program?	Year System Put into Place	Preprimary Program: Free or Fee-Based?	Percentage of Children Enrolled in Preprimary Education	Ratio of Students to Teacher in Preprimary Programs	Percentage of Children Enrolled in Private v. Public	National Preprimary Curriculum?	Year Curriculum Put into Place
Ghana (EGRA in 2013 and 2015)	In 2007, Ghana added two years of kindergarten onto its compulsory basic education program. Made policy that each primary school should have a kindergarten attached to it.	2007	Free	120.8% (2015)	34:1 (2015)	Unknown	Yes, kindergarten curriculum	2004
Indonesia (EGRA in 2014)	No, preprimary experience mainly provided by private for-profit and community services (faith-based and secular).	Not applicable (N/A)	Fee-based	58.2% (2014)	13:1 (2014)	4% public; 94% private or community-run	No, in development (2015)	N/A

Country	Government Established Preprimary or Kindergarten Program?	Year System Put into Place	Preprimary Program: Free or Fee-Based?	Percentage of Children Enrolled in Preprimary Education	Ratio of Students to Teacher in Preprimary Programs	Percentage of Children Enrolled in Private v. Public	National Preprimary Curriculum?	Year Curriculum Put into Place
Jordan (EGRA in 2012 and 2014)	As of early 2018, free kindergarten was beginning to be provided in some areas as Jordan moved toward making kindergarten compulsory.	2014	Free or fee-based, depending on area	32.2% (2012)	17:1 (2012)	25% public; 75% private	Yes, kindergarten curriculum	2007
Philippines (EGRA in 2013)	Education system includes a full year of kindergarten for all students, made compulsory in 2012.	2016	Free	48.2% (2009)	35:1 (2007)	Unknown	Yes	2011
Tanzania (EGRA in 2013 and 2016)	Education system includes two years of preprimary education. Government requires each community to establish early childhood development facilities, including preprimary classes attached to primary schools.	2008	Free	32.3% (2013)	57:1 (2010)	Unknown	Some regions, but not nationwide	2010
Zambia (EGRA in 2014)	No, and low coordination among stakeholders to facilitate implementation of early childhood programs.	N/A	Fee-based (private)	17% (2010)	Unknown	N/A	No curriculum or policy framework	N/A

Ghana

We found that the impact of preprimary education in Ghana was significant for both low- and higher-level literacy skills at second grade, but overall literacy skills were low across students. Ghana has shown a strong commitment to improving early reading since its first EGRA was implemented with USAID support in 2013, but has also encountered many challenges to quality, possibly leading to the low differences between students with preprimary experience and those without such experience. The relationship between preprimary experience and later reading outcomes in Ghana was statistically significant but not substantive. Students who had attended preprimary programs later identified correctly an average of 1.80 more letter sounds (11.01 letter sounds total) per minute in second grade than those without any preprimary experience (refer to Table 2). CLSPM was low (9.21 letter sounds) at second grade, even for children who did not go to preschool. In addition, students with preprimary experience later read correctly an average of only 1.44 more words (3.32 total words) per minute in second grade on a measure of reading fluency than those with no preprimary experience. ORF was very low, with only 1.88 words per minute read correctly by second graders who had not attended preschool.

In 1995, Ghana introduced free and compulsory universal basic education, which contributed to an enrollment rate in primary education of 82 percent in 2012 (Kochetkova & Brombacher, 2014). This commitment extended to early childhood education when Ghana released its White Paper on Education Reform, which added two years of kindergarten education to the basic education system beginning in the 2007–2008 school year (Adamu-Issah, Elden, Forson, & Schrofer, 2007). It also included a policy that each primary school should have an attached

kindergarten class. As a result, preprimary education enrollment increased from 35 percent in 1990 to more than full enrollment, or 113 percent, in 2012 (likely due to students outside the appropriate age range being enrolled), giving Ghana one of the highest gross enrollment ratios in the world (Yoshikawa & Kabay, 2015).

Although Ghana has made great strides in increasing enrollment in preprimary education, challenges remain when it comes to quality. Many kindergarten programs struggle with crowded classrooms, poor infrastructure, and a lack of trained teachers. The government of Ghana recognized this issue within its 2003–2015 Education Sector Plan, which stated that the country “continues to grapple with serious challenges on quality of education” (Yoshikawa & Kabay, 2015). Additionally, it has been estimated that one-third of Ghanaian children enrolled in kindergarten are not of the appropriate age, although it is unclear whether they are underage or overage (Yoshikawa & Kabay, 2015); regardless, it leads to overcrowded classrooms. Another challenge to quality in the classroom is the multitude of languages spoken in Ghana, estimated by Ethnologue at 81 (plus numerous dialects), although 11 local languages have been identified as the main languages of instruction for primary education (Simons & Fennig, 2017). A 2015 study assessing both literacy and numeracy found considerable variability when the researchers examined the proportion of second graders who spoke the LOI outside school, with almost half of students reporting that they do not speak the same language at home as the LOI. Additionally, the study uncovered that 20 percent of interviewed teachers did not speak the LOI for their given school. Although these findings were based on reports from early primary—rather than preprimary or kindergarten—educational experiences, it is likely that the challenges of Ghana’s multilingual context also applies to

preprimary education, given the comparison of 11 official LOIs and the much higher count of other Ghanaian languages used at home. These challenges to establishing high-quality preprimary education may be the reason for the small differences in literacy scores found between students with and without preprimary experience.

In 2013, RTI led a national survey of children's reading and math skills in Ghana, using the EGRA and an equivalent tool to measure numeracy, the Early Grade Mathematics Assessment (EGMA; see Platas, Ketterlin-Geller, Brombacher & Sitabkhan, 2014). The sample included 7,923 second-grade students: 4,017 boys (51 percent) and 3,906 girls (49 percent). Of these students, most (80.9 percent) said they had attended kindergarten or preschool before beginning first grade. However, while the standard age for second-grade students is 7–8 years of age, the majority of those surveyed (74.8 percent) were 9 years or older, thus overage for their grade. At the same time, only 12.1 percent of students reported that they were repeating their grade. This indicates that while most students were progressing from one grade to the next at a standard rate, most were beginning school at a later age than would be considered ideal (Kochetkova & Brombacher, 2014).

Jordan

Preprimary education in Jordan has long been characterized by high-quality, privately run preschools, plus a significant investment in basic education by the Jordanian government. We found the relationship between preprimary and later literacy outcomes in Jordan to be moderate, however. Students who with preprimary experience later identified correctly an average of 4.78 more letter sounds (25.8 letter sounds total) per minute in second or third grade than those without any preprimary

experience (refer to Table 2). In addition, students with preprimary experience later read correctly an average of 6.23 more words (11.6 total words) per minute in second or third grade on a measure of reading fluency than those without preprimary experience. Overall, CLSPM scores were high (21 letter sounds), even for children who had not attended preschool. However, ORF performance was low overall, with only 5.38 words per minute read correctly by second- or third-graders who had not attended preschool.

Looking more deeply at the preprimary and kindergarten education sector in Jordan, we found that at the time of the 2014 EGRA, Jordan was only beginning to make public investments in the preprimary education sector. Jordan moved toward making kindergarten compulsory in 2014, beginning to provide free preschool and kindergarten education in some areas. Only 25 percent of kindergarten programs were government-supported, but those programs had a low student-to-teacher ratio at 17:1. Additionally, although the gross enrollment ratio for primary education was 89 percent in 2012, the preprimary enrollment ratio was only 32 percent, and many students still began formal elementary schooling in first grade (UNESCO Institute for Statistics, 2017).

In 2012, RTI led a national survey of children's reading (EGRA) and math (EGMA) skills. A research team visited 156 public primary schools across Jordan. In each school, a second-grade teacher, a third-grade teacher, and 10 students from each of these grades were randomly selected. Students were given the EGRA and EGMA, and teachers were interviewed about their experience with school. In total, 3,120 students were selected for participation in the assessments and interview. Among the students sampled, 83.4 percent reported having attended preschool or kindergarten prior to primary school

(Brombacher, Collins, Cummiskey, Kochetkova, & Mulcahy-Dunn, 2012). Children who attended preschool or kindergarten showed significantly stronger letter-sound association skills, decoding skills, oral reading fluency, and reading and listening skills than those who had not attended preschool. Unlike with reading performance, there was no correlation between attending preschool or kindergarten and math performance.

Indonesia

Our model found statistically significant impacts of preprimary education in Indonesia on both lower- and higher-level literacy skills at second grade and revealed that overall literacy skills were quite high across students regardless of preprimary experience. Indonesia's early childhood programs are provided mostly by communities and private actors, which could mean high-quality learning environments and, thus, a lasting impact later in school.

Students with preprimary experience in Indonesia later identified correctly an average of 7.44 more letters per minute in second grade than those without such experience (refer to Table 2). Additionally, the overall average CLPM score was high in second grade at 53.24 even without preprimary experience, suggesting a strong basic education system. Regarding ORF, students with preprimary experience later read correctly an average of 12.83 more words per minute in second grade than those without preprimary experience. Similar to the findings on letter identification, reading fluency assessment scores were also high for second graders who had not attended a preprimary program, at 18.6 words per minute.

As of 2014, Indonesia had 50 million students and 2.6 million teachers in more than 250,000 primary and secondary schools, making it the fourth-largest education system in the world (Stern & Nordstrum, 2014). These high

numbers may be due in part to the large youth population: 43 percent of the country's 250 million people are under the age of 25 (Organisation for Economic Co-operation and Development [OECD] & Asian Development Bank [ADB], 2015). While the country has reached universal rates for primary school enrollment, it has continued to struggle with the expansion of early childhood education, with provision occurring mainly through communities and private providers (OECD & ADB, 2015). Preprimary education enrollment rates have steadily increased, and as of 2014, 58.2 percent of children in Indonesia were enrolled in preprimary education (UNESCO Institute for Statistics, 2014).

In 2010, Indonesia released its "Grand Design," a blueprint for early childhood education that included outcomes, targets, and principles for the expansion of early care and education, with goals to be reached by 2025 (OECD & ADB, 2015). Additionally, in 2013, the government introduced Presidential Regulation No. 20 on Holistic Integrated Early Childhood Development (HI-ECD). This regulation, among other things, created a multiagency taskforce to coordinate implementation of early childhood care and education throughout the country (OECD & ADB, 2015). In response, the Indonesian government has been gradually increasing investment in early childhood education, but its centers still remain in the minority.

In 2014, RTI, in partnership with the Ministry of Education and Culture, the Ministry of Religious Affairs, and USAID, implemented an EGRA in Indonesia. Two surveys were administered to 4,812 second-grade students across the four proposed "regions" of (1) Sumatra and its adjacent islands; (2) Java and Bali; (3) Kalimantan, Sulawesi, and its adjacent islands; and (4) the "MNP" region, consisting of Maluku, East Nusa Tenggara (Nusa Tenggara

Timur), West Nusa Tenggara (Nusa Tenggara Barat), and Papua islands (Eastern Region) (Stern & Nordstrum, 2014). The EGRA found a high correlation between attending preschool and oral reading fluency, with students who had attended preschool reading an average of 20 more words per minute (Stern & Nordstrum, 2014).

Philippines

In the past decade, the Philippines has shown a high regard for education by investing in early childhood education, increasing investment for basic education, and prioritizing a public–private alliance in education provision. Not surprisingly, then, the model results showed the impact of preprimary education in the Philippines as statistically significant and substantive for higher-level literacy skills at third grade, and also indicated high overall literacy skills across all students. Those with preprimary experience read correctly an average of 8.80 more words (55.54 total words) per minute on a measure of reading fluency than students without any preprimary experience. There was no substantive difference between preschool and non-preschool participants for lower-level literacy skills, however. Students who had attended preprimary programs identified correctly an average of only 1.77 more letter sounds (17.2 letter sounds total) per minute than those who had not (refer to Table 2).

In 2012, a full year of kindergarten for all students was made compulsory with the passage of the Kindergarten Education Act, which declared kindergarten education as “vital to the academic and technical development of the Filipino child” (Republic of the Philippines, 2011). The law decreed that kindergarten education would mean “one (1) year of preparatory education for children at least five (5) years old as a prerequisite for Grade I”

(Republic of the Philippines, 2011), and that instruction would be given in the child’s mother tongue. Additionally, the National Economic and Development Authority’s Philippine Development Plan 2011–2016 included a goal of increasing kindergarten enrollment from its 2009 baseline of 48.2 percent to 100 percent by 2016 (National Economic and Development Authority, n.d.).

RTI led a USAID-funded national survey of children’s reading (EGRA) skills in 2013, which included the development and implementation of both a national EGRA in Filipino and English, and a mother-tongue language (Ilokano) EGRA in one region. For the Filipino and English EGRA, a national sample of 2,410 students was selected randomly within six geographic areas of the Philippines: Northern Luzon, Metro Manila, South Luzon, Visayas, Mindanao, and the Autonomous Region of Muslim Mindanao (Gove et al., 2015). For the assessment in the Ilokano language, 500 students were selected in the one region where Ilokano was the predominant mother tongue and where schools were piloting literacy instruction in that language (Gove et al., 2015).

Tanzania

We found the relationship between preprimary experience and later reading outcomes in Tanzania to be statistically significant for both lower- and higher-level literacy skills at second grade, but we also noted low overall literacy skills in general (refer to Table 2). Students with preprimary experience in Tanzania correctly identified an average of 2.99 more letters per minute in second grade than those without any preprimary experience. However, the overall average CLPM score was low in second grade. Regarding ORF, students with preprimary experience later read correctly an average of 4.67 more words per minute in second grade than those with no preprimary experience. Reading

fluency performance for second graders who had not attended a preprimary program was 8.23 words per minute, as opposed to 12.9 words per minute for children with preprimary experience.

Tanzania has made a strong commitment to early education in the past 10 years, starting in 1995 when the Education and Training Policy required all 5- and 6-year-olds to attend a preprimary program prior to first grade (Bakuza, 2014). The subsequent Education Sector Plan (2007) added two years of preprimary education to the education system with the goal of achieving 50 percent enrollment in preprimary programs by 2012 (United Republic of Tanzania, 2008). Next, in 2013, Tanzania launched its Big Results Now initiative to guide the country from low- to middle-income status. One of the main strategies for doing so was increasing the investment in education, particularly in the early years (RTI International, 2016a). Despite this effort, enrollment in preprimary education remained flat between 2013 and 2015, at 32 percent (UNESCO Institute for Statistics, 2015). One possible reason is that progress made on the national level was not yet trickling down to local governments, thereby halting progress (Bakuza, 2014). Another deterrent may have been cost, as parents still had to pay for uniforms, books, and school meals (Bakuza, 2014).

When students do attend preprimary programs in Tanzania, the classes are typically overcrowded, with the average class ratio being 1 teacher to 57 students. Additionally, most public schools do not have teachers trained specifically in preprimary education, as there is no higher education track devoted to early childhood education (Bakuza, 2014), only an early childhood certificate.

RTI performed a baseline EGRA and EGMA in 2013, the results of which were disseminated at the national level in 2014. A national EGRA was performed in 2016, which allowed RTI to compare student progress over

time. In 2016, 73 percent of students interviewed reported having attended a preprimary program, which was a drop from the 80 percent that reported this in the original 2013 assessment (RTI International, 2016a).

Zambia

Our model revealed a relationship between preprimary experience and later reading outcomes in Zambia that was statistically significant for lower-level literacy skills, but findings for higher-level literacy skills were non-significant. Students who had attended preprimary programs later identified correctly an average of 1.99 more letter sounds per minute in second grade than those without any preprimary experience, but overall the average CLSPM score was low even among those with preprimary experience (4.51 letter sounds total in second grade; refer to Table 2). Additionally, students with preprimary experience later read correctly an average of only 0.64 more words per minute in second grade on a measure of reading fluency than those with no preprimary experience, showing a low ORF overall of 1.88 words per minute in second grade.

Although Zambia has recently shown a strong commitment to education by adding to the infrastructure, budget, and teacher workforce, many challenges remain in those areas (described below), possibly leading to the small differences between students with preprimary experience and those with no preprimary experience. For example, one of the poorest countries in the world, Zambia is also one of the most diverse, with approximately 72 ethnic groups. The official language is English, which is introduced as a subject in second grade. However, there are an additional seven official languages of instruction—Nyanja, Bemba, Lozi, Tonga, Kaonde, Luvale, and Lunda—which the Ministry of Education, Science, Vocational Training, and Early Education has directed to be

used for teaching initial literacy, from preschool through fourth grade (Brombacher et al., 2015).

Historically, early childhood education has been offered primarily by private providers, churches, and nongovernmental organizations. Zambia has made strides since public early childhood education became a priority in 2004, including the building of 20 model early childhood and education centers and plans for 60 more, the addition of 1,000 teachers, the development of an early childhood curriculum, and the allocation of 0.05 percent of the national budget (UNESCO, 2015c). However, the percentage of first graders reporting preprimary attendance declined from 15.9 percent in 2004 to 14.8 percent in 2013 (UNESCO, 2015c). Zambia continues to struggle with weak policy direction, the effect of the government's long-standing nonparticipation in early childhood education, inadequate infrastructure, and underqualified teachers.

RTI International conducted an EGRA and EGMA in November 2014, under consultation with the Examinations Council of Zambia, USAID/Zambia, and the British Department for International Development (Brombacher et al., 2015). RTI administered a survey to 4,855 second-grade students across all 10 provinces of Zambia and in all seven official local languages of instruction. The number of schools sampled was 486; these schools were a mix of Zambian government, grant-maintained, community, and private schools (Brombacher et al., 2015).

Discussion

The findings from both the regression analysis and deeper exploration of policy and practice trends are promising in terms of the persistence of preschool effects on reading outcomes in low- and middle-income countries. In seven of the 16 countries, there was persistent impact of preschool on foundational skills of letter identification or letter sounds; and in five

countries, preschool had a lasting effect on oral reading fluency. According to the country case studies, three of these five countries (Indonesia, Jordan, and the Philippines) are middle-income countries with higher levels of quality than many of the other countries studied. The persistence of preschool effects on reading fluency in these countries is extremely promising as it gives policy makers and practitioners a promising pathway to improving student learning outcomes.

We found the persistent effect of preschool participation on both letter skills and reading fluency to be present despite the generally low classroom conditions, quality of instruction, and overall student learning levels in many of the countries. We did not detect a pattern in terms of participation rates or overall average results predicting whether effects would persist or fade out, although it may be because our model did not capture issues of school quality or classroom instruction. Future efforts should endeavor to further standardize the information collected at both the student and classroom level to facilitate these types of multi-country studies and improve our ability to detect differences.

The principal limitation of the present analysis was the assessments' reliance on student self-reports on whether they had participated in preschool several years earlier. One possible remedy to this challenge is longitudinal data collection that begins in preschool and follows a cohort of students into primary school and beyond. Unfortunately, longitudinal studies are extremely rare in low- and middle-income countries. The barriers include external funders' and governments' reluctance to invest in the requisite 5 to 10 years of data collection, as well as difficulty in tracking students due to the near-universal lack of unique student identifiers. We hope to increase the number of longitudinal studies that track students from preschool into primary and have

successfully secured funding for one such study in Kenya. Perhaps the initial promising results presented above, which we found in a good number of countries despite the clear limitations, will increase interest in longitudinal work.

What is clear is the urgent need for more research on the ability of preschool to both boost individual student-level learning at the start of primary school and improve the efficiency and effectiveness of classroom instruction in primary education and beyond. The source studies cited above showed that with few exceptions, the average learning levels of students in the early grades of primary school were extremely low. Skills that should have been acquired in preschool were only just being mastered in second or third grade, and in many school systems, students were repeating multiple times. We are among those who believe that if done well, preschool can give students a leg up on acquiring the foundational skills that will set them up for success in primary school.

The promises made under the Sustainable Development Goals include ensuring that all children have access to high-quality early childhood education that helps them become ready for school. The results above showed that in several low- and middle-income countries, preschool participation has had a lasting effect and helped to increase the likelihood that children would have the requisite skills for later school success. We expect that these results can inform policy makers and practitioners alike.

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