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MICRO-ANALYSIS OF MOTHER'S EDUCATION AND CHILD MORTALITY: EVIDENCE FROM UGANDA†

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Abstract: We use maximum likelihood models to analyse the impact of mother's education on infant and child mortality in Uganda. The data were obtained from the Uganda Demographic and Health Survey 2006. Our results confirm the hypothesis that mother's education is fundamental in reducing infant and child mortality. This suggests that efforts to reduce child mortality need to target measures that aim to educate women. The government programme to extend free education at the secondary level is therefore a commendable effort that needs to be strengthened. This therefore needs to be embraced by all stakeholders to encourage girls to attain education beyond secondary level. Copyright © 2011 John Wiley & Sons, Ltd.

Keywords: mother's education; neonatal; post-neonatal; child mortality

1 INTRODUCTION AND STUDY CONCERN

The government of Uganda has implemented a number of institutional and economic reforms over the past two decades or so. These reforms have shaped a more conducive economic environment that has enhanced private sector participation in the economy and a robust GDP growth averaging of 6.3 per cent for 1992/1993–2006/2007. The economy has also witnessed a structural transformation with the services sector contributing more to GDP than agriculture. The government is also highly committed to achieving the targets set out in the Millennium Development Goals (MDGs): spanning health, education, poverty and environment; these goals spell out the milestones to be achieved by 2015. Despite the commendable efforts, huge challenges still remain. Uganda experiences some of the poorest health indicators in the world. For example, the country's life expectancy at birth of about 50 years is very low compared to the world average of about 66 years. According the Uganda Demographic and Health Survey

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Report (2006), one in every 13 babies born in Uganda does not live to the first birthday while those who survive to the first birthday, 67 out of 1000 would die before reaching their fifth birthday. The overall under-five mortality is 137 deaths per 1000 live births, which implies that one in every seven Ugandan babies does not survive to the fifth birthday. It is noteworthy that the survival rate is lower in the first month of a baby's life. According to the Uganda Bureau of Statistics and Macro International Inc. (2007), the neonatal mortality rate (between 1–27 days of life) is 29 deaths per 1000 live births, implying that nearly four out of every 10 infants die during the first month of life. On the other hand, post-neonatal mortality (between 1 month and 1 year of life) in Uganda is also relatively high, 46 per 1000 live births. The reduction of child mortality levels to half the level that was recorded in the year 2000 is one of the critical issues of the MDGs. Uganda, like other developing countries, shares the challenge and reduction of child mortality is pronounced as an express goal of population health programme efforts.

The Uganda Demographic and Health Survey Report (DHS, 2006) elaborated some of the factors that contribute to child mortality rate. The factors considered include age of the mother at birth, birth order, residence, region, wealth and mother's education level. It should be noted, however, that the DHS analysis is descriptive in nature and, therefore, does not provide a rigorous quantitative analysis. The descriptive evidence in the DHS Report underscores the importance of mother's education in reducing child mortality showing that mothers who have attained at least secondary education are associated with a lower child mortality rate, i.e. children borne to such women have 40 per cent less chances of dying before their fifth birthday than children whose mothers had no education. The under-five mortality rate for children whose mothers had primary education is 12 per cent lower than that of infants whose mothers had no education. Thus, it is reasonable to speculate that the introduction of Universal Secondary Education (USE) may be associated in the future with lower levels of under-five mortality, particularly improved survival of children between their first and fifth birthdays. The noted differences in child mortality among subgroups of the population (divided along certain key parameters like education) are useful for programme planning and targeting resources to areas in need. This paper analyses, quantitatively, the impact of mother's education on child mortality in Uganda with a view of suggesting possible policy implications. We provide answers to the following questions: does the level of education acquired by the mother influence child mortality? If so, what level of mother's schooling has a significant negative impact on child mortality in Uganda? What is the impact of other demographic and socioeconomic factors on neonatal, post-neonatal and child mortality in Uganda?

The study comes at such a time when the Government of Uganda and other stakeholders are committed to achieving the highest possible child health outcomes in line with the MDGs. Mother's education achievement is important in improving the health status of a child at birth and hence it must be a good way of reducing child's vulnerability to the risk of childhood illnesses and the chances of survival. This study provides evidence on the impact of mother's education on child mortality which will be useful in devising policies to achieve the desired child health outcomes. It will also add to the stock of knowledge on mother's education and the production of child health.

Empirical evidence explaining the cause of high mortality rate in Uganda remains scanty despite the international and national commitment towards the attainment of the MDGs by 2015. At the national level, previous work in Uganda has linked the variations in infant mortality to the HIV/AIDS epidemic (Ntozi *et al*., 1997). At a microeconomic level, Moller (2002) examines simple and multivariate correlations of a variety of household and community level variables with infant mortality. Ssewanyana and Younger (2004) investigate the

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determinants of infant mortality rates in Uganda using UDHS (2001); they find that household income, mothers' education and child vaccination have a significant effect in reducing infant mortality in Uganda. The current study extends the analysis of the relationship between mother's education and mortality by addressing the different forms of child mortality before the fifth birthday; neonatal (1–27 days of life), post-neonatal (1 month to 1 year of life) and child mortality (1–5 years of life) using the most recent DHS data set of 2006. These relationships have not been rigorously examined in Uganda, so this paper represents a real value added.

The paper is organised as follows: the preceding section presents the introduction and the study concern. The section that follows presents the theoretical and empirical literature related to the study. Section 3 presents the theoretical framework, estimation strategy and a description of the dataset. Section 4 presents and discusses the empirical findings while the last section concludes the study with the paper's implications for policy.

2 SELECTED LITERATURE

A fairly wide body of literature exists on the positive role that mother's education plays in the utilisation of health care services and the achievement of better child quality outcomes such as lower mortality rates (Caldwell, 1979; Cochrane *et al*., 1980; Cleland and van Ginneken, 1988; Cleland, 1990; Tulasidhar, 1993; Debpuur *et al*., 2005, Hosseinpoor *et al*., 2005). These authors present important pathways through which education of the mother contributes to the reduction of child mortality. According to Tulasidhar (1993), education of the mother may have both direct and indirect pathways through which it may contribute to mortality reduction. Indirectly, educated women are associated with a different fertility behaviour and higher economic and social status, which together reduce the risk of infant mortality. The contribution of the change in the fertility behaviour of educated women is observed in the shift away from quantity (numbers of children per se) to quality (usually fewer children but with first class quality outcomes in terms of health and education). This is emphasised by Hobcraft (1993) who argues that education of the mother reduces infant mortality through reduced fertility rates owing to late marriages as well as the ability to utilise modern health care services such as maternal health care and immunisation. In yet another study, Al-Meshari *et al*. (1996) indicate that, compared to illiterates, educated females in Saudi Arabia bear fewer children and achieve lower rates of mortality. Also, maternal education increases female labour force participation and hence changes the socioeconomic status of women and increases the likelihood of positively influencing the health of their children. Additionally, education changes the traditional balance of family relationships that shifts power away from the kin group and allows mothers to assume greater responsibility for their own health as well as that of their children (Caldwell, 1986).

Directly, education causes mothers to appreciate the importance of best practices in child care activities that include immunisation, feeding and seeking modern health care in case of sickness (Mosley and Chen, 1984; Cleland and van Ginneken, 1988; Tulasidhar, 1993). It is argued by Mwabu (2009) that health production begins in a mother's womb. Therefore, the ability of women to seek modern maternal health care services (which is highest in educated women) increases the chances of child survival during delivery and afterwards. Some authors contend that, compared to their counterparts, educated women have superior awareness of diseases and that they seek immediate and modern treatment (Cleland and van Ginneken, 1988 and Tulasidhar 1993). However, the health consequences of maternal education are not entirely without dispute. Some scholars (Caldwell *et al*., 1983; Lindenbaum *et al*., 1985)

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believe that mothers, especially at a lower level of education, may not necessarily have superior awareness of diseases and other health care related details. In another study conducted in Kenya, Hill *et al*. (2001) found that education of the mother and wealth status of household are negatively related to infant mortality. Without controlling for the HIV prevalence, the author finds that urban areas had a higher risk of infant mortality compared to the rural area. After controlling for HIV prevalence, the reverse was observed.

Mutunga (2004) undertook a comprehensive analysis of the factors influencing child mortality. In line with the theoretical exposition presented in Tulasidhar (1993), he pointed out a number of external factors most likely reducing the risk of infant and child mortality. These included among others living in wealthier households, access to drinking water and sanitation facilities and using low polluting fuels as the main source of cooking. Surprisingly, the author finds that maternal education had no significant association with child mortality. On the contrary, Maglad (1993), in a study based on household data from Sudan, revealed that parental education, income per adult and public health programs are significantly and negatively correlated with child mortality. Maternal education, in particular, is found to have a larger significant effect than that of the father.

There seems to be an agreement in the literature that the factors influencing infant and child mortality are age cohort specific. When children are still in their infancy stage, it is mainly the biological factors, such as breast feeding playing an important role (Cleland and van Ginneken, 1988; Tulasidhar 1993). However, as they grow up there are other factors called external or environmental factors as well as the child care practices that matter more than the biological factors. The environmental factors include among others, the existence of high quality and affordable health facilities such as public hospitals and health centers, accessibility to safe water sources, good housing facilities and good toilet types that facilitate good sanitary environment. These factors are argued to strengthen the contracting influence of maternal education on child mortality. Timaeus and Lush (1995), in a comparative study of rural areas of Ghana, Egypt, Brazil and Thailand, find out that children's health is affected by environmental conditions and the economic status of the household. Therefore, any study intending to lend an empirical regularity to the factors influencing child mortality need to take a holistic approach considering a whole set of factors at different stages of a child's life.

There is no consensus in the literature on the role of female labour force participation in reducing child mortality. It is presented by some authors as a 'blessing' and yet by other authors as a 'curse'. Along the line of a blessing, it is argued that female labour force participation stimulates the household's earning capacity and hence the household will afford the primary health care of children as well as good nutrition or feeding. On the other hand, working mothers have very little time devoted to their children and miss out on important issues such as breast feeding which may result into stunted growth of children. Working mothers usually leave their children in the attention of house helps who in many developing countries are not educated and, therefore, cannot follow up a child's health growth record. The net outcome of female labour force participation remains unclear being pulled either side by these two conflicting forces. Tulasidhar (1993) finds that child mortality is inversely related to both maternal education and female labour force participation. However, in his disaggregated analysis he finds that female labour force participation has no impact on child mortality among females with fewer than 7 years of education. A study by Hojman (1996) shows that increases in income are usually associated with a higher degree of female participation in the labour force, which, in turn, reduces the demand for children because the opportunity cost of rearing children will be

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higher. Waldmann (1992) argues that unequal access for males and females to economic opportunities; education, health and other social services, adversely affects the health prospects of infants and children. This emphasises the need for female education and the eventual labour force participation.

In summary, the body of literature reviewed has exposed a number of factors influencing child mortality which this paper benefits from during the empirical analysis.

3 THEORETICAL FRAMEWORK

In the recent years, economists have began to look more closely at the microeconomic determinants of household health in an attempt to provide a better theoretical and empirical explanation of the various health outcomes such as child mortality, maternal mortality, fertility and maternal health care utilisation, etc. The analysis and models used draw on both traditional and neoclassical theories of household and consumer behaviour and the principle of optimisation to explain the production of household health. Intrinsic in the model is the need to maximise household welfare, by making a choice between a certain level of health and other consumption goods. In the model, health is treated as a special form of good, from which satisfaction is derived and the cost of which is the time and money required to produce a given level of health.

3.1 Model Specification and Estimation Strategy

According to the Grossman's model (1972), households demand a certain level of health (h) in order to maximise utility subject to a given set of constraints. The utility of a typical household is also a function of the consumption of market goods(g), leisure(l) and taste (t) (Sackey, 2005). The same line of argument has been pursued by other authors; Mwabu (2009) used a simplified version of Rosenzweig and Schultz's (1982) model to study the production of child health in Kenya. The household is assumed to maximise a well-behaved twice differentiable utility function subject to a given set of constraints.

$$U = U[h, g, l, t] \tag{1}$$

In this model, we present the production function for child health. This relates health inputs to child health outcome (in this case child mortality rate). Health inputs include market purchased health inputs (e.g. medical care), time of the mother and father in producing child health, education of the mother and father and the term for the innate child health.

$$h = h(n, m_t, f_t, m_e, f_e, \omega) \tag{2}$$

where n, m_t, f_t, m_e, f_e, and ω refer to market purchased child health inputs (such as medical care), time of the mother devoted to producing child health, time of the father devoted to producing child health, education of the mother, education of the father and the innate child health, respectively.

There are two time constraints, one for the mother and the other for the father. Basic to the theory of child health production is the assumption that the various activities requiring the input of human time are mutually exclusive, implying that not too many activities can be undertaken at the same time. Total time of either the mother or father can be allocated to

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leisure, work and child health.

$$\begin{aligned} f_{\mathrm{T}} &= t_{\mathrm{f}} + y_{\mathrm{f}} + f_{\mathrm{t}} \\ m_{\mathrm{T}} &= t_{\mathrm{m}} + y_{\mathrm{m}} + m_{\mathrm{t}} \end{aligned} \tag{3}$$

where $f_{\mathrm{T}}, t_{\mathrm{f}}, y_{\mathrm{f}}$, and f_{t} is total time available to the father, distributed to leisure, work and producing child health, respectively. $m_{\mathrm{T}}, t_{\mathrm{m}}, y_{\mathrm{m}}$, and m_{t} is total time available to the mother, distributed to leisure, work and producing child health, respectively. We finally introduce a budget constraint that relates expenditures to income. Expenditures are spent on the composite good, market purchased child health inputs and leisure good. Income sources are earnings of both the mother and the father, and the exogenous non-labour income.

$$P_{\mathrm{n}}n + P_{\mathrm{t}}t + P_{\mathrm{g}}g = y_{\mathrm{m}}w_{\mathrm{m}} + y_{\mathrm{f}}w_{\mathrm{f}} + I \tag{4}$$

where $P_{\mathrm{n}}n$, $P_{\mathrm{t}}t$, $P_{\mathrm{g}}g$, $y_{\mathrm{m}}w_{\mathrm{m}}$, $y_{\mathrm{f}}w_{\mathrm{f}}$, and I refer to the cost of market purchased child health inputs, cost of the leisure good, cost of the composite good, labour income of the mother, labour income of the father and the exogenous non-labour income, respectively.

From this structural model, we can solve for the reduced forms of the endogenous variables (child mortality rate) in terms of exogenous variables. The exogenous variables include child health inputs, education of the mother and father and household wealth (instead of non-labour income). The mother's and father's expected lifetime wage rate is a crucial variable that may affect child health. But since the expected lifetime wage rate is not a directly observable variable, it is prudent to use educational attainment of the father to substitute for wages. On the other hand, mother's age cohort dummies are used as a proxy for the age of the mother at the time of giving birth. We do this later in our model estimations.

Following Schultz (1984), the regression equation to be estimated was specified as follows:

$$nn_i = \alpha_0 + \alpha_1 D_i + \alpha_2 B_i + \varepsilon_{1i} \tag{5}$$

$$D_i = \beta_0 + \beta_1 Z_i + \beta_2 B_i + \beta_3 P_i + \varepsilon_{2i} \tag{6}$$

where nn_i, Z_i, D_i, B_i, and P_i is neonatal mortality rate, child health status, the market purchased child health inputs such as medical care services (antenatal care and/or vaccination etc) that positively influence child health, biological endowments and preferences or goals of the mother, respectively.

Substituting Equation (6) in Equation (5) we get

$$\begin{aligned} nn_i &= \alpha_0 + \alpha_1(\beta_0 + \beta_1 Z_i + \beta_2 B_i + \beta_3 P_i + \varepsilon_{2i}) + \alpha_2 B_i + \varepsilon_{1i} \\ nn_i &= \alpha_0 + \alpha_1\beta_0 + \alpha_1\beta_1 Z_i + \alpha_1\beta_2 B_i + \alpha_1\beta_3 P_i + \alpha_1\varepsilon_{2i} + \alpha_2 B_i + \varepsilon_{1i} \\ nn_i &= (\alpha_0 + \alpha_1\beta_0) + (\alpha_1\beta_1)Z_i + (\alpha_1\beta_2 + \alpha_2)B_i + (\alpha_1\beta_3)P_i + (\alpha_1\varepsilon_{2i} + \varepsilon_{1i}) \\ nn_i &= \delta_0 + \delta_1 Z_i + \delta_2 B_i + \delta_3 P_i + \varepsilon_{3i} \end{aligned} \tag{7}$$

where $\delta_0 = \alpha_0 + \alpha_1\beta_0,\ \delta_1 = \alpha_1\beta_1,\ \delta_2 = \alpha_1\beta_2 + \alpha_2,\ \delta_3 = \alpha_1\beta_3$.

Equation (7) is a reduced form equation for neonatal mortality and we estimated the probability of child death between 1 and 27 days of life. We assume that the error term is well behaved with zero mean and constant variance and that there is no correlation amongst the regressors.

To analyse the post-neonatal (pnm_i)mortality in Uganda, we make the following model specification:

$$pnm_i = \delta_0 + \delta_1 D_i + \delta_2 B_i + e_{1i} \tag{8}$$

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Substituting Equation (6) into (8), we obtain

$$\begin{aligned} pnm_i &= \delta_0 + \delta_1(\beta_0 + \beta_1 Z_i + \beta_2 B_i + \beta_3 P_i + \varepsilon_{2i}) + \delta_2 B_i + e_{1i} \\ pnm_i &= \delta_0 + \delta_1\beta_0 + \delta_1\beta_1 Z_i + \delta_1\beta_2 B_i + \delta_1\beta_3 P_i + \delta_1\varepsilon_{2i} + \delta_2 B_i + e_{1i} \\ pnm_i &= (\delta_0 + \delta_1\beta_0) + (\delta_1\beta_1)Z_i + (\delta_1\beta_2 + \delta_2)B_i + (\delta_1\beta_3)P_i + (\delta_1\varepsilon_{2i} + e_{1i}) \\ pnm_i &= \lambda_0 + \lambda_1 Z_i + \lambda_2 B_i + \lambda_3 P_i + \varepsilon_{4i} \end{aligned} \tag{9}$$

where $\lambda_0 = \delta_0 + \delta_1\beta_0,\ \lambda_1 = \delta_1\beta_1,\ \lambda_2 = \delta_1\beta_2 + \delta_2,\ \lambda_3 = \delta_1\beta_3$.

Equation (9) is a reduced form equation for post-neonatal mortality and we estimated the probability of child death between 1 month and 1 year of life. We assume that the error term is well behaved with zero mean and constant variance and that there is no correlation amongst the regressors.

To analyse child mortality (cm_i) in Uganda we make the following model specification:

$$cm_i = \phi_0 + \phi_1 D_i + \phi_2 B_i + e_{1i} \tag{10}$$

where cm_i is the mortality rate of child i, and the rest of the variables are as defined previously above.

Substituting Equation (6) in Equation (10) we get

$$\begin{aligned} cm_i &= \phi_0 + \phi_1(\beta_0 + \beta_1 Z_i + \beta_2 B_i + \beta_3 P_i + \varepsilon_{2i}) + \phi_2 B_i + e_{1i} \\ cm_i &= \phi_0 + \phi_1\beta_0 + \phi_1\beta_1 Z_i + \phi_1\beta_2 B_i + \phi_1\beta_3 P_i + \phi_1\varepsilon_{2i} + \phi_2 B_i + e_{1i} \\ cm_i &= (\phi_0 + \phi_1\beta_0) + (\phi_1\beta_1)Z_i + (\phi_1\beta_2 + \phi_2)B_i + (\phi_1\beta_3)P_i + (\phi_1\varepsilon_{2i} + e_{1i}) \\ cm_i &= \pi_0 + \pi_1 Z_i + \pi_2 B_i + \pi_3 P_i + \varepsilon_{5i} \end{aligned} \tag{11}$$

where $\pi_0 = \phi_0 + \phi_1\beta_0,\ \pi_1 = \phi_1\beta_1,\ \pi_2 = \phi_1\beta_2 + \phi_2,\ \pi_3 = \alpha_1\beta_3$.

Equation (11) is a reduced form equation for child mortality and we estimated the probability of child death between 1 and 5 years of life. We assume that the error term is well behaved with zero mean and constant variance and that there is no correlation amongst the regressors. In the empirical analysis, child health status was proxied by child birth weight, whether a child was immunised, whether a child ever suffered from killer diseases such as measles, tetanus, malaria, etc. The biological factors were proxied by child sex, whether multiple birth, breast feeding, etc. The preferences or goals of the mother were proxied by education attainment, family planning (fertility choice), breast feeding, labour force participation, age at first birth (captured by mother's age cohorts), whether female head of the household, etc. In addition, based on the literature survey in Section 2, a number of environmental or external factors were captured in the regression. These include source of water, nature of the housing facility, toilet type and quality of primary health care provision, location and regional differences, father's education and age cohorts to capture the lifetime wage rate.

3.2 Data

The data used came from the Demographic and Health Survey (DHS) 2006 conducted by the Uganda Bureau of Statistics (UBOS). The DHS provides a rich source of data on the demographic characteristics of the country. They contain information on household size, age and sex distribution, religious affiliation, occupation of household members, the number of children ever borne by a woman, marital status, educational attainment of

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women and men as well as the average number of children that die before they reach their fifth birth day. The data set also provides a wealth index that is described to be constructed by combining information on household assets, such as ownership of consumer items, type of dwelling, source of water and availability of electricity into a single asset index. The sample is split into five equal groups (quintiles) from the first (lowest, poorest) to fifth (highest, richest).

4 DISCUSSION OF RESULTS

4.1 Introduction

This section presents a discussion of the results of the analysis of the relationship between mother's education and child mortality in Uganda. In the analysis, we include other factors that have an impact on child mortality, based on theory and evidence from other studies. We begin with a discussion of the descriptive evidence on child mortality and household characteristics to provide a foundation for the quantitative results.

4.2 Descriptive Evidence

Table 1a reveals the central role of mothers' education in enhancing the health status of children. It is shown that about 92 per cent of neonatal mortality is for children borne to mothers with no education, 5 per cent for children borne to mothers with primary education, 2 per cent for children borne to mothers with secondary education and only 0.6 per cent for children borne to mothers with post-secondary education. This confirms that infant mortality reduces with the level of education and the picture is not any different when we look at post-neonatal and child mortality. More insights on the relationship between mother's education and the different stages of child mortality can be shown by the pairwise correlation analysis (see Table 2). It is revealed that mother's education and post-neonatal deaths are negatively correlated. It is, therefore, important for the government to put greater efforts towards girl education and also encourage adult mother education in order to reduce the child mortality at different stages. Consequently, government programme of free primary and secondary education will go a long way in solving the child mortality problem and hence they should be strengthened.

Table 1b shows the relationship between child mortality at different stages and child weight at birth. For neonatal mortality, infants whose weight at birth is above average are associated with a death rate of 15 per cent compared to 38 per cent for children whose weight at birth is below average. The post-neonatal rate is about 16 per cent for children whose weight at birth is above average compared to 36 per cent for children whose weight at birth is below average. The child mortality rate is about 36 per cent for children whose weight at birth is below average compared to only 22 per cent for children whose weight at birth is above average. Consequently, the policy implication is that the production of child health right from its mother's womb is instrumental in ensuring a healthy child at birth and, by extension, ensuring the survival of the child. Mothers should be sensitised on the production of a healthy child through proper nutrition as well as access to prenatal, antenatal and postnatal health care services.

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Considering regional differences for the three stages of child mortality, Table 1c presents interesting results. The neonatal mortality rate is 35 per cent for the central, 24 per cent for the eastern region, 22 per cent for the northern region and 19 per cent for the western region. Compared to other regions, it is noteworthy that the central region is a worst performer in the three categories of child mortality with neonatal rate of 35 per cent, post-neonatal rate of 32 per cent and child mortality rate of 34 per cent. There is need for purposive government intervention to especially assist the regions in greater need for health facilities as well as health campaigns and nutrition.

The relationship between father's education and the different mortality measures can be seen in Table 1d. We note a higher neonatal mortality rate of 38 per cent for children borne to fathers with no education, 40 per cent for children borne to fathers with primary education, 16 per cent for children borne to fathers with secondary education, compared to only 6 per cent for children borne to fathers with post-secondary education. In regard to post-neonatal, we find a highest death rate of 40 per cent for children borne to fathers with no education, 38 per cent for children borne to fathers with primary and 16 per cent for children borne to fathers with secondary education, compared to only 6 per cent for children borne to fathers with post-secondary education. Likewise, child mortality is highest with 39 per cent for children borne to fathers with no education, 35 per cent for children borne to fathers with primary education, 20 per cent for children borne to fathers with secondary education and 6 per cent for children borne to fathers with post-secondary education. Against this evidence, therefore, father's education is important in reducing child mortality meaning that just as girl education, boy education is equally important in enhancing the health of a child.

Table 1e shows interesting evidence on the relationship between age cohort at birth of mothers and mortality in Uganda. It is observed that neonatal mortality rate is 40 per cent for mothers in the age cohort 16–20 years; thereafter, it rises to 49 per cent for mothers in the age cohort 21–25. Afterwards, it falls steadily to 0 per cent for mothers in the age cohort 36–40 years. The same pattern is observed for post-neonatal and child mortality categories. Therefore, government efforts that delay marriages may go a long way in reducing the different categories of child mortality. Table 1f underscores the importance of mosquito nets use in the fight against child mortality. Households that never used mosquito nets are associated with 64 per cent neonatal mortality, 66 per cent post-neonatal mortality and 70 per cent child mortality. There is, therefore, need for government efforts to provide free mosquito nets to the citizens as a way of fighting against malaria, which is a number one killer disease in Uganda. In terms of households headed by women (Table 1g), children borne to mothers with no education have the highest neonatal rate of about 63 per cent compared to 13 per cent of their counterparts borne to mothers with secondary education and only 2 per cent borne to mothers with post-secondary education. The same pattern is observed for both the post-neonatal and child mortality categories. In terms of marital status, women that are separated/widowed/divorced are associated with the highest per cent of deaths for the three categories of child mortality considered in this paper (Table 1h).

4.3 Quantitative Evidence

We now turn to the quantitative evidence. To test for factors that determine neonatal, post-neonatal and child mortality in Uganda, we estimate probit models relating the probability of death of a child to a set of household, individual, biological and community level

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characteristics as specified in Section 3. Tables 3–5 present results (marginal effects) obtained using the probit approaches to estimate Equations (7), (9) and (11) based on the 2006 DHS data set.

4.3.1 Determinants of neonatal mortality in Uganda

This section presents the marginal effects of the different factors that more likely influence the death of infants in their very early stage of life between 1 and 27 days. In our analysis, we estimate three different model specifications. In the first model, we include mother's education and the biological factors influencing infant mortality. In the second specification, we add environmental factors on the first model, yet, in the third specification, we exclude mother's education to see the effect of other factors alone. The results showing marginal effects and the corresponding standard error values are reported in Table 3.

It is worth noting that a number of variables in our estimation are statistically significant at the conventional levels with the expected theoretical signs. Our results reveal that mother's education, our variable of interest, significantly reduces the probability of infant mortality. Infants borne to mothers with primary and secondary education have a probability of death of 2.3 and 3.3 per cent, respectively, lower than infants borne to mothers with no education at all. Similar results are observed in model 2 even when we control for the environmental factors. These results are as expected and are as found in the previous literature. Educated mothers appreciate the importance of best practices in child-care activities that include immunisation, feeding and seeking modern health care. Additionally, educated mothers have superior awareness of diseases and that they seek immediate treatment (Mosley and Chen, 1984; Cleland and van Ginneken, 1988; Tulasidhar, 1993). Whereas primary and secondary educations are robust in models 1 and 2, post-secondary education turns out to be insignificant in both models and this is unexpected. This, notwithstanding, education of the mother plays a key role in reducing neonatal mortality in Uganda. Government programme of free primary and secondary education are in line with the need to reduce neonatal mortality and hence should be strengthened.

Mother's age cohorts at birth are used as a proxy for the age of the mother at birth. It is revealed that the higher the age at which a woman gives birth, the greater the probability of child survival. Children borne to mothers in the age cohorts 21–25, 26–30 and 31–35 have a probability of death of 1.9, 3.7, and 4.8 per cent, respectively, lower than their counterparts in the age cohort 16–20 (base category). Similar results are observed in models 2 and 3 and are all significant at 1 per cent level. Whereas age cohort 36–40 is insignificant in models 1 and 3, it is significant at 10 per cent level in model 2 with a probability of 4.4 per cent. The policy implication is that there is need by government and other stakeholder to advocate for late marriages by putting in place activities that can delay girl child marriage. Encouraging education of girls beyond secondary level is one way to be sure that the minimum at which a girl can get married is 23 years (in Uganda, undergraduation is normally finished at an average of 23 years).

In addition, it is not surprising to note that multiple births have an increasing effect on the neonatal mortality rate in Uganda. That is, children that are borne as twins are 8 per cent more likely to die in the first 27 days of life compared to their counterparts from single births. The result is significant at 1 per cent level and robust across the three specifications. The policy implication is that government and other stakeholders should increase access to modern medical facilities that can detect the likelihood of having a multiple birth with a

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view of providing such mothers with extra attention and facilitation. Consequently, such mothers can be provided with appropriate feeding, medical care and expert attention during child delivery. Our findings also show that the sex of the child matter for survival. Being a female is associated with a probability of death of 6–6.5 per cent higher than their male counterparts.

As expected, maternal health care prior to child birth is important in influencing child survival. Children borne to mothers that have had a tetanus injection are having a probability of death ranging from 1.5 to 1.6 per cent lower than their counterparts whose mothers never received this injection. The policy implication is that the government should make maternal health care services accessible both in terms of cost and distance. The donor community that is keeping a kin eye on the MDGs should treat maternal health care accessibility as a matter of great concern in order to achieve a double gain of reducing maternal and infant mortality.

It is interesting to note that religion matters in influencing neonatal mortality in Uganda. A child borne to a Catholic, Protestant and Muslim have a probability of death ranging 2.6–3, 2.2–2.5 and 2.5–2.7 per cent, respectively, lower than their counterparts borne to other faiths. These results are significant at 1 per cent level and robust across the three models. This is not surprising; in Uganda these three religions are the ones officially recognised by the government. They have clear organisational hierarchies, schools and hospitals. Therefore, it may be easier for their followers to access better medical care and schooling, hence resulting into favourable child outcomes. This result, however, should be treated with caution since accessibility to hospitals belonging to churches and mosques is predominantly determined by the ability to pay.

Being married produces conflicting results. In the second specification, children borne to married mothers have a probability of death of 3 per cent higher than their counterparts borne to divorced mothers. This result is rather surprising because the presence of both parents leads to better care than when one is missing. In model 3, on the contrary, being borne to a married mother yields a probability of death of 2.1 per cent lower than those borne to divorced mothers. This seems to be in line with the natural expectation and thinking.

As expected, environmental factors such as water sources, regions, location and housing facilities are overly insignificant in neonatal mortality specification. This is because, in the very early stage of life, it is mainly the biological factors more than the environmental factors at play. This has some support in the previous literature especially by Cleland and van Ginneken (1988). Unexpectedly, though, covered toilets in models 2 and 3 increase the probability of neonatal mortality compared the uncovered toilets.

For the neonatal mortality specification, model 2 is the most preferred. It includes all factors at play in influencing neonatal mortality making its coefficients more genuine and convincing.

4.3.2 Determinants of post-neonatal mortality in Uganda

Table 4 reports the marginal effects of the determinants of post-neonatal mortality (1 month to 1 year of life) in Uganda. Just as in the previous section, we specify three different models. The first one contains mother's education and the biological factors. The second specification is a fuller model with mother's education, biological factors and environmental factors. Yet, in the third specification, we seek to understand the effect of other factors without mother's education.

The results reveal that the mother's education attainment has a significant impact on the post-neonatal mortality. The results indicate that children borne to mothers with primary

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and secondary education have a probability of child death of 2 and 3.4 per cent, respectively, lower than those borne to mothers with no education. The impact of mother's education on post-neonatal mortality is significant at 1 per cent level and is robust in models 1 and 2. Surprisingly, just as in the neonatal mortality, post-secondary education is not significant in influencing post-neonatal mortality. In spite of this, education of the mother is a key factor in influencing the level of post-neonatal mortality. Since the probability at secondary level is bigger than the probability at primary level, it is natural to argue that the viable policy implication is for the government to encourage female education beyond primary level in order to reduce the post-neonatal mortality in Uganda.

The age of the mother at first birth is an important factor in influencing the probability of child survival. It is revealed that the higher the age at which a woman gives birth, the greater the probability of child survival. Children borne to mothers in the age cohorts 21–25, 26–30, 31–35 and 36–40 have a probability of death of 2.5, 4.3, 6 and 7 per cent, respectively, lower than their counterparts in the age cohort 16–20 (base category). This finding is significant at 1 per cent level and is robust across the three model specifications. It is noteworthy that the probability increases with the mother's age. The policy implication is again the need for government and other stakeholders to advocate for late marriages by encouraging girl education beyond secondary level.

Just as in the neonatal mortality results, we find that multiple births have an increasing effect on the post-neonatal mortality rate in Uganda. Children borne as twins are 1.2 per cent more likely to die between 1 month and 1 year of life compared to their counterparts from single births. The result is significant at 1 per cent level and is robust across the three specifications. It is worth noting that the probability on multiple births is bigger for neonatal mortality (8 per cent) compared to post-neonatal mortality (1.2 per cent) meaning that the danger reduces as the child grows. The policy implication is again for the government and other stakeholders to increase access to modern medical facilities that can detect the likelihood of having a multiple birth with a view of providing such mothers with extra attention and facilitation. Our findings also show that the sex of the child matter for survival. Being a female is associated with a probability of death of 6 per cent higher than their male counterparts. This result is significant at 1 per cent level and is robust across the three specifications.

Another interesting result is that the weight of children at birth significantly influences post-neonatal mortality in Uganda. Children borne with average weight have a probability of death of 3 per cent lower than those borne below average weight. This result is significant at 1 per cent level and is robust across the three model specifications. On the other hand, children borne with weight above average have a probability of death of 1.7 per cent (model 2) lower than those borne with below average weight. Consequently, significant attention should be focused on the production of child health in its mother's womb by encouraging expecting mothers to seek the right medication (prenatal and antenatal care), family planning and feeding among others.

Just as in the neonatal mortality, religion matters in influencing post-neonatal mortality in Uganda. A child borne to a Catholic, Protestant and Muslim have a probability of death of 5, 4.2, and 3.5–3.7 per cent, respectively, lower than their counterparts borne to other faiths. These results are significant at 1 per cent level, robust across the three models, and the probabilities are bigger than those in the neonatal findings. Again, this is not surprising as these three religions are the ones officially recognised by the government. They have

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clear organisational hierarchies, schools and hospitals. Therefore, it may be easier for their followers to access better medical care and schooling, hence resulting into favourable child outcomes.

As expected, working mothers are associated with poor child quality outcomes. Children borne to working mothers have a probability of death of 2.3 per cent higher than their counterparts borne to mothers who are housewives (model 1). It is worth noting that this result is confronted with mixed evidence and arguments in the literature. Others argue that working mothers make their children miss out on key issues like breast feeding and other care activities, which non-mothers may not adequately administer to the child. On the contrary, working mothers enhance family income which improves the general quality of feeding, medical care and education. In our case, it seems the case that female labour force participation is detrimental to child health. It is also not surprising that this variable was not significant in the neonatal mortality model. This is because between 1 and 27 days after birth normally working mothers have not yet reported back to work; therefore, their absence cannot be felt in the early days. The policy implication is that the government should make labour laws friendlier to working mothers. They should be allowed a long enough maternity leave and flexibility to care for children especially when they are sick. The law may provide that the reporting time for mothers at work be different from that of non-mothers to allow them more time with the children.

It is interesting to note that location and region matter in influencing post-neonatal mortality. Children borne to mothers in the rural areas have a probability of death of 2.5–2.7 per cent higher than their counterparts borne in the urban areas. This result is significant at 5 per cent level and is robust across models 2 and 3. This is not surprising given that in the rural areas there are no modern medical facilities and there are no qualified personnel. In most rural areas of Uganda, a doctor comes to the village health centre only on a certain specified day of the week irrespective of the case at hand. Government should disseminate modern health centres across the rural areas and also increase the remuneration of health workers in those areas to ensure quality of service. Children borne to mothers in the northern region have a probability of death of 1.9 per cent lower than their counterparts borne in the central region. This is a little surprising because the northern region is generally the poorest following a war that ravaged the area for two decades. However, peace has been restored and some areas like Gulu have been rebuilt to modernity, with a government university and a good hospital.

Being married is associated with a lower post-neonatal mortality. In the third specification, children borne to married mothers have a probability of death of 2.5 per cent lower than their counterparts borne to divorced mothers. This result is as expected because the presence of both parents leads to better care than when one is missing. Humanitarian organisations like religious movements and other stakeholders should sensitise the masses about the dangers of divorce and the major one being the poor quality of child development.

Just as in the neonatal mortality, model 2 which is a fuller specification is preferred to the other two models.

4.3.3 Determinants of child mortality in Uganda

The empirical results for the factors that determine child mortality in Uganda are presented in Table 5. We again follow the three model specifications that appear for neonatal and post-neonatal mortality. Mother's education attainment is an important determinant of child mortality just as in the neonatal and post-neonatal mortality regressions. The results

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reveal that children borne to mothers with primary, secondary and post-secondary education have a probability of death of 11, 21 and 30 per cent, respectively, lower than children borne to mothers with no education. These findings are significant at 1 per cent level and robust across the two model specifications. It is also worth noting that the probability becomes bigger with the higher level of education. Additionally, the probabilities under child mortality are higher than for post-neonatal and neonatal specifications. This seems to suggest that education of the mother is more powerful in reducing child mortality between 1 and 5 years of a child's life compared to earlier episodes. Therefore, government programme of free primary and secondary education are relevant in reducing child mortality and, therefore, should be strengthened. Extra attention should focus on girl education to help them attain education beyond secondary level.

Just as in the previous two cases, the age of the mother at first birth is an important factor in influencing the probability of child survival. It is revealed that the higher the age at which a woman gives birth, the greater the probability of child survival. Children borne to mothers in the age cohorts 21–25, 26–30 and 31–35 have a probability of death of 9–10, 14–17 and 15–17 per cent, respectively, lower than their counterparts in the age cohort 16–20 (base category). This finding is significant at 1 per cent level and is robust across the three model specifications. It is noteworthy that the probability increases with the mother's age and that the probabilities under child mortality are far bigger than those under post-neonatal and neonatal mortality. This seems to suggest that mother's age at first birth is more powerful during the episode of 1–5 years than earlier. The policy implication is again the need for government and other stakeholders to advocate for late marriages by encouraging girl education beyond secondary level.

From the results in Table 5, it is also noteworthy that family planning significantly increases the probability of child survival. Children borne to mothers practicing family planning have a probability of death ranging from 3.3 to 4.4 per cent lower than their counterparts borne to mothers who do not practice family planning. This result is significant at 1 per cent level and is robust across all model specification. This can be attributed to the quality of care in terms of feeding and medical care which the children can enjoy once they are well planned for. Therefore, government and other stakeholders should increase family planning campaigns by encouraging modern use of contraceptives. In addition, the government should stock both public and private health centres and pharmacies with affordable modern family planning facilities.

As expected, being widow matters for child mortality. Children belonging to widows have a probability of child death ranging between 4 and 23 per cent higher than their counterparts belonging to divorced women. Unexpectedly, children belonging to married women have a probability of death of 18–19 per cent higher than their counterparts belonging to divorced women (models 1 and 2). Model 3 produces the expected result that children borne to married mothers have a probability of death of 4.1 per cent lower than their counterparts borne to divorced mothers.

Just as in the previous two cases, we find that multiple births have an increasing effect on the child mortality rate in Uganda. Children borne as twins are 30 per cent more likely to die between 1 and 5 years of life compared to their counterparts from single births. The result is significant at 1 per cent level and is robust across the three specifications. It is worth noting that the probability on multiple births is bigger for child mortality (30 per cent) than neonatal mortality (8 per cent) and post-neonatal mortality (1.2 per cent) meaning that it is more dangerous during 1–5 year episode than earlier. The policy implication is again for the government and other stakeholders to

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increase access to modern medical facilities that can detect the likelihood of having a multiple birth with a view of providing such mothers with extra attention and facilitation. Our findings also show that the sex of the child matters for survival. Being a female is associated with a probability of death of 6 per cent higher than their male counterparts. This result is significant at 1 per cent level and is robust across the three specifications.

As expected, children borne to working mothers have a probability of death of 8–11 per cent higher compared to their counterparts borne to mothers who are housewives. It is noteworthy that the probability is bigger for child mortality than for post-neonatal mortality. This may imply that the effect of working mothers generates bigger danger to the child between 1 and 5 years than 1 month to 1 year. As already noted above, the government should make labour laws friendlier to working mothers, allow them longer maternity leaves, etc.

Just as in the post-neonatal, location matters in influencing child mortality. Children borne to mothers in the rural areas have a probability of death of 10 per cent higher than their counterparts borne in the urban areas. This result is significant at 1 per cent level and is robust across models 2 and 3. As noted in the post-neonatal case, this is not surprising given that in the rural areas there are no modern medical facilities and there are no qualified personnel. Appearing as though surprising is that children that have contracted measles are 13–14 per cent less likely to die compared to their counterparts. It is worth noting that immunisation is almost universal in Uganda and that immunised children are measles resistant. Even if an immunised child contracts measles, there will be little or no effect on his life and, hence, measles does not necessarily result into child death. Just as in the previous two cases, model 2 which is a fuller specification is preferred to the other two models.

5 CONCLUSIONS

We used maximum likelihood models to analyse the impact of mother's education on neonatal, post-neonatal and child mortality in Uganda. The data were obtained from the Uganda Demographic and Health Survey of 2006. Our results confirm the hypothesis that the level education of the mother is fundamental in reducing child mortality in the first 5 years of life. For neonatal and post-neonatal mortality, secondary education matters more than primary education (given the sizes of probabilities) and post-secondary is insignificant. For child mortality, post-secondary education matters more than secondary and primary education. Since these are different stages of a child's life, overall, the findings suggest that efforts to reduce child mortality need to target measures that aim to educate women beyond secondary level. The government programme to extend free education at the secondary level is, therefore, an important measure that may help to reduce child mortality in Uganda. This, therefore, needs to be embraced by all stakeholders and actively campaigned for to encourage girls to attain education beyond secondary level. Measures need to be put in place to minimise the factors that may lead girls to drop out of school early, including improving the quality of schools and teaching and ensuring that all schools have separate sanitary facilities for girls and boys.

Other factors significantly influencing child mortality include: birth age cohorts (age at first birth), multiple birth, sex of the child, location differences, family planning, religion, participation of the mother in the labour force and birth weight among others. It is noteworthy that father's education is not significant in all our regressions.

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APPENDIX I: RESULTS

Table 1. Descriptive statistics for selected variables

Variables	Neonatal mortality (%)	Post-neonatal mortality (%)	Child mortality (%)
a: Mother's education and mortality in Uganda			
No education	92	93.4	93.3
Primary	5.4	4.6	4.8
Secondary	2	1.5	1.4
Post-secondary	0.6	0.5	0.5
Total	100	100	100
b: Weight at birth and mortality in Uganda			
Below average	37.8	35.8	36
Average	47	47	42.9
Above average	15.2	16	21.6
Total	100	100	100
c: Regions and mortality in Uganda			
Central	35	32	34
East	23.6	20	21
North	22.4	24.7	25
West	19	22.6	20
Total	100	100	100
d: Father's education and mortality in Uganda			
No education	38	40	39
Primary	40	38	35
Secondary	16	16	20
Post-secondary	5.5	6	6
Total	100	100	100

(*Continues*)

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Table 1. (Continued)

Variables	Neonatal mortality (%)	Post-neonatal mortality (%)	Child mortality (%)
e: Age of birth cohorts and mortality in Uganda			
16–20	40	40	36
21–25	49	45	48
26–30	10	11	14
31–35	1	2	2
36–40	0	1	0
Total	100	100	100
f: Mosquito nets use and mortality in Uganda			
No use	64	66	70
Using nets	36	38	30
Total	100	100	100
g: Households headed by women, education level and mortality			
No education	63	65	58
Primary	22	19	30
Secondary	13	13	8
Post-secondary	2	3	3
Total	100	100	100
h: Marital status and mortality in Uganda			
Not married	4.7	4.3	3.7
Married	8.7	9.2	7.9
Separated/widow/divorced	86.5	86.5	88.5
Total	100	100	100

Source: Authors' own analysis using the DHS, 2006.

Table 2. Correlation between female education and mortality rates

	Primary	Secondary	University	Neonatal	Post-neonatal	Child mortality
Primary	1.000					
Secondary	−0.0341*	1.0000				
University	−0.0176*	−0.0105	1.0000			
Neonatal	0.0001	0.0040	0.0007	1.0000		
Post-neonatal	−0.0858*	−0.0676*	0.0128		1.0000	
Child mortality	−0.0436	−0.0447*	−0.0454*	1.0000*		1.0000

*5 per cent level of significance.

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Table 3. Determinants of neonatal mortality rates in Uganda (Marginal effects)

Variables	Model 1	Std Err	Model 2	Std Err	Model 3	Std Err
Mother's education						
Primary	−0.0231***	(0.00745)	−0.0270***	(0.00761)		
Secondary	−0.0332***	(0.00858)	−0.0338***	(0.00874)		
Post-secondary	−0.00454	(0.0203)	−0.00354	(0.0207)		
Birth age cohorts						
21–25	−0.0185***	(0.00676)	−0.0184***	(0.00671)	−0.0203***	(0.00708)
26–30	−0.0374***	(0.00707)	−0.0343***	(0.00724)	−0.0350***	(0.00768)
31–35	−0.0483***	(0.0101)	−0.0456***	(0.0106)	−0.0446***	(0.0128)
36–40	−0.0441	(0.0272)	−0.0435*	(0.0264)	−0.0378	(0.0365)
Marital status						
Married	0.029	(0.0184)	0.0321*	(0.0179)	−0.0210**	(0.00865)
Widowed	0.0187	(0.0277)	0.019	(0.0277)	0.023	(0.0278)
Use family planning	0.000892	(0.00343)	−0.000889	(0.00355)	−0.00336	(0.00371)
Girl child	0.0620***	(0.00873)	0.0597***	(0.00866)	0.0646***	(0.00918)
Multiple birth	0.0784***	(0.0165)	0.0775***	(0.0164)	0.0788***	(0.0169)
Tetanus injection	−0.0155**	(0.00753)	−0.0118	(0.00745)	−0.0150*	(0.00791)
Contracted measles	0.00373	(0.00722)	0.00392	(0.00718)	0.00537	(0.00761)
Child weight						
Average	−0.00789	(0.00727)	−0.00978	(0.00714)	−0.0122	(0.00751)
Above Average	−0.000267	(0.00891)	−0.00162	(0.00872)	−0.00235	(0.00919)
Religion						
Catholic	−0.0301***	(0.00953)	−0.0263***	(0.00955)	−0.0272***	(0.0101)
Protestant	−0.0217**	(0.00917)	−0.0225**	(0.00905)	−0.0252***	(0.00954)
Muslim	−0.0250***	(0.00957)	−0.0245**	(0.00956)	−0.0270***	(0.0100)
Working mother	0.0035	(0.0123)	−0.000871	(0.0131)	0.00171	(0.0137)
Female house head			0.00831	(0.00798)	0.0131	(0.00866)
Rural resident			0.0151	(0.0103)	0.0127	(0.0113)
Permanent shelter			0.0116	(0.00826)	0.0111	(0.00868)
Toilet facilities						
Covered toilet			0.0210**	(0.00892)	0.0172*	(0.00954)
VIP toilet			−0.00199	(0.012)	−0.00603	(0.0125)
Water source						
Protected springs			−0.00345	(0.00867)	−0.0034	(0.00917)
Piped water			0.000352	(0.0132)	−0.00249	(0.0137)
Father's education						
Primary					0.000128	(0.0094)
Secondary					−0.0113	(0.0107)
Post-secondary					−0.00888	(0.0149)
Regions						
Eastern			0.000213	(0.00938)	−0.0016	(0.00986)
Northern			−0.0148	(0.00927)	−0.0145	(0.00984)
Western			1.84E-06	(0.00978)	0.00114	(0.0104)
Observations	6436		6433		6144	
χ^2	207.69		232.13		195.33	
Log likelihood	−1646.31		−1633.84		−1611.38	

Notes: Standard errors in parentheses.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

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Table 4. The determinants of post-neonatal mortality rates in Uganda (marginal effects)

	Model 1	Std Err.	Model 2	Std Err.	Model 3	Std Err.
Mother's education						
Primary	−0.0201**	(0.009)	−0.0237***	(0.009)		
Secondary	−0.0341***	(0.011)	−0.0339***	(0.012)		
Post-secondary	−0.0295	(0.021)	−0.0273	(0.022)		
Birth age cohort						
21–25	−0.0247***	(0.008)	−0.0258***	(0.0840)	−0.0989***	(0.155)
26–30	−0.0433***	(0.009)	−0.0471***	(0.009)	−0.165***	(0.0199)
31–35	−0.0591***	(0.014)	−0.0634***	(0.015)	−0.170***	(0.0142)
36–40	−0.0680**	(0.031)	−0.0678*	(0.035)	−0.166	(0.119)
Marital status						
Married	0.0216	(0.021)	0.0253	(0.021)	−0.0251**	(0.011)
Widowed	0.00173	(0.025)	0.00302	(0.025)	0.00302	(0.014)
Use family planning	0.00202	(0.004)	0.00021	(0.004)	−0.0013	(0.004)
Girl child	0.0607***	(0.01)	0.0585***	(0.010)	0.0628***	(0.010)
Multiple birth	0.118***	(0.02)	0.118***	(0.020)	0.120***	(0.020)
Tetanus injection	−0.0085	(0.009)	−0.0042	(0.009)	−0.006	(0.009)
Contracted measles	−0.0002	(0.009)	−0.0005	(0.009)	−0.0002	(0.009)
Child weight at birth						
Average	−0.0273***	(0.008)	−0.0293***	(0.008)	−0.0298***	(0.009)
Above Average	−0.0161	(0.01)	−0.0169*	(0.010)	−0.0167	(0.010)
Mother's religion						
Catholic	−0.0516***	(0.011)	−0.0486***	(0.011)	−0.0464***	(0.012)
Protestant	−0.0415***	(0.011)	−0.0422***	(0.011)	−0.0425***	(0.011)
Muslim	−0.0372***	(0.011)	−0.0361***	(0.011)	−0.0346***	(0.012)
Working mother	0.0228*	(0.013)	0.0188	(0.014)	0.0201	(0.015)
Female house head			0.00678	(0.009)	0.0106	(0.010)
Rural resident			0.0277**	(0.012)	0.0251**	(0.013)
Permanent shelter			0.0164	(0.010)	0.0163	(0.010)
Toilet facilities						
Covered toilet			0.0168	(0.011)	0.012	(0.011)
VIP toilet			−0.0032	(0.014)	−0.0076	(0.015)
Water source						
Protected springs			−0.0063	(0.010)	−0.006	(0.011)
Piped water			−0.003	(0.016)	−0.0061	(0.016)
Father's education						
Primary					0.00438	(0.011)
Secondary					−0.0101	(0.013)
Post-secondary					−0.0109	(0.018)
Region						
Eastern			−0.0093	(0.011)	−0.0085	(0.012)
Northern			−0.0187*	(0.011)	−0.0151	(0.012)
Western			0.00134	(0.012)	0.00515	(0.013)
Observations		6436		6433		6144
χ^2		229.92		251.85		226.05
Log likelihood		−2052		−2041		−1987

Notes: Standard errors in parentheses.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

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Table 5. Determinants of child mortality rates in Uganda (marginal effects)

	Model 1	Std. Error	Model 2	Std. Error	Model 2	Std. Error
Mother's education						
Primary	−0.107***	−0.0162	−0.0940***	(0.0167)		
Secondary	−0.214***	−0.0216	−0.175***	(0.024)		
Post-secondary	−0.302***	−0.0307	−0.263***	(0.0362)		
Birth age cohorts						
21–25	−0.092***	(0.0152)	−0.096***	(0.0153)	−0.0989***	(0.0155)
26–30	−0.135***	(0.0197)	−0.147***	(0.0197)	−0.165***	(0.0199)
31–35	−0.154***	(0.0415)	−0.165***	(0.041)	−0.170***	(0.0422)
36–40	−0.0906	(0.1200)	−0.0925	(0.122)	−0.166	(0.119)
Marital status						
Married	0.183***	(0.0399)	0.187***	(0.0406)	−0.0412*	(0.0211)
Widowed	0.225***	(0.0446)	0.232***	(0.0448)	0.0369*	(0.021)
Use family planning	−0.0439***	(0.0075)	−0.0325***	(0.0079)	−0.0417***	(0.00797)
Girl child	0.336***	(0.0166)	0.333***	(0.0167)	0.346***	(0.0171)
Multiple birth	0.301***	(0.0248)	0.303***	(0.0249)	0.294***	(0.0245)
Tetanus injection	−0.0144	(0.0159)	−0.0162	(0.0161)	−0.0181	(0.0164)
Contracted measles	−0.131***	(0.0156)	−0.139***	(0.0157)	−0.141***	(0.0161)
Weight at birth						
Average	−0.0102	(0.0162)	−0.00818	(0.0163)	−0.0115	(0.0166)
Above Average	0.031	(0.0195)	0.0323	(0.0196)	0.0309	(0.0199)
Religion						
Catholic	−0.0196	(0.0229)	−0.0417*	(0.0233)	−0.0299	(0.0239)
Protestant	−0.0253	(0.0235)	−0.035	(0.0237)	−0.0311	(0.0243)
Muslim	−0.0461	(0.0282)	−0.0404	(0.0287)	−0.0371	(0.0296)
Working mother	0.113***	(0.0256)	0.0823***	(0.0273)	0.0791***	(0.0286)
Female house head			0.0167	(0.0169)	0.0246	(0.0174)
Rural resident			0.0995***	(0.0241)	0.0976***	(0.0249)
Permanent shelter			0.0197	(0.0176)	0.0181	(0.0179)
Toilet facilities						
Covered toilet			−0.0124	(0.0202)	−0.0177	(0.0208)
VIP toilet			−0.0116	(0.0257)	−0.0129	(0.0265)
Water source						
Protected springs			0.00737	(0.0191)	0.00648	(0.0195)
Piped water			−0.0334	(0.0288)	−0.0395	(0.0295)
Father's education						
Primary					−0.0143	(0.0205)
Secondary					−0.114***	(0.0235)
Post-secondary					−0.152***	(0.0306)
Region						
Eastern			−0.0232	(0.0213)	−0.0109	(0.0219)
Northern			0.0665***	(0.0221)	0.0964***	(0.0223)
Western			0.0348	(0.0223)	0.0486**	(0.0227)
Observations		6439		6436		6147
χ^2		1354.18		1404.65		1208.36
Log likelihood		−3760.38		−3732.96		−3645.27

Notes: Standard errors in parentheses.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

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