

Maternal Age as a Predictor of a Child's Preschool Enrollment in sub-Saharan African Countries

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Abstract

Background: Adolescent parenthood is prevalent in sub-Saharan Africa. Young maternal age may pose critical risks that aggravate inequalities in their children's early development and education. This study aims to investigate the association between maternal age and a child's preschool enrollment in 29 sub-Saharan African countries.

Methods: The study aggregated nationally representative Multiple Indicator Cluster Surveys (MICS) in 29 sub-Saharan African countries. The study used linear probability models, regressing a child's preschool enrollment status on age of a matched mother while sequentially adjusting child-, mother-, household-, and country-level confounders. The study then added an interaction term between maternal age and country in order to determine whether the association varies across the 29 countries.

Results: In the total sample, 81% of 90,152 children aged 3 and 4 were not enrolled in any forms of organized early childhood education program. After controlling comprehensive levels of covariates, one year increase in maternal age was estimated to be associated with 0.16 percentage points of increment in probability of a child's preschool enrollment ($p < .001$). However, such an association substantially varied in both magnitude and significance across 29 sub-Saharan African countries. Among the five countries that showed statistically significant results, the association was largest in Nigeria ($\beta = 0.0067$, $p < .001$).

Conclusion: The study documents a link between maternal age and a child's status of enrollment in early childhood education programs in 29 sub-Saharan African countries. Endeavors to support adolescent mothers may be pressing to mitigate inequalities in early childhood development and education in sub-Saharan Africa.

Keywords: Adolescent motherhood, Early childhood education, Maternal age, Multiple Indicator Cluster Surveys, sub-Saharan Africa

Background

Over 700 million women today were married or partnered before reaching the age of 18 [1]. In 2014, the average global birth rate among girls age 15 to 19 was 49 per 1000 (1 in 20), the highest rates of which were found in sub-Saharan Africa [2]. In Niger, for example, 77 per cent of women age 20 to 49 were married before age 18 in stark contrast to 5 per cent of male counterparts [1]. Teenage parenthood is associated with an increased risk of preterm birth and intrauterine growth restriction, infant mortality, and child undernutrition [3]. The biological etiology of these adverse outcomes is scientifically explicable: incomplete adolescent growth, complicated by chronic malnutrition, increases the risk of adverse pregnancy outcomes [4].

While the biological risks of young maternal age on pregnancy outcomes have often been

explored, few strands of research have aimed to understand the association between young maternal age and their children's early childhood education outcomes. One of the presumptions raised in research on low-income countries is that adolescent girls who quit school early are more likely to marry and become pregnant, compared to those who stay in school [5]. Also, across Africa, girls are often barred from school if they become pregnant, which serves as a social stigma [6]. These adolescent mothers, excluded from formal schooling, are often required by the house head to perform burdensome domestic work, under pressure to demonstrate fertility, and are "responsible for raising children while still children themselves...[facing] constrained decision-making and reduced life choices" [7]. In addition to the domestic burden, they often experience pervasive domestic violence and lack not only behavioral maturity to attend to their children's needs, but also necessary knowledge in child nurturing practices [7, 8].

The experiences of adolescent mothers serve as critical risk factors that aggravate inequalities in early childhood development in sub-Saharan African countries. One compelling strategy to reconcile such inequalities is to provide affordable preschool programs for those families facing biological, social, and cultural risks known to impact child development outcomes. The unique circumstances surrounding adolescent mothers warrant thoughtful investigation of whether teenage mothers are more likely to experience limited access to preschool programming for their children, compared to their adult counterparts. This question has a significant implication for future policy designs to support adolescent mothers and to prevent teenage pregnancy, thereby to break the intergenerational cycle of inequality between teenage mothers and poorer early child outcomes.

A recent body of research has shown the impact of a quality preschool experience on child development in the context of low- and middle-income countries, which can mitigate the adverse early childhood outcome potentially induced by adolescent mothers. In Ghana, for example, a quality preschool programming had positive impact on a child's literacy, numeracy, and social-emotional development [9]. This evidence is in a compelling parallel with an extensive strand of research on impacts of early childhood care and education (ECCE) programs in the context of the United States. Studies have found not only short-term benefits for children on intelligence quotient (IQ), but also long-term effects on school achievement, grade retention, and social adjustment [10]. Moreover, high quality birth-to-five programs for disadvantaged children have shown to have positive social benefits, such as health, the quality of life, crime reduction, and labor income, delivering a 13% per year return on investment" [11]. Therefore, enrollment in preschool programming can effectively mitigate individual and societal inequalities over time and help break intergenerational cycles of poverty.

The individual and social benefits of an access to preschool programming would be far profound in sub-Saharan Africa where such inequalities and international cycles of poverty are particularly salient. All of the major types of early childhood interventions have shown substantial average effect sizes across low-and middle-income countries, and their potential for

large economic benefits is large “nearly everywhere” [12]. No research has yet examined the association between maternal age and a child’s preschool enrollment in sub-Saharan African countries. The current study aims to investigate whether young maternal age predicts a lower rate of a child’s enrollment in an organized early childhood education program and whether such an association is consistent across 29 sub-Saharan African countries. The aforementioned individual, societal, and economic impacts of early childhood programming serve as the motivation to explore this current research and to identify the most vulnerable group of children to be intervened within sub-Saharan Africa. This research is especially pertinent to today’s global pandemic crisis, which has left millions of girls out of school and at significant risks of being forced into marriage and abused sexually [13].

Methods

Data

The study used data from UNICEF’s Multiple Indicator Cluster Survey (MICS), a global survey program that collects nationally representative information on health, nutrition, education, and development of children in LMICs. The MICS has remained as the primary data source measuring and monitoring Early Childhood Development outcomes in standardized and comparable ways. The MICS has extensively influenced international policy decisions and program interventions and thereby served a key role in tracking progress towards elimination of disparities and inequities [14].

The study aggregated nationally representative surveys from 29 sub-Saharan African countries, consisting of the total sample of 295,733 children aged 0 to 59 months. For the purpose of the study, the sample was restricted to 90,152 children aged 3 and 4 years for whom enrollment in any forms of organized early childhood education programs was reported on the questionnaire. Because MICS round 6, the most recent version of the survey, was not available all throughout 29 countries, the data ranged from round 3 to round 6 (2015-2019). Countries available with MICS round 6 included Central African Republic, Chad, Democratic Republic of Congo, Ghana, Lesotho, Madagascar, São Tomé and Príncipe, Sierra Leone, The Gambia, Togo, and Zimbabwe. Countries with round 5 included Benin, Côte d'Ivoire, Guinea, Guinea Bissau, Kenya (only available for Bungoma, Kakamega, and Turkana counties), Malawi, Mali, Mauritania, Nigeria, Senegal (only available for the city of Dakar), and Sudan. Countries with MICS 4 were Somalia (Northeast zone), Somaliland, and South Sudan; countries with MICS 3 were Burundi, Djibouti, and Mozambique.

Dependent/Independent variables

The main outcome variable of interest was a child’s status of enrollment in preschools. Due to the range of survey years spanning more than a decade from 2005 to 2019, there existed a variation in questionnaires in respect to a child’s preschool attendance/enrollment. For example, in MICS 6, which is the most recent and comprehensive version of the survey program, the

questionnaire asked whether a child “ever attended early childhood education programme,” “attended early childhood education programme anytime since the beginning of current school year,” and is “currently attending” any programme. However, the MICS 3 asked only one question of whether a child “attends some organized learning or education.” For the purpose of this study, responses to the most conservative question of whether a child “ever attended” an ECCE program were aggregated in order to maintain consistency throughout the different rounds of the survey. The study used maternal age as a primary independent variable of interest. Each child observation was merged with age of his or her mother. Due to the particular structure of the questionnaire, some children were reported to have caregivers who were not their mothers, such as older siblings and grandmothers, observations of which were dropped from the sample.

Covariates

The study adjusted for a comprehensive range of potential cofounders at child-, mother-, and household-levels. Some covariates were excluded in the main analysis because those variables were not available in previous rounds of the survey program. Child characteristics included age (in years) and sex (male or female). A mother-level covariate included a level of maternal education (pre-primary or none, primary, or secondary +). Household characteristics entailed wealth score (based on the principal component analysis of a basket of asset indicator variables) [15], and index (quintiles calculated by counting a group of assets owned by the household; poorest, second, middle, fourth, or richest) [16]. Household-covariates also included place of residency (urban or rural) and the number of household members.

Analysis

The analysis of this study was comprised of a sequential process of building up models, comparing the model fits, and illuminating a few countries with significant results. The study first specified a series of three linear probability models¹ regressing a child’s preschool enrollment status on maternal age, adjusting for controls at various levels. Model 1 only adjusted for child age and sex. In addition to child-level covariates, Model 2 adjusted for mother- and household-level covariates reflecting a child’s demographic and socio-economic status as well as country a child is from. Model 3 further added an interaction term between maternal age and country in order to determine whether the main association differs across countries across 29 countries of sub-Saharan Africa. Based on the result of Model 3 with the interaction term, this study selected and illuminated meaningful results from a few countries for international comparative purpose. As for the sensitivity check, the study conducted the aforementioned analytic procedures, using the dataset restricted in two compounded ways. First, the study restricted maternal age up to 49, which is deemed to be the maximum age to have a child of age

¹ The study specified another series of logistic regression models with the same sequential adjustment of covariates and interaction. After comparing the model fit between the two series of linear probability and regression models, the study selected the former series and interpreted the results with heteroskedasticity-robust standard errors for convenient interpretability. (Appendix I)

3 and 4. Then, the study further added more covariates – child and mother’s disability, status of a father on whether he is alive or not – which reduced the number of sampled countries due to the limited availability of such covariates across the different rounds of the survey (total 10 countries, with 27,537 children). Any significant differences in results and standard errors were examined and reported. All analyses were conducted using R version 4.0.4 [17] and figures were produced using the package ggplot2 [18].

Results

A total of 90,152 children aged 3-4 years from 28 sub-Saharan African countries were represented in the full sample. Sample characteristics for the total sample are presented in Table 1. Sierra Leone was excluded from the sample because no child in its corresponding sample was enrolled in preschools. Overall, 52% of the children in the sample were of age of 3 years, and nearly half of them were female. The majority of households (71%) resided in rural regions, and 62% of them were in and below the middle quintile of the wealth index.

Approximately, one in five children between age 3 and 4 (19%) attended (was enrolled) in any form of organized early childhood education programming. The average proportion of children enrolled in ECCE programs widely varied across 28 countries from 0% in Sierra Leone (thus excluded from the sample) to 70% in Ghana. In most of the countries in the sample, the rate was under 50%.

In Model 1, only adjusting for child age and sex, it was estimated that one year increase in maternal age was associated with an increment in probability of a child’s enrollment in any form of organized ECCE programs by 0.10 percentage points (95% CI: 0.00077, 0.00130; $t(90,117) = 7.635, p < .001$). In Model 2 additionally adjusting for mother- and household-level covariates, and country, it was estimated that one year increase in maternal age was associated with an increment in probability of a child’s preschool enrollment by 0.16 percentage points (95% CI: 0.00139, 0.00185; $t(90,078) = 13.521, p < .001$). In a meaningful context, a fifteen-year-old mother would be less likely to enroll her child in an ECCE program by 0.80 percentage points, relative to a twenty-year-old mother.

The χ^2 Difference test indicated that Model 3 fit the data better than Model 2 ($\chi^2(69) = 196.283, p < .001$). In Model 3 further adding an interaction term between maternal age and preschool enrollment, the study found that the associations differed in both magnitude and statistical significance across 28 countries. For example, in Benin, it was predicted that one year increase in maternal age was associated with an increment in probability of a child’s enrollment in preschool by 0.11 percentage points, the result of which was statistically significant ($t(90,053) = 2.233, p < .05$). Relative to the result in Benin, the relationship was 0.40 percentage points per year larger in Nigeria ($t(90,053) = 6.019, p < .001$), which was the largest in magnitude and statistical significance amongst 28 sub-Saharan African countries. The variation of the association across countries is presented in Graph 1.

The robustness-check suggested that restricting the sample to maternal age up to 49 produced slightly bigger results all throughout three models. The more complex model, which

further added such covariates of child and mother's disability and father's life status resulted in the strongest association ($\beta = 0.0036$, $p < .001$) without the country covariate, but such association disappeared in statistical significance once the country covariate was adjusted. Out of 28 sub-Saharan African countries, five countries showed a statistically significant association between maternal age and a child's preschool enrollment rate, the list of which is as follows: Benin ($\beta = 0.0017$, $p < .05$), Cameroon ($\beta = 0.0045$, $p < .001$), Nigeria ($\beta = 0.0067$, $p < .001$), Sudan ($\beta = 0.0018$, $p < .05$), and Somalia Northeast zone ($\beta = 0.0012$, $p < .05$).

Discussion

Using MICS data from 29 sub-Saharan African countries, the current study documented three main findings. First, preschool enrollment rate among the children aged from 3 to 4 years was considerably low in the pooled sample. Despite the recent global push for early childhood development and education and partnerships between governments and international NGOs, about four in five children aged 3 and 4 (81%) in the total sample were not enrolled in any form of organized learning. Such a generally low rate of ECCE program enrollment goes hand in hand with socio-economic complexion of the majority of the sampled household as studies have suggested that one of the major obstacles to children's education in Africa is poverty [19]. This rate within the sample might reflect not only inequalities in access to early childhood education by socioeconomic status and rural residency, but also history of post-independence Africa which has focused on primary education rather than preschool education since 1970s [20].

Second, the study found that the younger mothers are predicted to be less likely to enroll their children in ECCE programs. Even after controlling more covariates that could potentially confound the relationship between maternal age and a child's preschool enrollment, the association remained statistically significant. Nevertheless, the overall association was of a practically small degree and therefore did not dovetail with related studies that adolescent motherhood affects child outcomes due to the mothers' limited resources, knowledge, skills or agency [21]. One explanation for this modest result is that most of sub-Saharan African countries might not have widely penetrated access to ECCE programs, as the overall low rate of ECCE enrollment was previously noted in the sample. Another likely explanation for this modest association is that it is not particularly a mother's age *per se*, but the unique situation surrounding adolescent motherhood, such as poverty, is associated with whether the mother would enroll her child in an ECCE program.

Moreover, the study provided a compelling evidence that the association varies across sub-Saharan Africa. Such a result reflects difference among sub-Saharan African countries in respect to the pace and depth of early childhood education policies. For example of this discrepancy, in Sierra Leone, as 0% of preschool enrollment rate in the sample illustrated, preschool education "is mostly exclusive and private," and families usually need financial resources or connections with people in positions of power to provide an organized early learning for their young children [22]. In contrast, Kenya shows early and rapid penetration of early childhood care and education in that its constitution provides for the right to early

childhood services and expanded its ECCE infrastructure in the last few decades [20]. The historic trend toward universal ECCE and according expansion of infrastructure may shed a more meaningful light on the relationship between maternal age and a child's preschool enrollment and ensuing development outcome in forthcoming decades.

There are several limitations to this current study. First, the study pooled data from sub-Saharan African countries for which MICS data were available; moreover, the surveys of different rounds span over a decade, the variation of which could lead to less accurate and outdated representation of sub-Saharan Africa. Second, even though the study comprehensively adjusted for different levels of covariates, it could nevertheless have omitted other important variables that were not collected from the MICS survey, but could reflect unique living environment of adolescent mothers, availability of ECCE facilities and services, and cultural norms and values. For example, there may exist cultural expectations in sub-Saharan Africa where a mother self-sufficiently takes care of her child's development and education or a mother shares her child-care responsibilities with other members of the household, obviating any need for ECCE. Lastly, the particular nature of this study precludes any causal inference.

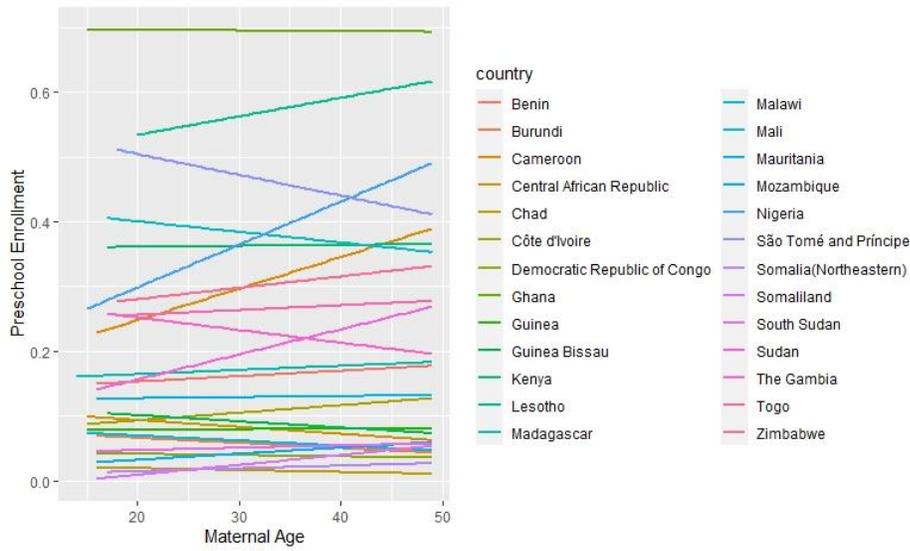
Conclusion

The current study highlights the prevalence of adolescent motherhood and its potential risk factors for early childhood education in sub-Saharan Africa. The study finds that younger mothers are less likely to enroll their children in any forms of organized early childhood learning programs, but the magnitude of association is modest. The association varies substantially across 29 sub-Saharan African countries. Early childhood care and education can be a critical means for mitigating risks associated with adolescent motherhood and allowing children at such risks to meet their full developmental potential. This endeavor may critically share a pathway of eradicating social and economic inequalities in sub-Saharan Africa.

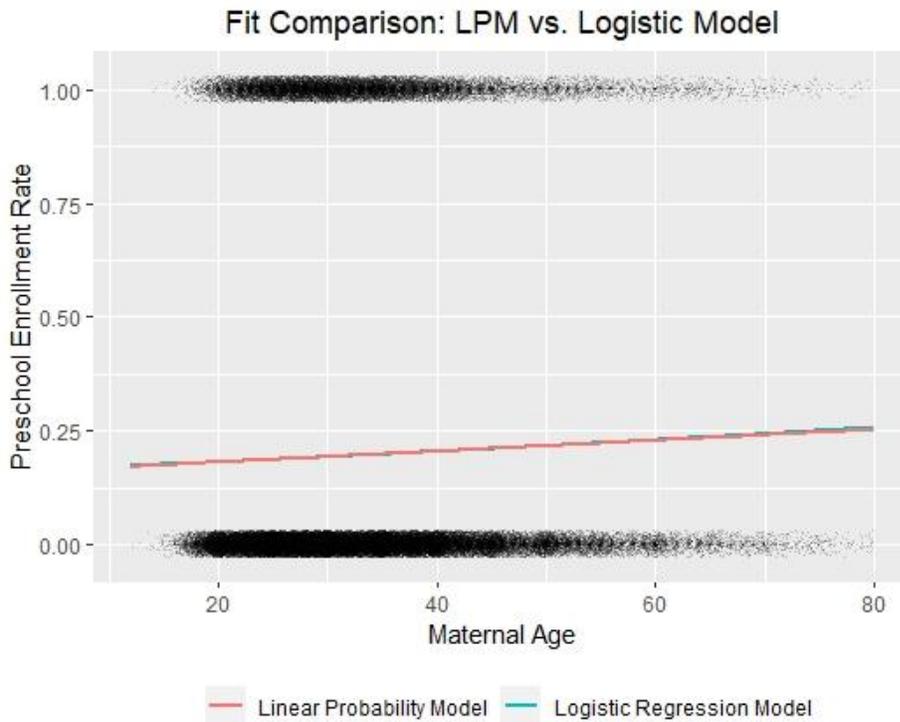
Table 1. Full sample characteristics among children aged 3 and 4 years by countries

| Country | Sample Size | | Age | | Enrollment | | Region | | Wealth Quintile | | | | |
|-------------------------------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-----------------|--------------|--------------|--------------|--------------|
| | Female | Male | 3 | 4 | N (Percent) | Rural | Urban | Poorest | Fourth | Middle | Second | Richest | |
| | | | | | | | | | | | | | |
| Overall | 90,152 | 44,900 (50%) | 45,252 (50%) | 46,623 (52%) | 17,383 (48%) | 43,529 (48%) | 64,138 (71%) | 26,014 (29%) | 22,975 (23%) | 15,619 (17%) | 17,725 (20%) | 20,457 (23%) | 13,376 (15%) |
| Benin | 4,319 | 2,167 | 2,152 | 2,208 | 2,111 | 695 (16%) | 2,168 | 2,151 | 883 | 798 | 802 | 784 | 1,052 |
| Burundi | 2,618 | 1,329 | 1,289 | 1,471 | 1,147 | 149 (5.7%) | 2,284 | 334 | 479 | 488 | 463 | 509 | 679 |
| Cameroon | 2,360 | 1,195 | 1,165 | 1,232 | 1,128 | 714 (30%) | 1,311 | 1,049 | 484 | 455 | 504 | 555 | 362 |
| Central African Republic | 3,102 | 1,562 | 1,540 | 1,564 | 1,538 | 253 (8.2%) | 2,118 | 984 | 665 | 659 | 622 | 829 | 255 |
| Chad | 4,688 | 2,320 | 2,368 | 2,358 | 2,330 | 76 (1.6%) | 4,095 | 593 | 876 | 980 | 981 | 1,132 | 719 |
| Côte d'Ivoire | 3,123 | 1,544 | 1,579 | 1,624 | 1,499 | 334 (11%) | 2,323 | 800 | 982 | 435 | 622 | 829 | 255 |
| Democratic Republic of Congo | 7,746 | 3,980 | 3,766 | 3,982 | 3,764 | 299 (3.9%) | 5,769 | 1,977 | 2,602 | 1,012 | 1,602 | 2,085 | 445 |
| Ghana | 3,067 | 1,570 | 1,497 | 1,551 | 1,516 | 2,133 (70%) | 1,838 | 1,229 | 966 | 489 | 545 | 578 | 489 |
| Guinea | 2,676 | 1,301 | 1,375 | 1,340 | 1,336 | 209 (7.8%) | 1,935 | 741 | 686 | 478 | 556 | 620 | 336 |
| Guinea Bissau | 1,962 | 994 | 968 | 978 | 984 | 170 (9.7%) | 1,460 | 502 | 642 | 279 | 399 | 475 | 167 |
| Kenya | 1,040 | 523 | 517 | 570 | 470 | 388 (37%) | 629 | 411 | 277 | 204 | 183 | 233 | 143 |
| Lesotho | 180 | 91 | 89 | 81 | 99 | 92 (51%) | 126 | 54 | 58 | 31 | 24 | 39 | 28 |
| Madagascar | 4,576 | 2,274 | 2,302 | 2,255 | 2,321 | 803 (18%) | 3,548 | 1,028 | 1,549 | 584 | 853 | 1,133 | 457 |
| Malawi | 7,167 | 3,609 | 3,558 | 3,817 | 3,350 | 2,745 (38%) | 6,394 | 773 | 1,577 | 1,366 | 1,536 | 1,598 | 1,090 |
| Mali | 4,322 | 2,084 | 2,238 | 2,324 | 1,998 | 259 (6%) | 3,275 | 1,047 | 1,119 | 807 | 748 | 845 | 803 |
| Mauritania | 3,463 | 1,738 | 1,725 | 1,775 | 1,688 | 437 (13%) | 2,126 | 1,337 | 825 | 570 | 700 | 847 | 521 |
| Mozambique | 3,634 | 1,872 | 1,762 | 1,885 | 1,749 | 157 (4.3%) | 2,287 | 1,347 | 677 | 781 | 709 | 717 | 750 |
| Nigeria | 10,833 | 5,318 | 5,515 | 5,520 | 5,313 | 4,112 (38%) | 7,925 | 2,908 | 2,580 | 1,910 | 2,031 | 2,423 | 1,889 |
| São Tomé and Príncipe | 692 | 347 | 345 | 322 | 370 | 323 (47%) | 295 | 397 | 155 | 140 | 146 | 142 | 109 |
| Senegal | 1,800 | 897 | 903 | 977 | 823 | 756 (42%) | n/a | n/a | 438 | 412 | 388 | 393 | 387 |
| Somalia (NE) | 1,933 | 961 | 972 | 988 | 945 | 38 (2%) | 680 | 1,253 | 424 | 391 | 371 | 376 | 371 |
| Somaliland | 1,870 | 922 | 948 | 1,005 | 865 | 51 (2.7%) | 954 | 916 | 414 | 345 | 396 | 432 | 283 |
| South Sudan | 2,882 | 1,425 | 1,457 | 1,603 | 1,279 | 145 (5%) | 2,218 | 664 | 604 | 618 | 606 | 584 | 470 |
| Sudan | 5,271 | 2,605 | 2,666 | 2,908 | 2,363 | 1,050 (20%) | 3,935 | 1,336 | 1,348 | 778 | 1,103 | 1,432 | 610 |
| The Gambia | 2,599 | 1,230 | 1,369 | 1,308 | 1,291 | 604 (23%) | 1,631 | 968 | 1,091 | 304 | 404 | 566 | 234 |
| Togo | 1,822 | 853 | 969 | 894 | 928 | 488 (27%) | 1,275 | 547 | 466 | 308 | 384 | 397 | 267 |
| Zimbabwe | 2,207 | 1,086 | 1,121 | 1,060 | 1,147 | 659 (30%) | 1,539 | 668 | 546 | 409 | 414 | 451 | 387 |

Graph 1 Varying associations between maternal age and preschool enrollment by 28 countries



Appendix I Empirical Fit Comparison between Linear Probability Model and Logistic Model



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