Preprimary Education and Early Childhood Development: Evidence from Government Schools in Rural Kenya

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Abstract

We provide evidence on the link between enrollment in public preschool and child vocabulary, a critical precursor to early literacy. We measure early childhood development among both in-school and out-of-school children in Kenya, allowing us to examine the association between preschool enrollment and cognitive outcomes. Children in our sample are more likely to start school at age three rather than age four if they live within a few hundred meters of the nearest primary school. Three-year-olds living closer to the school also have stronger vocabulary skills, though a similar pattern does not exist among older children. Using proximity to school as an instrument for preprimary enrollment, we find that preprimary enrollment raises mother tongue receptive vocabulary by more than one standard deviation at age three, but does not impact vocabulary at later ages.

JEL codes: O12, I25, J24, H52

Keywords: preschool, early childhood, preprimary education, human capital, school readiness, early literacy, mother tongue instruction, instrumental variables

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1 Introduction

Investments in health and human capital during early childhood influence later life outcomes such as educational attainment and adult income (Behrman, Engle and Fernald 2013, Tanner et al. 2015, Britto et al. 2017). In low- and middle-income countries (LMICs), more than a third of all children under five do not receive adequate nutrition and cognitive stimulation (Black et al. 2017). Inadequate parental stimulation at home contributes to a lack of school-readiness, particularly among children from low-income households (Bradley and Caldwell 1976, Engle et al. 2011, Cabrera et al. 2020). High-quality early childhood education can help to address these disparities (Burger 2010, Schady et al. 2015). We shed light on the impact of attending a public preschool on cognitive development in a sample of three year old children in rural Kenya.

In recent years, many LMIC governments have expanded preprimary education programs to promote school readiness and improve young children's human capital (Berlinski and Schady, eds 2015). Between 2000 and 2020, gross preprimary enrollment in LMICs increased from 28 percent to 58 percent of preschool-aged children (World Bank 2023). Yet, the evidence on the developmental impacts of preprimary education in LMICs is limited. Evaluations of large-scale public preschool expansions in Latin America have found positive impacts on child development and human capital (Berlinski, Galiani and Manacorda 2008, Berlinski, Galiani and Gertler 2009, Bastos, Bottan and Cristia 2017).[1] However, evidence on the effects of public preschool outside Latin America is scarce. Lassassi (2021) and Bloem and Wydick (2023) study public preschool expansions in Algeria and the Philippines, respectively, documenting modest positive impacts on child development, while Brinkman et al. (2017) show that a government program that funded the creation of community-based preschools in Indonesia had positive impacts on child development. Almost all other estimates of the causal impacts of preschool in LMICs come from evaluations of private preschools or NGO-supported programs (cf. Martinez, Naudeau, and

[1] There is also an extensive literature documenting the impacts of preschool in high-income country settings (cf. Cascio 2009). For a review, see Almond and Currie (2010).

Pereira 2017, Bougen et al. 2018, Berkes et al. 2019, Dean and Jayachandran 2020, Spier et al. 2020, Bjorvatn et al. 2022, Gray-Lobe et al. 2022, Blimpo et al. 2023).

At present, there is very little credible causal evidence on the impacts of at-scale government preprimary education in Sub-Saharan Africa. A difficulty in estimating the impact of national preschool programs is that there is rarely any systematic collection of learning outcomes at ages where schooling is not compulsory, making it challenging to compare those who attend preschool to those who do not. Existing evidence suggests that NGO-supported preprimary programs in Africa have positive impacts in some contexts (cf. Martinez, Naudeau, and Pereira 2017), but not others (cf. Blimpo et al. 2023). In any case, findings from these studies may not generalize to the public sector – and in some cases, government preprimary may in fact serve as the counterfactual against which the impacts of private preschool are estimated (Gray-Lobe et al. 2022).

In Sub-Saharan Africa and other LMIC settings, school quality is often low, and attending school may have minimal impacts on human capital (Bold et al. 2017). Evaluations of NGO-sponsored preschool programs demonstrate that low-quality early childhood education does not always benefit children (Bougen et al. 2018, Blimpo et al. 2023, Wong et al. 2013) and that enrolling in preschool does not always benefit low-income children (Berkes, Bouguen, Filmer and Fukao 2019). When institutional quality is low relative to the counterfactual, access to daycare and preschool can have negative impacts on child development (Behrman, Fernald and Engle 2013). Though there is a growing body of research on programs intended to improve the quality of existing preprimary education facilities (cf. Özler et al. 2018, Wolf, Aber, Behrman and Tsinigo 2019, Blimpo et al. 2023), preschool quality is still a concern in many settings, and we do not know whether the current status quo quality of public preprimary education in Africa improves children's human capital. We are among the first to fill this evidence gap.

Using a novel data set containing direct assessments of child development outcomes, we provide new evidence on the link between enrollment in public preschool and vocabulary, a critical precursor to early literacy. We measure early childhood development among both in-

school and out-of-school children, allowing us to examine the association between preschool enrollment and cognitive outcomes. Our work is most similar to Bietenbeck, Ericsson and Wamalwa (2019), who use a household fixed effects approach to estimate the causal impact of attending preschool on subsequent educational outcomes among children in Kenya and Tanzania.

We document three facts about preprimary education in rural Kenya. First, children who live within a few hundred meters of a government school are more likely to begin preprimary at age three as opposed to age four, relative to children who live slightly further away from the school. Second, among three year olds, there is also a strong negative association between distance from the local school and vocabulary. Finally, the link between distance and vocabulary disappears at older ages, when enrollment becomes nearly universal. Taken together, these facts provide suggestive evidence that enrollment in preprimary improves children's vocabulary skills, though these early impacts do not seem to translate into persistent advantages in terms of developmental outcomes.

Our research contributes to a large and growing literature on early childhood development interventions in LMICs (Engle et al. 2011, Black et al. 2017, Britto et al. 2017, Devercelli and Beaton-Day 2020). The literature on the impacts of public preschool in Sub-Saharan Africa is still extremely small, as discussed above, but the evidence base on the overall impacts of early childhood education is growing rapidly as LMIC governments expand preschool access. Our work is also related to research on access to daycare (for children under three years old) in LMICs contexts (cf. Clark et al. 2019, Attanasio et al. 2022) and on other types of ECD interventions such as parenting education and home visits from child development specialists (cf. Knauer et al. 2019, Garcia et al. 2023).

The rest of this paper is organized as follows. In Section 2, we describe our research design and the context of our study. We present our empirical results in Section 3. Section 4 concludes.

2 Research Design

Data for our study comes from a cross-sectional survey of households with children aged three to six in 73 ethnolinguistically-homogeneous rural communities in Kisumu District, Kenya.[2] Household and child surveys were conducted as part of the baseline for an impact evaluation of a pre-literacy intervention (Jakiela, Ozier, Fernald and Knauer 2020). In each of the 73 communities in our sample, we interviewed all the families living within 750 meters of the government primary school who had at least one child between the ages of three and six, generating a sample of 2,503 preschool-aged children from 2,013 households.

2.1 Local Context

The rural villages in our sample are located in Kisumu County, a predominantly Luo-speaking area in the western part of Kenya. Data from the Demographic and Health Survey conducted in 2014, three years prior to our study, indicate that Kisumu County is broadly similar to Kenya as a whole in terms of educational attainment, fertility, and household assets. However, the county has relatively low rates of stunting among children under five, and also does comparatively well on other measures of child and maternal health (Kenya National Bureau of Statistics 2015). Kisumu County is ethnolinguistically homogeneous, with 94 percent of DHS respondents indicating that Luo is their mother tongue.

Luo is a Nilotic language spoken by approximately five million Kenyans – just over ten percent of the country's population. Kenya's official policy is that children's mother tongue should be the language of instruction in preprimary and the first three years of primary school, while English is the language of instruction for the later years of primary as well as secondary school (USAID 2021, Kenya Institute of Curriculum Development 2019).[3]

[2]Communities were chosen from a sample frame that included all the government primary schools in rural areas of Kisumu District that were not within 1.5 km of another public primary school. We excluded 15 communities because they either had too few preschool-aged children (six communities), were selected for piloting (four communities), were hostile to survey enumerators (four communities), or were not predominantly Luo-speaking (one community).

[3]See discussion in USAID (2021) and Begi (2014). Recent national policy documents make explicit that "In pre-primary education, the medium of instruction is the language of the catchment area" and that "The Constitution of Kenya 2010, accords English the status of one of the official languages while according to

In practice, mother tongue instruction is implemented unevenly (Piper, Zuilkowski and Ong'ele 2016), but Luo is widely used in primary schools throughout our study area, as it is the mother tongue of almost all local children (only four of the 634 three-year-olds in our sample do not have at least one parent whose mother tongue is Luo).

Data was collected in the second half of 2017. At that time, all the schools in our sample followed the 8-4-4 curriculum that was first implemented under President Daniel Arap Moi in 1985 (including eight years of primary school and four years of secondary school). The schools in our sample also offered three levels of preprimary education: two years of preschool ("Baby Class" followed by "Nursery") as well as a kindergarten year ("Pre-Unit").[4] Figure A1 demonstrates that school enrollment increases rapidly with age in our study area: almost no children are enrolled in school at 24 months of age, but by 48 months more than 80 percent of children are enrolled.[5]

2.2 Data

Our data set includes information on child, parent, and household characteristics. For children aged three to six, developmental outcomes were measured through direct child assessment. Trained survey enumerators from Innovations for Poverty Action administered locally-adapted assessments of vocabulary and fine motor skills, and also measured children's heights. We assessed receptive vocabulary in English and Luo separately (the primary languages of instruction in upper and lower primary, respectively), and we also measured expressive vocabulary, which is the ability to produce an appropriate word in

the language policy of 1976, it is the language of instruction from grade four onwards" (see pp. 32 and 49 of Kenya Institute for Curriculum Development 2019). See Piper and Miksic (2011) and Kerwin and Thornton (2021) for discussion of language-of-instruction policy in East Africa, and the implications for child development and literacy.

[4]This system was replaced in 2018, when Kenya restructured preprimary education in an attempt to guarantee that all children complete two years of preprimary (PP1 and PP2) before beginning primary school.

[5]Data on enrollment is available for all children in the household, since it was collected as part of the household roster. Data on child development is available for children aged three to six.

any relevant local language (English, Luo, or Swahili).[6,7] We measured fine motor skills using items from the Malawi Developmental Assessment Tool (Gladstone et al. 2010), a holistic instrument for assessing early childhood development in African contexts. All child development outcomes including height-for-age are converted into age-adjusted z-scores, following standard practice.[8]

In addition to child outcomes, we also collected data on parent and household characteristics including parental background and educational attainment, household composition, and information on household assets. Our study takes place in a rural, predominantly agricultural area, and all the households in our sample grow some of their own food. Our survey does not contain detailed information on parents' income-generating activities, household consumption, or other adult-focused outcomes. However, detailed information on durable assets provides a reasonable proxy for household wealth and socioeconomic status (Filmer and Pritchett 2001). Critically, our data set also includes the precise GPS coordinates of each family's dwelling, which allows us to construct a household-specific measure of distance to the local primary school.[9]

3 Results

3.1 Distance and Enrollment

Within our sample, three year olds are more likely to be enrolled in school if they live closer to the school, but a similar pattern does not exist among children at older ages. Figure A2 plots the locations of all the households in our sample that include either a three-year-

[6]Receptive vocabulary is a measure of children's comprehension of words while expressive vocabulary is a measure of the ability to produce words. Receptive vocabulary begins developing first: children begin to understand what is being said to them before they develop the ability to articulate their own thoughts and ideas (Fernald, Prado, Kariger and Raikes 2017).

[7]Our measures of English and Luo receptive vocabulary are locally-adapted versions of the British Picture Vocabulary Scale, which is itself an adaptation of the Peabody Picture Vocabulary Test appropriate for people speaking British or Commonwealth English (Dunn and Dunn 1997; Dunn, Dunn and Styles 2009). We developed and validated a locally-appropriate tool for measuring receptive vocabulary as part of an earlier evaluation of an early literacy intervention (Knauer et al. 2019b).

[8]Height-for-age z-scores are calculated relative to external norms available from the World Health Organization.

[9]We measure Euclidean distance. All households in our sample live within 750 meters of the local school.

old (left panel) or four-year-old (right panel) child. The figure shows that four-year-olds are more likely to be enrolled in school than three-year-olds, irrespective of where they live (within our narrowly-defined catchment areas). Among three year olds, there are fewer out-of-school children near the school: within the first tercile of distance to the school (within approximately 360 meters of the school building) approximately 72 percent of three-year-olds are enrolled, but the proportion drops to 58 and 51 percent enrolled for, respectively, the second and third terciles of distance to the school.

Panel A of Figure 1 presents local polynomial regressions of enrollment on distance to the school for three-year-olds (on the left) and six-year-olds (on the right). Among six-year-olds, the proportion enrolled is close to one and does not vary with distance from the school. However, among three-year-olds, the proportion enrolled declines substantially between about 300 meters and 500 meters from the school.

In Table 1, we present the relationship between distance from the school and enrollment in a regression framework. We estimate OLS regressions of the form

$$P_{ih} = \alpha + \delta D_h + \theta X_{ih} + \epsilon_{ih} \tag{1}$$

where P_{ih} is an indicator equal to one if child i in household h is enrolled in school, D_h is the distance from household h to the school, X_{ih} is a vector of controls (fixed effects for schools/communities, child age, gender, and height-for-age z-score; mother's education and ethnicity; whether the child's mother is their primary caregiver; father's education and ethnicity; an indicator for the father's presence in the household; household size; the number of older siblings present in the household; and household wealth), and ϵ_{ih} is a conditionally-mean-zero error term.[10] Panel A of Table 1 includes no covariates, while Panel B reports results from regressions including controls. Among three-year-olds (Column 1), distance from the school is a robust predictor of enrollment, consistent with the visual evidence in

[10]We focus on household-level controls that are unlikely to be impacted by treatment (whether that is defined by either distance from the school or preschool enrollment). As discussed above, our survey did not collect data on consumption or income, crop production, or other household-level outcomes. Summary statistics are presented in Online Appendix Tables A1 and A2.

Figures A2 and 1. Coefficient estimates suggest that a child aged three who lived half a kilometer further from school would be 20-25 percentage points less likely to be enrolled. In contrast, distance is not a robust predictor of enrollment for children ages four and up (within the narrow range of distances observed in our sample). Among five year olds (Column 3), the estimated coefficients (on distance from the school) are approximately one tenth the size of those in Column 1, though they remain (at least marginally) statistically significant. Among four and six year olds (Columns 2 and 4, respectively), the relationship between distance from the school and enrollment is not statistically significant – and coefficient magnitudes are, again, much smaller than those in Column 1. Thus, within our sample, distance is a robust predictor of enrollment among three year olds, but not for older children.

3.2 Distance and Child Development

Next, we examine the reduced form relationship between distance from the local school and early childhood development. Panel B of Figure 1 presents local polynomial regressions of mother tongue vocabulary on distance to the school for three-year-olds (on the left) and six-year-olds (on the right). The relationship between vocabulary and distance parallels the relationship between enrollment and distance: there is a pronounced negative association between vocabulary and distance to the school among three-year-olds, but no apparent relationship between vocabulary and distance to the school among older children – all of whom are enrolled in school.

In Table 2, we replicate the regression specification from Equation 1, but consider five measures of early childhood development as our outcome variables: Luo (i.e. mother tongue) receptive vocabulary, English receptive vocabulary, expressive vocabulary, fine motor skills, and an aggregate index of child development that combines these four sub-indices.[11,12] Among three-year-olds, there is a negative relationship between distance from the school

[11] As discussed above and in footnote 3, Luo is the official language of instruction in preprimary, though English is also widely used in schools and is the official language of instruction in grades four and up.

[12] In Table 2, we report regression coefficients from specifications including controls. Online Appendix Table A3 replicates these specifications without controls.

and Luo receptive vocabulary, expressive vocabulary, fine motor skills, and our aggregate index of early childhood development, though the association with fine motor skills is imprecisely estimated. In contrast, we do not observe a negative relationship between distance from the school and receptive vocabulary in English – the estimated coefficient is positive and close to zero.[13] We also observe no evidence of an association between distance and child development at older ages: estimated coefficients are smaller, a few are positive, and none are statistically significant.

3.3 Instrumental Variables

One plausible interpretation of the strong association between distance from the school, enrollment, and early childhood development among three-year-olds is that preprimary has a causal impact on young children's human capital. To characterize the magnitude of this impact, Table 3 reports two-stage least squares (2SLS) estimates from regressions of child development outcomes on predicted enrollment, using distance from the school as an instrument for enrollment.

This instrumental variables strategy builds on a large literature in labor economics using similar instruments (cf. Card 1993, Kane and Rouse 1993, Dee 2004). In a variety of contexts and at many levels of schooling, access to school predicts school participation (cf. Duflo 2001, Muralidharan and Prakash 2017). Attanasio, Maro and Vera-Hernández (2013), for example, also use a similar distance-based instrument to estimate the effect of nursery participation on child nutrition in Colombia. In the present context of very young children, though, the distances involved are quite small. By comparison, in India, Muralidharan and Prakash (2017) show that there is a roughly 20 percentage point drop in the probability that 16 and 17 year olds are enrolled in secondary school as the distance

[13] To the extent that we believe the observed association with other measures of child development might reflect the causal impact of preschool on three-year-olds who enroll, the absence of impacts on English language skills is to be expected – since Kenya's official policy is that children's mother tongue be used as the language of instruction in preprimary (through third grade) in linguistically homogeneous areas (see footnote 3). The absence of impacts on English vocabulary provides suggestive evidence that observed positive impacts on other domains represent genuine increases in human capital, and not simply greater familiarity and/or comfort with adults outside the household or the procedures used for direct child assessment.

from home to school rises from 0 to 15 kilometers; whereas in the present setting, there is a roughly 20 percentage point drop in the probability a three year old attends preschool, but this occurs as the distance from home to school rises from 0.1 to 0.7 kilometers. Along with the lack of a reduced-form effect of these distances on child development at older ages, the small distances involved in this study allay some of the potential concerns regarding the exclusion restriction.[14]

2SLS coefficients suggest that preprimary enrollment has large and statistically significant positive impacts on Luo receptive vocabulary: the coefficient estimate is 1.16 SD when no controls are included (p-value 0.026) and 1.669 SD with controls (p-value 0.020).[15] Among three year olds, a standard deviation represents approximately four correct responses on the direct child assessment. The median number of correct responses is five, and the mean is six – so this is a developmentally meaningful increase in vocabulary.[16] 2SLS estimates also suggest a meaningful impact of preschool enrollment on expressive vocabulary: 0.70 SD when no controls are included (p-value 0.140) and 1.328 SD with controls (p-value 0.025). In contrast, IV estimates of the impact of preprimary on English receptive

[14]For our instrument to be valid, it must satisfy an exclusion restriction: distance from the primary school should not impact outcomes of interest except through enrollment in preprimary. We argue that this assumption is reasonable in our specific context because the distances involved are quite small: all households in our sample live within 750 meters of their local school. Households that are relatively further from the school are not more rural or more remote in any meaningful sense because all sample households are quite close together. We argue that these differences in distance from the school are only likely to matter for very young children, who may not yet be used to walking around their villages unaccompanied. Though it is impossible to test the exclusion restriction, Table A4 presents evidence that households that are further from the school do not look different from those closer to the school in terms of their observable characteristics. The table reports the results of regressing each of twelve baseline characteristics on our measure of a household's distance from the primary school. None of the estimated coefficients on distance is statistically significant at the 5 percent level, and coefficient magnitudes suggest that households closer to the school are similar to those further away in terms of observable characteristics. If we regress distance from the school on all of these baseline covariates in a single OLS regression, we cannot reject the joint hypothesis that the coefficients are all equal to zero (p-value 0.3125). Though this does not prove that exclusion restriction is satisfied, the absence of meaningful differences in observable characteristics between households that are closer to and further from the local primary school is consistent with our identifying assumptions.

[15]The 2SLS confidence intervals are relatively wide, so the 95-percent confidence interval associated with each statistically significant positive effect is of course consistent with a range of effect sizes besides our point estimates, including both more modest effects and more dramatic ones.

[16]For comparison, three year olds from the highest quintile of household wealth in our sample score approximately 0.25 SD higher on the Luo receptive vocabulary assessment than those from the lowest quintile of household wealth.

vocabulary are negative, smaller in magnitude, and not statistically significant.[17]

Column 5 of Table 3 reports IV estimates of the impact of preprimary on the overall index of early childhood development which aggregates our four individual outcome measures. Coefficients estimates suggest that preschool improves child development by between 0.78 SD (without controls, p-value 0.098) and 1.026 SD (with controls, p-value 0.067). Again, these are developmentally meaningful effects, suggesting that preprimary education is an effective child development intervention.

3.3.1 Characteristics of the Compliers

Instrumental variables regressions provide estimates of the local average treatment effect on compliers, in this case children who are induced to enroll in preschool at age three by their proximity to the school. In Table A5, we test the extent to which our instrument has a differential impact on the likelihood of enrollment at age three for different subgroups. To do this, we regress enrollment on distance to the school, a specific characteristic (e.g. whether a child is male), and an interaction between that characteristic and distance to the school. The interaction term provides a test of the hypothesis that observations with the given characteristic are over-represented (or under-represented) among compliers.

We consider four characteristics: whether a child is male, whether a child has a below-median height-for-age z-score, whether a household has at or below the median number of durable assets, and whether a child's mother has below median education. We find no evidence of heterogeneity in the strength of the first stage as a function of child gender, height-for-age z-score, or mother's education. However, our results suggest that households with low levels of durable assets – in other words, low-SES households – are disproportionately represented among the compliers.

[17] Our results differ from those of Piper, Zuilkowski, Kwayumba and Oyanga (2018), who find that a mother tongue literacy program improved literacy in English.

3.3.2 Comparing IV and OLS

For completeness, we report the cross-sectional OLS relationship between preprimary enrollment and child development outcomes in Appendix Table A6. These regressions are potentially biased in relation to the causal effect estimates reported in Table 3: if children's home environments or levels of development determine when they are enrolled in school, coefficient estimates in Appendix Table A6 will be biased. Comparing Panel A to Panel B in Appendix Table A6, we find evidence consistent with this bias (what is often referred to as "ability bias" at higher grades), as the inclusion of controls substantially diminishes the magnitudes of these estimates, so it is more advanced pupils who are endogenously enrolled.[18] Our instrumental variables estimates provide evidence of large effects of preprimary enrollment for Luo language but none for English, while in contrast, the cross-sectional OLS relationships between preprimary enrollment and language skills are very similar in the two languages. (The reduced form coefficients are statistically different for Luo and English, $p = 0.001$, while the potentially biased OLS coefficients are statistically indistinguishable for the two languages, $p = 0.452$.) This suggests that endogenous enrollment decisions may substantially misstate effects of preprimary, and that the impacts on the asset-poor compliers are substantially larger than cross-sectional OLS estimates would suggest. We must emphasize, of course, that the 2SLS confidence intervals are relatively wide, so comparisons between those coefficients and the OLS coefficients would generally not yield any statistically significant differences.

3.4 Discussion

We document a strong negative association between distance from school and vocabulary among three-year-olds, but only during a time window when children are also more likely to be enrolled in preschool if they live closer to the school. Our results are consistent with many other studies which document large impacts of early childhood interventions that eventually fade (Tanner et al. 2015, Andrew et al. 2018, Özler et al. 2018). In some cases,

[18] Here we use the term "ability bias" in the sense described by Griliches (1977).

ECD interventions can have long-term impacts, even when their short-term effects initially fade (cf. Gertler et al. 2014). It is important to view our results in context: children who enroll in preprimary at age three receive an additional year of early childhood education, but this does not put them on a more advanced curricular trajectory than children who start later. Instead, our data suggests that children who start school at age three are no more likely to be at or above the appropriate grade-for-age level by age four (Table 4). Most three and four year olds in our sample are enrolled in "Baby Class," the initial year of preprimary education. Hence, one potential explanation for the rapid diminution of the impacts of early enrollment is that schools don't appear to push children forward to the next grade level after a year in the first level of preprimary. This is analogous to the situation described by Andrew et al. 2018, in which an intervention's effects on early childhood outcomes were no longer detectable two years after the intervention concluded.[19]

It is also possible that there is a cognitive or non-cognitive impact of preprimary that is not captured by the measurements conducted in this study along which there might be persistent gains. For early childhood programs in the United States such as Head Start and the Perry Preschool Program, a fade-out of an initial effect followed by a reappearance of effects for longer-term outcomes might be explained this way (cf. Bailey et al. 2020; Deming 2009; Gray-Lobe, Pathak and Walters 2023). We cannot rule out the possibility that the apparent fade-out we observe might eventually be followed by a reappearance of effects on other dimensions later in life.

4 Conclusion

High-quality preprimary education is a core component of early childhood development policy, though until recently few LMIC governments in Sub-Saharan Africa offered free and universal preprimary (Behrman, Engle, and Fernald 2013, Richter et al. 2017, Devercelli and Beaton-Day 2020). Many countries in Sub-Saharan Africa have expanded access to prepri-

[19] Özler et al. (2018) and Bernal, Giannola and Nores (2023) also estimate positive short-run impacts of center-based child-development programs that subsequently become indistinguishable from zero, in Malawi and Colombia, respectively.

mary in recent years, but to date there is little evidence on the developmental impacts of public preschool in Sub-Saharan Africa. Many recent studies measure the impacts of NGO-sponsored or community preschools (cf. Martinez, Naudeau and Pereira 2017, Blimpo et al. 2022) or private preschools (Bjorvatn et al. 2022, Gray-Lobe et al. 2022). We complement these studies by exploring the relationship between preschool enrollment at age three and child development outcomes, shedding light on the impact of existing national-scale government preschools on a set of three-year-olds who are induced to enroll at a young age by their proximity to the local school.

Among three year olds in rural Kenya, preschool enrollment appears to lead to large improvements in child development, particularly mother tongue receptive vocabulary and expressive vocabulary. However, we we do not find evidence of persistence over time. Whether the early gains in vocabulary and motor skills that we document lead to meaningful improvements in later life outcomes remains an open question.

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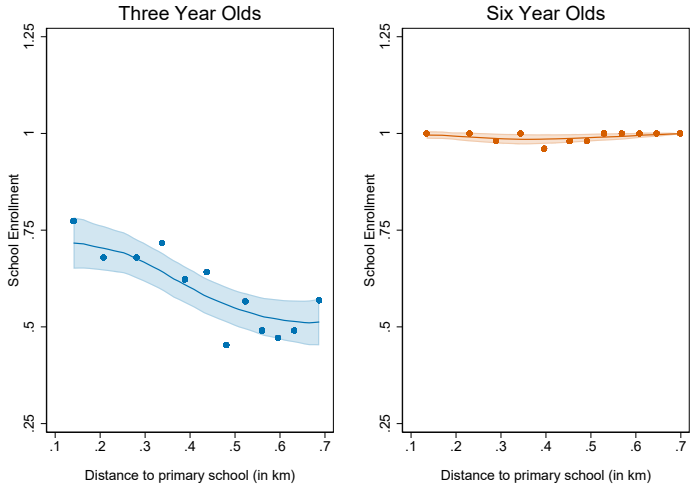
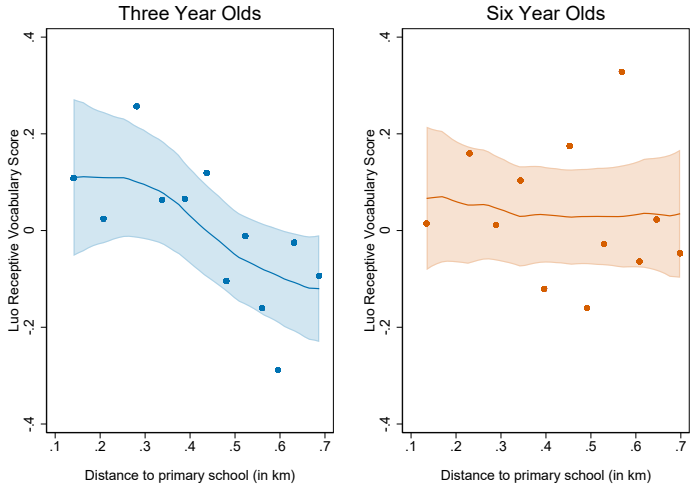
Figure 1: Distance from the Primary School, Enrollment, and Luo Vocabulary

Panel A. School Enrollment



Panel B. Receptive Vocabulary in Luo



Data from 1,100 households with a child aged three or six years. Figures plot local polynomial regressions of school enrollment (Panel A) or Luo receptive vocabulary (Panel B, measured in age-normalized z-scores) on distance to the local school (measured in kilometers). Scatter plots depict averages in bins containing approximately fifty households. Shaded areas are 95% confidence intervals. We do not cluster the confidence intervals by household in this figure, but only 12 households (out of 622 total) have more than one child in the sample.

Table 1: Distance from School and Preprimary Enrollment

Age in Years:	3 Years	4 Years	5 Years	6 Years
	(1)	(2)	(3)	(4)
Panel A: without covariates				
Distance to school (km)	-0.496	0.003	-0.041	0.009
	(0.116)	(0.075)	(0.025)	(0.012)
	[p<0.001]	[0.969]	[0.099]	[0.469]
Panel B: covariate-adjusted				
Distance to school (km)	-0.399	0.010	-0.059	0.007
	(0.120)	(0.082)	(0.039)	(0.012)
	[p<0.001]	[0.902]	[0.132]	[0.560]
Obs.	634	610	669	590

All regressions estimated via OLS. Standard errors (clustered at the household level) in parentheses, p-values in brackets. Dependent variable is indicator for being enrolled in school. Covariates included in Panel B: school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, a dummy for having an imputed value of the height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

Table 2: Distance from School and Child Development

Age in Years:	3 Years	4 Years	5 Years	6 Years
	(1)	(2)	(3)	(4)
Panel A: dependent variable is early childhood development index				
Distance to school (km)	-0.410	-0.165	-0.070	-0.195
	(0.244)	(0.241)	(0.237)	(0.223)
	[0.094]	[0.494]	[0.769]	[0.383]
Panel B: dependent variable is Luo receptive vocabulary index				
Distance to school (km)	-0.667	-0.245	-0.367	-0.363
	(0.265)	(0.257)	(0.263)	(0.244)
	[0.012]	[0.341]	[0.164]	[0.137]
Panel C: dependent variable is English receptive vocabulary index				
Distance to school (km)	0.190	-0.330	0.307	-0.278
	(0.249)	(0.262)	(0.265)	(0.242)
	[0.446]	[0.209]	[0.247]	[0.252]
Panel D: dependent variable is expressive vocabulary index				
Distance to school (km)	-0.530	-0.016	0.067	0.083
	(0.247)	(0.240)	(0.251)	(0.222)
	[0.032]	[0.946]	[0.790]	[0.708]
Panel E: dependent variable is fine motor skills index				
Distance to school (km)	-0.206	0.102	-0.213	-0.019
	(0.234)	(0.262)	(0.239)	(0.278)
	[0.377]	[0.697]	[0.373]	[0.946]
Obs.	634	610	669	590

All regressions estimated via OLS. Standard errors (clustered at the household level) in parentheses, p-values in brackets. All specifications include controls for school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

Table 3: 2SLS Estimates of the Impact of Preprimary Enrollment on Child Outcomes

	Vocabulary				
	Luo	English	Expressive	Fine Motor	ECD Index
	(1)	(2)	(3)	(4)	(5)
Panel A: without covariates					
Enrolled in preprimary	1.160	-0.131	0.701	0.581	0.780
	(0.520)	(0.483)	(0.475)	(0.444)	(0.471)
	[0.026]	[0.786]	[0.140]	[0.191]	[0.098]
Panel B: covariate-adjusted					
Enrolled in preprimary	1.669	-0.475	1.328	0.517	1.026
	(0.717)	(0.612)	(0.592)	(0.531)	(0.560)
	[0.020]	[0.438]	[0.025]	[0.331]	[0.067]
Obs.	634	634	634	634	634

All specifications estimated via 2-stage least squares (2SLS). First-stage F-statistics: 18.28 (Panel A) and 11.02 (Panel B). Standard errors (clustered at the household level) in parentheses, p-values in brackets. Covariates included in Panel B: school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, a dummy for having an imputed value of the height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

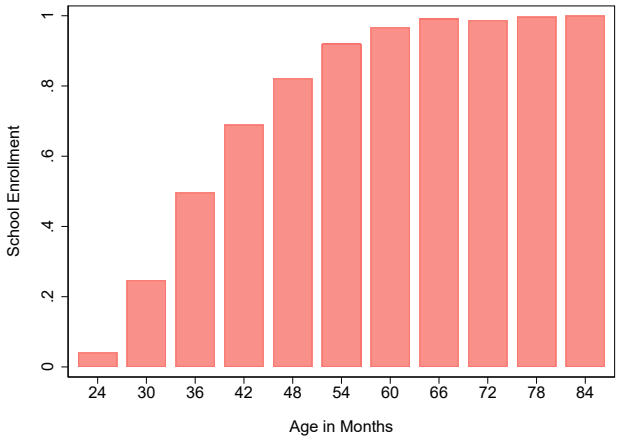
Table 4: The Impact of Distance on Likelihood of Being at Appropriate Grade-for-Age

Age in Years:	3 Years	4 Years	5 Years	6 Years
	(1)	(2)	(3)	(4)
Panel A: without covariates				
At or above appropriate grade-for-age level	-0.496	-0.151	0.041	0.005
	(0.116)	(0.114)	(0.114)	(0.106)
	[p<0.001]	[0.183]	[0.716]	[0.964]
Panel B: covariate-adjusted				
At or above appropriate grade-for-age level	-0.399	-0.132	0.069	0.069
	(0.120)	(0.109)	(0.114)	(0.105)
	[p<0.001]	[0.225]	[0.546]	[0.509]
Obs.	634	610	669	590

All regressions estimated via OLS. Standard errors (clustered at the household level) in parentheses, p-values in brackets. Dependent variable is indicator for being at or above appropriate grade-for age (i.e. in first year of preprimary at age three, in second year of preprimary at age four, in third year of preprimary at age five, and in standard one at age six). Covariates included in Panel B: school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, a dummy for having an imputed value of the height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

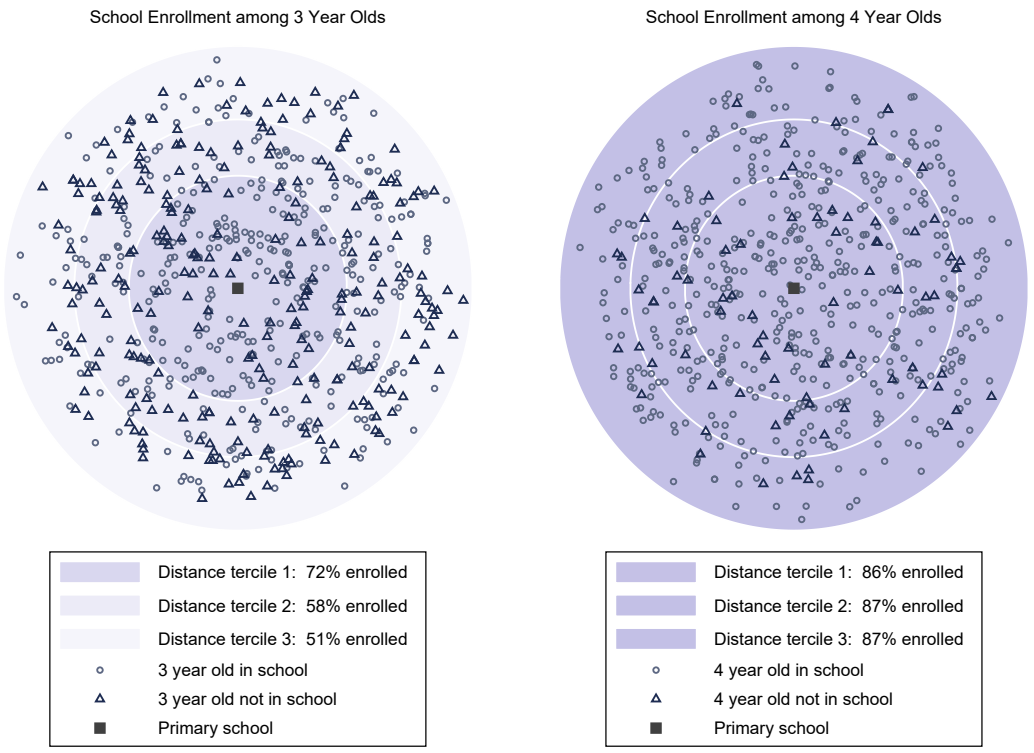
A Online Appendix: not for print publication

Figure A1: School Enrollment by Age



Data from 2,869 children aged 24 to 83 months in 2,013 households in 75 rural villages in western Kenya. Bars indicate the proportion of children in each 6 month age bin who were enrolled in school, based on parent reports.

Figure A2: Probability of Enrollment in Local School Among Three and Four Year Olds



Data from 1,188 households with a child aged three (left panel) or four (right panel). Figure plots the GPS location of each household, relative to the GPS location of the primary school. Households in the first tercile of distance are less than 359.2 meters from their local school; those in the second tercile are between 359.3 and 532.5 meters from their local school, and those in the furthest tercile are between 532.7 and 750 meters from their local school.

Table A1: Summary Statistics on Three Year Olds

	Mean	S.D.	Median	Min.	Max.	N
Child age (in months)	41.70	3.37	42	36	47	634
Height-for-age z-score	-0.57	1.44	-0.66	-4	4	634
Child is male	0.49	0.50	0	0	1	634
Mother is child's primary caregiver	0.88	0.33	1	0	1	634
Mother's education in years	7.88	2.48	8	0	13	634
Mother is Luo	0.95	0.22	1	0	1	634
Father absent from household	0.14	0.35	0	0	1	625
Father's education in years	8.49	2.67	8	0	13	568
Father is Luo	0.98	0.12	1	0	1	568
Household size	5.80	1.98	6	2	14	634
Older siblings in household	1.40	1.29	1	0	6	634
Asset index (out of 10)	3.43	1.47	3	0	9	634
Distance to school (in km)	0.44	0.17	0.46	0.05	0.75	634
Child is enrolled in school	0.60	0.49	1	0	1	634

Data on 634 children aged 36 to 47 months. Children are from 622 unique households (12 households include two three-year-old children). Asset index is the sum of indicators for having a cement floor, iron roof, latrine, or connection to the electricity grid, and indicators for owning a motorized vehicle, a bicycle, a television, a mobile phone, a computer, or a radio.

Table A2: Summary Statistics on All Children Age Three to Six

	Mean	S.D.	Median	Min.	Max.	N
Child age (in months)	59.23	13.65	60	36	83	2503
Height-for-age z-score	-0.41	1.36	-0.46	-4	4	2503
Child is male	0.50	0.50	1	0	1	2503
Mother is child's primary caregiver	0.86	0.35	1	0	1	2503
Mother's education in years	7.72	2.39	8	0	13	2503
Mother is Luo	0.95	0.22	1	0	1	2503
Father absent from household	0.17	0.37	0	0	1	2486
Father's education in years	8.55	2.63	8	0	13	2270
Father is Luo	0.98	0.12	1	0	1	2270
Household size	5.88	1.92	6	2	17	2503
Older siblings in household	1.53	1.25	1	0	8	2503
Asset index (out of 10)	3.55	1.50	3	0	9	2503
Distance to school (in km)	0.43	0.16	0.45	0.02	0.75	2503
Child is enrolled in school	0.86	0.35	1	0	1	2503

Data on 2,503 children aged 36 to 83 months. Children are from 1,994 unique households. Asset index is the sum of indicators for having a cement floor, iron roof, latrine, or connection to the electricity grid, and indicators for owning a motorized vehicle, a bicycle, a television, a mobile phone, a computer, or a radio.

Table A3: Distance from School and Child Development (Without Controls)

Age in Years:	3 Years	4 Years	5 Years	6 Years
	(1)	(2)	(3)	(4)
Panel A: dependent variable is early childhood development index				
Distance to school (km)	-0.387	-0.148	0.068	0.264
	(0.247)	(0.257)	(0.239)	(0.249)
	[0.118]	[0.565]	[0.778]	[0.288]
Panel B: dependent variable is Luo receptive vocabulary index				
Distance to school (km)	-0.575	-0.256	-0.052	-0.075
	(0.246)	(0.248)	(0.241)	(0.249)
	[0.020]	[0.302]	[0.828]	[0.763]
Panel C: dependent variable is English receptive vocabulary index				
Distance to school (km)	0.065	-0.404	0.187	0.142
	(0.236)	(0.249)	(0.241)	(0.248)
	[0.783]	[0.105]	[0.439]	[0.568]
Panel D: dependent variable is expressive vocabulary index				
Distance to school (km)	-0.348	0.024	0.229	0.516
	(0.246)	(0.251)	(0.251)	(0.236)
	[0.158]	[0.925]	[0.362]	[0.030]
Panel E: dependent variable is fine motor skills index				
Distance to school (km)	-0.288	0.199	-0.163	0.200
	(0.230)	(0.253)	(0.231)	(0.260)
	[0.210]	[0.431]	[0.481]	[0.441]
Obs.	634	610	669	590

All regressions estimated via OLS. Standard errors (clustered at the household level) in parentheses, p-values in brackets. All specifications include controls for school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

Table A4: Does Distance Predict Observable Characteristics of Children and Households?

	Coefficient	S.E.	p-value
Child age (in months)	-0.511	0.793	0.519
Height-for-age z-score	-0.483	0.330	0.143
Child is male	0.025	0.121	0.836
Mother is child's primary caregiver	0.000	0.080	0.995
Mother's education in years	0.347	0.619	0.575
Mother is Luo	-0.044	0.054	0.420
Father absent from household	-0.000	0.084	0.996
Father's education in years	1.137	0.666	0.088
Father is Luo	0.074	0.040	0.062
Household size	0.419	0.510	0.412
Older siblings in household	0.528	0.301	0.080
Asset index (out of 10)	0.541	0.355	0.128

Coefficients from OLS regressions of outcome variables on distance from the school (in km). Data on 634 children aged 36 to 47 months. Children are from 622 unique households (12 households include two three-year-old children). Standard errors clustered at the household level. Asset index is the sum of indicators for having a cement floor, iron roof, latrine, or connection to the electricity grid, and indicators for owning a motorized vehicle, a bicycle, a television, a mobile phone, a computer, or a radio.

Table A5: Complier Characteristics: OLS Regressions of School Enrollment on Distance

		Indicator for Below Median:		
Characteristic:	Male	HAZ	Assets	Mother's Ed.
	(1)	(2)	(3)	(4)
Distance to school (km)	-0.571	-0.421	-0.074	-0.401
	(0.158)	(0.150)	(0.169)	(0.155)
	[0.000]	[0.005]	[0.660]	[0.010]
Characteristic	-0.165	0.058	0.293	-0.033
	(0.102)	(0.119)	(0.113)	(0.117)
	[0.105]	[0.627]	[0.010]	[0.780]
Characteristic × distance	0.368	0.031	-0.625	-0.001
	(0.225)	(0.235)	(0.230)	(0.255)
	[0.102]	[0.896]	[0.007]	[0.997]

All specifications estimated via OLS. Standard errors (clustered at the household level) in parentheses, p-values in brackets. The outcome variable in all specifications is an indicator for school enrollment. The sample is restricted to three year olds. All specifications include the following covariates: school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, a dummy for having an imputed value of the height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.

Table A6: Cross-Sectional Relationship Between Preprimary Enrollment and Outcomes

	Vocabulary				
	Luo	English	Expressive	Fine Motor	ECD Index
	(1)	(2)	(3)	(4)	(5)
Panel A: without covariates					
Enrolled in preprimary	0.451	0.492	0.654	0.720	0.782
	(0.078)	(0.075)	(0.077)	(0.076)	(0.075)
	[p<0.001]	[p<0.001]	[p<0.001]	[p<0.001]	[p<0.001]
R^2	0.048	0.060	0.101	0.125	0.140
Panel B: covariate-adjusted					
Enrolled in preprimary	0.327	0.403	0.463	0.465	0.560
	(0.092)	(0.089)	(0.088)	(0.092)	(0.085)
	[p<0.001]	[p<0.001]	[p<0.001]	[p<0.001]	[p<0.001]
R^2	0.258	0.228	0.344	0.349	0.380
Obs.	634	634	634	634	634

All cross-sectional specifications estimated via OLS. A separate regression for each outcome is presented in each column of each panel. Child outcomes are listed at the top of each column. Standard errors (clustered at the household level) in parentheses, p-values in brackets. As in other estimates, the sample includes 634 children aged 36 to 47 months. Covariates included in Panel B: school catchment area (i.e. community) fixed effects, child age in months (fixed effects), child gender (indicator for male), child height-for-age z-score, a dummy for having an imputed value of the height-for-age z-score, an indicator equal to one if a child's mother is their primary caregiver, mother's education, an indicator for having a Luo mother, father's education, an indicator for having a Luo father, an indicator for father's presence in the household, and an indicator for missing data on the child's father, household size, the number of older siblings in the household, and a household wealth index.