Early-Life Access to a Basic Health Care Program and Adult Outcomes in Indonesia *

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Abstract

Access to primary care during early life can have substantial benefits in developing countries. This study evaluates the long-run impact of the Village Midwife Program in Indonesia. It utilizes the roll-out-variation of the program and link individual background and community characteristics in early childhood to adult outcomes in the Indonesian Family Life Survey. It finds that the presence of a midwife in a community in utero leads to an improvement in overall health, cognition, and economic outcomes among men, but not for women. Greater receipt of antenatal care and skilled birth-attendance could, in part, drive these results.

Keywords: Primary Care, Midwife, Early-Life, Adult Human Capital, Indonesia

JEL Classifications: I15, I18, J13, O15

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1 Introduction

This paper estimates the long-run benefits of maternal care and childcare. The long-run outcomes are of interest for three reasons. First, many effects of an early-life intervention remain latent for a long period; outcomes at birth or during early childhood may not fully capture these latent effects (Miller and Wherry, 2018). Second, the effects of such a program on human capital formation, economic and labor market outcomes can only be fully understood during adulthood. Third, subsequent parental investment may lead to a catch-up in the long-run. Thus, early life differences in health may not lead to similar long-term differences (Crimmins and Finch, 2006; Sohn, 2017).

There are a limited number of studies on the long-run impacts of maternal care and child care interventions because datasets that track individuals over long periods of time and collect detailed data on several dimensions of health, education, and labor market outcomes, are rare. This paper uses multiple waves of the Indonesian Family Life Survey (IFLS), a detailed panel of households spanning over a period of 22 years. The long-run panel nature of the dataset helps tracking individuals from childhood to adulthood.

This paper studies the Village Midwife Program, a central intervention in Indonesia for increasing access to antenatal care, postnatal care, and safe delivery services among reproductive-age women from families of all social backgrounds. The program was introduced in 1989 and was rolled out in a phased manner, with villages in poor and remote communities getting priority (Frankenberg and Thomas, 2001; Frankenberg et al., 2005, 2009; Cas, 2012). This paper uses a difference in difference strategy that combines the spatial variation in the rollout of the program with a temporal variation by comparing individuals who were old enough (five years and older) at the time of the roll-out of the program with individuals in their early life (*in utero* or in their first three years).[1] Thus, the comparison is between these two groups born in the same community, with outcomes measured about 20–25 years after they were first exposed to the program. The regressions also control for maternal and time-varying community characteristics, in addition to the

[1] A separate indicator for whether children were four years old at the time of the program expansion in their community is included in the regressions. This allows for the impact of access to a midwife to differ for children who were four at the time the midwife began working.

year and community of birth fixed effects and province-level yearly trends.

The results indicate that the presence of a midwife in the community of birth in early life leads to better adult outcomes for males along several dimensions, while outcomes for females remain unchanged. The effect size for males who were exposed to the program *in utero* is 0.4 on a health index comprised of observed health,[2] self-reported health status, body mass index (BMI), lung capacity, hypertension, and height, all of which are measured 20–25 years after the first exposure. Exposed males also perform significantly better on a cognitive index, consisting of Raven's test (measuring fluid intelligence) and two memory tests, and also on an economic index, comprising income and years of schooling. The effect sizes are about 0.3 and 0.4 for cognitive and economic indices, respectively. However, there is no significant impact of the program on mathematical tests.[3]

The main results remain robust to several checks. The robustness checks do not find strong evidence of selective migration of mothers into the program receiving communities, non-parallel trends between program receiving and non-receiving communities, selective attrition in the panel, and other confounding government programs. The paper also explores plausible mechanisms of the effect. Individuals who were exposed to the program *in utero* were significantly more likely to have received antenatal care and assistance from a midwife during their birth.[4] Consistent with Frankenberg and Thomas (2001), the results also indicate that the provision of village midwives is associated with an increase in birth weight.

To the best of the knowledge of the authors of this study, this is the first paper that investigates the long-term (i.e., beyond childhood and adolescence) effects of access to qualified midwifery services in early life on human capital formation in a developing country. Although similar home visiting programs are increasingly being introduced in developing countries, systematic evalua-

[2] A trained health worker (typically a nurse) rated the health of IFLS respondents on a nine-point scale.

[3] It is important to emphasize that these effects are, in essence, reduced form. This means that there are possibly important (but not identified) relationships among the outcome variables. For example, improved health could be linked to higher economic productivity, but also, higher productivity could be linked to improved health. The authors thank an anonymous referee for pointing this out.

[4] While various postnatal inputs (such as immunizations and vitamins) are also relevant, they were not presented in this study because of data limitations.

tions of such programs are very few (Bhalotra et al., 2017). A few recent studies have examined the long-run impacts of access to midwives or trained nurses (Bhalotra et al., 2017; Lazuka, 2018; Hjort et al., 2017). However, much of the evidence is from developed countries, or is based on an historical context in such countries which may not be applicable in developing countries.[5] Moreover, most studies focus on a limited set of long-run outcomes. This paper provides some of the earliest evidence of long-run effects of midwife services on a large set of outcomes capturing effects on human capital formation in a less developed country.[6]

This paper also contributes to the small literature on early-life origins of cognition in developing regions.[7] A large number of animal and human studies in the field of developmental psychobiology show that under-nutrition, micro-nutrient deficiencies, environmental toxins, and poor stimulation early in life can lead to permanent changes in brain structure and function and thus have long-lasting cognitive and behavioral effects (Liu et al., 2000; Pollitt et al., 1993; Cas, 2012). In particular, poor nutrition and micro-nutrient deficiencies *in utero* and during the first two years of life are associated with cognitive deficits among humans (Pollitt et al., 1993; Cas, 2012). Thus, the paper adds to the literature by providing causal evidence for the role of primary public health care in improving adult cognition.

[5]Especially quality, access, and demand for primary health care delivery are very different in the developing world as compared to say, the US (Macfarlane et al., 2000).

[6]This paper also adds to the scant literature of long-term effects of positive, policy-based treatments, especially in developing countries. In this way, this paper differs from studies that analyze the impacts of interventions early in life in developing countries such as Ito and Tanaka (2018) and Field et al. (2009) in that we focus on a host of adult outcomes rather than the child or adolescent outcomes.
The study by Cas (2012) comes closest to the present study, which examines the impact of the same program as ours on education and cognition outcomes for children of age 11-17 years, using the data from the first four waves of IFLS. The analysis of this paper expands on this by focusing on adult cognition (as opposed to early and middle adolescents) by considering the latest fifth wave of IFLS and considering a wider variety of outcomes such as health and earnings of these adults. Please refer to the subsection S1.1 "Additional Literature Review" in the Online Appendix available at *The World Bank Economic Review website* for more details.

[7]The authors are not aware of any large-scale intervention study other than Venkataramani (2012) and Cas (2012) to study later life cognition in developing countries for an early-life health intervention.

2 The Village Midwife Program

The Village Midwife Program, also known as Bidan di Desa (BDD), was launched in 1989, reflecting a concern that women in rural Indonesia had poor access to skilled medical care (including prenatal and delivery assistance) during their pregnancies. It was a significant intervention by the Ministry of Health, and within a decade, 96 percent of all locales in the country had access to midwives as the number of midwife villages increased five-fold (WHO, 2013). In the beginning, village midwives typically were recruited from nursing programs and received one additional year of training in midwifery. Later, it was changed to require that village midwives attend a three-year midwifery academy. Once assigned to a community, village midwives were guaranteed a government salary for at least three years. They were expected to engage in public practice during normal working hours, while they could have their own private practice after duty hours. The goal was to support the midwives sustaining their practice without a government remuneration, once the government contract ended (Frankenberg and Thomas, 2001).[8]

The main task of the midwife was to act as a general health resource in a community. They were expected to conduct outreach programs, provide preventive care, and advise on different health-promoting behaviors, including sanitation and nutrition, dispensing medication, and providing acute-care services, such as sick-patient visits, administering antibiotics, and attending to wounds. They were also responsible for providing basic child care such as immunizations and micro-nutrients. Please refer to Online Appendix Table S7.1 for details.

The program's expansion led to a significant increase in the uptake of maternal inputs. Pregnant women received better ante-natal care and were less likely to rely on traditional birth attendants during delivery (Frankenberg et al., 2009).[9] Women were more likely to use injectable contraceptives and decreased their use of oral contraceptives and implants (Weaver et al., 2013). The pro-

[8] Sections S1, S2, and S3 of the Online Appendix discuss some additional details regarding village midwives, including the degree of their presence in the Indonesian health care system, training, responsibilities, interaction with other health care officials, and so on.

[9] The expansion of the program was accompanied by an increase in skilled delivery from 34 to 64 percent along with the percentage of women receiving antenatal care increasing from 57 percent in 1987 to 88 percent by 1998. The average number of antenatal care visits per woman also rose by nearly 50 percent in just six years (Shiffman, 2003).

gram also led to improvements in the body mass index of reproductive age women (Frankenberg and Thomas, 2001). Children exposed to village midwives in their early life also benefited from the program by attainting better nutritional status (as measured by height for age) (Frankenberg et al., 2005), and by having better cognitive and educational outcomes in late childhood (between 11 and 17 years of age) (Cas, 2012).

The program was rolled out in a phased manner. Figure 1 shows the percentage of IFLS villages that gained a midwife between 1989 and 2007. The increase in the number of communities with a midwife follows a steep pattern between 1991 and 1994. By 1997, on average around 1.25 village midwives were serving a program community (Cas, 2012). Furthermore, there was substantial heterogeneity in the timing of the spread of the Village Midwife Program, both within and across provinces. This is shown with the help of Online Appendix Figure S6.1 and shaded maps in Online Appendix Figure S6.2 to Online Appendix Figure S6.6.[10]

The empirical strategy relies on this variation in the timing of treatment initiation to identify the long-run effects of the program.[11] Online Appendix Table S7.2 compares the community characteristics between the program and non-program communities. These results indicate that the program areas differ significantly in various characteristics from the control areas. For instance, the program communities are substantially more likely to be rural, are less likely to have electricity or public telephone, and are more likely to receive *Inpres Desa Tertinggal* (IDT). Moreover, the program areas are mostly remote in terms of distance to the nearest market, nearest health facility center, and district capital. On average, the program areas also have a lower number of health

[10]Each map shows the percentage of IFLS communities with a midwife on a yearly basis for all provinces in Indonesia—the darker a province, the greater is the percentage of IFLS communities that have received a midwife.

[11]Please note that elaborate program details from any sources, including government documents, are lacking. Thus, information on the way the program was implemented and rolled out; the responsible officials for implementing the program and reaching its objectives; the role of national, provincial, and district governments, and officials; the way the midwives were allocated to a particular community; and so on; are not available. In addition, the research articles, or the World Bank, or the UN Reports on the Village Midwife Program, also do not provide any such information.

On a related note, as discussed in the Online Appendix S.3, the central government authorities retain key decision-making responsibilities and financial control of the rural health system, while civil service reforms, including managerial capacity building at the local level, are yet to be materialized. In particular, the Ministry of Health (MoH) is involved in planning and managing regional staff and programs, for lack of skilled manpower and, the development of sectoral objectives, policies, and plans, and related tasks, such as setting minimum performance standards, manpower planning, and preparation of the annual *formasi* exercise (WHO, 2013).

posts. These results are comparable to the findings in Frankenberg and Thomas (2001).

3 Data

This study uses the Indonesian Family Life Survey (IFLS) for the main empirical analysis. The IFLS is an ongoing longitudinal survey. So far, there are five waves which were conducted in 1993, 1997, 2000, 2007, and 2014. The fifth wave of the IFLS is primarily used, since the paper is interested in adult outcomes of children born between 1984 and 1994.

IFLS asks the village leaders and the head of the Village Women's Group about the availability of any village midwife in the community, and the year a midwife started serving the community. This information is again verified with the volunteers at the Village Health Post, where women obtain prenatal and obstetric care for the consistency of reporting on the village midwife's presence in the community (Cas, 2012). While the first wave of the IFLS has information on whether there is a village midwife in the community, it does not have the start year information. It is only from the second wave that the information on both the availability and start year is available. Since the empirical strategy requires both pieces of information, this paper uses the availability of midwife information from wave one and subsequent waves, and the placement year of midwives from the follow-up waves for the IFLS communities.

Birth year information is available on the roster, as well as book 3A of the fifth wave.[12] The sample is limited to individuals born between 1984 and 1993 and are listed in the first wave and individuals born in 1994 and listed in the second wave. This process eliminates any adults who may have joined the panel household later in their adulthood.

A notable feature of the IFLS is that it provides various measures on health, cognition, economic, and math skills. Since there are multiple outcomes under each broad category of outcome—including health, cognition, economic, and math skill— a summary index for each category is constructed such that the program impact on that category can be estimated using a single test

[12] In some cases, the roster birth year does not match the self-reported birth year information in book 3A of the fifth wave. For such cases, self-reported birth year is used.

Anderson (2008).[13]

Following the existing literature, six health measures are used to construct the health index from the data available in IFLS 5: the general health status (GHS) as perceived by the visiting health worker, self-reported health status, dummy for not being underweight (using the information on body mass index (BMI)), natural logarithm of lung capacity score, dummy for no hypertension, and the adult height (in centimeters).[14] The math test index uses scores from three separate tests which measure different aspects of mathematical skills. A separate cognition index, uses scores from the Raven test and two memory tests, available in IFLS 5.[15] The final index is the economic index which combines income and years of education completed for males. Because of low labor force participation among females, a dummy indicating if a woman is in the labor force (or in school) is used, instead of the income measure. All the indices and the constituent variables are constructed in such a way that a greater value implies a better outcome. Data Appendix section S5 of the Online Appendix discusses the details (source, construction, motivation, and so on) of all constituent variables. Table 1 reports the summary statistics of outcomes of interest for male and female samples separately.

District-level information on health facilities is added to the IFLS data for the year 1983 from PODES to deal with possible confounding factors. PODES is a village-level survey data. To arrive at the figures for district level, the available village level data is aggregated at the district level.[16]

[13]Online Appendix, section S4 titled "Construction of the Summary Index", explains the construction of the index .

[14]The midwife program can also affect other dimensions of health like the likelihood of diabetes and inflammation level in the body. The IFLS collects the information on HbA1C (a measure of blood sugar level) and c-reactive protein (a measure of inflammation) for a limited number of individuals—the sample decreases by about three-fourths if this information is included. To avoid this decrease in sample size, this information is not used for the construction of the health index.

[15]Cognitive (non-numerical tests) and math skill tests (numerical tests) are intentionally separated. Please note that math tests require numerical literacy, and a health intervention may not necessarily increase educational attainment while may increase other dimensions of cognition nonetheless (Costa, 2015). Thus, combining math with other tests on cognition may or may not improve the overall index which may lead to erroneous conclusions.

[16]More information about the data set can be found in https://www.rand.org/labor/bps/podes/1983ag.html

4 Empirical Model

The empirical strategy compares the adult outcomes of children who are exposed to the program in their early lives (*in utero* and first four years of life) with those who already are more than four years old when the midwife arrived in the community. The children living in communities with no midwife program serve as another control group. Accordingly, this study applies a difference-in-difference model illustrated by the equation below:

$$O_{ijt} = \beta_0 + \beta_1 E_{jt}^{IU} + \beta_2 E_{jt}^{PB,\,1} + \beta_3 E_{jt}^{PB,\,2} + \alpha X_{ijt} + \alpha_m + \delta_t + \eta\, C_{js} + \theta_j + \gamma_p \times t + FAC_d \times \delta_t + \epsilon_{ijt} \quad (1)$$

The dependent variables O_{ijt} are the various adult health, math skill, economic, and cognition outcomes of individual i in the year t, and living in community j, at the time of survey wave s (here first or second wave of the survey). X_{ijt} is a set of maternal characteristics, such as maternal education and maternal age at the time of the survey (during first or second wave).[17] Variation in the availability of a midwife and placement-timing makes it possible to control for unrestricted cohort effect at the national level with δ_t, unrestricted community-level effect with θ_j, and province-level birth year time trends with $\gamma_p \times t$. α_m is the birth month fixed effect, which controls for seasonality.

The exposure measures (E) are constructed based on the birth year of the adult and the placement year of midwives, available in the IFLS. If the placement year coincides with, or precedes the birth year, it is defined as *in utero* exposure (E^{IU}). Since a midwife also provides postnatal care and basic health care to young children, the benefits of the program also can extend to children who were exposed to a midwife after they were born. Accordingly, two post birth exposure measures are constructed. The first of these measures, $E^{PB,\,1}$ indicates the impact of exposure in the first three years after birth, excluding the *in–utero* period. In other words, $E^{PB,\,1}$ takes the value 1 if the difference between the birth year and midwife placement year is greater than 0 but less than 4, and zero otherwise. The second measure $E^{PB,\,2}$ takes the value 1 if the difference between the birth year and midwife placement is exactly four, and zero otherwise. Much of the literature

[17]Following Frankenberg and Thomas (2001), the maternal background variables are specified as spline functions with several knots to allow flexibly for non-linearities. Maternal education has splines with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45.

suggests that the impact of the early-life interventions is the greatest during the first three years of life. However, those interventions also could influence the four–year–old (Halim et al., 2015). This approach allows estimating the impact of the intervention *in utero*, plus the first three years after birth, while controlling for the impact of exposure at age four.[18] The parameters of interest are, therefore, β_1 and β_2.[19]

In a number of ways, the possible endogeneity of the introduction of the Village Midwife Program is addressed so that the empirical design is valid. First, community fixed effects are used, which absorb time-invariant community characteristics (both observable and unobservable). This is important because as shown in Online Appendix Table S7.2 the program communities are very different in observable characteristics from the non-program communities. Second, the number of health facilities, family planning posts, and private practitioners available in a district in 1983 is interacted with the birth year dummy (denoted by $FAC_d \times \delta_t$ in Equation 1) to control for trends in the observable determinants of midwife adoption in different districts.[20] Third, the regressions control for time-varying characteristics at the community level between the two survey years (C_{js}). These time-varying characteristics include the urban status of the community, electrification status at the community level, distance to the nearest market, distance to the district center, whether road in the community is paved, and distance to the nearest health facility. These steps will arguably distill the effects of the midwife program from possible confounders, including other public programs during the time of midwife introduction.[21]

Please note that the estimates could be attenuated for two reasons. First, the midwives may provide some services in nearby control communities that have not been assigned a midwife so far.

[18]The impact of exposure on age four is not reported; they are available upon request. There is no statistically significant impact of exposure at age four on any indices, with the exception of health index for females.

[19]The regressions are not using any weighting scheme (like IFLS person weights) in the regression analysis.

[20]Please recall that the sample is born between 1984 and 1994.

[21]The estimates still can suffer from "selection into identification" (*SI*) since the impacts are identified using villages that "switch," which means a shift from no midwife to having a midwife during the study period (Miller et al., 2018). Since switching villages are systematically different from the non-switching villages (Online Appendix Table S7.2), *SI* can cause the estimate to deviate from the sample Average Treatment Effect (ATE) under heterogeneous treatment effects, especially for the small sample size of the switchers. While this does not affect the internal validity of the regression results, it relates to the generalizability of the results. Following the suggestion in Miller et al. (2018), the breakdown of the sample by exposure groups for different outcomes is reported in the Online Appendix Table S7.3.

Second, Hjort et al. (2017) argue that the informational components of such a program may spill over to parents in control areas.

Finally, the interpretation of the exposure to midwife coefficients is slightly different than in the usual early-life literature, where one-time events, such as natural disasters, or one-time public interventions are mostly used as identification strategies. Unlike those studies, a village midwife continues working in a community even after a child is born.[22] This empirical strategy estimates the impact of midwife exposure that begins *in utero*, or in early childhood, and continues throughout later childhood, relative to the impact of midwife exposure that does not begin until later in childhood.[23]

5 Results

5.1 Long-run Impact on Health and Cognition

The first set of results shows the impacts of the program on adult health and cognition outcomes. All the regressions control for maternal characteristics (namely, maternal education and age at survey), cohort and community fixed effects, province-level yearly linear trends, and year of birth interacted with 1983 district characteristics.

Table 2 shows the impacts of the midwife program on a host of physical health outcomes. Because of the multidimensional nature of health (Strauss and Thomas, 2007), exposure to a midwife in early life can improve health along a number of dimensions. Panel A of Table 2 presents the results for adult males. The effect size of access to a midwife during pregnancy is 0.4 for males (statistically significant at 5 percent level of significance), when measured 20 years or later after exposure. The effect size of access to a midwife during the first three years after birth is positive but not statistically significant at conventional levels.

Since each component of the index measures a very different aspect of health, Table 2 presents

[22] After the Asian financial crisis in 1997, a few midwives left their posts. Since the youngest individuals in the sample were born in 1994, they were exposed to the program for the large part of their first four years.

[23] For further discussion on this point, please refer to Hoynes et al. (2016).

the regressions separately for each component in the same panel. Height and logarithm of lung capacity show significant improvements, while the other components do not show statistically significant results. Particularly, the results show about a 2-centimeter increase in height and a 5-percent increase in lung capacity for *in utero* exposure to midwives among males. Panel B presents the results for females. It shows no significant impact on health index or its individual components (except for lung capacity).[24]

The impacts of the midwife program on cognitive health is shown in Table 3. The first column presents effect sizes for the cognitive index which is constructed by following the procedure as outlined in Anderson (2008). The components of the index are measures of Raven's test (a measure of fluid intelligence) and two memory tests. As before, higher values of the cognitive index imply better cognitive health.

The effect size of *in utero* exposure to midwives is 0.33 for males, when measured 20 years or later (statistically significant at 5 percent level of significance). There are no significant effects on cognitive health for exposure during the first three years after birth. The remainder of the columns provides the estimates for the individual components of the cognitive index. All coefficients suggest that *in utero* exposure leads to a statistically significant improvement in later life cognitive outcomes. Individuals, exposed to the program *in utero*, answer 11 percentage points more questions correctly on Raven tests and answer 0.6 more questions correctly on the first memory test. Panel B shows the results for females. Again, there are no statistically significant impacts on females for cognitive index or any of its components. The results for cognition are similar to the findings by Venkataramani (2012), who finds that malaria eradication in the birth year led to a 0.11 to 0.22 standard deviation improvement in Raven scores among males from the highest malaria-prone areas in Mexico, while no impact was found for females.[25]

[24]One concern, with all these results, could be that the statistical significance presented in Table 2 and some other subsequent tables depend on the vector of controls mentioned in the empirical strategy. Results from a parsimonious specification with only birth year and community fixed effects are presented in Online Appendix Table S7.4. The impact estimates have similar magnitudes and are statistically not different from the ones in the main tables.

[25]The results on cognition possibly shed some light on the explanation of the *Flynn Effect*. Improved prenatal and postnatal care can lead to better nutrition and a reduced disease environment. This is critical as most of the brain development happens *in utero* or in the first few years of life. Improved nutrition and a reduced disease environment aid the process of brain development as infections may channel the nutrients from brain development toward building

Table 4 presents the results for a similarly calculated math skill index, measuring numeracy and mathematical calculation skills. This is comprised of tests requiring to solve basic mathematical problems, a subtraction test, and a block test for recognizing numerical patterns. Broadly, there are no significant impacts of midwives on mathematical skills, either for males or females.[26, 27]

The results on the health and cognitive indexes are consistent with the medical literature. The intrauterine period is critical for growth, and adequate diets and fewer infections can spur the growth process. Similarly, lung architecture develops *in utero* and during the first three years of life. Adverse conditions in early life, such as infections and poor nutritional intake, also can affect cognitive development by directly damaging the structure of the brain. These effects often persist in the long-run due to the lack of remediation efforts in poor settings (Victora et al., 2008). A village health care worker such as a midwife can help to moderate the conditions in early life by providing basic health care and information, leading to long-term benefits, as are observed in this paper.

5.2 Earnings and Education

Do improvements in physical and cognitive health due to early life exposure to midwives lead to more human capital and better economic conditions? Table 5 presents the results on the economic well-being. This study considers two measures: logarithm of income and years of education for males. Since the labor force participation for females is low, a dummy if a woman is in the labor

an immune response to fight off pathogens.

[26]These results highlight the difference between fluid intelligence and crystallized intelligence. Cognitive outcomes in this paper measure fluid intelligence and working memory of a person, while math tests are a measure of crystallized intelligence. Educational training and past knowledge often shape crystallized intelligence, while fluid intelligence is not affected by these factors. The World Bank (2017) report identifies four proximate determinants of learning, which are teachers, school management, school inputs, and learners. While early-life interventions, such as the Village Midwife Program can improve the quality of learners, it has no effect on the three other determinants. Therefore, one may not necessarily observe an improvement in learning outcomes, measured by test scores in math and reasoning tests with numbers, following an early-life intervention.

[27]The sensitivity of the estimates to different start months of midwives in a community are checked as a robustness exercise (for the male sample only). Communities with a midwife are assigned a start-month randomly (as the start-month information is unavailable in the IFLS). Exposure measures are computed accordingly to estimate the program effect. The exercise is repeated 250 times. Figures S6.7, S6.8 and S6.9 in the online appendix plot the density of *in utero* exposure coefficient estimates for health index, cognition index, and economic index respectively–the mean values of the estimates are statistically indistinguishable with the estimates of interest in the main tables.

force (or in school) is used, instead of the income measure. As before, the index of these two measures is constructed following the procedure in Anderson (2008). Panel A shows the results for males. The effect size of exposure to the midwife program *in utero* for males on the economic index is 0.435 (statistically significant at 5 percent). The results are driven by a significantly large increase in income and a reasonably large rise in years of schooling.[28] For males, exposure to the midwife program *in utero* leads to a 35 percent rise in income and 0.48 more years of schooling. There is no impact on males who were exposed to the program during the first three years after birth. Panel B reports the impact on females. Consistent with the earlier findings, exposure to a midwife program early in life does not translate into better economic well-being for females.[29] The findings in this subsection are consistent in direction with a number of studies that examine the long-term impacts of early life health interventions in low-income settings.[30]

The results indicate that exposure to a midwife early in life increases years of schooling in Indonesia among both males and females (although not statistically significant in this case). A similar result of an increase in schooling due to reproductive health and family planning interventions have been found in Bangladesh and Colombia and among women for fetal iodine supplementation in Tanzania (Field et al., 2009; Halim et al., 2015). Protein supplementation in Guatemala for male children aged less than 3 years led to 46% higher wages in adulthood (Victora et al., 2008). Halim et al. (2015) document that with an increase in earnings between 7% and 46%, the economic returns of RMNCH interventions appear to be sizeable when they are compared, albeit crudely, with the

[28]While interpreting the results, please note that the impact estimates are for adults who still are quite young, with age not exceeding thirty years. For those who are close to twenty years old, it is possible that they still are transitioning into the labor market or completing schooling.

[29]As an alternative to creating a different measure of labor market success for men and women because labor force participation is much lower among women, the inverse hyperbolic sine (Burbidge et al., 1988) is used to deal with the zero-income issue without affecting the interpretation of the results much. The results do not vary much (available upon request).

[30]Online Appendix Table S7.5, shows that the effects of midwives in the previous and the present subsections are slightly stronger among children from mothers with low levels of education, although not statistically significant at conventional levels. However, the sum of coefficients for less educated mothers is significant at the convention level for all indices except math test index.
Online Appendix Table S7.6 shows that the impacts of midwives are mainly concentrated in the prosperous Java-Bali region as compared to the rest of Indonesia. This is possibly due to greater program intensity, and the greater prosperity of these islands possibly contributing to the creation of better complementary factors (such as schools, better jobs) to obtain greater benefits from the program, and so on.

economic returns of poverty reduction programs, namely, microfinance and conditional cash transfer programs. The authors argue that poverty reduction programs were shown to have increased earnings by up to 18% for poor households in low and middle-income countries.[31]

5.3 Event Study Analysis

This section presents the event study analysis of the results reported in the previous sections. A slightly modified version of the main regression equation is used by including a series of treatment exposure dummies with 1-2 year intervals, starting from 4 years prior to birth until the age of 8 years.[32] The omitted category for event time is exposure at age 9 years or above. Following Hoynes et al. (2016), the focus is on the event study coefficients inside the unbalanced endpoints of programs: initiated 2 years or more prior to birth, and age 9 years or more.

The event study analysis serves two purposes. First, it helps to identify the period in early life where the impact is the highest. Finding out the causal impacts of shocks at different points in the life cycle is difficult given the strong correlation of deprivation across the vulnerable periods in the life cycle (Maccini and Yang, 2009). One of the key insights from the research on child nutrition is the concept of "critical-period programming", where environmental conditions in a certain sensitive period of life may have long-term, irreversible effects. While Barker (2000) stresses that nutritional deprivation *in utero* permanently reduces body size in adulthood, more recent studies

[31] The results in the previous and the present section indicate that exposure to a midwife during early childhood significantly improves the outcomes for adult males, but not for adult females. Note that these results are consistent with a number of recent studies that find greater health and cognition impacts among adult males for early life interventions such as greater nutrition (Hoynes et al., 2016; Stein et al., 2006), quality childhood care (García et al., 2017; Campbell et al., 2014), and malaria eradication (Venkataramani, 2012; Cutler et al., 2010; Rosenzweig and Zhang, 2013). Furthermore, the findings of increased earnings among males also are observed for a nutritional intervention in Guatemala (Hoddinott et al., 2008) and malaria eradication programs in India and Mexico (Halim et al., 2015). Given the weak evidence of discriminatory allocation of nutrition and educational investment for children in Indonesia (Kevane and Levine, 2000; Suryadarma, 2015), one can explore the biological evidence of greater sensitivity of males to the surrounding environment *in utero* and early childhood as a likely pathway (Kraemer, 2000; Eriksson et al., 2010; Hoynes et al., 2016). For instance, males could benefit more from the midwifery services both in dimensions of physical health and cognition which translates into better adult outcomes along a number of dimensions. However, testing these different hypotheses would require at least detailed panel data on parental investments, cognition and a host of health outcomes, and job opportunities for men and women.

[32] The event time takes a value of -1 for children born one year after the arrival of midwives. Children born two years or after the arrival of midwives are grouped as less than or equal to -2.

have argued that the period after weaning from breast milk until age 24 to 36 months may also be "critical," as protection from the mother during pregnancy and breastfeeding ends (Maccini and Yang, 2009). Second, this approach helps to check the validity of the research design by testing for differential trends between program receiving and non-receiving communities.

The results of the health index, cognition index, and economic index are shown in Figure 2 to Figure 4 for males and females separately. The coefficients for males are strictly positive for age of exposure less than or equal to 0 years, while it is slightly positive until age 2 years (but statistically insignificant) and zero for age greater than 5 years. The graphs thus indicate that prenatal exposure (especially around conception) to midwives is the most beneficial in terms of adult outcomes, while the impacts are minimal if exposed 4 years after birth. The graphs for females show flat stretches around zero, indicating a negligible impact of midwives in adult outcomes for females. Thus, the evidence from the event study is consistent with the results presented in Table 2, Table 3, and Table 5.

The results also help in validating the research design. The flat stretches of the diagram for any exposure in late childhood lessen the concern that the estimates are confounded by differential cohort trends between program receiving and non-receiving communities. The graphs are also consistent with the fact that the results presented in Table 2 to Table 5, are not driven by the disproportionate impact of the 1997 financial crisis on older cohorts living in the program areas.

6 Discussion and Additional Results

This section extends the previous analysis to examine the robustness and sensitivity of the results to alternative specifications. Moreover, it analyzes plausible mechanisms behind the results and explores the results with different sub-samples.[33]

[33] Additional regression analyses to provide suggestive evidence on the likely pathways through which early-life midwife exposure affects adult economic well-being are shown in the Online Appendix S7. Moreover, while the main focus is on pregnancy inputs, birth spacing, and fertility, the child outcomes could improve because of an improvement in maternal health.

6.1 Plausible Mechanisms

Several plausible mechanisms can explain the improvement in health, cognition, and labor market outcomes due to exposure to a village midwife early in life. First, a number of studies find that the midwife programs are associated with greater antenatal and postnatal care (Frankenberg et al., 2009; Rao, 2014). Accordingly, the effect of the program on antenatal care is investigated. Here, the panel feature of the IFLS is particularly advantageous, as it gives information on the receipt of such inputs for individuals who were exposed to the program early in life and then were interviewed in 2014.[34]

Table 6 shows the mean effect of the program expansion on three outcomes: use of antenatal care, skilled delivery at birth, and one postnatal input, breastfeeding. While all the regressions control for birth year fixed effects and community fixed effects, the last four columns additionally control for province-specific linear trends. Column (1) of Table 6 shows the effect on the use of antenatal care—individuals who were exposed to the midwife program during pregnancy were 10 percent more likely to receive antenatal care compared to individuals who were not exposed to the program during pregnancy or exposed during their first four years of life. In the same table, column (2) shows the effect on attendance of midwife during birth. Individuals exposed to the program are more likely to be attended by a midwife during their birth. Finally, there are no effects of the midwife program on breastfeeding practices for any group.[35,36] The results are very similar when both province-specific linear trends and 1983 district health facilities interacted with year of birth

[34]In this case, a slightly different econometric specification is used than in equation (1)–the children who are exposed at age 1-3 and age 4 are treated as controls and everything else is same as the main specification. The reason is that many of the mechanisms involve outcomes such as birth weight, antenatal care, and attendance of midwife during birth which are available only in the last five years from the survey (birth cohorts born between 1989 and 1994). Therefore, including cohorts with exposure to *in utero*, between age 1 and 3 years, and age 4 years together will not produce enough variation. Given that the program is not going to affect these mechanism outcomes for children who are exposed to the program during 1-4 years after birth, one can treat them as controls and focus on the program's impact on those who were exposed *in utero*.

[35]Information from the first two waves of the IFLS is used. Using the information from the third wave in the IFLS, Frankenberg et al. (2009) confirm that the placement of village midwives in communities is associated with significant increases in a woman's receipt of iron tablets and in her choices about care during delivery.

[36]Because of the unavailability of information in the first wave of the IFLS, the impact of midwives on other postnatal investments, including vaccination and micro-nutrient supplementation (other than breastfeeding), could not be explored.

dummies are included (columns 5-8).

Motivated by these "first stage" results, the impact of the program on birth weight for children born between 1989 to 1994 is examined in Table 7. The birth weight information is reported by mothers and is only available for a fraction of the adult sample. Consistent with the findings of Frankenberg and Thomas (2001), there is a positive impact on birth weight for children exposed to the program. It is important to note that the significance is understated due to the heaping of birth weight (Frankenberg and Thomas, 2001).

A concern with birth weight data is that the midwife program also may improve the likelihood of birth weight reporting. Online Appendix Table S7.7 examines the likelihood of birth weight reporting following the program. It shows that, indeed, birth weight reporting has increased after the program. Column (2) of the same table shows that the change in birth weight reporting is primarily driven by less educated mothers. Almost universally, mother's education is positively associated with child height (Schultz, 2002). Currie and Vogl (2013) argue that child height is a good proxy for birth weight. Therefore, it follows that educated mothers are likely to give birth to babies with higher birth weight. As a result, an increase in birth weight reporting among less educated mothers means the impact estimates on birth weight in Table 7 have a downward bias.[37]

Second, midwives can encourage adequate spacing between subsequent births by providing information and providing access to contraception (Dickson-Tetteh and Billings, 2002; Cleland et al., 2012). The better spacing of birth, in turn, can lead to better adult outcomes (S. Buckles and L. Munnich, 2012).[38] In the context of the current study, if midwives really are associated with greater spacing between successive births, then one should observe a change in those dimensions. Online Appendix Table S7.8 shows the results for regressions on birth spacing and incidence of any subsequent births. The results indicate that birth spacing and incidence of any subsequent births did not change following the program.

[37] Studies by Lazuka (2018) and Bhalotra et al. (2017) find a decline in neonatal mortality following the introduction of early life health care interventions including home visits in Sweden. There is no significant impact of midwives on the incidence of neonatal mortality in Indonesia (not shown in the paper).

[38] Weaver et al. (2013) actually find that the Village Midwife Program did not affect overall contraceptive prevalence but did affect method choice—midwives are associated with increased usage of injectable contraceptives, as opposed to oral contraceptive and implant use among women.

Third, the availability of midwives may lead to smaller families in the exposed communities due to improved family planning services. A recent study finds that the abolishment of user fees for maternal and childcare, following the end of Apartheid law in South Africa, led to a decrease in fertility rate (Ito and Tanaka, 2018). In the present context, reduction in the 'quantity' of children due to a midwife in a community can lead to an improvement in the quality of children, since parents can allocate greater resources among a smaller number of children (Becker and Tomes, 1976). In contrast, in this context, there is no evidence of change in fertility following the arrival of a midwife (see Online Appendix Table S7.9).[39] This lends further support to the findings of Weaver et al. (2013) that contraceptive prevalence did not increase following the program.[40]

6.2 Threats to Identification

This section explores some possible threats to the identification. First, it is possible that the midwife program is associated with a greater number of individuals in the sample whose mothers are educated. This would confound our results, since it is well-established that educated mothers are associated with healthier children (Glewwe, 1999; Grossman, 2006). There are two possible reasons why there could be an over-representation of individuals with educated mothers in our sample. First, midwives may be associated with reduced fertility among less educated mothers. Alternatively, it is also possible that educated mothers from non-program communities migrated to the program communities, thus changing the composition of mothers whose children were exposed to the program early in life. Online Appendix Table S7.10 tests for these possibilities. Maternal education (in years) is regressed on early life midwife exposure to their children, by pooling the male and female samples together. Based on the observation that educated mothers marry and bear

[39] Two birth year cohorts are considered: 1983-1994 and 1983-2007. The first birth year cohort represents children born during the study time frame. An even larger period, 1983-2007 is also considered, because a decline in fertility in later years could affect children born earlier.

[40] An anonymous referee suggested that the large program impacts can be explained by reinforcing parental investment toward the exposed child. Accordingly, the program effects are estimated controlling for sibling fixed effects by pooling the male-female sample. The results indicate suggestive evidence toward reinforcing investments (compensatory investment should eliminate any strong program impacts) as the estimates for health and cognition index are larger with the sibling fixed effects. Results are available upon request.

children at an older age, maternal age at the time of the survey is included as an additional outcome variable. Thus, these regressions mimic the main regressions, except the outcome variables are now maternal characteristics. The results clearly show that the program did not lead to any change in maternal characteristics. Thus, it is unlikely that there is an over-representation of individuals with educated mothers in the sample so as to confound the main results. The conclusions do not change if this exercise is done separately for male and female samples (results not shown in the paper).

A more explicit assessment of the parallel pre-trends assumption is explored by examining the impact of placebo reforms.[41] For this test, consider the cohort born between 1974 and 1984 and assume that a midwife started working in the community 10 years before she actually started working. For example, if a midwife started working in a community in 1990, it is assumed that the midwife started working in 1980. Based on the assumed placement year and actual birth year, one can now create the exposure measures. In the absence of non-parallel trends, it is unlikely one will find estimates of the impact of midwives that are similar to the ones found earlier. Table 8 presents the results—the new estimates are much smaller and are usually insignificant at conventional significance levels. Thus, there is not sufficient evidence to reject the assumption of parallel trends between program receiving and non-receiving communities.

One important concern with the analyses involving long-term outcomes is selective attrition. While the IFLS team puts a great effort in following up households and respondents, not all the individuals, who were born between 1984-1994 in the IFLS households, are interviewed in the IFLS 5, conducted in 2014. Thus, it is obligatory to examine if there is any selective attrition with respect to the program. The panel structure of the IFLS can be used to test for this possibility. First, consider the entire sample of births for IFLS between 1984-1994 from IFLS 1 and IFLS 2 and calculate the amount of exposure to midwives in their community of birth. Finally, match this sample of children with the set of individuals who could not be tracked in IFLS 5 and regress a dummy, if an individual could be tracked in IFLS 5 on early life midwife exposure. Online

[41] The authors thank an anonymous referee for suggesting this exercise.

Appendix Table S7.11 shows the results. This result suggests that the main results do not suffer from the problem of selective attrition. Although there is 23 percent attrition over 30 years, the attrition is unrelated to midwife exposure.

Finally, the identification comes from variation in allotment of midwives across communities and birth cohorts. Other programs initiated by the government at the same time can confound the results. In 1993, the Indonesian government initiated the *Inpres Desa Tertinggal* (IDT) program. Besides the goals of strengthening the democratic institution and supporting the decentralization policy, the program aided families below the poverty line and human resource development (Shah et al., 1994). Since the timing of IDT overlaps with the timing of the midwife program, it is important to evaluate whether the exposure estimates of the midwife are robust to the inclusion of IDT exposure. Fortunately, the second wave of the IFLS has information on the availability and start time for IDT in a community. A dummy exposure measure based on the timing of IDT and birth year of children is used: it takes a value of 1 if a child was exposed to program at an age younger than four and 0 otherwise. Online Appendix Table S7.12 reports the results. The results indicate that midwife exposure estimates for different indices remain comparable to those without the inclusion of IDT.

6.3 Multiple Inference Adjustment

Recall that this paper has presented results on four indices. It is imperative to calculate statistical significance after adjusting for multiple comparisons. Online Appendix Table S7.13, presents both naive p-values as well as p-values after controlling for family wise error rate (FWER).[42] The table shows that the *in utero* estimates of health index and economic index for males remain statistically significant (less than 0.10) even after controlling for FWER.

There are 14 adult outcomes in this paper. Given these large number of individual outcomes, one may observe statistical significance for these outcomes by chance. To address this concern, q-values, following Anderson (2008), are calculated. Online Appendix Table S7.14 reports the

[42] The FWER is calculated using the free step-down resampling method (Westfall and Young, 1993).

q-values for treatment estimates for males and females separately. The results indicate that none of the *in utero* exposure estimates are significant at the 10 percent level. This means that *in utero* exposure to the midwife program has led to better overall health, cognition, and economic outcomes but has not led to betterment of any specific outcome.

7 Conclusion

This paper presents evidence that access to basic health care early in life improves health, cognition, and economic outcomes for adult males. It focuses on the introduction of midwives in Indonesia during the late 80s that aimed at providing important health services to reproductive age women and little children. Exploiting the variation in the timing of implementation across communities, it shows that a child's exposure to a midwife *in utero* of life improves adult health (height, subjective health condition—both observed and self-reported, lung capacity, incidence of not underweight, and absence of hypertension), cognition (Raven test and memory performance), and economic well-being (monthly income and years of education) among adult males. It does not find any evidence of sample selection in terms of parental characteristics or attrition. The results are robust to a number of checks: inclusion of controls for time-varying community characteristics, various placebo tests, and event study models. An important finding of this paper is that exposure during *in utero* period matters the most–exposure to midwives later in life is mostly ineffective in improving adult outcomes.

Since midwives act as a general health resource in a community, they provide a host of services to people of all ages and both genders and also play a key role in raising health awareness in the community (Frankenberg and Thomas, 2001). Naturally, it is difficult to disentangle the relative importance of different program components for the observed program effects and to pinpoint the exact set of mechanisms that can explain the results. The analysis of this paper and previous studies roughly suggests that access to midwives leads to greater usage of antenatal care and better short-term health status for mothers of reproductive age, which translates into better nutrition and cognition for infant boys (and, to some extent, girls). Another pathway could be totally informational where parents engage in better health and hygienic behavior due to greater awareness (Lazuka, 2018; Bhalotra et al., 2017; Hjort et al., 2017). If this is true, such interventions can properly orient parental investment in child health by providing greater knowledge and skills for child development to parents and thus can have long run positive consequences.

From the policy point of view, this paper indicates the potential benefits of public health investments in resource-strapped developing economies. The evaluation of such programs usually suffers from the challenges of non-random program placement and a strong focus on short-term outcomes only. Thus, it is not clear if access to the public health care system really improves health in the long-term (Coarasa et al., 2014). This analysis addresses the concerns of endogenous program placement and indicates that a widespread basic health program, such as the Village Midwife Program in Indonesia, can be extremely effective in raising the living standards of a great number of people several decades later. A proper cost-benefit analysis of such programs must factor in these long-term benefits.

One important topic for future research is examining the long-term impact of midwife exposure on personality traits, including perseverance, patience, and concentration. Recent research highlights these factors as important in determining adult health, non-health, and different economic outcomes (Heckman, 2007). Also, it is worthwhile to examine the role of potential complementarities for the success of midwife programs. There is suggestive evidence that the prosperous regions have benefited more from the program, in part due to greater program intensity and possibly due to the presence of complementary factors, such as better schools and the availability of jobs. As such, an important area of future research could be to examine this program in connection to other public interventions, such as schooling, other health interventions, employment guarantee, social insurance schemes, and food security. Finally, another interesting avenue of future research could be whether the program is more effective for children who are born during negative shocks. Recently, a number of papers have used bad rainfall years as negative shocks, and then explored whether government programs can help these children catch up in the later period (see Duque et al. (2018);

Adhvaryu et al. (2018)). It might be useful to learn whether midwives had a larger positive impact on children who experienced a negative shock in early life.

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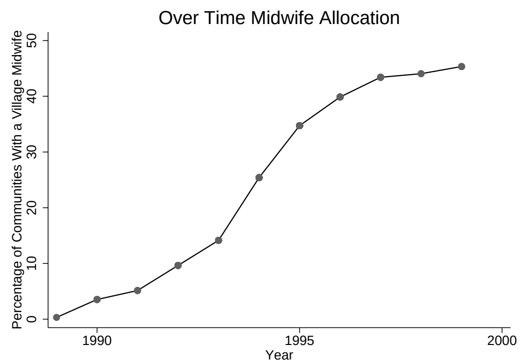
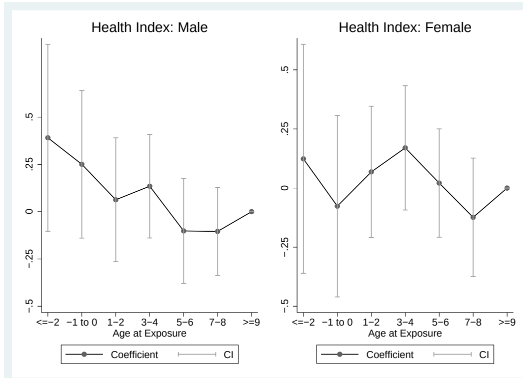
8 Figures

Figure 1: Rollout of Midwives



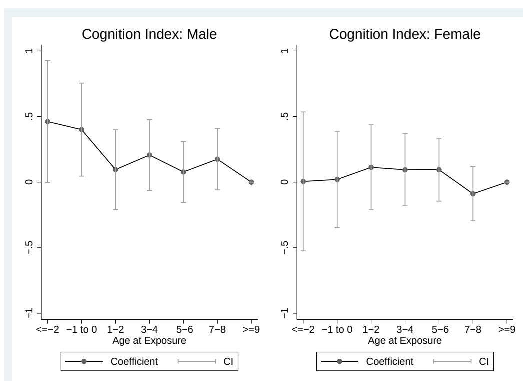
Notes: The figure is based on the community data of the IFLS. There are total 311 communities in the IFLS.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Figure 2: Event Study Health Index



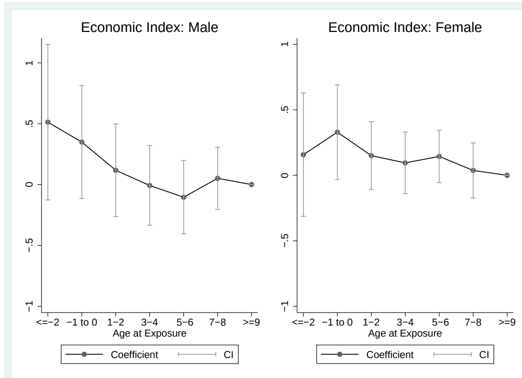
Notes: Event study coefficients are plotted in the figure for health index. Event time is defined as the age when the midwife program started in the community of residence. The age of exposure is calculated using birth year and the year the midwife started working in the community. Age greater than 9 or above is the omitted category.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Figure 3: Event Study Cognitive Index



Notes: Event study coefficients are plotted in the figure for cognition index. Event time is defined as the age when the midwife program started in the community of residence. The age of exposure is calculated using birth year and the year the midwife started working in the community. Age greater than 9 or above is the omitted category.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Figure 4: Event Study Economic Index



Notes: Event study coefficients are plotted in the figure for economic index. Event time is defined as the age when the midwife program started in the community of residence. The age of exposure is calculated using birth year and the year the midwife started working in the community. Age greater than 9 or above is the omitted category.
Source: Authors' analysis based on The Indonesian Family Life Survey.

9 Tables

Table 1: Summary Statistics

Male Sample

Variables	Observations	Mean	SD
Economic Index: Male	1771	2.67	1.04
Years of Education	2303	9.70	3.39
Natural Log of Income	1775	14.25	0.80
Health Index: Male	2014	0.11	1.02
General Health Status	2037	7.17	1.08
Not Underweight(=1)	2033	0.83	0.37
Natural log of Average Lung Capacity	2024	6.44	0.15
Absence of Hypertension(=1)	2030	0.89	0.31
Height in CM	2034	164.76	6.03
Self-Reported Health Status	2033	1.93	0.62
Cognitive Tests Index: Male	2306	0.03	1.07
Raven test score (Proportion Corrected)	2306	0.66	0.32
Memory Test 1	2309	4.94	2.40
Memory Test 2	2309	4.19	2.23
Math Tests Index: Male	2008	0.36	1.04
Basic math test (Proportion Corrected)	2306	0.34	0.30
Answered All Five Subtraction Questions Correctly=(1)	2309	0.40	0.49
Block Number Test	2010	9.40	3.30

Female Sample

Variables	Observations	Mean	SD
Economic Index:Female	2249	0.11	1.03
Years of Education	2374	10.03	3.50
Primary Activity Last Week: Earn Income, Search Job, Attend School (=1)	2253	0.49	0.50
Health Index: Female	2197	0.18	1.00
General Health Status	2243	7.02	1.06
Not Underweight(=1)	2237	0.90	0.31
Natural log of Average Lung Capacity	2232	6.15	0.13
Absence of Hypertension(=1)	2219	0.94	0.23
Height in CM	2242	152.68	5.51
Self-Reported Health Status	2237	2.00	0.63
Cognitive Tests Index: Female	2378	0.05	1.05
Raven test score (Proportion Corrected)	2378	0.67	0.28
Memory Test 1	2378	5.52	2.06
Memory Test 2	2378	4.62	2.03
Math Tests Index: Female	2226	0.17	1.02
Basic math test (Proportion Corrected)	2378	0.39	0.31
Answered All Five Subtraction Questions Correctly=(1)	2378	0.43	0.49
Block Number Test	2226	9.06	3.35

Notes: Calculations are based on the information from IFLS 5. Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 2: Exposure to Midwives and Health Index

	Health Index	Genereal Health Status	Not Underweight	Ln Lung Capacity	Absence of Hypertension	Height	Self-reported Health Status
Panel A: Male							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Exposed During In Utero	0.381**	0.071	0.040	0.053**	0.040	2.047*	0.008
	(0.152)	(0.171)	(0.068)	(0.024)	(0.044)	(1.117)	(0.104)
Exposure During First Three Years After Birth	0.153	0.063	0.001	0.026*	0.038	0.480	-0.011
	(0.113)	(0.119)	(0.042)	(0.015)	(0.039)	(0.659)	(0.068)
R2	0.244	0.290	0.228	0.268	0.200	0.264	0.211
Observations	2014	2037	2033	2024	2030	2034	2033
Mean of Dependent Variable	0.110	7.173	0.832	6.437	0.892	164.764	1.932
Joint Significance	2.62	1.80	0.20	1.72	0.61	1.50	0.03
P-Value-Joint Significance	0.05	0.15	0.89	0.16	0.61	0.22	0.99
P-value(In Utero-Early Life)	0.10	0.96	0.50	0.12	0.95	0.09	0.81
Panel B: Female							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Exposed During In Utero	-0.018	-0.143	-0.031	0.014	0.017	-0.334	0.014
	(0.149)	(0.154)	(0.045)	(0.021)	(0.037)	(0.975)	(0.091)
Exposure During First Three Years After Birth	0.092	0.067	-0.062*	0.032***	-0.016	0.265	0.103
	(0.090)	(0.097)	(0.036)	(0.012)	(0.023)	(0.461)	(0.064)
R2	0.249	0.254	0.218	0.246	0.166	0.266	0.191
Observations	2197	2243	2237	2232	2219	2242	2237
Mean of Dependent Variable	0.180	7.023	0.895	6.148	0.942	152.681	1.999
Joint Significance	1.98	0.83	1.18	2.25	2.83	0.31	1.39
P-Value-Joint Significance	0.12	0.48	0.32	0.08	0.04	0.82	0.24
P-value(In Utero-Early Life)	0.41	0.13	0.49	0.39	0.28	0.48	0.23

Notes: Standard errors are clustered at the community level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal education, maternal age at survey, province-specific linear trends, 1983 district characteristics interacted with birth year dummies and time-varying community characteristics. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility. The regressors also include age at exposure at the fourth year, but the coefficient estimate is not reported in the table. General health status takes value from 1 to 9, the higher value means better. Not underweight takes a value of 1 if BMI is 18.5 or higher and 0 otherwise. Ln Lung Capacity is natural log of lung capacity. Absence of hypertension takes a value of 1 if either systolic measure is not greater than 140 or diastolic measure is not greater than 90 and 0 otherwise. Height is measured in centimeter. Self-reported health status takes a value from 1 to 4, the higher value means better.

Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 3: Exposure to Midwives and Cognitive Index

	Cognitive Index	Raven Test	Memory Test 1	Memory Test 2
Panel A: Male				
	(1)	(2)	(3)	(4)
Exposed During In Utero	0.324**	0.110**	0.551*	0.464
	(0.150)	(0.046)	(0.327)	(0.317)
Exposure During First Three Years After Birth	0.054	0.032	0.161	-0.071
	(0.107)	(0.032)	(0.237)	(0.222)
R2	0.241	0.228	0.235	0.230
Observations	2306	2306	2309	2309
Mean of Dependent Variable	0.026	0.659	4.944	4.186
Joint Significance	1.91	2.43	1.05	1.70
P-Value-Joint Significance	0.13	0.07	0.37	0.17
P-value(In Utero-Early Life)	0.03	0.03	0.15	0.05
Panel B: Female				
	(1)	(2)	(3)	(4)
Exposed During In Utero	-0.047	-0.003	0.082	-0.222
	(0.143)	(0.040)	(0.270)	(0.273)
Exposure During First Three Years After Birth	0.041	-0.016	0.256	0.208
	(0.109)	(0.031)	(0.191)	(0.195)
R2	0.226	0.224	0.210	0.215
Observations	2378	2378	2378	2378
Mean of Dependent Variable	0.054	0.670	5.516	4.621
Joint Significance	0.84	1.26	0.97	1.49
P-Value-Joint Significance	0.47	0.29	0.41	0.22
P-value(In Utero-Early Life)	0.43	0.68	0.38	0.05

Notes: Standard errors are clustered at the community level (*** $p<0.01$, ** $p<0.05$, * $p<0.1$). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal education, maternal age at survey, province-specific linear trends, 1983 district characteristics interacted with birth year dummies and time-varying community characteristics. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility. The regressors also include exposure at age four, but the coefficient estimate is not reported in the table. Raven test measures proportion of Raven test questions corrected by the sampled individual. Both memory tests take value 0 to 10, the higher means better.

Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 4: Exposure to Midwives and Math Test Index

	Math Test Index	Math Test	Subtraction Test	Block Test
Panel A: Male				
	(1)	(2)	(3)	(4)
Exposed During In Utero	0.110	0.028	0.126*	-0.080
	(0.159)	(0.043)	(0.073)	(0.521)
Exposure During First Three Years After Birth	0.006	-0.018	0.006	0.076
	(0.100)	(0.027)	(0.047)	(0.363)
R2	0.303	0.241	0.217	0.257
Observations	2008	2306	2309	2010
Mean of Dependent Variable	0.362	0.342	0.404	9.399
Joint Significance	0.37	0.76	1.78	0.13
P-Value-Joint Significance	0.77	0.52	0.15	0.94
P-value(In Utero-Early Life)	0.42	0.19	0.05	0.71
Panel B: Female				
	(1)	(2)	(3)	(4)
Exposed During In Utero	-0.149	-0.085**	0.039	-0.139
	(0.149)	(0.039)	(0.073)	(0.553)
Exposure During First Three Years After Birth	-0.079	-0.023	-0.014	0.200
	(0.099)	(0.030)	(0.047)	(0.319)
R2	0.354	0.275	0.219	0.290
Observations	2226	2378	2378	2226
Mean of Dependent Variable	0.175	0.389	0.429	9.056
Joint Significance	0.44	1.70	0.23	0.37
P-Value-Joint Significance	0.73	0.17	0.88	0.78
P-value(In Utero-Early Life)	0.60	0.07	0.42	0.47

Notes: Standard errors are clustered at the community level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal education, maternal age at survey, province-specific linear trends, 1983 district characteristics interacted with birth year dummies and time-varying community characteristics. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility. The regressors also include exposure at age four, but the coefficient estimate is not reported in the table. Math test measures proportion of questions corrected by the sampled individual. Subtraction test takes a value of 1 if the participant corrected all five questions and 0 otherwise. Block test takes value from 0 to 16, the higher means better. See the Data Appendix to learn more about the construction of block test.

Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 5: Exposure to Midwives and Economic Index

	Economic Index	Natural Log of Income	Years of Education
Panel A: Male			
	(1)	(2)	(3)
Exposed During In Utero	0.435**	0.354**	0.478
	(0.197)	(0.157)	(0.470)
Exposure During First Three Years After Birth	0.101	0.099	-0.223
	(0.128)	(0.100)	(0.330)
R2	0.335	0.311	0.415
Observations	1771	1775	2303
Mean of Dependent Variable	2.669	14.245	9.704
Joint Significance	1.80	1.91	2.07
P-Value-Joint Significance	0.15	0.13	0.10
P-value(In Utero-Early Life)	0.04	0.05	0.06
Panel B: Female			
	Economic Index	**Primary Activity (School or Job)**	**Years of Education**
	(1)	(2)	(3)
Exposed During In Utero	0.163	0.029	0.799*
	(0.143)	(0.078)	(0.421)
Exposure During First Three Years After Birth	0.042	0.052	0.038
	(0.094)	(0.050)	(0.282)
R2	0.418	0.265	0.479
Observations	2249	2253	2374
Mean of Dependent Variable	0.113	0.493	10.035
Joint Significance	0.45	0.43	1.76
P-Value-Joint Significance	0.72	0.73	0.15
P-value(In Utero-Early Life)	0.35	0.73	0.05

Notes: Standard errors are clustered at the community level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal education, maternal age at survey, province-specific linear trends, 1983 district characteristics interacted with birth year dummies and time-varying community characteristics. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility. The regressors also include exposure at age four, but the coefficient estimate is not reported in the table. Primary activity school or job takes a value of 1 if the primary activity of the participant is job searching or attending school and 0 otherwise.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 6: Effects of Midwives on Prenatal and Postnatal Inputs–Cohorts Born Between 1989 and 1994

	Excluding Trend Variables					Including Trend Variables				
	Antenatal Care	Attendance of Midwife During Birth	Attendance of Physician or Nurse During Birth	Breastfed Six Months	Exclusive Breastfeeding Duration	Antenatal Care	Attendance of Midwife During Birth	Attendance of Physician or Nurse During Birth	Breastfed Six Months	Exclusive Breastfeeding Duration
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exposed During In Utero	0.102**	0.164***	0.002	-0.023	0.056	0.079**	0.147***	-0.000	-0.041	0.060
	(0.043)	(0.045)	(0.026)	(0.053)	(0.146)	(0.040)	(0.041)	(0.026)	(0.052)	(0.137)
R2	0.335	0.432	0.282	0.344		0.350	0.449	0.296	0.357	
Observations	2162	2227	2227	2163	2147	2162	2227	2227	2163	2147
Mean of Dependent Variable	0.880	0.336	0.071	0.429	9.129	0.880	0.336	0.071	0.429	9.129

Notes: Standard errors are clustered at the community level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal age, maternal education, and time varying community characteristics. The last four columns also include province-specific linear trends and 1983 district characteristics interacted with birth year dummies. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility. The variable "Antenatal Care" takes a value of 1 if the mother has sought a pregnancy check-up, and 0 otherwise. The variable "Attendance of Midwife During Birth" takes a value of 1 if mother received care from a village midwife and 0 otherwise. "Attendance of Physician and Nurse During Birth" takes the value of 1 if mother received care from physician and nurse and 0 otherwise. The variable "Breastfed Six Months" takes a value of 1 if mother has exclusively fed her child breast milk for at least six months, and 0 otherwise. "Exclusive breastfeeding duration" measures number of a mother has breastfed a child exclusively. Cox proportional hazard model was used to calculate the estimates for "Exclusive breastfeeding duration"–column (4) and (8) report coefficients.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 7: Exposure to Midwives and Birth Weight–Cohorts Born Between 1989 to 1994

	Excluding Trend Variables	Including Trend Variables
	(1)	(2)
Exposed During In Utero	0.146*	0.169**
	(0.083)	(0.085)
R2	0.316	0.335
Observations	1333	1333
Mean of Dependent Variable	3.167	3.167

Notes: Standard errors are clustered at the community level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include dummy for child gender, community fixed effects, birth month fixed effects, birth year fixed effects, maternal age, maternal education, and time varying community characteristics. Column (2) also includes province-specific linear trends and 1983 district characteristics interacted with birth year dummies. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Time-varying community characteristics include: paved road status, electricity status, number of health posts, urban status, public phone status, distance to market, distance to the district capital center, and distance to the nearest health facility.
Source: Authors' analysis based on The Indonesian Family Life Survey.

Table 8: Program Exposure on Various Indices—Placebo Treatment: Cohorts Born Between 1974 to 1984

	Health Index	Cognitive Index	Economic Index	Math Test Index
Panel A: Male Sample				
	(1)	(2)	(3)	(4)
Exposed During In Utero	-0.098	-0.205	-0.015	0.054
	(0.139)	(0.129)	(0.158)	(0.168)
Exposure During First Three Years After Birth	-0.069	-0.006	0.068	0.022
	(0.093)	(0.095)	(0.104)	(0.108)
R2	0.216	0.202	0.309	0.314
Observations	1989	2264	1969	1981
Mean of Dependent Variable	0.092	0.009	1.722	0.333
Joint Significance	0.24	3.05	0.34	0.92
P-Value	0.87	0.03	0.79	0.43
Panel B: Female Sample				
	(1)	(2)	(3)	(4)
Exposed During In Utero	0.163	0.071	0.069	0.251*
	(0.151)	(0.147)	(0.132)	(0.132)
Exposure During First Three Years After Birth	0.067	0.069	0.015	0.081
	(0.104)	(0.097)	(0.091)	(0.101)
R2	0.215	0.247	0.366	0.344
Observations	2034	2240	2118	2070
Mean of Dependent Variable	0.259	0.097	0.140	0.318
Joint Significance	0.46	0.29	0.12	1.37
P-Value	0.71	0.83	0.95	0.25

Notes: Standard errors are clustered at the community level (*** $p<0.01$, ** $p<0.05$, * $p<0.1$). All regressions include community fixed effects, birth month fixed effects, birth year fixed effects, maternal education, maternal age at survey, and province-specific linear trends. The variable maternal education has spline with knots at 6,9, and 12 and maternal age at survey has splines with knots at 20, 25, 30, 35, 40, and 45. Exposure measures were constructed assuming that the midwives started working 10 years before the actual start year. The regressors also include exposure at age four, but the coefficient estimate is not reported in the table.

Source: Authors' analysis based on The Indonesian Family Life Survey.