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Risk Factors of Infant and Under-Five Mortality in Burkina Faso

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Abstract
This paper examines and quantifies the effects of risks factors on infant and under-five mortality in Burkina Faso. Using national representative survey of 2010 Demographic and Health Survey (DHS) program, we consider different sociodemographic characteristics of mothers and their children and check how much they correlate with observed level of infant and childhood mortality. The results suggest that the interval with preceding child birth, birth order, children breastfeeding at birth and anthropometric measures (birth weight and size at birth) are the most relevant risks factors that determine infant and under-five mortality. The analysis of predictive probabilities suggests that first pregnancies have high risk of adverse birth outcomes and preceding birth interval from 36 to 41 months is relevant to reduce childhood mortality in the country.
Keywords: infant mortality, under-five mortality, determinants.

1. Introduction

Reducing child mortality is one of the most important concern since the beginning of this century. According to World Health Organization, in 2015, about 4.5 millions deaths world-wide (75% of all under-five deaths) occurred within the first year of live. The risk of child dying before completing the first year of age was highest in the African region (55 per 1000 live births), which is five times higher than that in European region (WHO,2015). The majority of infants deaths in Africa occurs in Sub-Saharan Africa where the childhood mortality rate was 180 per 1000 live births in 1990 and 83 per 1000 live births in 2015 representing a reduction of 54% between 1990 and 2015 [1] .

Despite this significant decline in Sub-Saharan countries, the child mortality statistics of United Nations Development Program (2015) reveal that the conditions of child deaths could be prevented or treated. Reducing child mortality is the fourth target of United Nations' Millennium Development Goals[2]. Child mortality rate is a good indicator of level of development of a given country and then makes child mortality to remain a major public health issue in developing countries.

In Sub-Saharan Africa, the trend of child mortality remains unacceptable. Burkina Faso is one of such country. Data from 2015 of Word Bank Group indicate that 9 of 100 children born in Burkina Faso will die before five years old and 6 of 100 will die before reaching one year old; this represents a reduction of 56% for child mortality and 40.5% for infant mortality rate since 1990.

Many researchers have investigated the determinants of infant and under-five mortality in developing countries (Hossain and Al. (2002), Jamal and Al. (2009), Preston (1982), Miller (1993), Hobcraft and Al. (1983)). This literature suggests that one of the most important causes of childhood mortality is early marriage and early motherhood (Shrim, Ates, Mallozzi, and Brown (2011); Kang, Lim, Sugam, and Lee (2015), Jocelyn E Finlay and Al. (2011)). Because of their strong correlation young mothers are more likely to experiment adverse births outcomes than their older counterpart (Wang, Wang, and Lee (2012)). Biological vulnerability among younger mothers (before 18 years old) may persist through physical immaturity (S Merha (2004); CP Stewart (2007); Shrim, Ates, Mallozzi, and Brown (2011)) and exacerbation of the effects of chronic malnutrition by competition for scarce nutrients between mother and fetus (Lenders and McElrath (1995)). Correlating with these findings, early motherhood is also linked with adverse maternal health outcomes, including pregnancies complications and maternal mortality.

Most particularly, according to Amnesty International [3], Burkina Faso is the third county in Africa with high rates of child marriage and in the top ten worldwide. In rural area, 30% of young women aged 15 to 19 are pregnant or had their first child despite the relatives risks of pregnancy and delivery. According to the United Nations Population Fund[4], 8 of the 10 highest rates of child marriage are located in Sub-Saharan Africa.

This paper sharpens these previous finding by revisiting the risks factors of Infants and Under-5 mortality in Burkina Faso. The paper is structured as follows. Section 2 presents the data and empirical strategy. In section 3 we present the descriptive statistics. Section 4 presents our main results. In section 5 we discuss our results and avenues for public health policies interventions. Section 6 concludes.

[1] Level and Trend in Child Mortality, report 2015, World Bank
[2] Reduction by two-thirds in the under five mortality rate between 1990 and 2015
[3] Amnesty International, report 2016-2017
[4] 2012 report, United Nations Population Fund

2. Data and Methods

The data used in this study come from the 2010 Demographic and Health Surveys (DHS) program in Burkina Faso. These surveys are based on scientifically selected samples of households and women of reproductive age to produce nationally representative data on fertility, infant and child mortality, child and reproductive health, nutritional status, family planning and on many other health issues. Our analysis focuses on children born in the 5 years prior to the interview or kids file for a total of 15044 observations.

In our multivariate analysis, we assess the probability to observe infant or child death using logistic regression and controlling for different characteristics of mothers and their children. We also interpret our results in term of odds ratio and marginal effects using predictive probabilities.

3. Descriptive Statistics

Burkina Faso is one of the country in Africa with high rate of teens marriage and early motherhood. In the North of the country, more than half of teenagers aged 15 to 17 are married[1]. The rate of infant mortality was 60 per 1000 live births in 2015. The mean age at first childbearing is 19 years and 78% of women in the survey live in rural area according to table 1. 83% of women have no education and 11% have completed primary education. The statistics on mortality show that 6% of childhood mortality observed in the data are due to infants deaths (before reaching one year old) and 9% to under five mortality (before reaching five years old). 40% of women are poor and 50% belong to Mossi ethnic group (the most represented ethnic group in the country).

In Table 2 and table 3, we present the distribution of infant and under-five mortality according to some characteristics of mothers. According to the place of residence, the rate of infant mortality is 64.06 ‰ in rural area and 44.4 ‰ in urban area. Mothers' level of education seems to be associated with infant and under-5 mortality rates. No educated mothers are more likely to experiment infant and child death than educated one. The level of under-five mortality is 94.4 ‰ for no educated mothers, 63.5 ‰ for those who have primary education and 47.4 ‰ for secondary education level.

The literature suggests that the age of mother at first childbearing is an important risk factor for childhood mortality (Titilayo Ayotunde and Al. (2009), John Lekan Oyefara (2013), Eric Boahen and Al(2016), Omedi Gilbert and Al. (2014)). The level of infant mortality is 62.6 ‰ when mother has not reached 20 years old and 53.9 ‰ when she belongs to the interval 20 to 29 years old. Table 4 shows that the preceding birth interval is an important risk factor of infant and child mortality. The high rate of infants and under-5 death (186.2 ‰ and 247.4 ‰ respectively) is observed when the preceding birth interval doesn't exceed 18 months. These rates drastically decrease when the interval between births increases.

In order to test if these variables in bivariate analysis statistically determine the level of infant and under-five mortality observed in the data, we perform a logistic regression with two dependant variables. Our first dependant variable is $\boldsymbol{y_i^{Infant}}$ and the second one is $\boldsymbol{y_i^{Under-Five}}$ such that:

$$\boldsymbol{y_i^{Infant}} = \begin{cases} 1 & if\ Infant\ \boldsymbol{i}\ dies\ before\ one\ year\ old \\ 0 & otherwise \end{cases} \quad \text{and} \quad \boldsymbol{y_i^{Under-Five}} = \begin{cases} 1 & if\ child\ \boldsymbol{i}\ dies\ before\ five\ years\ old \\ 0 & otherwise \end{cases}$$

[1] Amnesty International, report 2016-2017

Table 1: Descriptive statistics

	Mean	SE	Min	Max
Infant mortality	0.06	0,23	0	1
Under-five mortality	0,09	0,28	0	1
Age at first birth	18,9	2,97	12	37
Mother level of education				
No education	0,83	0,37	0	1
Primary	0,11	0,31	0	1
Secondary	0,05	0,21	0	1
Higher	0,004	0,05	0	1
Place of residence				
Rural	0,78	0,41	0	1
Urban	0,22	0,41	0	1
Wealth index				
Poor	0,40	0,40	0	1
Middle	0,22	0,4	0	1
Rich	0,37	0,41	0	1
Ethnicity				
Mossi	0,50	0,5	0	1
Fulfuld´e	0,09	0,29	0	1
Bobo	0,03	0,19	0	1
Gourmatch´e	0,08	0,27	0	1
Bissa	0,04	0,19	0	1
Gourounsi	0,04	0,2	0	1
Sénoufo	0,05	0,22	0	1
Lobi	0,04	0,19	0	1
others	0,05	0,22	0	1

Our covariates include the age of mother at first childbearing, mother level of education, preceding birth interval, place of residence, region, ethnicity, place of delivery (government hospitals, private hospitals, at home, others) , number of prenatal visits, source of drinking water (piped into dwelling, public tap, Tube well or borehole, protected well, unprotected well, etc.), type of toilet facility (pit latrine with slab, no facility/bush/field), birth height and weight, mother wealth index, birth order and the sex of child.

4. Results

The results show that the probability to observe infant and child death is mostly affected by the preceding birth interval and the order of birth. Table 5 summaries the risks factors of childhood mortality. The age of mother at first birth and her level of education do not affect the probability of infant and under-five death. According to the regions, the risk of infant death is higher in the region of Cascades (OR 2.43, 95% CI 1.37 to 4.31), Centre-Sud (OR 2.35, 95% CI 1.23 to 4.47), Sud-Ouest (OR 2.88, 95% CI 1.73 to 4.78) and Plateau-Central (OR 2.65, 95% CI 1.44 to 4.87). No breastfeed at child birth is associated with an increased likelihood to die before reaching one year old (OR 5.80, 95% CI 3.80 to 8.85). The risk of infant death is about 6 times higher than those who have been breastfeed at their birth.

The source of drinking water, ethnicity, the type of toilet don't affect the probability of infant and under-five mortality. Living in rural area increases the probability to experiment infant and under-five mortality (OR 1.27, 95% CI 0.79 to 1.82) but this result is not statistically significant. The probability of infant mortality is about 5 times higher when the mother has twins (OR 4.98, 95% CI 3.60 to 6.89). Caring for twins is always difficult if the mother does not have permanent assistance.

The interval with preceding child birth is associated with high risk of infant and under-five mortality. When the interval with preceding birth increases, the likelihood of childhood mortality decreases. In figure 1 and 2, we present the predictive probabilities of infant and under-five mortality according to the preceding birth interval. Less than 18 months between births is associated with a probability of infant death of 24% and 36% for under-five deaths. These probabilities decrease as and when the birth interval becomes large. Mothers' first birth are at high risk of adverse birth outcomes compare to the second and third births. This result is also presented in the literature that women' first childbearing and children who were born later (from the fifth or sixth birth) present are at risk of dying in infancy. The predictive probabilities of infant and under-five mortality are presented in figure 3 and 4.

Our results suggest that the relevant risks factors of childhood mortality are poor anthropometric measures

(small size at birth and low birth weight), the interval with preceding birth, the breastfeeding status of child, the regions of residence and birth order. The current age of mother, the age at first childbearing and the level of education don't matter.

5. Discussion

Six variables in our study are relevant to explain the level of infant and under-five mortality observed in our data (anthropometrics variables, breastfeeding status, preceding birth interval, the region of residence, birth order and having twin). The median space between births is 36 months and our results suggest that the risk of childhood mortality decrease for 36 to 41 months between births. Promoting births planning or family planning with more spacing between pregnancies should be intensify in order to reduce the level of childhood mortality in the country by raising awareness of parents about the importance of these methods. In Burkina Faso, the median intergenesis interval is about 35 months[1] and only 16% of women use contraceptive methods.

Children's breastfeeding is also important to reduce their mortality (Plloni and Millman (1985)). Children who have never been breastfeed have high risk to die in their infancy than their counterpart and this must be take into account in the strategies to reduce childhood mortality. Almost all regions are at risk of childhood mortality but 5 of them are more exposed, that are : Cascades, Centre-Ouest, Centre-Sud, Plateau-central and Sud-Ouest. Public health interventions must focus primarily in these regions to promote goods practices about the relevant variables determining infant and under-five mortality.

Low birth weight (less than 2500g) and a small size at birth (less than 50cm) also determine the probability to observe infant or under-five death. This means that children with low birth weight and small birth size should be taken care of at birth and must have special follow-up by health professionals to bring them back to a reasonable weight and size in the first two years of life.

The level of education of mother is presented in the literature as an important risk factor of infant and under-five mortality. Our results suggest that its effects on mortality are not significant at 5% and 10% level of significance. Having twins is 5 times more risky to experiment one child death than a single birth. It is so important to mothers to be permanently assisted in that case. The order of a birth is also an important factor of childhood mortality. The first birth is associated with a probability of 0.25 of child death while from second to nineth births the probability is about 0.17. Although the first child is a necessary part of a woman's reproductive life, this result presages the attention that should be given to the first pregnancies.

6. Conclusion

This paper analyzed the determinants of childhood mortality in Burkina Faso using data of 2010 DHS, the last Demographic and Health Survey available. Our analysis focuses on children born in the 5 years prior to the interview for a total of 15044 observations. Using bivariate analysis, we present the distribution of infant and under-five mortality according to socioeconomic and demographic characteristics of mothers. Mothers who are less educated (less than 6 years of education), living in rural area and those who have had their first birth before 20 years old are more likely to experiment infant and under-five mortality. Preceding birth interval less than 18 months is associated with high rate of child mortality. According to the ethnics groups, Dioula and Lobi are those who present high risk of infant mortality. For under-five mortality ethnics groups like Dioula, Fulfulde, Gourmatche, Lobi, Touareg and Dagara are those presenting high rate of mortality.

Our multivariate analysis using logistic regression and controlling for some characteristics of mothers and their children suggests the negative correlation between child mortality and preceding birth interval. The predictive probabilities show that the interval from 36 to 41 months between births is necessary to reduce infant mortality. According to United Nation Population Fund (2013), in Burkina Faso, the intergenesis interval is higher (41.7 months) in urban area than in rural (35.2 months). Children who have never been breastfeed and those with low birth weight and small size at birth are at risk of dying in their infancy. The order of births is positively correlated with children survival in infancy until their 4 years old. The first birth is at risk of mortality rather than second and third and having twins is 5 times more risky than a single birth. Mother's education only affect infant mortality at 15% level of significance. These results suggest that public health policies should reconsider some variables in their strategies to reduce the level of infant and under-five mortality in the country.

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Appendix

Table 2: Quotient of childhood mortality for 1000 lives births and socioeconomics characteristics

socioeconomics characteristics	Infant Mortality	Under-five Mortality
Place of residence		
Urban	44,4	61,05
Rural	64,06	95,75
Region		
Boucle du Mouhoun	49,5	79,9
Cascades	66,2	87,5
Centre	41,6	57,3
Centre-Est	43,4	53,8
Centre-Nord	52,6	66,8
Centre-Ouest	63,7	84,6
Centre-Sud	57,08	74
Est	71,8	114,2
Hauts Bassins	49,6	70
Nord	51,3	87,5
Plateau Central	47,1	79,5
Sahel	82,5	138,9
Sud-Ouest	94,35	135,06
Mother level of education		
No education	63,13	94,4
Primary	46,3	63,5
Secondary	38,15	47,4
Higher	20	20
Wealth index		
Poorest	67,9	108,6
Poorer	72,5	106,5
Middle	62,5	87,3
Richer	51,7	78,5
Richest	40,4	53,4

Table 3: Quotient of childhood mortality for 1000 lives births and demographic characteristics

Demographic Characteristics	Infant Mortality	Under-5 Mortality
Sex of child		
Male	64	93,5
Female	55,6	82,9
Age of mother at first birth		
< 20	62,6	92,6
20-29	53,9	79,9
30-39	91,7	100,9
≥ 40	0	0
Ethnicity		
Bobo	52,8	74,7
Dioula	114,75	139,4
Fulfuld´e/Peul	71,9	108,9
Gourmantch´e	79,7	127,9
Gourounsi	63	84,4
Lobi	101,3	150,1
Mossi	48,7	74,5
S´enoufo	60	86,35
Touareg/Bella	76,04	121,7
Dagara	85,8	108,35
Bissa	52,5	56,04
others	68,6	93,5

Table 4: Preceding birth interval (in months) and childhood mortality (per 1000 live births)

	Preceding birth interval								
	< 18	**18 - 23**	**24 - 29**	**30 - 35**	**36 - 41**	**42 - 47**	**48 - 53**	**54 - 59**	**60+**
Infant Mortality	186,2	112,7	69,9	51,2	46,3	37,5	37,25	32,25	57,4
Under-5 Mortality	247,4	155,5	121,5	83,3	76,9	49,0	50	41,2	75,8

Table 5	Infant Mortality				Under-five			
	Odds	95% Confidence-		(P-	Odds	95% Confidence-		(P-value)
Mother age at								
< 20 (ref)								
20-29	0,93	0,68	1,27	0,645	0,98	0,76	1,27	0,896
30-39	0.97	0.19	4.79	0.967	1.01	0.26	3.95	0.983
Sex of child								
Male(ref)								
Female	0.91	0.73	1.14	0.412	0.93	0.78	1.11	0.411
Mother education								
No education								
Primary	0,73	0,47	1,12	0,146	0,78	0,55	1,11	0,169
Secondary	1.74	0.87	3.52	0.12	1.44	0.78	2.69	0.246
Wealth index								
Poorest (ref)								
Poor	1,36	0,98	1,88	0,063	1,22	0,94	1,58	0,13
Middle	1,25	0,89	1,77	0,197	1,06	0,80	1,40	0,695
Rich	1.34	0.92	1.94	0.127	1.30	0.97	1.75	0.084
Place of delivery								
At home(ref)								
Government	1,47	0,69	3,18	0,316	1,05	0,54	2,04	0,878
Private	3.20	0.59	17.40	0.178	1.34	0.31	8.28	0.574
Birth interval								
< 18(ref)								
18-23	0,74	0,44	1,23	0,245	0,56	0,36	0,88	0,011
24-29	0,36	0,22	0,59	0,000	0,43	0,28	0,65	0,000
30-35	0,33	0,20	0,55	0,000	0,35	0,23	0,54	0,000
36-41	0,21	0,12	0,38	0,000	0,27	0,17	0,43	0,000
42-47	0,25	0,13	0,48	0,000	0,19	0,11	0,33	0,000
48-53	0.33	0.16	0.71	0.004	0.26	0.14	0.50	0.000
Region								
Boucle du								
Cascades	2,43	1,37	4,31	0,002	1,86	1,16	2,98	0,01
Centre	1,97	0,95	4,07	0,069	1,72	0,94	3,14	0,079
Centre-Nord	1,76	0,96	3,23	0,066	1,18	0,72	1,94	0,517
Centre-Ouest	2,10	1,24	3,57	0,006	1,27	0,82	1,97	0,292
Centre-Sud	2,35	1,23	4,47	0,01	1,71	1,01	2,91	0,046
Hauts Bassins	1,68	0,96	2,97	0,071	1,30	0,82	2,07	0,27
Nord	1,82	1,05	3,16	0,032	1,95	1,27	3,00	0,002
Plateau	2,65	1,44	4,87	0,002	2,31	1,43	3,73	0,001
Sahel	1,40	0,83	2,37	0,203	1,62	1,08	2,45	0,021
Sud-Ouest	2.88	1.73	4.78	0.000	2.38	1.57	3.59	0.000
Birth order								
1(ref)								
2	0,41	0,19	0,89	0,025	0,41	0,21	0,80	0,009
3	0.44	0.19	1.02	0.056	0.44	0.22	0.91	0.026
Breastfeeding								
Ever								
Never breastfeed	5,80	3,80	8,85	0,000	2,89	1,96	4,26	0,000
Mother Current age	1,00	0,95	1,05	0,866	1,00	0,96	1,04	0,915
Child is twin								
No (ref)								
Yes	4,98	3,60	6,89	0,000	3,75	2,78	5,06	0,000
Size at birth	1,20	1,08	1,34	0,001	1,17	1,07	1,28	0,001
Place of residence								
Urban(ref)								
Rural	1,20	0,79	1,82	0,392	1,27	0,91	1,79	0,410
Birth Weight	1,00	1,00	1,00	0,015	1,00	1,00	1,00	0,086
ethnicity	1,00	1,00	1,00	0,743	1,00	1,00	1,00	0,605
Source of drinking	1,00	0,99	1,01	0,903	1,00	0,99	1,01	0,873
Type of Toilet	1,01	0,99	1,03	0,332	1,01	0,99	1,03	0,241
Constant	3,35	0,58	19,28	0,176	3,61	0,85	15,29	0,081

Figure 1: Predictive probabilities of infant death by preceding birth interval

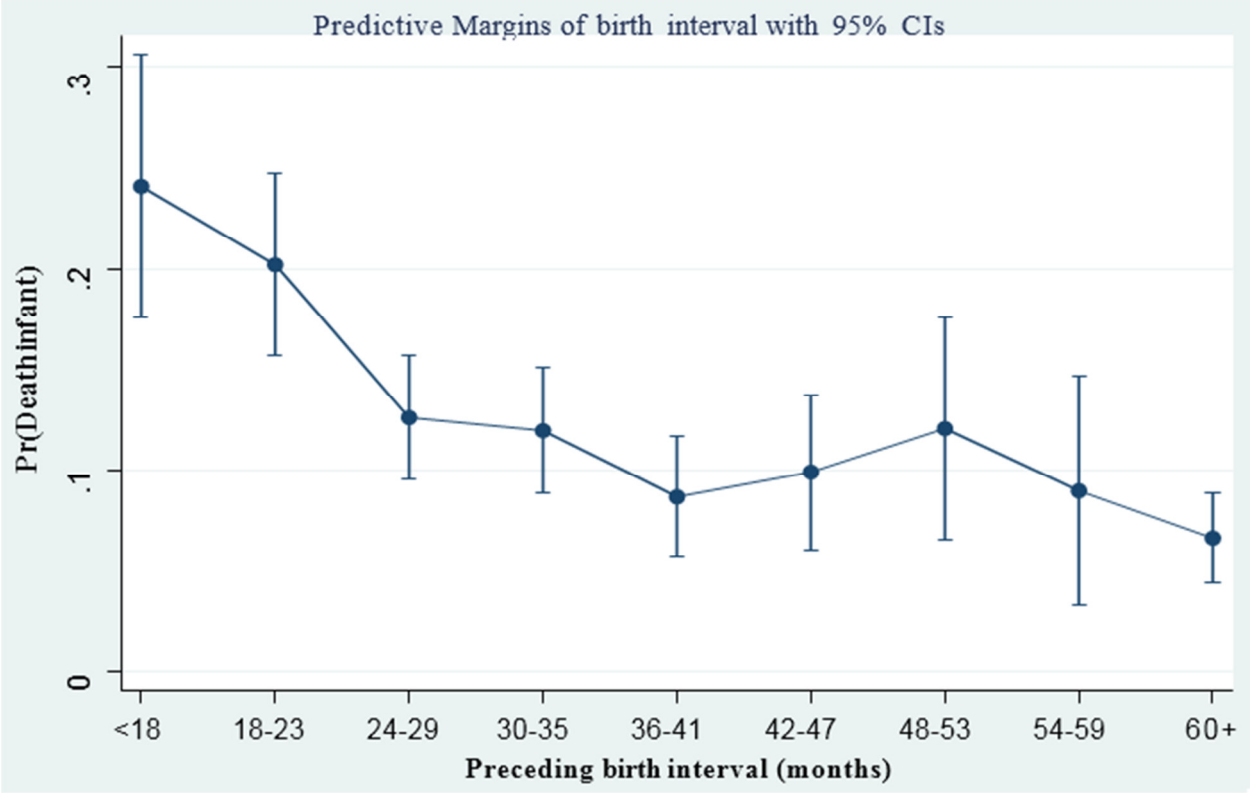

Figure 2: Predictive probabilities of under-five death by preceding birth interval

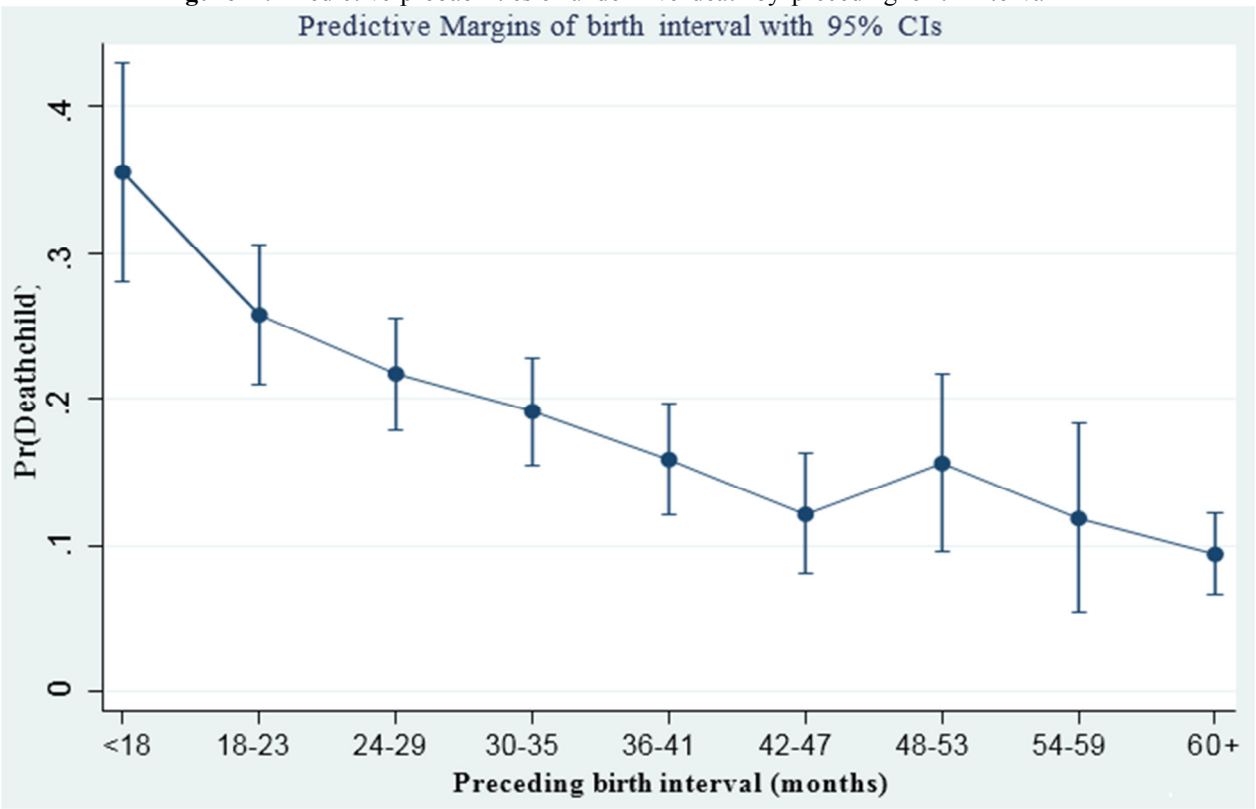

Figure 3: Predictive probabilities of under-five death by birth order

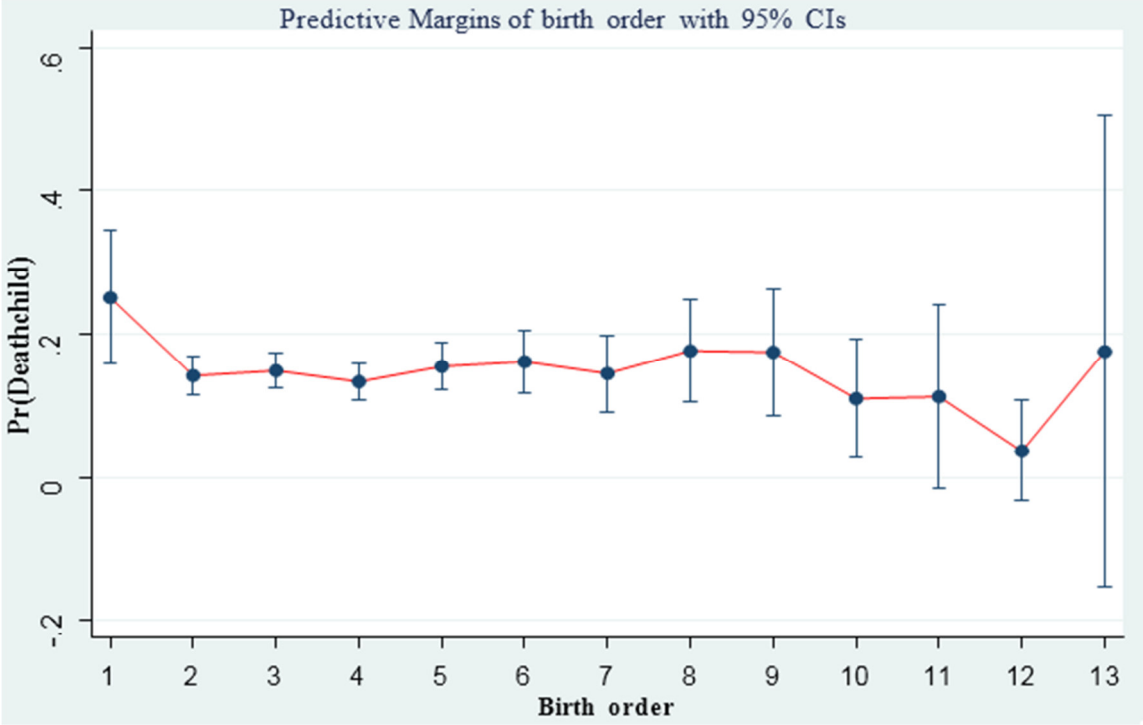

Figure 4: Predictive probabilities of infant death by birth order