Intergenerational Impacts of Secondary Education: Experimental Evidence from Ghana[1]

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Abstract

We provide experimental evidence on the intergenerational impacts of secondary education subsidies in a low-income context, leveraging a randomized controlled trial and 14-year longitudinal follow up that includes direct cognitive testing tailored to our context. For females, receiving a secondary education subsidy (a scholarship) delays childbearing and marriage, as well as reduces unwanted pregnancies. When female scholarship recipients marry and have children, they are more likely to marry a partner with tertiary education and their children have better early childhood development outcomes. In particular, we document a sizable reduction in under-three mortality as well as meaningful cognitive development gains once children are of school age. The primary mechanism seems to be that more-educated caregivers have the knowledge and skills to stimulate their children's cognitive development and safeguard their health. In contrast, we find no evidence of impact for the children of male scholarship recipients. This is likely driven by the fact that male scholarship recipients marry "down", so the caregiver of their children (typically the mother) is not more educated. Together, these results suggest a key role for maternal education (and maternal education alone) in child outcomes. We estimate the benefit-cost ratio for secondary school scholarships and find that the impact on child survival alone is sufficient to make them a highly cost-effective investment.

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1 Introduction

Following the widespread adoption of free primary education in low-income countries and the subsequent surges in primary school enrollment rates, policymakers' attention has shifted to secondary school. The U.N's new Sustainable Development Goals call for "... free, equitable and quality primary *and secondary* education leading to relevant and effective learning outcomes". However, the extent to which secondary education should be publicly subsidized is still a very active policy debate in developing countries and is not settled in the academic literature. This paper provides experimental evidence on one important aspect of this debate: the extent to which free secondary education has intergenerational impacts.

In Ghana, the setting of this study, debates about whether secondary education should be free have been central to political and policy debates over the past decade. In 2016, the National Patriotic Party (NPP) won the presidential elections on a promise to make Senior High School (SHS) free for all qualified students and implemented a free SHS policy that covered tuition and fees for all Ghanaian students admitted to SHS from the 2018 school year and onwards. The opposition critiqued the policy as overcommitting resources to the educational sector and diluting the quality of secondary education.[2] While the free SHS program is popular among Ghanaians, even NPP politicians have raised concerns over the government's ability to fund the program absent increases in tax revenue.[3]

At the heart of the debate is the fact that secondary education is expensive and making secondary school free generates a transfer to households who would be sufficiently well off to send their children to secondary school if they had to pay for it. Offsetting these costs are any benefits of secondary education for all those unable to afford it, as well as the possible externalities to society of a more educated population.

One such possible externality is that more educated individuals, especially women, may choose and be able to have fewer children, and to invest more in the human capital of the children they do have (Becker, 1991). This implies that the benefit of providing free education to one cohort of

[2]https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Free-SHS-to-go-Mahama-threatens-689275
[3]https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Review-Free-SHS-Kwame-Sefa-Kayi-urges-government-1478996 "In recent debates over a controversial E-levy (a tax on mobile money transactions), NPP MPs claimed that the free SHS program would have to be discontinued if the E-levy was not enacted."

adolescents would benefit future generations as well. A large literature finds a correlation between education, lower fertility, and better outcomes for children (Thomas, 1991; Mohanty et al, 2016; Wietzke, 2020). Moreover, there is a demonstrated causal link between parental inputs in childhood and cognitive scores and performance in school (Walker, Wachs, et al., 2007; Gertler et al, 2014; Attanasio et al. 2022), and it is at least plausible that more educated parents provide more of these inputs (Attanasio et al., 2020).

However, establishing a causal link between education and future family outcomes is difficult: adolescents who receive more education may be different in various ways, which may in turn explain why their own children would be more educated. Countries that invest in the education of one cohort might continue to invest in future cohorts, which means that educational reforms cannot easily be used as natural experiments.[4] To fill this gap, we provide what is, to the best of our knowledge, the first experimental evidence on the impact of secondary education on the timing, the quantity and the quality of children, leveraging a randomized controlled trial and a very long longitudinal follow up.

The trial began in 2008, several years before free secondary education was enacted in Ghana, when the NGO IPA awarded four-year secondary school scholarships to 682 adolescents, randomly selected among a study sample of 2,064 rural youth who had gained admission to a public high school but did not immediately enroll because they were not able to pay the fee. In Duflo et al. (2021), we show that adolescents that received a scholarship were 27 percentage points more likely to attend and complete secondary school, compared to those who did not get a scholarship (with results similar for men and women), and received on average 1.25 more years of education.

Since 2013, i.e., right after (potential) graduation from secondary school, we have been regularly following up with the sample to collect data on their occupation, their earnings, and their family formation. In 2017 we began collecting data on the cognitive development of their children at specific milestone ages. We use locally-appropriate tests developed by the Harvard Laboratory for Developmental Studies, based on the best available evidence and practice on how to measure cognitive development in young children, and designed to be implemented by laypeople, as opposed to trained psychologists (unlike the standard psychometric assessments like the Bailey or MacArthur

[4] Barr and Gibbs (2022) exploit spatial variation in the rollout of the Head Start program in the United States and find positive inter-generational effects from pre-school education.

tests). In the tests, the child plays interactive games that target cognitive abilities that emerge in infancy and remain important through adolescence.

Our first key set of results is that, for females, receiving a scholarship impacted *when* they started having children and *whom* they had children with, as well as when and whom they married. At our first follow up in 2013, female scholarships recipients were 7 percentage points (15%) less likely to have had a pregnancy, and by 2019, when they were 28 years old on average, they had .152 fewer children but were just as likely to have at least one child. They were also still less likely to be married or cohabitating with a partner. Their current or most recent partner, typically the father of their children, was more educated–in particular, he was more likely to have tertiary education.

The second key result is that children of female recipients are more likely to survive. Of the children born to our sample individuals more than 3 years prior to our last survey round, 6.4% of them have died before the age of 3 in the control group, but this falls to 4.3% among children of female scholarship recipients (p-value=0.081).

The third set of results concerns child cognitive development. To avoid bias stemming from the fact that treated women started having children later in life, and thus their children tend to be younger, we collect data on children at specific age milestones: 18 months, three and half years, five years, and seven years. We don't find a significant difference in the cognitive scores of children at lower age ranges, but by five years of age, the aggregate score is 0.31 standard deviation higher, and by seven it is 0.39 standard deviation higher if their mother received a scholarship. Those are large impacts, found both for average test scores and for most of the cognitive domains tested.

The fourth set of results is that we find none of these intergenerational impacts for male education subsidies: young men who had received a scholarship do not have fewer children than those who did not, and their partners (and the mother of their children) are, if anything, less well educated. We find neither mortality impacts nor any impact on cognitive scores for children of male scholarship recipients.

Turning to potential channels for the effects of women's access to free education, in our previous work, we don't find large or significant impacts of receiving the scholarship on earnings in the 12 years that follow (Duflo et al. 2021). The main channel for the intergenerational impacts is thus unlikely to be the material well-being of these children. Indeed, we don't find any significant difference in their material living conditions (amount of food purchased, quality of the infrastructure in the house, etc.). We also don't find any difference in formal schooling inputs (time spent in school, age at which they started school) or even educational aspirations (which is very high across the board, since 81% of the mothers in our sample hope their child will go to University). What seems to be different are inputs that are not costly, but require perhaps more awareness, namely care investment and time spent interacting with children. Children of mothers who received the scholarship have received more preventive care, and mothers who received a scholarship reported more often playing with their children, doing simple mathematics with them, and singing them songs. This is consistent with the impact of early childhood stimulation programs, which show impacts on cognitive scores of programs training parents to spend time playing and interacting with their child (Gertler et al., 2014; Walker et al., 2011; Attanasio et al., 2022), although the impacts here are seen in middle rather than in early childhood.

Overall, these results strongly support the idea that providing free access to secondary education for girls would ensure that not only they, but also their children, would be more educated and live healthier lives. A cost benefit analysis suggests that, taking into consideration only the impact of child survival, investing in girls' scholarships would be a highly socially valuable investment for Ghana, with a cost effectiveness comparable in terms of order of magnitude to the most cost effective health intervention.

2. Setting and experiment

In 2008, Duflo et al. (2021) initiated a randomized controlled trial of SHS scholarships that sampled 2,064 students who were admitted to a senior high school (SHS), but had not enrolled because they could not afford to pay the fees. Of these students, 682 (half girls and half boys) were randomly selected to receive a scholarship for SHS. Below we provide a summary of the important features of the experiment, hereafter referred to as the Ghana Youth Study ("GYS").

2.1 Sampling and randomization

Secondary school admission in Ghana is conditioned on an exam taken at the end of Junior High school. Based on the exam results and their wishes, students who qualify are assigned to a school by a deferred acceptance algorithm.

The GYS study sampled students who had been offered a spot to start SHS in the Fall 2008 but had not yet enrolled in any SHS (usually due to financial constraints) by the end of the Fall quarter. The research team administered a baseline survey to the students themselves as well as to one of their guardians, most commonly the mother, that included questions on perceptions of education, guardian literacy, values and beliefs, as well as modules on members of the household, household living conditions, and assets. After the survey, each student received a basic mobile phone with a SIM card and was assigned a phone number. Then, a third of students were randomly assigned to the “treatment group” (offered a scholarship) and two thirds to the “comparison group” (no scholarship), after stratifying by district, senior high school, junior high school, gender and year of junior high school finishing exam.[5]

The scholarship covered full tuition and fees for a day student for four years. It was paid directly to the school and covered the entire school bill. Students who received the scholarship were only responsible for the cost of school materials, transportation to school, and school meals.

Students were on average 17 years old at the onset of the study, in 2008, and just over 30 at our last follow up in 2022. Students were from poor families in rural areas. At baseline, over 40% of the students lived in households with no male head and 48% of household heads had only primary education or less, compared to 24% and 35%, respectively, in Ghana as a whole. In the whole sample, students’ characteristics were balanced at baseline (Duflo et al, 2021).

From 2009-2012, the GYS study team called respondents once a year to update contact information and basic outcomes (education status, fertility, cohabitation). In 2013, there was a detailed in-person follow-up survey covering schooling, occupation, cognitive skills, labor market expectations, health and fertility, among other topics. The cognitive test was an oral test loosely based on the PISA testing instrument, measuring competencies both in reading and in mathematics, and the ability of the respondent to apply this knowledge to practical situations. In 2015, 2016, 2017, 2019, 2020, and 2022, 30-minute phone follow-up surveys were conducted to update contact information and outcomes such as tertiary education, fertility, cohabitation, and labor market activities.

[5] About 30% of the sample is composed of women who had been admitted in SHS for the Fall 2007 but had not enrolled yet by Fall 2008. This group was included to ensure gender balance in the final sample.

2.2 Impact of the scholarship on education, cognitive skills, and labor market outcomes

Duflo et al (2021) reports the impact of the scholarship offer on education, cognitive skills, and labor market outcomes of the generation of recipients. Winning a scholarship increased the SHS completion rate (the fraction of the entire group – including those that do not enroll – who graduate from SHS) from 38.9% to 64.7% among women (a 66% increase) and from 48.5% to 76.6% among men (a 58% increase). The effect of scholarships on SHS completion is large and statistically significant at the 1% level at all quartiles of the initial test score distribution. Overall, as of 2019 the scholarship had led to a 1.24 years increase in total years of education on average.

While this increase is mainly due to more years of secondary education, Duflo et al. (2021) also document significant impacts of the secondary school scholarship on access to tertiary education, but for women only. As of 2019, 12.6% of women in the comparison group had ever enrolled in tertiary education, and 7.8% had graduated. Treatment increased enrollment rates by 7.7 percentage points and graduation by 4 percentage points. By 2022, the treatment effect on tertiary completion had increased to 11.5 percentage points. While average tertiary enrollment in the control group was slightly higher among males in the comparison group, there was no impact of scholarships on them.

In 2013, scholarship winners scored 0.157 standard deviations higher on our cognitive tests, with gains found in both math and reading. These gains were experienced across the distribution of test scores, and among students who were admitted to the lower quality schools. They were higher for females (0.194) than for males (0.113), although the difference is not statistically significant. Duflo et al. (2021) also found that recipients were more likely to use the internet and to adopt preventative health technologies.

In contrast to the clear gains in educational achievements and cognitive skills, the labor market impacts were very mixed. By 2019, on average, no significant impacts on earnings were observed (although the earnings data is very imprecise). For female scholarship winners, there was a significantly higher likelihood of having a public sector job, though this concerns a very small share of the sample (10.4% of scholarship recipients vs. 6.3% of the control group).

2.3 Child cognitive development test instruments and caregiver surveys

By 2016 many of the GYS study participants had children of their own, making it possible to assess whether the secondary school subsidies affected the cognitive development of recipients' children.

A first task was to develop cognitive tests for a range of children's age. The existing batteries of tests to measure early childhood cognitive development were developed and piloted for advanced economies, and were therefore unlikely to be appropriate for Ghanaian children in mostly rural settings. These tests are also expensive, because they need to be administered in controlled conditions by a psychologist. An important contribution of our study is the development of a battery of cognitive tests that can be administered to children by trained field officers, but without a psychology degree, at the homes of the children in low-income contexts.

The psychology Laboratory of Development Studies at Harvard developed such tests, based on research in cognitive science conducted in multiple cultures and with children at diverse economic levels. The tests also are based on the work of Pratham, an education NGO that developed tests of school learning for poor children in India, that have now proved effective in multiple countries (Dillon et al., 2017). The tests consist of interactive games targeting cognitive abilities, such as language, attention, working memory, executive function, numerical and spatial reasoning, and social cognitive skills including reasoning about mental states of belief, perception and emotion. The tests are meant to be engaging. They use rules that are easy for children to understand and easy for surveyors to administer (by laptop computer for children over age 5, and with simple materials for the younger children such as pictures, small objects, and cups). We also administer a detailed caregiver survey to illuminate the channels through which parent education affects early childhood development. The caregiver survey covers respondent demographics, respondent education, respondent health, indicators of household socio-economic status, caregiver beliefs, child health, child health care, child education, cognitive stimulation of the child by household members, child time use, and infant language development.[6]

In June 2017, we began testing children of GYS study participants and surveying their primary caregivers when they entered the following age windows: 14-22 months old (we refer to these as the "18 month" group), 39-45 months old ("Three") and 60-69 months old ("Five"). To be eligible, the

[6] We only asked for caregiver reports on a child's language development if they were 14-22 months old since our language development tests were unsuitable for children of this age.

child had to be a biological child of an initial GYS participant. The caregiver of every eligible child entering the appropriate age window was contacted to arrange an interview and a test. The primary caregiver was defined as the person responsible for making the day-to-day decisions about the child's life.

In May 2019, we began administering a test for 84-96 month olds ("Seven").[7] Starting in January 2018, we permitted the field team to survey children slightly above the maximum age for an age window if, due to time constraints among the field team, the child had not yet been surveyed for that age window.[8] We had to pause fieldwork from March-October 2020 due to the Covid-19 pandemic.

2.4. Intergenerational Impacts: Study Sample

Our sampling frame for studying the intergenerational impacts of the scholarships on cognitive development consists of the initial GYS participants (i.e. students who were included as either treatment or comparison in the original study) with at least one child eligible for the child cognitive development games/tests.

In the most recent follow-up with initial study participants (conducted in Spring 2022), 76.5% of women and 49.8% of men reported having had at least one child (Table A1). At the time of writing, we have measured cognitive development for at least one eligible child for 61.8% of initial female GYS participants (80.7% of those who had a child) and 38.1% of initial male GYS participants (76.6% of those who had a child). Some of the children were already past seven years by the time we started measurements, some have not yet reached 14 months, and some sadly passed away, so the share with a child *ever eligible* for our measurement is somewhat lower than the share who ever had a child, at 67.0% for women and 44.6% for men. Respondents with children who were too old for the child games when measurement began account for the largest share of never-eligible parents with 7.1% of female GYS participants and 2.6% of males falling into this category. Given that the 7-year old games launched in May 2019, these respondents must have had children prior to May 2012 (when they were 21 years old on average) but not between May 2012 and Spring 2022 (when they

[7] We added a 30-36 month old test ("Two") in July 2021. We do not include these tests in our analysis because we do not yet have a large enough sample size.
[8] Starting in January 2018, the surveyors were permitted to survey children up to 25 months old using the 14-22 month old instrument, children up to 55 months old using the 39-45 month old instrument and children up to 83 month olds using the 60-69 month old instrument. The surveyors were permitted to survey children up to 99 month olds using the 84-96 month old instrument and up to 39 month olds using the 30-36 month old instrument.

were 31 years old on average). Other reasons for unsurveyed children include inability to reach the respondent and/or the child's primary caregiver (5.7% of female GYS participants; 6.7% of male participants) and the respondent or child's primary caregiver refusing to consent to the survey (1.4% of females; 1.2% of males). In total, we have administered 3,295 tests to 1,738 unique children to date.

For the effects on child mortality, our sample includes all GYS participants who ever reported having had a pregnancy/pregnant partners. Table A2 shows that among this subsample, pre-treatment characteristics (as measured in the 2008 baseline survey) are balanced across treatment (scholarship recipients) and control groups. To estimate survival to age 1 (or 3), we limit the sample to children who had reached age 1 (or 3) by the time their parent was last surveyed.

3. Statistical methods

The analysis is straightforward and follows a pre-analysis plan filed on the AEA registry for social experiments.[9] To evaluate the impact of the scholarship, we run intent-to-treat regressions at the individual recipient (indexed by *i*) or at the child level (indexed by *j*). At the child level, the regression we run is

$$Y_{ij} = \alpha_i + \beta_1 T_j + \beta_0 X_{ij} + \varepsilon_{ij} \qquad (1)$$

Where Y_{ij} is the outcome for child i of initial study participant j, T_j is an indicator that the initial study participant (the child's parent) was randomly sampled for a scholarship, and X_{ij} is a set of control variables including survey round fixed effects, enumerator fixed effects, scholarship-eligible parent's baseline region fixed effects, scholarship-eligible parent's Junior High School finishing exam

[9] The GYS study started before the AEA RCT registry existed; it was registered immediately upon the creation of the registry in 2013. At the time, we hadn't anticipated being able to follow-up with the children of the initial study participants. We registered a pre-analysis plan for the intergenerational impact study in February 2022 https://www.socialscienceregistry.org/trials/15.

score, child's birth order, and child's age at the time the outcome was measured. We cluster the standard errors at the GYS study participant level.[10] Since the scholarships were randomized within gender, we study effects separately by gender of the parent in the scholarship study sample.

One threat to the validity of our estimates is differential sampling bias across the treatment and control groups. Given limited funding (and limited patience from our respondents for surveys after over a decade), we could not survey every child born to the respondents over the course of their life in each age window. Our chosen age windows and survey periods reflect our attempts to survey any child of a respondent born between May 2012 and August 2021. On average, the respondents were 21 years old in May 2012 and 30 years old in August 2021. Fewer children of treated females were excluded from the tracking compared to the control females for being too old (17.6% to 20.2%). We would expect that the unsurveyed children born to mothers between the ages of 17-21 years old would have lower cognitive scores relative to the surveyed children born to mothers aged 21-31 years because of the empirical association between delaying fertility and improved early childhood outcomes (Finlay et al., 2011), meaning that our estimates for females would likely be downwardly biased. For other sources of sampling bias, such as refusing or unreachable respondents or caregivers, there are no significant differences between the treatment and control group for either gender. Of course, given the fertility impacts, our sample has relatively more first-born children in the treatment group than the comparison group (see Table A4). For this reason, we include controls for birth order in all specifications.

4. Results

In this section, we start by presenting the impact of the scholarship on family formation and fertility choices. We then show the impact on child survival for all children born to GYS study participants and the impact on child cognitive development for those with children who completed our cognitive development measures. We show that female scholarship recipients (who were on average 27 percentage points more likely to complete secondary school than the control group) delay fertility and marriage relative to the control group. When these women have children, their children have

[10] From the perspective of the surveyed children, this is equivalent to clustering at the biological mother-level for the female respondent results and at the biological father-level for the male respondent results.

lower child mortality and, by age 5 and 7, have significantly higher cognitive scores than children of non-recipients–but we see no such effects for children of male scholarship recipients. Finally, we present evidence on possible channels explaining these striking results, including parent/caregiver characteristics and their investments in the child.

4.1 Fertility and family formation

Table 1 presents results on the impacts of the scholarship on fertility and marriage, and shows consistent patterns over a wide range of outcomes for women.

Scholarships greatly delay childbearing onset and reduce unwanted pregnancies for women. By 2013, women in the scholarship arm were 6.9 percentage points less likely to have ever been pregnant (on a base of 48.3% in the control group). Because the great majority of first pregnancies are reported to be unwanted, the fertility decline is almost exclusively a decline in unplanned, out-of-wedlock pregnancies (column 2). As shown in Figure A1, the delay in childbearing onset is sustained over many years. By 2019, female scholarship recipients are still 7 percentage points less likely to have started childbearing than non-recipients; they had fewer children (-0.152 fewer children, p value 0.065) (column 3).

These results are consistent with those of an earlier randomized experiment that reduced the cost of access to upper primary school in Kenya and found that the onset of childbearing was also delayed, with no-catch up in the three years following school exit (Duflo et al., 2015). They are also consistent with estimates based on natural experiments, such as the discontinuity created by admissions cutoff for secondary school in Kenya (Ozier, 2016) or the introduction of free primary school in Uganda (Keats, 2018).

The finding that the gap in childbearing between treatment and comparison groups persists once the majority of scholarship winners are out of school suggests that the mechanism is not an “incarceration effect”, preventing fertility for a few years while in school (Black, Devereux and Salvanes, 2008). We have collected data that sheds light on the importance to our respondents of the mechanisms most discussed in the literature, namely (1) increase in the opportunity cost of bearing and raising children (Becker, 1991) (2) the decrease in the cost of investing in each child’s quality (education and health), which in turns affects the demand for the quantity children (Becker, 1991) (3) the ability to control fertility due to better decoding of information (Rosenzweig and Schultz,

1989) (4) changes in the type or preferences of the partner, and in the bargaining power of each partner.

In Duflo et al (2021), we find that, consistent with channels (1) and (3), female scholarship winners are more likely to have regular salaried employment than female non-winners, which presumably increases the opportunity cost of a child. Duflo et al. (2021) also document large increases in learning and cognitive scores for both men and women.

Here we document patterns consistent with channel (4). First, fertility changes coincide with changes in cohabiting behavior. By 2016 (age 25 on average), treatment women were 12.1 percentage points (24% of the control mean) less likely to report having ever lived with a partner (Table 1, column 4). As of 2019, they are 6.2 percentage points (p-value 0.067) less likely to be married or cohabiting (compared to a base of 47.5% in the control group). Conditional on having a partner, they are more likely to have a partner with some post-secondary education.

In contrast, we see few changes in fertility and marriage behavior for men, although it is worth noting that men marry/cohabit later and that parenthood is likely measured with much more error for them: since many pregnancies are out of wedlock and not all of them lead to shotgun marriages, it is possible that male respondents under-report births they may have been responsible for. One clear impact on male scholarship winners is that they are more likely to still be living with their parents (+ 7.8 percentage points, or 30% of the control mean, in 2019), which is not true for women.

In the rest of the paper, we show evidence that is consistent with either channel (2) (education lowers the costs of investing in children quality) or with a direct impact of the timing of children on their quality: children of scholarship recipients are healthier, and they have higher cognitive achievement.

4.2 Child mortality

In Table 2, we present the results on child mortality. The unit of observation in this table is the child. Data was obtained through phone and in-person surveys conducted almost yearly between 2009 and 2022 and is available for *all* children of initial GYS study participants (not only those eligible for our cognitive development measurements). We include controls for the child's age,[11] the child's gender and birth order, as well as for their GYS-scholarship-eligible parent's baseline region and Junior High School (JHS) finishing exam score. Since randomization is at the scholarship-eligible parent's level, we cluster standard errors at the scholarship-eligible parent's level. In column 1-3, we rely on the GYS participant's reports from surveys in 2017 and 2019 which reached 97.5% of the GYS sample. In columns 4-6, we use all the survey data gathered from GYS participants and primary caregivers between 2009-2022 to determine whether a child is alive.

The children of female scholarship recipients are about 2 percentage points more likely to be alive according to the 2017 and 2019 surveys (column 1). This represents a 40% decrease in child mortality. There is no impact on the children of male recipients (coefficient, -0.001, SE is 0.018). The results using all surveys from 2009-2022 are similar, with children of female scholarship recipients 2.1 pps (p-value=.03) more likely to be alive and a positive but noisy effect on male scholarship recipients (column 4).

In columns 2 and 4 (3 and 5), we limit the sample to children born at least one year (three years) prior to the 2019 (2022) survey, so that we can compare survival to specific milestone ages. This allows us to cleanly compare outcomes between treatment and control groups despite the fact that children in the treatment group were born later on average. The results are noisier since we have fewer observations by construction, but they confirm the mortality impact, with the survival-to-age-3 probability increasing by 2.3 percentage points for children of female scholarship recipients, and no change for children of male scholarship recipients.

Because we collected data over the phone, it was not possible to collect information about the cause of death. (Verbal autopsies with grieving parents require highly trained enumerators and are typically conducted in-person). The major causes of child mortality in the study context are neonatal deaths, malaria and water-borne diseases.

[11] We include child age fixed effects for the child mortality results to account for the fact that the control group has older children on average.

4.3 Child cognitive development

In Table 3, we present results on child cognitive development; once again, the unit of observation is the child. In addition to the controls in Table 2, we include enumerator fixed effects and survey round fixed effects in Table 3 to account for any changes in adherence to survey protocol between enumerators and/or survey rounds.[12] We estimate each child's cognitive development in the age windows using item response theory (IRT). For each measure, we estimate a one-parameter logistic model on the relevant cognitive games questions.[13] The model assigns a difficulty-level to each question and then a latent trait to each individual which measures their ability to respond correctly to the questions. We use the standardized latent trait assigned to a child as a measure of the child's cognitive ability (we will call this their IRT score). Consistent with the pre-analysis plan, non-responses by the child are dropped from our analysis since these were often caused by distractions arising in the field (eg. other children distracting the child) or equipment failures. In Table C1, we show that our results are robust to scoring these questions as incorrect responses for all children.

For female scholarship recipients, the estimated effects are insignificant and slightly negative for 18 month olds (-.034 standard deviations; p-value =.736) and three year olds (.044 standard deviations; p-value=.615). In contrast, the five and seven year olds of females score substantially higher on the cognitive development tests, .31 and .39 standard deviations (SDs) respectively (p-values<.01). These effects fall just above the 80th and 90th percentile of effect sizes for the 96 RCTs on educational interventions measuring impacts on learning in low-and-middle-income countries considered by Evans and Yuan (2022) in a recent meta-analysis. In terms of early childhood education interventions, these effects are similar to the most effective rigorously evaluated interventions, such as hiring an additional teacher focused on preschool instruction (.29 and .46 standard deviation increases in math and language scores) (Ganimian et al., 2021), offering scholarships to high-quality kindergartens (.40 SDs), and improving preschool curricula (.11-.26 SDs) (Duflo et al., 2017; Gallego et al., 2019; Oreopoulos et al., 2018). Breaking the results for female respondents down by

[12] After each survey round, a member of the Laboratory of Development Studies would meet with the enumerators and review videotapes of selected field sessions and field reports and discuss ways to improve survey quality.
[13] Specifically, we estimate the model on a set of binary variables indicating whether the child was correct or incorrect on a given trial.

cognitive domain (Tables C2-C5), we find that the strongest effects are on language skills (.20 SDs for five year olds; .38 SDs for seven year olds), math & numeracy (.24 SDs; .39 SDs),spatial reasoning (.24 SDs; .39 SDs), and executive function (.26 SDs; .27 SDs) while the evidence for effects on socio-cognitive development is weaker.

It is noteworthy that a treatment effect emerges only once children reach age 5, increases from age 5 to 7, and focuses primarily on cognitive skills that underlie, and are enhanced by, learning to read and calculate in school. These findings suggest that having a more educated mother leads to gains in children's readiness for learning in school. Another, more mechanical, interpretation is that all the cognitive tests are more robust at older ages, and that tests of language and math are more robust than tests of socio-emotional development and executive functions. We tested construct validity by measuring overall correlations between game scores within the same domain cross-sectionally and longitudinally, and indeed the five and seven year old games appear to be significantly more reliable measures of the targeted cognitive abilities than the 18 mo and three year old games.[14] It is thus possible that the null effects on 18 mo and three year olds, and the uncertain effects of mother's education on children's socio-emotional or executive function skills, are driven by our inability to accurately capture these cognitive development for these age groups and measures.

Turning to male respondents, we find no measurable effects on cognitive development of their children at any age. Estimates are close to zero for 18 month olds (.064 SDs; p-value =.631), three year olds (-.052 SDs, p-value=.655) and seven year olds (.137 standard deviations; p-value =.551). For five year olds, our estimate is negative but noisy (-.207 standard deviations; p-value=.131). The difference in effect sizes for male respondents compared to female respondents is significant for five year olds (p-value=.002) but not for seven year olds (p-value=.483).

These results suggest that investing in universal female secondary school education improves the cognitive abilities of the next generation, especially those that are most directly tied to learning in school, while additional investments in males' education alone does not appear to have the same magnitude of effects.

[14] If the tests are measuring a cognitive domain accurately, performance on one of the tests should predict performance on a subsequent test in the same domain. We find that, for children who took both sets of tests, the five year old game scores are highly correlated with seven year old game scores (.70), while 18 month old game scores have little correlation with three year old game scores (.03).

4.3 Channels

4.3.1 Parental education

Table A3 shows the scholarship treatment effect on the subsample of initial study participants whose children could be measured and hence form the sample for the results on cognitive development.[15] The results are nearly identical to those reported by Duflo et al. (2021) for the full sample, confirming large differences in parental education.

Female scholarship winners are also significantly more likely to have partners with tertiary education (+7.1pp on a basis of 19.5%. Col 7 of Table 1). However the opposite holds for men: while only 7.2% have a partner who has tertiary education in the control group, this reduces further by a significant 5.1 pps in the treatment group.

4.3.2 Channels of impact of parental education

Maternal education could affect child survival and cognitive development through more investments in health and/or education, more and higher quality adult-child interactions, and/or by improving the child's home and neighborhood environment.

We gathered data on these channels through the survey with the child's primary caregiver. In 84% of the cases, the primary caregiver is the child's mother (see Table 4). If not, the primary caregiver is typically the father (7%) or the grandmother (7%) (Table A4). Starting with the children of female scholarship recipients, we see that the child's primary caregiver had about 1 year more of education than the control group (Table 4; Column 2). In contrast, for children of male scholarship recipients, the primary caregiver of the child has fewer years of education than for the children of male non-scholarship recipients. This result is driven by treatment males choosing less-educated partners (Table 1) (recall that the mother of the child is typically the primary caregiver: 75% of primary caregivers are mothers while 17% are fathers for children of male scholarship recipients).

Remarkably, education is the only caregiver characteristic that is significantly different between treatment and control groups for female scholarship recipients. In particular, we see no significant

[15] The results are identical if we include those who had a child who could not be surveyed.

difference in SES status, caregiver's aspirations, or caregiver's beliefs (the treatment effects for each component of the indices are shown in Appendix B–see Tables B1-9).

Table 5 turns to caregiver *behavior*, and a number of meaningful differences emerge. Turning first to health investments, we find that female scholarship recipients are significantly more likely to receive prenatal care during pregnancy (col 1). While we do not have vaccination status for children who passed away, which means that our estimates of the treatment effects on vaccination are likely downward biased, we find that surviving children of female scholarship recipients are 6.0 percentage points (12%) more likely to have received complete vaccination (p-value 0.04), as observed by enumerators when caregivers were asked to show vaccination records (col 2). We see no difference in other preventive health behaviors for surviving children (col 3) such as usage of anti-malarial bednets or water treatment – bednet usage is widespread (over 63%) while water treatment is rare (less than 5%).[16] However, we observe an increase in caregiver-reported child health (Table A5). Finally, for the subset for which anthropometric outcomes could be measured (see breakdown in Table B6), we find that stunting and wasting are not differential across treatment and comparison groups–if anything, they are worse for children of female scholarship recipients), which may be due to the fact that the frailest children in the comparison group were more likely to pass away prematurely.

Turning to channels for cognitive development, Table 5 shows that, among children of female scholarship recipients, the caregiver is more likely to interact with the child in stimulating ways (col 4). This is despite the fact that caregivers do not have different *beliefs* about the pace of child development – namely, how soon one should converse to a child in full sentence, a behavior that has been shown to improve child cognitive development (Monnot, 1999; Weisleder and Fernald, 2013), including in the Ghanaian context (Dupas et al., 2022). We also do not see any differences in educational investments.

Consistent with the fact that the caregiver of children of male scholarship recipients have *less* education, we see no positive impact on caregiver behavior for children of male GYS respondents–all the coefficients in Table 5 are insignificant and the sign is more often than not negative.

[16] The other preventive health behaviors in the index are shown in Table B4. The most common source of drinking water for the children in our sample is sachet/bottled water (main source for 53.6% of children).

5. Cost Effectiveness

Intergenerational impacts rarely factor into policy debates around subsidizing secondary school in developing countries. Our findings of substantial inter-generational impacts for female students suggests that ignoring this dimension could lead to underinvestment in secondary education. In Table 6, we calculate the cost per death averted, cost per life year gained, and benefit-cost ratio of secondary school scholarships when one only considers the benefits from the reduction in child mortality. We exclude the benefits to the scholarship recipients since the focus of this paper is intergenerational impacts. We also exclude the positive effects on cognitive development scores since translating from standard deviation increases on our cognitive game measures to traditional policy outcomes would require additional assumptions.[17]

We estimate a cost per scholarship recipient of approximately \$370 by multiplying the yearly tuition (\$120) by the average *total* years of SHS attended by a scholarship recipient (thus, the cost of subsidizing inframarginal students who would have gone to school anyways is taken into account). Combining this estimate with the child mortality reductions (Table 2) gives us a cost per death averted of \$30,698 of subsidizing all students. Assuming that each death averted leads to 35 additional life years (Lopez et al, 2006), we get a cost per life year gained of \$877. To account for the uncertainty around the value of a statistical life year (VSLY), we present benefit-cost ratios using three different estimates: the WHO recommendation of 3 times GDP per capita, a stated-preferences willingness-to-pay (WTP) estimate of 6.5 from an experiment in Burkina Faso[18] (Trautmann et al., 2021), and the stated-preference willingness-to-accept (WTA) estimate of 33.5 from the same experiment. We calculate a benefit-cost ratio of 24, 52, or 267 depending on our VSLY assumption. Even with the most conservative VSLY, the benefit-cost ratio would still classify the intervention as highly cost-effective according to the WHO's standards (WHO, 2002; Trautmann et al., 2022).

In rows 4-6 of Table 6, we estimate the cost per death averted, cost per life year gained, and benefit-cost ratio if secondary school subsidies targeted females exclusively. In this case, the cost per

[17] Refer to the results section for a comparison of our child cognitive development effect sizes to other early childhood educational interventions.
[18] Burkina Faso is a neighboring country to Ghana in West Africa. The GDP pc of Ghana is about twice that of Burkina Faso.

death averted ($13,490) and cost per life year gained ($385) are about halved and the benefit-cost ratio roughly doubles (55 with VSLY=3; 118 with VSLY=6.5; 608 with VSLY=33.5). To put this in perspective, the cost per death averted for the most cost-effective health interventions are $3,500 for Vitamin A supplementation in children, $5,000 for seasonal malaria chemoprevention in children, $5,000 for cash incentives for routine child vaccines, and $5,500 for antimalarial bednets.[19]

6. Conclusion

In this paper, we find strong evidence that secondary school education for females has strong positive impacts on the next generation. Given the size of the cognitive development and child mortality gains, this externality should be considered when governments or international donors consider whether to fund the expansion of free secondary school education, particularly in environments where women are disproportionately likely to drop out absent this policy. Our results indicate the primary mechanism through which women benefit the next generation is by raising the quality and investment of the primary caregiver of the child. Access to secondary education seems to cause these caregivers to gain the skills to stimulate their children's cognitive development and safeguard their children's health. One interesting question is whether these parenting aptitudes were improved directly by secondary school instruction, were affected indirectly through secondary schools causing students to "learn how to learn" or improvement of students' cognitive abilities, or were learnt from secondary school peers who were higher SES than the marginal students in our study.

On the other hand, we find no evidence of positive impacts on the children of male scholarship recipients. Duflo et al (2021) models the labor market outcomes for the scholarship recipients and demonstrates how gender bias might mean that the marginal male induced to attend secondary school by the scholarship would have lower returns to secondary school than the marginal female. Our work supports this interpretation by indicating that the non-labor market returns for the marginal male were also lower than for the marginal female.

[19] Cost-effectiveness calculations by GiveWell: https://www.givewell.org/charities/top-charities

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Table 1: Direct Impact of Scholarship on Fertility and Marriage

	(1) Ever pregnant/ had a pregnant partner (2013)	(2) Had unwanted first pregnancy (full sample) (2013)	(3) Number of children ever had (2019)	(4) Ever lived with partner (2016)	(5) Currently married or cohabitating (2019)	(6) Still living with parents (2019)	(7) Most recent partner completed tertiary education (2019)
Panel A: Female GYS participants							
Treatment	-0.069**	-0.067**	-0.152*	-0.121***	-0.062*	0.003	0.071*
	(0.033)	(0.032)	(0.082)	(0.033)	(0.034)	(0.033)	(0.039)
P-value	0.039	0.038	0.065	0.000	0.067	0.933	0.071
Comparison mean	0.483	0.390	1.332	0.498	0.475	0.355	0.195
N	1009	985	986	1007	986	986	575
Panel B: Male GYS participants							
Treatment	-0.018	-0.012	-0.026	-0.058**	-0.047	0.078**	-0.051**
	(0.020)	(0.017)	(0.060)	(0.026)	(0.030)	(0.031)	(0.022)
P-value	0.368	0.475	0.671	0.027	0.117	0.011	0.021
Comparison mean	0.112	0.075	0.568	0.229	0.291	0.242	0.072
N	982	980	965	988	965	966	371
P-val male=fem	0.210	0.136	0.246	0.138	0.703	0.097	0.008

*** p<0.01, ** p<0.05, * p<0.1

An observation is someone enrolled in the 2008 lottery for secondary school scholarships (GYS study). Panel A shows results for female GYS participants; Panel B shows results for male GYS participants. “Treatment" means having won the scholarship lottery for Senior High School (SHS). Data Sources: surveys conducted in 2013, 2016, 2019 and 2022. Year of survey in parentheses. “Last pregnancy prenatal care index" is an index over dummies for reporting having gotten prenatal care at last pregnancy in survey rounds 2017, 2019 and 2022. The last row shows the p-values for tests that the effects are identical between males and females. The estimated treatment effects are in each panel’s first row; standard errors are in each panel’s second row in parentheses clustered at scholarship-eligible respondent-level; p-values from the test that a respective treatment effect is non-zero are reported in the third row; control group means are in each panel’s fourth row; sample size for the estimation is in each panel’s fifth row. Controls include JHS finishing exam score and baseline region fixed effects.

Table 2: Inter-generational Impact of Scholarship on Child Mortality

	2019			2022			
	(1) Child Alive	(2) Survived to one year	(3) Survived to three years	(4) Child Alive	(5) Survived to one year	(6) Survived to three years	(7) Mother's age at birth
Panel A: Children of Female GYS participant							
Treatment	0.020*	0.019	0.023*	0.021**	0.012	0.021*	0.229
	(0.011)	(0.012)	(0.013)	(0.009)	(0.009)	(0.012)	(0.208)
P-value	0.073	0.104	0.080	0.029	0.174	0.081	0.271
Comparison mean	0.950	0.958	0.949	0.952	0.963	0.946	22.937
N	1295	1183	1069	1794	1660	1380	1330
Panel B: Children of Male GYS participant							
Treatment	0.000	0.002	-0.003	0.015	0.014	0.024	-0.771*
	(0.021)	(0.022)	(0.024)	(0.012)	(0.011)	(0.016)	(0.411)
P-value	0.998	0.928	0.913	0.212	0.203	0.142	0.062
Comparison mean	0.962	0.962	0.957	0.954	0.971	0.954	21.912
N	552	472	407	961	882	665	893
P-val male=fem	0.298	0.364	0.300	0.988	0.810	0.786	0.038

*** p<0.01, ** p<0.05, * p<0.1

An observation is a child of a participant in the lottery for secondary school scholarships (GYS study). Col 1 include all children born as of the 2019 survey. Col 2 (respectively, col 3) include all children who had reached 12 (respectively, 36) months as of the 2019 survey. Col 4 include all children born as of the 2022 survey. Col 5 (respectively, col 6) include all children who had reached 12 (respectively, 36) months as of the 2022 survey. Col 7 include all children born as of the 2022 survey for which both child's and mother's date of birth are known. Panel A shows results for children of female GYS participants; Panel B shows results for children of male GYS participants. "Treatment" means the child's GYS-parent won the scholarship lottery for Senior High School (SHS). The estimated treatment effects are in the first row; standard errors clustered at the GYS participant level are in the second row in parentheses; the third cell row reports p-values of tests of hypotheses of equality of treatment effects; comparison group means are in the fourth cell row; the fifth cell row reports no. of observations. Regression controls include birth order, child age fixed effects, GYS participant baseline region fixed effects and the JHS finishing exam score of the GYS participant. Standard errors are clustered at the GYS participant-level.

Table 3: Inter-generational Impact of Scholarship on Children's Cognitive Development: Total scores, by testing window - unattempted questions are missing

	(1)	(2)	(3)	(4)
	18 months	Three	Five	Seven
Panel A: Children of Female GYS participant				
Treatment	-0.034	0.044	0.306***	0.394***
	(0.099)	(0.088)	(0.093)	(0.136)
P-value	0.736	0.615	0.001	0.004
Comparison mean	-0.002	-0.003	0.013	0.092
N	477	522	574	279
Panel B: Children of Male GYS participant				
Treatment	0.064	-0.052	-0.207	0.137
	(0.132)	(0.116)	(0.136)	(0.229)
P-value	0.631	0.655	0.131	0.551
Comparison mean	0.003	0.007	-0.034	-0.195
N	280	270	244	128
P-val male=fem	0.482	0.574	0.002	0.483

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

An observation is a child of a participant in the lottery for secondary school scholarships (GYS study) at a given age window (there can be multiple observations per child if the child was surveyed at multiple age windows). Panel A shows results for children of female GYS participants; Panel B shows results for children of male GYS participants. The estimated treatment effects are in the first row; standard errors clustered at the GYS participant level are in the second row in parentheses; the third cell row reports p-values of tests of hypotheses of equality of treatment effects; comparison group means are in the fourth cell row; the fifth cell row reports no. of observations. All regressions control for child age in months at last completed survey of GYS participant, child gender, phase fixed effects, surveyor fixed effects, GYS participant baseline region fixed effects, and the JHS finishing exam score of the GYS participant. The latent abilities of the child is estimated using a one parameter logistic item response theory model. The results when we score unattempted questions as zeroes instead of missing are shown in Table C1.

Table 4: Mechanisms: Caregiver Characteristics, Aspirations and Beliefs

	(1) Caregiver is Mother	(2) Cg years of education	(3) Cg earns income	(4) SES index	(5) Cg depression index	(6) Aspiration: child's years of education	(7) Cg child development beliefs
Panel A: Children of Female GYS participant							
Treatment	-0.003	0.884***	0.019	0.095	-0.003	0.017	0.018
	(0.019)	(0.169)	(0.032)	(0.069)	(0.070)	(0.040)	(0.071)
P-value	0.858	0.000	0.553	0.172	0.961	0.673	0.800
Comparison mean	0.899	9.356	0.737	0.013	0.048	15.754	0.042
N	2242	2230	2239	2242	2239	2199	1473
Panel B: Children of Male GYS participant							
Treatment	0.045	-0.243	-0.052	-0.016	-0.140	0.133*	-0.005
	(0.028)	(0.318)	(0.039)	(0.093)	(0.088)	(0.076)	(0.080)
P-value	0.104	0.445	0.179	0.863	0.112	0.083	0.947
Comparison mean	0.711	8.373	0.803	-0.024	-0.094	15.529	-0.074
N	1174	1169	1169	1174	1168	1150	852
P-val male=fem	0.058	0.001	0.169	0.244	0.272	0.192	0.721

*** p<0.01, ** p<0.05, * p<0.1

An observation is a child of a participant in the lottery for secondary school scholarships (GYS study) at a given age window (there can be multiple observations per child if the child was surveyed at multiple age windows). Panel A shows results for caregivers ("Cg") of children of female GYS participants; Panel B shows results for children of male GYS study participants. The estimated treatment effects are in the first row; standard errors clustered at the GYS participant level are in the second row in parentheses; the third cell row reports p-values of tests of hypotheses of equality of treatment effects; comparison group means are in the fourth cell row; the fifth cell row reports no. of observations. All regressions control for child age in months, child gender, child age group fixed effects, phase fixed effects, surveyor fixed effects, GYS participant baseline region fixed effects, and the junior high school finishing exam score of the GYS participant. All indices are Anderson indices (the higher the better the score). The details of the indices are shown in Appendix B. "Aspiration": shows the answer to the question "What is the highest level of education that you would like [child name] to complete?" Child Development Beliefs Index: A higher value means that the caregiver is more aware of the positive impact of parental stimulation on infant brain development. See breakdown in Table B3.

Table 5: Mechanisms: Caregiver Behavior

	(1) Last pregnancy prenatal care index	(2) Shows card and has all vaccines	(3) Other preventive health behaviors index	(4) Child stimulation index	(5) Child investment index	(6) Child Education Index
Panel A: Children of Female GYS participant						
Treatment	0.129**	0.060**	0.044	0.133**	-0.009	0.092
	(0.057)	(0.029)	(0.064)	(0.061)	(0.055)	(0.073)
P-value	0.023	0.040	0.490	0.030	0.865	0.208
Comparison mean	0.023	0.502	0.004	0.011	0.060	0.066
N	793	2055	2064	2062	2064	1428
Panel B: Children of Male GYS participant						
Treatment	0.049	-0.036	-0.026	-0.122	-0.073	0.057
	(0.093)	(0.041)	(0.080)	(0.098)	(0.078)	(0.107)
P-value	0.594	0.372	0.744	0.216	0.349	0.597
Comparison mean	-0.038	0.511	-0.008	-0.021	-0.117	-0.145
N	500	1040	1047	1047	1047	659
P-val male=fem	0.352	0.058	0.496	0.015	0.504	0.684

*** p<0.01, ** p<0.05, * p<0.1

For the 'Child education index', the sample is restricted to children over 36 months old. Refer to Appendix B for components of the 'Child stimulation index', 'Child investment index', 'Child education index', 'Other preventive health behaviors index', and 'Last pregnancy prenatal care index'. See Table 4 for other details on specifications and outcomes.

Table 6: Cost-benefit analysis of child mortality reduction

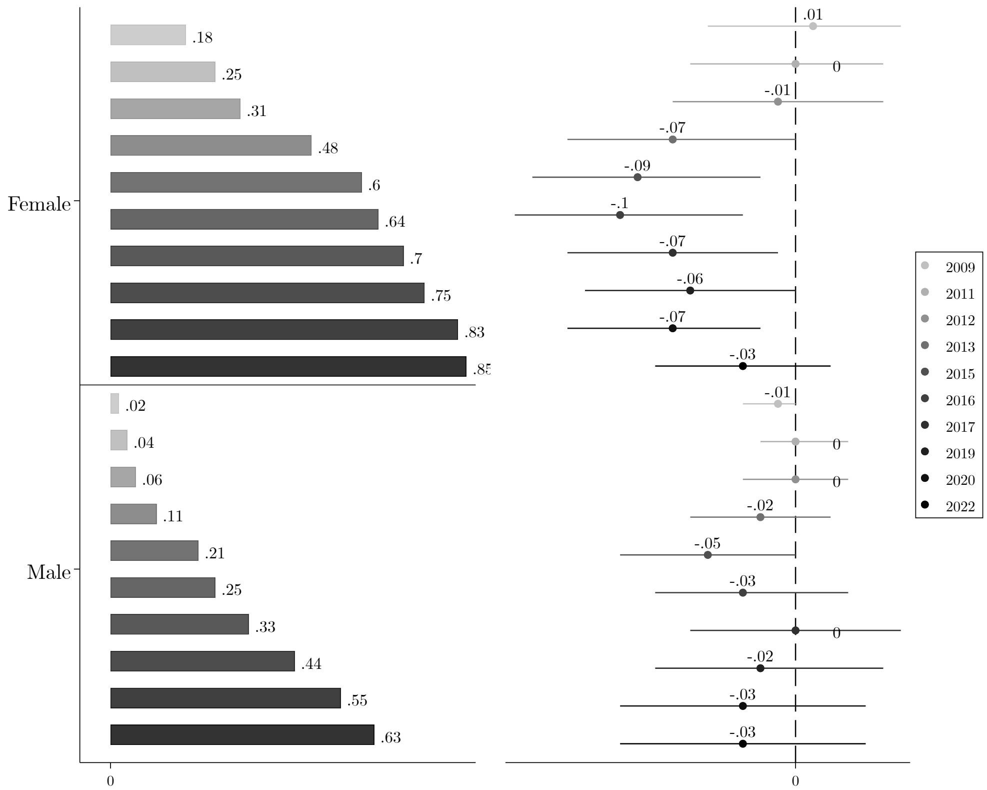
Assumptions	Cost per recipient	Mort. effect	$ per death averted	$ per LY	VSLY	B-C ratio
Female; VSLY-to-GDP pc=3	337.2	-0.021	13493.4	385.53	20958	54.36
Female; VSLY-to-GDP pc=6.5	337.2	-0.021	13493.4	385.53	45409.0	117.78
Female; VSLY-to-GDP pc=33.5	337.2	-0.021	13493.4	385.53	234031.0	607.04
All; VSLY-to-GDP pc=3	369.6	-0.014	30697.67	877.08	20958	23.9
All; VSLY-to-GDP pc=6.5	369.6	-0.014	30697.67	877.08	45409.0	51.77
All; VSLY-to-GDP pc=33.5	369.6	-0.014	30697.67	877.08	234031.0	266.83

VSLY stands for value of a statistical life year. In row 1 and 2, we use the WHO's standard for cost-effectiveness (three times GDP per capita). We use the World Bank's estimate of GDP per capita in Ghana in 2021 ($2445). In row 3 and 4, we use a stated-preference willingness-to-pay estimate of the VSLY per GDP per capita from an experiment in Burkina Faso (a neighboring country to Ghana) (Trautmann et al., 2021). In row 5 and 6, we use the stated-preference willingness-to-accept estimate from the same study. Cost per recipient is estimated as the average cost of paying for the years of secondary school of the parent who received the scholarship. The cost per school year of the program was $120 (Duflo et al., 2021). The mortality effect is the estimated treatment effect on survival until 3 years old[a] for children of the parents in the scholarship lottery shown in Table 2. '$ per death averted' is the mortality effect (the 'survival until 3 years' estimates from tab:mortality multiplied by the number of children per scholarship recipient (table:first) divided by the cost per recipient. With a discount rate of .03 and a age-weight parameter of .04, we estimate that each death averted translates to 35 additional life years following Lopez et al. (2006) to calculate '$ per LY' (life years) and the 'B-C ratio' (benefit-cost ratio) column. The benefit-cost ratio measures the ratio of benefits (converted into $) over the monetary costs. For example, the estimated B-C ratio in row 4 suggests that the benefit of a given scholarship is 62 times greater than the cost. For the benefit-cost ratio, we assume that the only benefits of the intervention come from reduced child mortality and value of an averted death is the number of life years gained (estimated as 35) multiplied by the VSLY which we estimate according to the indicated assumptions in the 'Assumptions' column. Rows 1-3 estimates the costs and benefits for a program available to females and males. Row 4-6 estimates the costs and benefits for a program available to females only. The differences in these rows are attributable to differing estimates of the number of school years (Table A3), number of children (Table 1), and child mortality effects (Table 2) for male and female GYS participants.

[a]We take the lower of our two estimates in Table 2

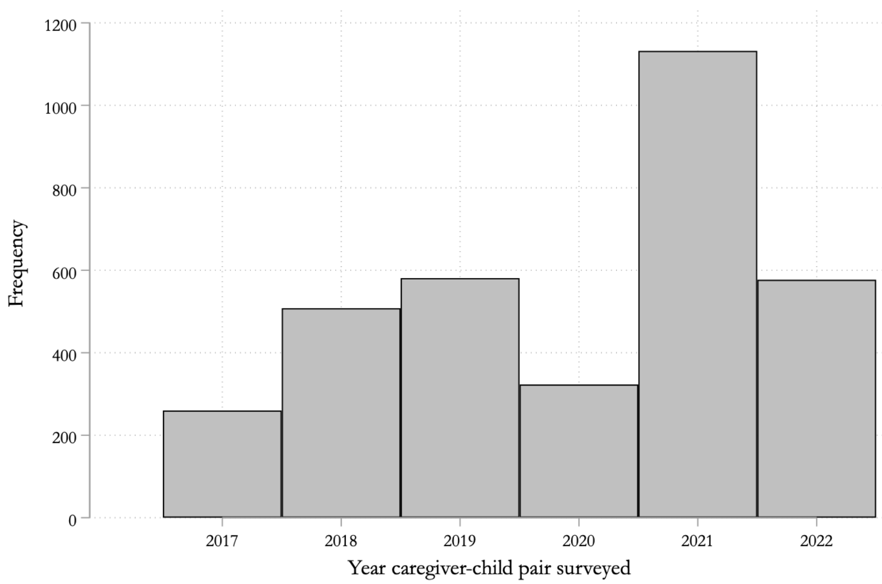
Appendix A: Appendix Figures and Tables

Figure A.1: Impact of Scholarship on Childbearing Onset: Ever Pregnant/Had a Pregnant Partner, by year



Notes: Data from 2013 in-person follow-up and yearly phone surveys. The outcome shown is "Ever pregnant" (for females) and "Ever had a Pregnant Partner" (for males). Left half of graph shows means in comparison group; right half shows estimated treatment effects and 95% confidence intervals.

Figure A.2: Distribution of caregiver-child in-person surveys by year



Caregiver-child in-person surveys refer to the surveys where the caregiver answered a series of questions and the child attempted the child cognitive games.

Table A1: Scholarship-eligible parent-level survey rates

	(1) F	(2) M	(3) T-F	(4) C-F	(5) T-M	(6) C-M
Ever had a child	0.765	0.498	0.749	0.774	0.497	0.499
	(0.424)	(0.500)	(0.435)	(0.419)	(0.501)	(0.500)
Any child ever elig. during tracking	0.675	0.448	0.665	0.679	0.434	0.456
	(0.469)	(0.498)	(0.473)	(0.467)	(0.496)	(0.498)
All children too old when tracking began	0.0705	0.0263	0.0599	0.0755	0.0259	0.0265
	(0.256)	(0.160)	(0.238)	(0.264)	(0.159)	(0.161)
Any child ever surveyed	0.618	0.381	0.611	0.621	0.376	0.384
	(0.486)	(0.486)	(0.488)	(0.485)	(0.485)	(0.487)
Refused surveying of children	0.0135	0.0117	0.0150	0.0128	0.00287	0.0162
	(0.116)	(0.107)	(0.122)	(0.113)	(0.0536)	(0.126)
Any child surveyed if had child	0.807	0.766	0.816	0.803	0.757	0.770
	(0.395)	(0.424)	(0.388)	(0.398)	(0.430)	(0.422)
Seven: Any child ever surveyed if had child	0.304	0.201	0.300	0.306	0.179	0.212
	(0.460)	(0.401)	(0.459)	(0.461)	(0.385)	(0.410)
Five: Any child ever surveyed if had child	0.571	0.420	0.548	0.582	0.393	0.434
	(0.495)	(0.494)	(0.499)	(0.494)	(0.490)	(0.496)
Three: Any child ever surveyed if had child	0.569	0.449	0.608	0.551	0.480	0.434
	(0.496)	(0.498)	(0.489)	(0.498)	(0.501)	(0.496)
18 mo: Any child ever surveyed if had child	0.532	0.492	0.540	0.529	0.491	0.493
	(0.499)	(0.500)	(0.499)	(0.500)	(0.501)	(0.501)
Observations	1036	1028	334	702	348	680

Observations are at the scholarship-eligible parent-level. “Any child ever elig. during tracking" means child ever eligible to be surveyed during tracking period from 2017-2022. “Any child ever surveyed" means that one of their children’s caregiver completed the caregiver survey and the child attempted to complete the cognitive games. Col. 1 is treatment group, Col. 3 is control, Col. 4 is female-treatment, Col. 5 is female-control, Col. 6 is male-treatment, Col. 7 is male-control. Means are in the first row; standard deviations below in parentheses.

Table A2: Baseline (2008) Characteristics and Balance: Scholarship-Eligible Students (subsample with at least one child born by 2022)

	(1) Age in 2008	(2) BECE exam performance	(3) No male head in the household	(4) Highest education of HH head: primary or less	(5) Highest education of HH head: SHS or more	(6) Perceived returns to SHS (%)
Panel A: Female GYS participants						
Treatment	-0.107	0.001	-0.033	0.016	0.015	3.601
	(0.130)	(0.007)	(0.043)	(0.042)	(0.031)	(44.366)
P-value	0.411	0.833	0.439	0.703	0.621	0.935
Comparison mean	17.545	0.618	0.468	0.534	0.141	263.669
N	628	584	624	624	624	533
Panel B: Male GYS participants						
Treatment	-0.145	0.005	0.115**	0.017	-0.078**	-25.354
	(0.189)	(0.008)	(0.054)	(0.055)	(0.037)	(64.761)
P-value	0.443	0.552	0.033	0.749	0.037	0.696
Comparison mean	17.736	0.618	0.397	0.522	0.187	304.169
N	384	361	382	380	380	342
P-val male=fem	0.866	0.753	0.034	0.966	0.047	0.807

*** p<0.01, ** p<0.05, * p<0.1

The unit of observation is a GYS participant. Sample limited to GYS participants who ever had a child. Data Source: Baseline survey conducted in 2008 with GYS participants and their guardians. Controls include JHS finishing exam score and region fixed effects. Refer to Table 1 for other notes.

Table A3: Direct Impact of Scholarship on Education Outcomes: GYS participants with at least one child surveyed

	(1) Total standardized score (2013)	(2) Total years of education to date (2019)	(3) Completed SHS (2019)	(4) Completed tertiary (2019)	(5) Most recent partner's years of education (2019)
Panel A: Female GYS participants					
Treatment	0.236**	1.483***	0.282***	0.050**	0.606**
	(0.091)	(0.191)	(0.041)	(0.021)	(0.280)
P-value	0.010	0.000	0.000	0.019	0.030
Comparison mean	-0.357	10.416	0.284	0.036	10.851
N	612	605	612	612	551
Panel B: Male GYS participants					
Treatment	0.041	1.377***	0.301***	0.035	-0.733**
	(0.100)	(0.204)	(0.052)	(0.028)	(0.322)
P-value	0.682	0.000	0.000	0.220	0.023
Comparison mean	0.019	11.048	0.371	0.052	9.792
N	370	379	381	381	329
P-val male=fem	0.150	0.715	0.766	0.596	0.001

*** p<0.01, ** p<0.05, * p<0.1

Observations are GYS participants who ever had a child. Refer to Table 1 Col 1-8 for notes.

Table A4: Household composition

	(1) Caregiver is Father	(2) Caregiver is Grandmother	(3) Lives with Mother	(4) Lives with Father	(5) Lives with both parents	(6) Number of siblings from GYS respondent	(7) Number of adults in household	(8) First-born child
Panel A: Children of Female GYS participant								
Treatment	0.000	0.010	-0.007	-0.018	-0.006	-0.098	0.131	0.065*
	(0.005)	(0.017)	(0.017)	(0.038)	(0.038)	(0.139)	(0.096)	(0.033)
P-value	0.989	0.561	0.670	0.644	0.878	0.479	0.175	0.052
Comparison mean	0.015	0.064	0.929	0.649	0.533	1.902	2.367	0.376
N	2308	2308	2286	2163	2313	2299	2209	2299
Panel B: Children of Male GYS participant								
Treatment	-0.026	-0.033*	0.032	-0.085*	-0.073*	0.269*	0.123	-0.017
	(0.018)	(0.018)	(0.022)	(0.044)	(0.044)	(0.152)	(0.112)	(0.043)
P-value	0.153	0.066	0.146	0.057	0.095	0.078	0.271	0.695
Comparison mean	0.183	0.079	0.880	0.709	0.531	1.380	2.366	0.552
N	1209	1209	1178	1164	1211	1203	1156	1203
P-val male=fem	0.091	0.074	0.106	0.227	0.214	0.172	0.901	0.202

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

An observation is a child of a participant in the lottery for secondary school scholarships. Panel A shows results for children of female Scholarship Study participants; Panel B shows results for children of male Scholarship Study participants. The estimated treatment effects are in the first row; standard errors clustered at the GYS participant level are in the second row in parentheses; the third cell row reports p-values of tests of hypotheses of equality of treatment effects; comparison group means are in the fourth cell row; the fifth cell row reports no. of observations. Regression controls include child gender, child age fixed effects, GYS participant baseline region fixed effects and the JHS finishing exam score of the GYS participant. Standard errors are clustered at the GYS participant-level.

Table A5: Mechanisms: Child Health and Location

	(1) Caregiver reported child health index	(2) Physical development index	(3) Child lives in urban area	(4) Under 3 yrs when began creche/daycare/nursery
Panel A: Children of Female GYS participant				
Treatment	0.084*	-0.000	-0.003	0.020
	(0.050)	(0.042)	(0.039)	(0.031)
P-value	0.094	0.994	0.947	0.531
Comparison mean	0.058	0.002	0.446	0.751
N	2211	2059	2122	1493
Panel B: Children of Male GYS participant				
Treatment	-0.012	-0.149**	-0.033	0.019
	(0.085)	(0.073)	(0.048)	(0.048)
P-value	0.884	0.043	0.501	0.687
Comparison mean	-0.114	-0.004	0.406	0.649
N	1157	1094	1113	711
P-val male=fem	0.309	0.101	0.626	0.953

*** p<0.01, ** p<0.05, * p<0.1

The details of the indices are shown in Table B5 and Table B6. Refer to Table 4 for other details on specifications and outcomes.

Appendix B: Indices Components

Table B1: SES: Index Components

	(1) Num. bedrooms per a.e.	(2) Food consumption per a.e.	(3) Metal sheet roof	(4) Mud walls (reversed in index)	(5) GYS resp. works for a wage	(6) Likelihood partner works for a wage
Panel A: Children of Female GYS participant						
Treatment	0.012	-3.940	0.010	-0.023	0.033	0.027
	(0.014)	(2.741)	(0.012)	(0.026)	(0.035)	(0.038)
P-value	0.396	0.151	0.392	0.387	0.350	0.476
Comparison mean	0.400	66.899	0.959	0.155	0.156	0.407
N	2201	2202	2238	2239	2201	1823
Panel B: Children of Male GYS participant						
Treatment	0.023	-5.293	0.004	-0.024	0.054	-0.098***
	(0.019)	(4.059)	(0.015)	(0.041)	(0.062)	(0.027)
P-value	0.230	0.193	0.802	0.549	0.380	0.000
Comparison mean	0.406	74.590	0.965	0.252	0.404	0.187
N	1145	1150	1168	1168	1168	939
P-val male=fem	0.684	0.735	0.628	0.930	0.947	0.006

*** p<0.01, ** p<0.05, * p<0.1

An observation is a child of a Scholarship Study (GYS) participant at a given age window (meaning there can be multiple observations per child). Panel A shows results for children of female Scholarship Study participants; Panel B shows results for children of male Scholarship Study participants. The estimated treatment effects are in the first row; standard errors clustered at the Scholarship Study participant level are in the second row in parentheses; the third cell row reports p-values of tests of hypotheses of equality of treatment effects; comparison group means are in the fourth cell row; the fifth cell row reports no. of observations. All regressions control for child age, child gender, child age group fixed effects, phase fixed effects, surveyor fixed effects, GYS participant baseline region fixed effects, and the junior high school finishing exam score of the GYS participant.In column names,“reversed" means this component was reverse-scored when we created the relevant index and a.e. stands for number of adult equivalents in the household. The variables ‘GYS resp. works for a wage’ and ‘Likelihood partner works for a wage’ are based on the 2019 follow-up survey of the GYS respondent. Since we only have the occupation for the partner of the GYS respondent, we estimate the likelihood of working for a wage based on the occupation of the partner.

Table B2: Caregiver Depression: Index Components

	(1) Felt bothered more in past week	(2) Trouble focusing in past week	(3) Felt sad in past week	(4) Things took more effort in past week	(5) Felt hopeful in past week	(6) Felt fearful in past week	(7) Restless sleep in past week
Panel A: Children of Female GYS participant							
Treatment	-0.042	-0.090	-0.061	0.017	-0.161*	-0.076	-0.080
	(0.080)	(0.078)	(0.093)	(0.087)	(0.089)	(0.060)	(0.076)
P-value	0.601	0.247	0.512	0.845	0.072	0.205	0.289
Comparison mean	4.217	4.369	3.983	3.998	2.204	4.589	4.294
N	2239	2239	2239	2239	2238	2239	2239
Panel B: Children of Male GYS participant							
Treatment	0.011	-0.135	-0.102	-0.045	0.206	-0.044	-0.095
	(0.099)	(0.104)	(0.108)	(0.112)	(0.125)	(0.084)	(0.101)
P-value	0.911	0.195	0.346	0.686	0.102	0.603	0.344
Comparison mean	4.154	4.195	3.892	3.811	2.193	4.428	4.252
N	1168	1167	1168	1168	1168	1168	1168
P-val male=fem	0.755	0.894	0.853	0.707	0.024	0.800	0.991

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1.

Table B3: Caregiver Child Development Beliefs: Index Components

	(1) Believes parents should sing songs to child before turns 6 mos	(2) Believes parents should read stories to child before turns 1	(3) Believes should talk to child in full sentences before turns 1
Panel A: Children of Female GYS participant			
Treatment	0.026	0.015	-0.028
	(0.033)	(0.026)	(0.026)
P-value	0.434	0.554	0.283
Comparison mean	0.614	0.175	0.264
N	1471	1469	1468
Panel B: Children of Male GYS participant			
Treatment	0.004	-0.002	-0.008
	(0.041)	(0.029)	(0.030)
P-value	0.918	0.944	0.793
Comparison mean	0.593	0.148	0.210
N	852	845	852
P-val male=fem	0.746	0.579	0.871

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1.

Table B4: Other Preventive Health Behaviors: Index Components

	(1)	(2)	(3)	(4)	(5)	(6)
	Took child for check-up in past 12 mo	Child sleeps under mosquito net	Toilet quality index	HH has priv. toilet	Treats child's drinking water	Main drinking source: Sachet/bottled water
Panel A: Children of Female GYS participant						
Treatment	0.002	0.051	-0.017	0.038	-0.002	-0.049
	(0.020)	(0.035)	(0.078)	(0.028)	(0.012)	(0.038)
P-value	0.916	0.142	0.822	0.177	0.897	0.192
Comparison mean	0.371	0.626	2.481	0.198	0.048	0.547
N	2211	2211	1473	1476	2211	2211
Panel B: Children of Male GYS participant						
Treatment	-0.023	0.065	0.044	-0.016	-0.006	0.011
	(0.027)	(0.045)	(0.100)	(0.034)	(0.022)	(0.048)
P-value	0.397	0.148	0.663	0.632	0.788	0.824
Comparison mean	0.417	0.605	2.430	0.171	0.064	0.536
N	1157	1157	852	852	1157	1157
P-val male=fem	0.477	0.665	0.776	0.173	0.772	0.293

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table Table B1.

Table B5: Caregiver-reported Child Health: Index Components

	(1) Cg-report of health	(2) Fevers over 3 mos	(3) Diarrhea over 3 mos	(4) Burned badly ever	(5) Broke bone ever	(6) Concussed ever
Panel A: Children of Female GYS participant						
Treatment	0.015	-0.089**	-0.005	-0.030	0.000	-0.005
	(0.046)	(0.041)	(0.019)	(0.019)	(0.010)	(0.009)
P-value	0.749	0.031	0.775	0.123	0.982	0.591
Comparison mean	4.182	0.539	0.157	0.140	0.037	0.048
N	2211	2210	2210	2211	2211	2211
Panel B: Children of Male GYS participant						
Treatment	-0.032	0.031	0.004	0.019	-0.001	-0.020
	(0.059)	(0.055)	(0.029)	(0.032)	(0.016)	(0.012)
P-value	0.592	0.577	0.888	0.544	0.941	0.100
Comparison mean	4.117	0.545	0.211	0.188	0.047	0.059
N	1157	1155	1156	1157	1157	1157
P-val male=fem	0.408	0.096	0.866	0.226	0.972	0.485

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1. Caregiver-report of child health was on a Likert scale from 1 (very bad) to 5 (very good). When constructing the index, the variables shown here are reversed so that a higher Child Health Index indicates a higher health level.

Table B6: Physical Development: Index Components (Anthropometrics)

	(1) Weight-for-age Z-score	(2) Body Mass Index-for-age	(3) Lenght/height for-age	(4) Weight-for lenght/ height
Panel A: Children of Female GYS participant				
Treatment	-0.020	-0.030	0.033	-0.000
	(0.080)	(0.092)	(0.096)	(0.091)
P-value	0.801	0.746	0.733	0.996
Comparison mean	-0.687	-0.515	-0.589	-0.556
N	2053	1541	1548	1359
Panel B: Children of Male GYS participant				
Treatment	-0.280***	-0.067	-0.307***	-0.127
	(0.107)	(0.109)	(0.113)	(0.118)
P-value	0.009	0.540	0.007	0.280
Comparison mean	-0.703	-0.460	-0.677	-0.484
N	1089	783	792	713
P-val male=fem	0.052	0.896	0.011	0.560

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1.

Table B7: Child Stimulation: Index Components

	(1) Sang to child in past month	(2) Read to child in past month	(3) Told stories to child in past month	(4) Played with child in past month	(5) Named/counted/drew with child in past month
Panel A: Children of Female GYS participant					
Treatment	0.049*	0.015	0.024	0.027*	0.055**
	(0.026)	(0.027)	(0.031)	(0.015)	(0.024)
P-value	0.055	0.566	0.438	0.060	0.022
Comparison mean	0.642	0.613	0.382	0.879	0.672
N	2208	2205	2202	2207	2206
Panel B: Children of Male GYS participant					
Treatment	-0.027	0.025	-0.057	-0.049*	-0.020
	(0.041)	(0.040)	(0.038)	(0.025)	(0.040)
P-value	0.512	0.531	0.137	0.052	0.624
Comparison mean	0.658	0.509	0.379	0.910	0.639
N	1151	1154	1153	1155	1154
P-val male=fem	0.074	0.991	0.095	0.007	0.067

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1.

Table B8: Child Investment: Index Components

	(1) Child ate protein in the morning	(2) Child ate protein in the evening	(3) Number of books	(4) HH has writing materials
Panel A: Children of Female GYS participant				
Treatment	-0.016	0.021	-0.072	-0.001
	(0.028)	(0.016)	(0.127)	(0.020)
P-value	0.557	0.192	0.574	0.963
Comparison mean	0.661	0.887	1.518	0.780
N	2082	2150	2193	2203
Panel B: Children of Male GYS participant				
Treatment	-0.003	0.008	-0.082	-0.055
	(0.036)	(0.023)	(0.140)	(0.035)
P-value	0.936	0.723	0.556	0.113
Comparison mean	0.644	0.872	1.149	0.718
N	1116	1131	1149	1150
P-val male=fem	0.801	0.623	0.904	0.217

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table B1.

Table B9: Education: Index Components

	(1) Currently attends school	(2) Currently private school	(3) Mins. in school per day	(4) Under 3 yrs when began creche/daycare/nursery
Panel A: Children of Female GYS participant				
Treatment	0.023	0.023	0.124	0.020
	(0.021)	(0.038)	(10.698)	(0.031)
P-value	0.273	0.542	0.991	0.531
Comparison mean	0.873	0.550	445.939	0.751
N	1247	1247	1493	1493
Panel B: Children of Male GYS participant				
Treatment	0.029	0.033	9.307	0.019
	(0.033)	(0.054)	(18.411)	(0.048)
P-value	0.370	0.540	0.614	0.687
Comparison mean	0.823	0.457	406.695	0.649
N	587	587	711	711
P-val male=fem	0.998	0.823	0.727	0.953

*** p<0.01, ** p<0.05, * p<0.1

The sample is restricted to children over 36 months old. Refer to Table B1 for other table notes.

Appendix C: Cognitive Development Results: Robustness to Scoring Decisions, and Results by Skill Type

Table C1: Robustness to Scoring Decisions: unattempted questions scored as incorrect

	(1)	(2)	(3)	(4)
	18 months	Three	Five	Seven
Panel A: Children of Female GYS participant				
Treatment	-0.057	0.050	0.306***	0.385***
	(0.105)	(0.090)	(0.093)	(0.136)
P-value	0.586	0.579	0.001	0.005
Comparison mean	0.010	0.004	0.013	0.092
N	479	523	574	279
Panel B: Children of Male GYS participant				
Treatment	0.076	-0.053	-0.218	0.140
	(0.133)	(0.117)	(0.136)	(0.229)
P-value	0.569	0.648	0.111	0.541
Comparison mean	-0.017	-0.009	-0.033	-0.196
N	280	270	244	128
P-val male=fem	0.464	0.523	0.002	0.503

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table 3. The only difference with Table 3 is that in this case we consider unattempted questions as failed/incorrect (i.e., scored 0) instead of missing.

Table C2: Language Skills Development:
Total scores, by testing window

	(1) Three	(2) Five	(3) Seven
Panel A: Children of Female GYS participant			
Treatment	-0.008	0.208**	0.382***
	(0.092)	(0.092)	(0.126)
P-value	0.934	0.025	0.003
Comparison mean	-0.007	-0.030	0.053
N	523	574	279
Panel B: Children of Male GYS participant			
Treatment	-0.118	-0.461***	0.129
	(0.127)	(0.123)	(0.211)
P-value	0.353	0.000	0.544
Comparison mean	0.016	0.078	-0.112
N	270	244	128
P-val male=fem	0.701	0.000	0.389

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table 3. The 18 months language outcome is based on caregiver reports so it is not included in the overall 18 months cognitive score.

Table C3: Math and Numeracy Development:
Total scores, by testing window

	(1) Three	(2) Five	(3) Seven
Panel A: Children of Female GYS participant			
Treatment	0.109	0.236**	0.385***
	(0.091)	(0.093)	(0.132)
P-value	0.234	0.012	0.004
Comparison mean	0.006	0.036	0.111
N	523	574	279
Panel B: Children of Male GYS participant			
Treatment	0.096	-0.099	0.304
	(0.115)	(0.147)	(0.228)
P-value	0.407	0.503	0.186
Comparison mean	-0.014	-0.094	-0.235
N	270	244	128
P-val male=fem	0.803	0.072	0.865

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table 3.

Table C4: Social Cognitive Development:
Total scores, by testing window

	(1) Three	(2) Five	(3) Seven
Panel A: Children of Female GYS participant			
Treatment	-0.124	0.034	0.127
	(0.086)	(0.100)	(0.134)
P-value	0.150	0.730	0.345
Comparison mean	-0.045	0.009	0.088
N	523	574	279
Panel B: Children of Male GYS participant			
Treatment	-0.229	-0.235	0.406*
	(0.157)	(0.179)	(0.238)
P-value	0.148	0.189	0.090
Comparison mean	0.095	-0.022	-0.186
N	270	244	128
P-val male=fem	0.665	0.296	0.369

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table 3.

Table C5: Spatial Reasoning:
Total scores, by testing window

	(1) Three	(2) Five	(3) Seven
Panel A: Children of Female GYS participant			
Treatment	0.087	0.238**	0.393***
	(0.093)	(0.094)	(0.133)
P-value	0.351	0.012	0.003
Comparison mean	-0.002	0.003	0.060
N	523	574	279
Panel B: Children of Male GYS participant			
Treatment	-0.082	-0.282**	0.175
	(0.128)	(0.133)	(0.259)
P-value	0.519	0.035	0.499
Comparison mean	0.005	-0.009	-0.128
N	270	244	128
P-val male=fem	0.197	0.005	0.614

*** p<0.01, ** p<0.05, * p<0.1

Refer to Table 3.

Table C6: Executive Function:
Total scores, by testing window

	(1)	(2)	(3)	(4)
	18 months	Three	Five	Seven
Panel A: Children of Female GYS participant				
Treatment	-0.040	-0.015	0.262***	0.270*
	(0.099)	(0.091)	(0.088)	(0.150)
P-value	0.691	0.870	0.003	0.073
Comparison mean	-0.002	0.042	0.021	0.066
N	479	523	574	279
Panel B: Children of Male GYS participant				
Treatment	0.064	0.120	0.152	-0.250
	(0.133)	(0.126)	(0.160)	(0.222)
P-value	0.631	0.339	0.344	0.262
Comparison mean	0.003	-0.088	-0.053	-0.139
N	280	270	244	128
P-val male=fem	0.454	0.225	0.262	0.152

*** p<0.01, ** p<0.05, * p<0.1
Refer to Table 3.