1

Maternal Socio-Economic Status and Childhood Birth Weight: A Health Survey in Ghana

Edward Nketiah-Amponsah[1,*], Aaron Abuosi[2] and Eric Arthur[1]
[1]*Department of Economics, University of Ghana,*
[2]*Department of Public Administration and Health Services Management, University of Ghana, Ghana*

1. Introduction

Low birth weight (LBW) is one of the key reproductive health indicators whose outcome is influenced by consumption of reproductive health care. Rosenzweig and Schultz (1983) argue that one of the key measures of child health is that of birth weight. Birth weight is a good gauge of health of the child in the womb because the weight is taken immediately after birth. Consequently, a malnourished fetus will be born at low birth weight. On average, the worldwide incidence of low birth weight varies among countries, ranging from 4% to 6% in western countries like Sweden, France, United States and Canada (UNICEF 2003). Nevertheless, LBW is prevalent in developing countries especially those in the Sub-Saharan region due to the high levels of malnutrition and infectious diseases. A child's birth weight is an important indicator of the child's vulnerability to the risk of childhood illnesses and the chances of survival. Sub-Saharan Africa (SSA) has the second highest incidence of low birth weight infants the world over (16%), with South Central Asia being the highest at 27% (UNICEF and WHO 2004). The most recent evidence on Ghana shows that approximately 10% of all births are LBW (GSS, 2009). In particular, the UN envisages a reduction of low birth weight by at least one-third in the proportion of infants. This target is in fact, one of the seven major goals for the current decade of the "A World Fit for Children" programme of the United Nations (UN, 2004).

LBW is considered a major public health concern. Hence, a significant reduction in LBW is regarded as an important catalyst towards the achievement of the Millennium Development Goals (MDGs). LBW is defined as a birth weight of less than 2.5kg or 2500 grams. There are two types of LBW infants, that is, small-for-date and pre-term babies. Small-for-date infants are those who are delivered after a full gestation period of 37-40 weeks but due to intra-uterine growth retardation (IUGR), their birth weights are below 2.5 kg. Conversely, LBW can be caused by short gestation duration; <37 weeks of gestation as in the case of pre-term babies. LBW is immensely connected with fetal and neonatal morbidity and mortality

* Corresponding Author

(McCormick, 1985; Gortmaker and Wise, 1997; Caulfield et al. 2004). It is also a potential recipe for impaired cognitive development and the advent of chronic diseases in later life including diabetes and coronary heart disease (Bale et al. 2003). Other known triggers of LBW include maternal malnutrition, biological conditions such as multiple births, sex of the child, malaria episodes during pregnancy, complicated pregnancy due to pre-eclampsia or antepartum haemorrhage and behavioural or life style factors such as smoking (Vahdaninia, et al. 2008; Alderman and Behrman 2006; Bhargava et al. 2004). The literature on low birth weight on the African continent is on the ascendancy (see Mwabu 2008; Okurut 2009). In Botswana, Ubomba-Jaswa and Ubomba-Jaswa (1996) found that multiple births, birth order (first order), marital status and mothers' stature were important predictors for low birth weight. A study by Vahdaninia (2008) reports that primary and secondary education and non-smokers are highly correlated with low birth weights.

In the 2003 Ghana Demographic and Health Survey, information on birth weights is known for only 28% of babies born five years preceding the survey. In the 2008 GDHS however, birth weights were reported for 43 percent of births in the five years preceding the Survey, indicating a 15 percentage point improvement in birth weight registration as compared to the GDHS 2003. Generally, the low registration of birth weights is due to the high non-institutional and non-supervised deliveries mostly in the rural areas of the country[1]. Since many respondents did not deliver in health facilities and would not have had their babies weighed at birth, the survey solicited information on the women's own subjective assessment of whether their babies were average or larger than average, smaller than average or very small at birth (see Blanc and Wardlaw, 2004). Even though the mothers' reportage of the size of the infant is subjective, it can be a useful proxy for the weight of the child. Hence, this paper attempts to estimate the factors that influence the weight of a baby at birth using the sub-set of children who were actually weighed by the health facilities in addition to those whose weights are subjectively reported by their mothers. The novelty of this paper lies in the attempt to empirically estimate maternal socio-economic and demographic factors and perceived baby size at birth. Modelling mothers' evaluation of baby size at birth is an important step in solving the sample selection bias in reported birth weights due to low institutional delivery in developing countries such as Ghana (Okurut 2009 and Nwabu, 2008). To the best of our knowledge, this gap has not been explored since studies surveyed by far are entirely based on children who were actually weighed at birth at the health facilities. The study emphasises maternal attributes on infant birth weight due to the fact that birth weight is correlated between half siblings of the same mother but not of the same father because of the greater contribution of the maternal genotype and environment (Gluckman, 1994 and Walton, 1954). Among the socio-economic factors of interest are income (wealth), education, occupation or employment and marital status.

2. Related literature

Previous studies on the phenomenon in Ghana and elsewhere had paid less attention to mothers' subjective evaluation of the size of the baby. In the context of developing countries where institutional delivery is very low, concentrating only on the children weighed at the health facilities creates some informational gap. The effects of socio-economic, biological

---

[1] Approximately, 57% of deliveries occur in health facilities, with the public health facilities accounting for 46% of such deliveries.

and nutritional attributes of LBW are well documented (Klufio et. al. 2000; Dreyfuss et al. 2001). The key determinants of birth weight include nutritional status and age of the mother, area of residence, mother's immunization against preventable diseases and behavioural change during pregnancy (Deshmukh et al. 1998; Stephenson and Symons, 2002; UNICEF, 2003; Torres-Arreola et al. 2005; Negi, et al. 2006, Khatun and Rahman, 2008).

Utilization of maternal health services such as immunization against tetanus is further assumed to be complementary to other inputs that improve the health of the child in the womb, such as presumptive malaria treatment and avoidance of risky behaviours (Dow et al, 1999). Ajakaiye and Mwabu (2007) argue that tetanus vaccination does not directly increase birth weight, but that vaccination is strongly correlated with health care consumption and behaviours that increase birth weight implication; the adoption of a specific behaviour or the uptake of a specific input improves health, creates incentives to engage in other health-augmenting behaviours or consumption that improve birth weight. Guyatt and Snow (2004) also argue that that malaria infection have a substantial adverse effect on pregnancy outcomes (causing both premature birth [gestation of <37weeks] and intrauterine growth retardation, which lead to LBW).

Employing the 2006 Uganda Demographic and Health Survey (UDHS) data, 2006, Bategeka et al. (2009) examined the factors that influence birth weight in Uganda using instrumental variable (2SLS) technique. The findings suggest that birth weight is positively and significantly influenced by the mother's tetanus immunization status, education level, and antenatal care, but negatively influenced by mother's smoking of tobacco and malaria infection. In a related study, Okurut (2009) investigated the determinants of birth weight in Botswana. Applying instrumental variable (2SLS) technique to the Botswana Family Health Survey (BFHS) data for 1996, he found that birth weight is positively and significantly influenced by the mother's socio-economic characteristics (tetanus immunization status, age, and education level) and the husband's education level. The results from Bategeka (2006) and Okurut (2009) reinforce the role of maternal socio-economic factors and biomedical inputs such as antenatal care services and tetanus vaccination on childhood birth weight. The authors thus suggested that policy should be geared at, improving education of the girl child and improving access to reproductive health services (tetanus immunization and quality antenatal care) is critical in enhancing the health status of the unborn children in Botswana.

Similar evidence was adduced by Deshmukh (1998) who noted that tobacco exposure was a significant risk factor for LBW. Further empirical evidence by Almond et al (2002) also suggested that maternal smoking during pregnancy has negative and significant effects on birth weight and gestation length. Mwabu (2008) and Okurut (2009) sought to identify the determinants of birth weight in Kenya and Botswana respectively. In both studies, a two-stage least squares approach was adopted and the results were comparable. The mother's characteristics, age, education level and tetanus immunization were found to have a positive significant impact on birth weight. In both studies, tetanus immunization was used as an instrument for antenatal visits.

This paper uses the most recent nationally representative Demographic and Health Survey, GDHS 2008 to throw more light on the factors that contribute to the relatively high prevalence of low birth weight in Ghana. Contrary to most studies where birth weight is modelled as a continuous variable, this study measures birth weight as a discrete outcome.

3. Overview of the Ghanaian health sector

Prior to Ghana's independence from the British crown, the colonial administration provided healthcare for civil servants through general taxation while non-civil servants received healthcare at their own expense (out-of-pocket). Following Ghana's independence in 1957, health care was provided "freely" to subscribers of public health facilities. This ensured that there was no direct out-of-pocket payment at the point of delivery of health care in public health facilities. Financing of health in the public sector was, therefore, entirely through tax revenues. The sustainability of the free medical care policy became questionable as the economy began to show signs of decline in the 1970s and 1980s with economic growth and inflation being the major culprits. The ensuing economic decline eventually ushered Ghana into the World Bank/IMF's sponsored ERP/Structural Adjustment Programmes during the 1980s and 1990s. A key component of the ERP was health sector reform, which was intended to improve the efficiency of the health systems and the quality of care via cost recovery mechanism, in particular out-of-pocket payments with its concomitant effect of decreasing access to health care by the poor (Nyonator and Kutzin, 1999; Asenso-Okyere et al, 1997).

Consequently, Ghana has since 1985, operated a cost-recovery health delivery system known as the "cash-and-carry" system, whereby patients are required to pay up-front for health services at government clinics and hospitals. The advent of out-of-pocket payments constrained access to health care to many Ghanaians especially during emergency and accident cases where deposits are required before care. This coupled with reduction in public spending on health care created problems of inaccessibility and inequity in health care.

In the midst of these financing challenges, the Government of Ghana and its global partners consider the improvement of maternal health as crucial for socio-economic development. In 1987, the World Health Organization (WHO) and other UN agencies including UNICEF launched the Safe Motherhood Initiative which was genially embraced by Ghana. In 1998, the government introduced a free antenatal care services for all pregnant women. The commitment of the government of Ghana in promoting safe motherhood was further enhanced by the introduction of the policy of exempting users of maternal services from delivery fees in the four most deprived regions of Ghana namely, Upper East, Upper West, Northern and Central, in September 2003. The policy was later expanded to incorporate the remaining six regions of Ghana in April 2005. Furthermore, the government of Ghana armed with a grant support of US$90 million from the UK government in July 2008 strengthened the free maternal care initiative (Government of Ghana, 2010, United Nations, 2008). The main rationale for the introduction of these policies is to reduce financial barriers and to induce the utilization of maternal health services with the overall objective of improving maternal and child health outcomes including birth weight. Other policies introduced by the government to improve access and equity to essential health care services include the introduction of interventions such as the Community-based Health Planning and Services (CHPS) and the introduction of the National Health Insurance Scheme (NHIS) and the free maternal care programme. However, access still remains a problem. For instance, institutional delivery remains a low of 53% (WHO, 2011).

Country	LBW	IMR	U5MR	MI	MMR	LE	PCHE
Ghana	**14.3**	**47**	**69**	**93**	**350**	**60**	**114**
Nigeria	26.7	86	138	41	840	54	113
Benin	20.2	75	118	72	410	57	61
Burkina Faso	37.4	91	166	75	560	52	82
Cape Verde	-	23	27	96	94	71	176
Cote D'Ivoire	16.7	83	118	67	470	50	88
Gambia	15.8	78	103	96	400	60	75
Guinea Conakry	20.8	88	142	51	680	52	58
Liberia	20.4	80	112	64	990	56	46
Mali	27.9	101	191	71	830	53	76
Niger	39.9	76	160	73	820	57	40
Senegal	14.5	51	93	79	410	62	102
Sierra Leone	21.3	123	192	71	970	49	104
Togo	20.5	64	98	84	350	59	70
Guinea Bissau	17.4	115	193	76	1000	49	48
African Average	-	80	127	69	620	54	146

Table 1. Selected Health Indicators for Ghana and other Regional Neighbours (ECOWAS). LBW=Low Birth weight; IMR=Infant Mortality Rate; MI=Measles Immunization; MMR=Maternal Mortality Rate; LE=Life Expectancy; PCHE= Per capita Health Expenditure. *Source: World Health Statistics 2011. World Health Organization, Geneva*

The passage of the National Health Insurance law in 2003 (Government of Ghana, 2003) was in particular to remove the financial barrier to health care and to promote access and equity. The Act mandates the establishment of District-wide mutual health insurance schemes (DMHIS) where minimum premium of roughly US$8 per adult (Jehu-Appiah et al. 2011) for non Social Security and National insurance trust contributors are charged. The scheme provides generous exemptions for those aged under 18, and over 70, pensioners, pregnant women or deemed indigent (core poor). Formal and informal sector employees who contribute to the Social Security and National Insurance Trust (SSNIT) pay 2.5% of their SSNIT contributions as insurance premium. Though enrolment is compulsory, non-compliance is quite high while there are virtually no enforcement mechanisms.

While Ghana's selected health indicators are better than almost all its West African neighbours, the indicators do not compare favourably with other countries within the African sub-region, with the gap widening in comparison with the developed world (see Table 1 and WHO Health Reports, 2010 and 2011). Migration of health workforce, inadequate health personnel (high doctor patient ratio), poor health infrastructure and general dissatisfaction with working conditions are some of the major challenges facing the country's health sector (Ghana Health Service, 2007; Agyepong *et al*. 2004)

4. Methods

4.1 Data

The study uses the 2008 Ghana Demographic and Health Survey (GDHS), the fifth Demographic and Health Survey (DHS) to be undertaken in Ghana since 1988. It is a nationally representative household survey conducted by the Ghana Statistical Service with technical support from the World Bank. The 2008 GDHS was implemented in a representative probability sample of more than 12,000 households selected throughout Ghana. The survey centred on general welfare, education, health and healthcare and demographic issues that impinge on the wellbeing of women, children and the average Ghanaian household. Three questionnaires were used for the 2008 GDHS: (i) the Household Questionnaire, (ii) the Women's Questionnaire, and (iii) the Men's Questionnaire. In all, 4,916 women aged 15-49 and 4,568 men aged 15-59 from 6,141 households were interviewed from all the ten regions of Ghana from early September to late November 2008. This study is based on the maternal questionnaire which contains detailed information on fertility, marriage, sexual activity, fertility preferences, breastfeeding practices, nutritional status of women and young children and other socioeconomic attributes of the women. The study sample consists of children who were born within the five years preceding the 2007-08 GDHS and whose mothers were interviewed in the survey. The analyses will thus be based on children aged 0-59 months who were weighed at birth and those whose mothers subjectively reported their size at birth. The variables which were included in the empirical estimation are shown in Table 2.

5. Estimation

In this paper, the birth weight of the infant is captured as a dichotomous and in an ordered form. In the case of the dichotomous dependent variable, cases with a birth weight of below 2.5 kg (2500grams) are considered LBW while those with 2.5kg or more are non-LBW. With regards to the ordered birth size, the mothers' subjective assessment of their babies is ranked from very large, the highest which is accorded a value of one(1) to very small, the lowest which is assigned a value of five (5) with 5 categories as presented in Table 3. Discrete choice, particularly the logistic and ordered logistic regressions are used to estimate the correlates of low birth weight. The use of these methods is appropriate and enables us to assess each explanatory variable with the likelihood of a child having low birth weight. Where appropriate the marginal effects and/or the odds ratios are computed to ease the interpretation.

5.1 Logit

The Logistic model is used for the prediction of the probability of occurrence of a discrete binary variable. It is employed in cases where the variable has only two outcomes. As employed in this study, the outcome variable is coded zero(0) if the child has normal weight(>=2500grams) and coded one (1) if the baby weighs below 2500grams in which case the child is considered to have low birth weight. Gujarati (2004) estimates the logistic regression model as;

$$Y^* = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + e_i$$

Where;

Y* = Dependent variable (Birth weight)
X_i = Independent variables; maternal bio-demographic and socioeconomic characteristics
β_0 = Intercept
β_i = Regression coefficients

The model is estimated using Stata.

5.2 Ordered logit

The ordered logistic model is a regression model for ordinal dependent variables. It is an extension of the logistic regression model for binary dependent variables, allowing for more than two ordered response categories. It is usually estimated using the maximum likelihood estimation technique. The ordered logistic model, according to Greene (2003) can be written as,

$$y_i^* = \beta' x_i + \varepsilon \ .$$

Where y_i^* = the underlying response, which is the birth weight of the baby.

x_i = a set of explanatory variables and u_i = the residual error, which is assumed to be normally distributed.

According to Greene (2003), y*, the variable of interest (which is the subjective or perceived birth weight of the baby) is unobserved, what we observe rather is a variable y, which in this study is the size of the baby as ranked by the mother. Consequently, we model the mother's perceived size of the baby at birth using a 5 point Likert scale from very large (1), larger than average (2), average (3), smaller than average (4) and very small (5) where very large (1) is the highest and very small (5) is the lowest.

5.3 Results and discussion

5.4 Logistic regression

The mean birth weight for the entire sample is 3239.24 grams (SD=832.30) while the mean birth weights for the normal and LBW infants are 3368.0 (SD=761.99) and 2098.90(SD=302.11) grams respectively. At the bivariate level, gender and multiple births were significantly different between mothers of LBW and normal birth weight infants (see Table 2). Multivariate analysis however, showed that multiple birth (odds ratio = 13.72) was the most important risk factor for LBW in Ghana.

The wealth index of the household (used as a proxy for household income) was constructed in quintiles (1 = poorest, 2 = poorer, 3 = middle, 4 = richer, 5= richest). The results suggest that women in the poorest wealth quintile are less likely to have LBW compared to those in the highest income quintiles, though this was only significant at the 10% (p = *0.065*). However, those in the poorer, middle and richer quintiles did not show significant association with LBW. Our finding is in sharp contrast with that of Torres-Arreola et al. (2005) who found low socio-economic status as the most important risk factor for

LBW.Though this result is not unexpected, it is not inexplicable. The wealth index is used a proxy for income since there is no direct measure of income. Wealth per se is not a direct determinant of health outcome unless it is translated into the consumption of health inputs. We can thus conclude that we did not detect any significant relationship between wealth index and LBW for Ghana. Normally, differences found in the effect of socioeconomic factors on LBW are probably due to the use of different socioeconomic indicators. It should be noted however, that obtaining information that accurately reflects social and economic characteristics can be difficult, leading to the generation of proxy variables.

Education as expected proved significant in explaining LBW in Ghana. Our finding indicates that there is a threshold effect of education on LBW. While primary education has the expected negative relationship, it is statistically insignificant. Rather, it is secondary education or better which exerts the requisite effect on LBW. In particularly, women who have secondary education or better are 6 percentage points less likely to have LBW compared to their counterparts with no education. The significant inverse relationship between education and LBW is consistent with Koupilova et al. (2000), Mwabu (2008), Khatun and Rahman (2008) and Okurut (2009). Although other studies have reported the negative effect of maternal education on LBW, the association was not statistically significant (see Torres-Arreola et al. 2005; Ubomba-Jaswa and-Ubomba-Jaswa, 1996). In Iran, Jafari et al. (2010) rather found a positive and significant relationship between primary and secondary education on one hand and LBW on the other hand. The results also indicate that the gender of the child is highly associated with birth weight. A boy child has a higher probability of experiencing low birth weight relative to a girl child. More specifically, being a boy increases the odds of LBW by 1.7 (3 percentage points) relative to their girl counterparts.

The study's finding further points to a significant regional variation in low birth weights. Women in the Western region (p=0.005), Ashanti(p=0.042) and the Brong-Ahafo (p=0.090) have a higher propensity of giving birth to LBWs as compared to children born in the Greater Accra Region. For instance, children born to women in the western region of Ghana are approximately 16 percentage points more likely to be of LBW compared to their counterparts in the Greater Accra region. The descriptive statistics in Table 2 also lend support to this empirical finding. Although women who are employed showed the expected inverse relationship with LBW, the effect is insignificant.

Variable : Birth weight	**Normal birth weight**	**Low birth weight**	**Pearson's chi square test**
Wealth			
poorest	96.94	3.06	5.36
poorer	90.32	9.68	
middle	89.76	10.24	
richer	90.64	9.36	
richest	92.73	7.27	
Education			
no education	91.86	8.14	
primary	90.34	9.66	
secondary	92.02	7.98	
Mother's Age			
15 – 19 years	97.06	2.94	2.29
20 – 34 years	91.99	8.01	

Variable : Birth weight	Normal birth weight	Low birth weight	Pearson's chi square test
35 – 49 years	89.91	10.09	
Tetanus Injection			
No injections	94.12	5.88	0.59
Received Injections	91.44	8.56	
Birth order			
1 child	93.01	6.99	0.94
2 – 5 children	91.44	8.56	
More than 5 children	90.36	9.64	
Gender of Child			
Male	93.36	6.64	3.60*
Female	89.81	10.19	
Birth type			
Single birth	92.57	7.43	31.74***
Multiple birth	61.54	38.46	
ANC			
No visits	87.5	12.5	0.65
1 – 3 visits	89.77	10.23	
4 or more visits	91.9	8.1	
Rural*Education			
No education	92.47	7.53	2.28
Primary	91.76	8.24	
Secondary plus	89.01	10.99	
Residence			
Urban	92.46	7.54	0.98
Rural	90.6	9.4	
Employment			
Not working	93.55	6.45	0.68
Working	91.33	8.67	
Marital status			
Not married	91.67	8.33	0.0001
Married	91.65	8.35	
Administrative Regions			
Western	84.93	15.07	12.83
Central	92.86	7.14	
Greater Accra	95.51	4.49	
Volta	91.67	8.33	
Eastern	89.8	10.2	
Ashanti	89.52	10.48	
Brong Ahafo	90.41	9.59	
Northern	94.74	5.26	
Upper East	98	2	
Upper West	91.67	8.33	

Tables 2. Bivariate Analysis for Selected Variables 2008[2]. ***: Significant at 1 %(p<0.001); **: Significant at 5% (p<0.05 and *: Significant at 10% (p<0.10)

[2] The variables for the empirical estimation were chosen with recourse to the literature and the peculiarity of the health care situation of a developing country. For instance, alcohol consumption and

The age of the woman is hypothesized to be statistically and significantly associated with LBW overtime. This variable is statistically significant at the 10% level. That is, an increase in the age of an expectant mother by one year increases the probability of giving birth to a LBW by 3 percentage points. The positive association between maternal age and LWB which is largely due to the health depreciation effect is consistent with Vahdaninia et al.(2008) Who found same for Iran. Further, women who live in the urban areas have a lower propensity of giving birth to LBWs but this variable is not significant.

Dependent Variable : Birth weight	**Coefficient**	**Standard**	**P>z**	**Marginal Effects**	**Odds Ratio**
Wealth (Ref: Richest)					
Poorest	-1.506*	0.816	0.065	-0.055	0.222
Poorer	-0.31	0.484	0.521	-0.016	0.733
Middle	-0.045	0.462	0.923	-0.003	0.956
Richer	0.045	0.374	0.905	0.003	1.046
Mother's Education					
Primary	-0.386	0.464	0.406	-0.02	0.68
Secondary plus	-0.944**	0.482	0.05	-0.06	0.389
Other Socioeconomic Indicators					
Mother's Age	0.583*	0.337	0.083	0.033	1.791
Tetanus Injecton given	-0.672	0.549	0.221	-0.03	0.511
Multiple birth	2.619***	0.47	0	0.395	13.718
Gender of child: Female	0.524**	0.266	0.049	0.03	1.689
Rural and Educated	0.406	0.355	0.252	0.023	1.501
Mother's Body mass index	0.0001	0	0.738	0	1
Antenatal care visits	-0.109	0.133	0.416	-0.006	0.897
Birth Order	-0.149*	0.084	0.076	-0.009	0.861
Residence: Rural	-0.034	0.576	0.953	-0.002	0.967
Employment (Ref: Not working)	-0.132	0.433	0.761	-0.007	0.877
Marital status(Ref: Not married)	-0.219	0.419	0.6	-0.014	0.803
Administrative Regions					
Western	1.539**	0.548	0.005	0.156	4.658
Central	0.423	0.773	0.585	0.029	1.526
Volta	0.669	0.711	0.347	0.05	1.952
Eastern	0.842	0.547	0.124	0.065	2.32
Ashanti	1.028**	0.506	0.042	0.076	2.794
Brong Ahafo	0.988*	0.582	0.09	0.082	2.685
Northern	0.031	0.717	0.966	0.002	1.031
Upper East	-0.555	1.171	0.636	-0.026	0.574
Upper West	0.955	0.708	0.177	0.08	2.599
Constant	-3.382	1.238	0.006		
Number of observations : 874 LR chi2(26) = 55.07 Prob>chi2 = 0.0007 Log likelihood = -223.56078 Pseudo R2 = 0.1097					

Table 3. Logit estimates of the effects of maternal socio-economic factors and LBW. ***: Significant at 1 %(p<0.001); **: Significant at 5% (p<0.05 and *: Significant at 10% (p<0.10)

cigarette smoking were not included because only few women indicated the use of alcohol and smoking of cigarette during pregnancy. The inclusion of these variables would create a problem of matrix singularity.

The results also indicate a negative association between LBW and the number of antenatal care visits, though the effect is not robust. Antenatal care visits are used to diagnose and treat for any infections which affect the unborn babies. The results suggest that the higher the number of antenatal visits, the lower the probability of LBW. Other studies including Negi et al (2006) and Joshi et al (2005) had found a significant negative correlation between mother's antenatal care visits and LBW.

The most robust finding from our study is the significant statistical relationship between multiple births and LBW (*p<0.0001*). Children who are born twins or mutilple are approximately 40 percentage points more likely to be of LBW as compared to singletons. This finding is consistent with Ubomba-Jaswa and Ubomba-Jaswa (1996) who found a robust positive association between multiple births and LBW for infants in Botswana. Thus, if women who had not received immunization against tetanus were to be immunized, the probability of experiencing a LBW will drop by 3 percentage points. The low birth weight of twins compared with singletons is somewhat influenced by the higher congenital abnormality rate in twins, or the increased incidence of proteinuric pre-eclampsia in the mothers, (MacGillivray, 1983). Also, vaccination against tetanus was found to have the desired negative effect on LBW, albeit insignificant (*p=0.221*). We also found an inverse relationship between birth order and LBW. Our finding is however at variance with Phung et al. (2003) who found that higher parity was associated with significantly higher birth weight.

5.5 Ordered logistic regression

At the bivariate level (see Table 4), the Pearson chi-square test indicates that there are statistically significant differences between perceived birth size on one hand and the gender of the child, antenatal care visits, marital status, area of residence and geographical area of residence on the other hand (*p<0.001*). However, a number of covariates contemporaneously determine an outcome such as birth weight, hence the result from the multivariate ordered logistic regression is emphasized.

Variable : child size at birth	**Very large (1)**	**Larger than Average (2)**	**Average (3)**	**Smaller than average (4)**	**Very small (5)**	**Pearson's chi square test**
Wealth						
Poorest	20.3	32.01	29.37	12.54	5.78	23.65*
Poorer	24.29	31.07	31.51	8.97	4.16	
Middle	22.74	32.33	33.7	6.85	4.38	
Richer	20.9	34.39	32.54	8.73	3.44	
Richest	24.15	37.74	25.66	9.81	2.64	
Education						
No education	23.71	31.98	28.73	10.57	5.01	11.66
Primary	19.43	31.58	33.2	11.13	4.66	
Secondary	22.53	34.8	30.99	8.1	3.58	
Gender of child						
Male	255	364	330	81	35	19.52***
Female	20.38	31.81	30.42	11.93	5.47	

Birth type						
Single birth	22.38	33.15	30.73	9.44	4.3	
Multiple	14.89	27.66	29.79	21.28	6.38	
Birth Order						
1	19.37	32.88	31.98	10.36	5.41	6.64
2	22.55	34.06	30.45	8.85	4.09	
3	23.78	31.25	30.21	10.76	3.99	
Antenatal Care						
No visits	17.07	24.39	36.59	9.76	12.2	21.28***
1 -3 visits	21.37	31.34	29.91	11.68	5.7	
4 or more visits	22.65	33.82	30.59	9.28	3.66	
Employment						
Not working	22.35	32.95	30.79	9.6	4.3	0.4
Working	21.24	33.59	30.12	10.42	4.63	
Married						
Not married	16.6	29.79	37.45	10.21	5.96	10.18**
Married	22.93	33.44	29.85	9.64	4.14	
Residence						
Urban	23.58	36.31	29.13	8.27	2.71	15.15***
Rural	21.46	31.21	31.58	10.5	5.25	
Rural* Education						
No Education	23.58	33.96	28.81	9.7	3.96	10.72
Primary	19.57	31.19	33.64	10.7	4.89	
Secondary plus	19.8	31.44	34.65	8.91	5.2	
Tetanus Injection						
No injection	20.78	30.59	31.37	9.41	7.84	13.18
Received Injections	22.39	33.43	30.56	9.76	3.86	
Mother's Age						
15 – 19 years	16.83	30.69	36.63	11.88	3.96	12.71
20 – 34 years	20.94	34.44	29.87	10.25	4.5	
35 – 49 years	25.9	30.29	31.6	8.14	4.07	
Region						
Western	18.38	28.65	46.49	5.41	1.08	239.62***
Central	22.73	32.47	38.31	5.84	0.65	
Greater Accra	20.4	44.28	25.37	8.46	1.49	
Volta	6.86	32.57	44.57	14.86	1.14	
Eastern	34.64	31.84	20.11	6.15	7.26	
Ashanti	22.29	28.66	35.67	6.05	7.32	
Brong Ahafo	9.9	41.09	33.66	11.88	3.47	
Northern	38.98	27.12	14.92	10.85	8.14	
Upper East	16.05	35.19	27.78	14.2	6.79	
Upper West	22.06	33.33	27.94	14.71	1.96	

Tables 4. Bivariate Analysis for the Variables used for the Ordered Logistic Regression (Mother's Perception of Baby Size). ***: Significant at 1 %(p<0.001); **: Significant at 5% (p<0.05 and *: Significant at 10% (p<0.10)

Variable : Birth size	Coefficients	Robust Standard Error	z	P>z
Wealth (Ref: Richest)				
Poorest	0.064	0.195	0.33	0.742
Poorer	-0.252	0.179	-1.41	0.159
Middle	-0.158	0.164	-0.96	0.336
richer	0.009	0.152	0.06	0.951
Mother's Education				
Primary	-0.05	0.143	-0.35	0.728
Secondary plus	-0.320*	0.178	-1.8	0.072
Other Socioeconomic Indicators				
Age	-0.08	0.102	-0.79	0.432
Tetanus injection	0.078	0.137	0.57	0.568
Multiple births	0.874***	0.283	3.09	0.002
Gender (female)	0.276***	0.081	3.42	0.001
Rural*Educated	0.134	0.107	1.26	0.209
BMI of mother	0.0001	0	-0.13	0.899
Antenatal care visits	-0.068**	0.036	-1.91	0.057
Birth order	-0.026	0.026	-0.99	0.324
Rural	0.097	0.175	0.56	0.579
Employment (not working)	0.07	0.124	0.57	0.57
Marital Status (not married)	-0.399***	0.134	-2.97	0.003
Administrative Regions	-	-	-	-
Western	0.263	0.174	1.51	0.131
Central	-0.033	0.191	-0.17	0.864
Volta	0.679***	0.173	3.92	0
Eastern	-0.416**	0.203	-2.05	0.041
Ashanti	0.289*	0.168	1.73	0.084
Brong Ahafo	0.422**	0.171	2.47	0.013
Northern	-0.503**	0.206	-2.44	0.015
Upper East	0.305	0.221	1.38	0.167
Upper West	0.073	0.195	0.37	0.71
Number of Observations: 2072 Wald chi2(26) = 138.73 Prob>chi2 = 0.000 Log pseudolikelihood = -2894.5102 Pseudo R^2 = 0.0223				

Table 5. Ordered Logit Estimates of the effects of Maternal Socio-economic Factors and Perceived Baby Size. ***: Significant at 1 %(p<0.001); **: Significant at 5% (p<0.05 and *: Significant at 10% (p<0.10)

Table 5, presents the results of the ordered logistic regression where the size of the baby is ranked from very large (1), lager than average (2), average (3), smaller than average (4) to very small (5). A negative value denotes a movement from a very small size at birth towards a very large size at birth while a positive suggests otherwise. None of the wealth indicators was found to statistically influence perceived size of the baby. Just as in the first model, the results suggest that mothers with secondary education or better are less likely to perceive LBW. Though, primary education had the a priori expectation, it was insignificant, buttressing the threshold effect of secondary education on childhood birth weight. Interestingly, we found that higher birth orders are associated with a lower risk of perceived LBW (*p=0.007*).

The gender of the child was another variable that was found to exert significant influence on perceived size of the baby (*p=0.001*). Children born males are more likely to gravitate from very large baby size towards very small baby size relative to their female counterparts. The gender difference in perceived size might be due to the differences in the biological attributes. The gender effect is corroborated by the estimations in Table 3 where males were found to have a higher probability of LBW. Also residents of the Western and Volta geographical regions of Ghana have a higher propensity of experiencing perceived LBW than those residing in the greater Accra region. However, women in the Northern region of Ghana are less likely to have LBW (*p=0.004*). This result is quite surprising given that the Northern region is one of the poorest regions of Ghana. It is, thus probable that some attributes inherent in the region other than wealth and the consumption of biomedical inputs promote perceived normal birth sizes.

Unlike the logistic regression model where LBW is predicted, the effect of marital status (*p=0.003*) and antenatal care visits (*p= 0.057*) are correctly signed and significant in predicting perceived baby size by mothers. More specifically, married women and those who intensify the use of antenatal care visits are less likely to register LBW. These variables were also found to be significant at the bivariate level (see Table 4). Other covariates including urban residence had no significant effect on perceived baby size while that of multiple births had a positive and significant association with same.

6. Summary and concluding remarks

In summary, LBW is positively and significantly predicted by geographical area of residence, gender of the child, multiple births and mother's age. Conversely, maternal education especially beyond the primary education and birth order were found to be statistically and inversely related to LBW. In particular, women with secondary education or better are approximately 39 percentage points less likely to experience LBW relative to their uneducated counterparts. While biomedical inputs such as immunization against tetanus and the number of antenatal care visits have the expected inverse relationship, they proved insignificant in predicting LBW.

The ordered logistic regression indicates that marital status, the utilization of antenatal care services, secondary education or better and residents of the Eastern and Northern geographical regions of Ghana are significantly and inversely associated LBW. However, multiple births, gender, and residents of Volta and Northern geographical regions are positively and significantly associated with having babies with small sizes. Overall, multiple births, gender and secondary education or better were consistently significant in predicting LBW and perceived baby size in both the logistic and ordered logistic regression models.

Although, the proxy for income (wealth index) did not prove to be an important determinant, other studies have used education as a proxy for socio-economic status (Nordstrom and Cnattingius, 1996; Parker et al. 1994). At least, using data from the most recent survey, we have demonstrated a strong inverse association between secondary education or better and LBW.

In the context of a free and universal access to health care, it is recommended that policy makers should place more emphasis on education as it imparts knowledge and thus influences dietary habits and birth-spacing behaviour. This will lead to a better nutritional status, particularly in dealing with pregnancy, resulting in lower rates of low birth weight. Thus the government should target policies that reduce the regional disparities in health facilities and infrastructure to curb the regional differences in birth weight outcomes. Due to the robust effect of education on health outcomes including birth weight, intensifying especially girl child education via formal and informal means in addition to the provision of health infrastructure constitutes an important policy intervention.

7. References

Alderman, H., and Behrman, J. (2006). "Reducing the Incidence of Low Birth Weight in Low-Income Countries Has Substantial Economic Benefits." *World Bank Research Observer*, 21(1):25-48.

Agyepong, I. A., Anafi, P., Asiamah, E., Ansah, E. K., Ashon, D. A., & Narh-Dometey, C. (2004). Health worker (internal customer) satisfaction and motivation in the public sector health care providers. *International Journal of Health Planning and Management,* 19(4):319-36.

Ajakaiye, O. and Mwabu, G. (2007). The Demand for Reproductive Health Services: An Application of Control Function Approach. AERC Working Paper Series.

Bale, J. R., Stoll, B.J., Lucas, A.O. (2003). (eds). Improving Birth Outcomes: Meeting the Challenge in the Developing World. Washington, D.C: The National Academies Press.

Bategeka, L., Leah, M., Okurut, A., Barungi, M., Apolot, J. M. (2009). The Determinants of Birth weight in Uganda. A Final Report Submitted to AERC, Nairobi, Kenya.

Bhargava, S.K., Sachdev, H.S., Fall, C. H .D, Osmond, C., Lakshmy, R., Barker, D. J. P., Biswas, S. K. D., Ramji, S., Prabhakaran, D. and Reddy, K. S. (2004). Relation of Serial Changes in Childhood Body-Mass Index to Impaired Glucose Tolerance in Young Adulthood. *New England Journal of Medicine*, 350:865-75.

Blanc, A. K. and Wardlaw, T. (2004). Monitoring Low Birth Weight: An Evaluation of International Estimates and an Update Estimation Procedure, *Bulletin of the World Health Organization*, 83:3.

Blunch, N. (2004), "Maternal Literacy and Numeracy Skills and Child Health in Ghana" A paper presented at the Northeast Universities Development Consortium Conference, HEC Montreal, October 1-3, 2004.

Caulfield, L. E., De Onis, M., Blossner, M., Black, R. E. (2004). Under nutrition as an Underlying Cause of child deaths associated with Diarrhoea, pneumonia, malaria and measles. *American Journal of Clinical Nutrition*, 80: 193-198.

Deshmukh, J.S,. Motghare, D. D. Zodpey, S. P and Wadhva, S.K. (1998). Low birth weight and associated maternal factors in an urban area, *Indian paediatrics*, 35: 33-36

Dreyfuss, M. L., Msamanga, G. I., Spiegelmam, D., Hunter, D. J., Ernest, Urassa, E. J. N., Hertzmark E. and Fawzi, W. W. (2001). Determinants of Low Birth Weight among HIV-infected Pregnant Women in Tanzania, American Journal of Clinical Nutrition, 74(6): 814-826.

Ghana Health Service. (2007). Annual report. Ministry of health, Accra. Ghana Statistical Service Ghana Statistical Service and Macro International Inc. (MI). (2004). Ghana Demographic and Health Survey 2003. Calverton, Maryland: GSS and MI.

Ghana Statistical Service (GSS) and Macro International Inc. (MI). (2009). Ghana Demographic and Health Survey 2008. Calverton, Maryland: GSS and MI.

Government of Ghana(GOG). The National Health Insurance Act: Act650. Accra: Government of Ghana.

Gortmaker, S. L., Wise, P. (1997). The First Injustice: Socio-economic Disparities, Health Services Technology and Infant Mortality. *Annual Review of Sociology*, 23:147-70

Gluckman, P, Harding J. E. (1994). Nutritional and hormonal regulation of fetal growth: evolving concepts. *Acta Paediatrica*(Suppl)399:60–3.

Jafari , F, Eftekhar, H, . Pourreza, A. and Mousavi, J. (2010). Socio-economic and medical determinants of low birth weight in Iran: 20 years after establishment of a primary healthcare network. *Public Health*, 124(3):153-158.

Jehu-Appiah, C., Aryeetey, G., Agyepong, I. Spaan, E. and Baltussen, R. (2011). Household Perceptions and their implications for enrolment in the National Health Insurance Scheme in Ghana. *Health Policy and Planning*, 2011:1-12. doi: 10.1093/heapol/czr032.

Joshi, H. S., Subba, S. H., Dabral1, S. B., Dwivedi, S., Kumar, D. and Singh, S. (2005). Risk Factors Associated with Low Birth Weight in Newborns. *Indian Journal of Community Medicine*, 30: 4.

Hernández, S., Villa-Barragán, Juan Pablo and Rendón-Macías, E (2005). Socioeconomic factors and low birth weight in Mexico. *BMC Public Health*, 5:20 .doi:10.1186/1471-2458-5-20.

Khatun, S. and Rahman, M. (2008). Socio-economic determinants of low birth weight in Bangladesh: a multivariate approach. *Bangladesh Medical Research Council Bulletin.* 34(3):81-6

Klufio, C. A., Lassey, A. T, Annan, B. D. and Wilson, J. B. (2000). Birth weight Distribution at Korle-Bu Teaching Hospital, Ghana. *East African Medical Journal*, 78(8):418-423.

Koupilova, I, Rahu, Kaja, Rahu, M,, Karro, H. and Leon, D. A. (2000). Social determinants of birth weight and length of gestation in Estonia during the transition to democracy, *International Journal of Epidemiology*, 29:118–124

MacGillivray, I. (1983). Determinants of birth weight of twins. *Acta Genet Med Gemellol* (Roma).32(2):151-7

McCormick, M.C. (1985). The Contribution of Low Birth Weight to Infant Mortality and Childhood Morbidity, *New England Journal of Medicine.* 312: 82-90.

Mbuya, M. N. N., Children, M., Chasekwa, B. and Mishra, V. (2010). Biological, Social and Environmental Determinants of Low Birth Weight and Stunting among Infants and Young Children in Zimbabwe, Zimbabwe Working Papers, No.7.

Negi, K.S., Kandpal, S.D. and Kukreti, M. (2006), "Epidemiological Factors Affecting Low Birth Weight", *JK Science*, 8(1): 31-34

Nordstrom, M. L, Cnattingius, S. (1996). Effects on birthweights of maternal education, socioeconomic status, and work-related characteristics. *Scandinavian Journal of Social Medicine* 24:55-61

Mwabu, Germano (2008). "The Production of Child Health in Kenya: A Structural Model of Birth Weight." Yale *University Economic Growth Center Discussion Paper.* New Haven: Yale Economics Department Working Paper No. 52, 2008.

Okurut F. N. (2009). Determinants of Birth weight in Botswana. A Paper presented at the CSAE Conference, 22nd – 24th March 2009, University of Oxford, UK.

Parker, J. D., Schoendorf, K.C., Kiely, J. L. (1994). Associations between measures of socioeconomic status and low birth weight, small for gestational age, and premature delivery in the United States. *Annals of Epidemiology*, 4:271-278.

Phung H.,. Bauman, A. Nguyen, T. V, Young, L., Tran, M. and Hillman K. (2003). Risk Factors for Low Birth Weight in a Socio-Economically Disadvantaged Population: Parity, Marital Status, Ethnicity and Cigarette Smoking. *European Journal of Epidemiology,* 18(3):235-243

Rosenzweig, M. R., and Schultz, T.P (1982). The behavior of Mothers as Inputs to Child Health: The determinants of Birth Weight, Gestation, and the Rate of Fetal Growth, in Fuchs, V.R. (ed) *Economic Aspects of Health*, pp.53-92. Chicago: The University of Chicago Press.

Rosenzweig, M R., and Schultz, T. P (1983). Estimating a Household Production Function: Heterogeneity, the Demand for Health Inputs, and their Effects on Birth Weight. *Journal of Political Economy*, 91(5): 723 – 746.

Stephenson, T., Symonds, M. E. (2002). Maternal nutrition as a determinant of birth weight. *Arch Dis Child Fetal Neonatal Ed.* 86:F4-F6 doi:10.1136/fn.86.1.F4.

Ubomba-Jaswa, P and Ubomba-Jaswa, S. R. (1996). Correlates of low birth weight in Botswana. *South African Journal of Demography*, 6(1):64-73.

UNICEF, and WHO (2004). Low Birth Weight: Country, Regional and Global Estimates. New York: UNICEF.

UNICEF 2003 [http://www.unicef.org/spanish/pubsgen/sowc03/sowc03-sp.pdf, Accessed: June 5, 2011].

Vahdaninia, M., Tavafian, S. S. and Montazeri, A. (2008). Correlates of Low Birth Weight in Term Pregnancies: A retrospective Study from Iran. *BMC Pregnancy and Childbirth,* 8:12

Vogazianos, P; Fiala, J, Vogazianos, M. (2005). The Distribution of Birth Weights and their Determinants in the Republic of Cyprus for the period of 1990-2002", *Scripta Medica (BRNO)*, 78(1): 31-44

Walton, A., Hammond, J. (1954). The maternal effects on growth and conformation in Shire horse-Sheltand pony crosses. *Proc R Soc Lond B Biol Sci,* 125:311–35.

WHO (2010). World Health Statistics 2010. World Health Organization, Geneva.

WHO (2011). World Health Statistics 2011. World Health Organization, Geneva.