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Determinants of Low Birth Weight in Sri Lanka

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Abstract— *This is a cross-sectional study that examines the determinants of low birth weight in Sri Lanka. The study models maternal, socio-economic and environmental effects on low birth weight using the Demographic and Health Survey conducted by the Department of Census and Statistics in 2016. A logit regression model technique is engaged in the analysis and the interpretation of the results. Findings suggest mother's age at giving birth, wealth quintile, geographical location, ethnicity, mother's education, gestational age at birth, birth order, new-born's sex, mother's height and body mass index, multiple delivery, type of delivery and the number of antenatal care visits to be statistically significant variables that determine the birth weight of the child.*

Keywords— *Low birth weight, Logit model, Demographic and Health Survey, Sri Lanka.*

I. INTRODUCTION

The birth weight of an infant is the first weight recorded after birth and measured within the first hours before significant postnatal weight loss occurs (Cutland, Lackritz, & Moore, 2017). A low birth weight is defined as a birth weight <2500g (World Health Organisation, 2004). It could be due to genetic factors, mother's health or mother's lifestyle to problems with the development of the placenta (Cebolla-Boado & Salazar, 2016). Low birth weight is not a homogenous pregnancy outcome and is composed of infants with a preterm birth or with fetal growth restrictions (Goldenberg & Culhane, 2007). It is a critical risk factor for child undernutrition with long term consequences including impaired cognitive development, increased adulthood risks of non-communicable diseases such as diabetes, dementia, hypertension and heart diseases (Castro-Martín, 2010). Low birth weight is key to perinatal and childhood mortality both in developed and developing countries (United Nations Childrens Fund & World Health Organisation, 2004). During the last ten years, low birth weight has been a chronic issue for Sri Lanka. It was high as 16 percent during 2006/7 and slightly dipped to 15.7 percent by 2016. These levels of low birth weight is even comparable to some countries in the sub-Saharan Africa (Asmare, Berhan, Berhanu, & Alebel, 2018). While the national average for low birth weight is 15.7 percent, the criticality of the issue is much severe in Ratnapura (22.4 percent), Nuwara-Eliya (20.7 percent), Matara (20.5 percent), Vavuniya (19.4 percent), Batticaloa (18.9 percent), Moneragala (18.8 percent), Kurunegala (18.7 percent), Puttalam (18.7 percent), Polonnaruwa (17.3 percent), Badulla (17.0 percent), Kegalle (18.8 percent) and Ampara (16.0 percent). On a sectoral classification, the prevalence of low birth weight is high as 25.4 percent in the estate sector.

The complexity and the chronic nature of low birth weight in the country provides the overall motivation of this paper, while the Sri Lankan government has acknowledged the severity of the problem. Although numerous and scattered counter measures have been initiated by government and non-government actors, only a handful of research attempts have been undertaken in this area that informs policy. Therefore, the aim of this study is to identify the determinants of low birth weight in Sri Lanka, focusing more on the modifiable risk factors.

The structure of the paper is as follows. Section 2 reviews the demographic and epidemiological literature on the determinants of low birth weight. Section 3 presents the methodology. Section 4 presents the estimation results, while section 5 concludes the discussion.

II. LITERATURE REVIEW

The preceding section briefly introduced to the research problem and the motivation of this paper. The main objective of this section is to analyse the available literature on the determinants of low birth weight. Hence the idea is to not to present the whole gamut of literature available, but to carefully select and analyse those literatures that are within the scope of this study so to develop the conceptual framework presented in section 3. The discussion begins with literature from developing economies and gradually shifts to the developed world.

Banerjee, Kumar Singh, and Chaurasia (2020) analyses at the determinants of Low birth weight in India based on Family Health Survey data. Findings indicate lower chances of low birth weight prevalence among educated mother's, mothers who have >4 antenatal care visits, took iron folic acid tablets during pregnancy, normal body mass index and age >20 years. On mother's age and birth weight of the child, there seems to be an agreement that birth weight of the child tend to increase with the mothers age. Ford (1903) finds that the proportion of mothers in each age group that has given birth to the heaviest infants increases consistently with mothers age, while the proportion of small infants to decrease with the age of the mother up to 39 years. Taywade and Pisudde (2017) study the sociodemographic determinants of low birth weight babies in Wardha district in India. Among various sociodemographic and socioeconomic determinants of low birth weight, maternal age <20 years or >30 years, nuclear family, poor standard of living, tobacco use by father, female sex of the baby, absence of sanitary latrines was found to have significant association with low birth weight. In another study from Pune district in India, Hirve and Ganatra (1994) study the determinants of low birth weight. Findings reveal that the odds of low birth weight were significantly higher for those from a lower socio-economic status, maternal age <20 years, last pregnancy interval <6 months, non-pregnant weight <40kg, height <145cm, haemoglobin <9g/dl and third trimester bleeding. In the case of Bharatpur, Nepal, the prevalence of low birth weight was found to be statistically significantly high among institutional deliveries. Socio-cultural and maternal risk factors such as rest received in the afternoon during pregnancy, dietary intake during pregnancy and the period of gestation were also found to be significantly associated with low birth weight babies (Bansal, Garg, & Upadhyay, 2010). In a study from Lombok, Indonesia, the determinants of low birth weight included infant's sex, woman's education, season at birth, mothers' residence, household wealth, maternal mid-upper arm circumference, maternal height, birth order, and pregnancy interval (Sebayang, Dibley, Kelly, Sankar, & Shankar, 2012). To determine the effect of physical activity and psychosocial stress on low birthweight, a study was conducted on 885 pregnant mothers from a selected district in Sri Lanka. Standing >2.5 hours/day during the second trimester and sleeping 8 hours or less/day either during the second, third or both trimesters together, an increase in maternal age in years and body mass index <19.8 kg/m had a statistically significant association with low birth weight. Psychosocial stress was not associated with low birth weight (Abeysena, Jayawardana, & Seneviratne, 2010). Anuranga, Wickramasinghe, Rannan-Eliya, hossain, and Abeykoon (2012) on Sri Lanka, based on the Demographic and Health Survey 2006/7 finds maternal body mass index, height and education, altitude and ethnicity as key determinants of low birth weight.

In sub-Saharan Africa and in most developing countries, poverty, low level of education and the lack of women's autonomy are related to late initiation of obstetric care, irregular or incomplete immunization, poor nutrition, and micronutrient supplementation during pregnancy that bears an impact on the weight of the child (Spangler & Bloom, 2010). World Health Organization identifies inadequate weight gain during pregnancy, low pre-pregnancy weight, short stature, malaria and other infectious diseases, hard physical work during pregnancy, lower status of women, malnutrition, and lack of antenatal care as determinants of low birth weight in developing countries (Kumaria, Garge, Kumara, & Gurua, 2019; Tema, 2006). In Ethiopia, mothers who delivered female infants, had health problems during pregnancy, absence of antenatal care, lack of iron supplementation, and gestational age <37 completed weeks were found to report low birth weight (Asmare et al., 2018). A study from Debre Berhan Referral Hospital in Ethiopia finds pre-term birth, history of experience in physical trauma during pregnancy, pregnancy complications and caesarean and instrumental deliveries to be determinants of low birth weight (Hailu & Kebede, 2018). To assess the prevalence and associated factors of low birth weight among term neonates delivered in Adwa Hospital, Northern Ethiopia, Gebregzabiherher, Haftu, Weldemariam, and Gebrehiwet (2017) uses a cross-sectional study. The risk factors of low birth weight were identified as mothers aged < 20 years, mother's whose pregnancy was undesired, mothers with a history of abortion. Abubakari, Taabia, and Ali (2019) study the maternal determinants of low birth weight in the Upper West region of Ghana. Determinants of low birth weight were analysed using a multivariate logistic regression model. It identified that the risks of giving birth to a low birth weighted baby was high among mothers who consumed alcoholic beverages, those who had food taboos during pregnancy and not having additional meals during pregnancy.

Islam and ElSayed (2015) analysed the factors of low birth weight in Oman. The data is derived from the Oman National Health Survey. Data on birth weight were gathered from health cards of the infants born within five years before the survey date. A multivariate linear regression and logistic regression models have been used for data analysis. Findings suggest mother's education, economic status, area of residence, late initiation of first antenatal care visit and experience of pregnancy complications as significant determinants of low birth weight. Maternal education has a strong effect on birth outcomes and a higher maternal education attainment is better for the child (Parker, Schoendorf, & Kiely, 1994). Jafari, Eftekhar, Pourreza, and Mousavi (2010) study the socio-economic and medical factors related to low birth weight in Iran. Findings suggest mothers with a primary and secondary education, who lived with farmer and unskilled worker husbands, with a birth interval of <1 year or height <155 cm were more likely to have low-birthweight infants.

Hidalgo-Lopezosa et al. (2019) determine the socio-demographic factors associated with preterm birth and low birth weight in Spanish women using a cross-sectional study. Findings suggest low birth weight was related to maternal age ≤19 years and ≥35 years, educational level less than or equal to secondary studies, and single mothers. Parity is an important predictor of birth weight (Côté, Blanchard, & Lalmière, 2003). Wilcox (2001) find elevated risks of low birth weight among first-born children than for the second-born, while Seidman, Dollberg, Stephenson, and Gale (1991) found no adverse effects of high parity in Israel. Yang, Greenland, and Flanders (2006) also confirms that first-borns are usually smaller than second-order children for physiological reasons. Furthermore, first-order births, children of mothers with no education, and children born to mothers in the lowest wealth quintile were most likely to report very small (Prudhivi & Bhosgi, 2015). Similarly, the length of the earlier birth intervals is an important determinant of the birth weight of the child as a birth interval below two years tends to be a risk factor for a preterm or low birth weight delivery (Rawlings, Rawlings, & Read, 1995). Kodzi and Kravdal (2013) modelled the probability of having a child with low birth weight. They find no adverse effect of increasing parity on the odds of having a child with low birth weight at normative ranges, while concluding that such effects only manifest at extremely high parities; nine or more children. Brazilian studies on low birth weight suggest that the main risk factors to include low family income, low education, black or brown skin colour, young maternal age, short stature, low pre-pregnancy weight, primiparity, short birth intervals, lack of prenatal care and maternal smoking during pregnancy (Silveira et al., 2019). A determinant of birth weight that is relatively understudied and with varying conclusions is the season of birth. Ford (1903) finds that infants born in the spring to be 3,547 g; those born in the summer to be 3,540 g; in the fall 3,580 g; and in the winter 3,547 g and argues that it could be quite possible that the winter and early spring diet of the mothers which is often high in meat and low in fruit and vegetable content might account partly for a higher proportion of infants under 2,500 g being born in the spring. Various racial and ethnic groups are strongly associated with both preterm birth and growth restrictions (Insaf & Talbot, 2016). For example, black women in the United States are approximately twice and likely to have a very early preterm birth and are 3 to 4 times as likely to have a very early preterm birth as women are from most other racial or ethnic groups. On the other hand, East Asian women have low rates of preterm birth, similar to Hispanic women. However, women from South Asia and especially those from India are reported to have high rates of fetal growth restrictions (Goldenberg & Culhane, 2007).

Bruckner, Modin, and Vågerös (2014) tested the relation between cold ambient temperature during pregnancy in Sweden and four outcomes: stillbirth, preterm, birth weight for gestational age, and birth length. The results indicated no relation between cold and birth weight for gestational age. Using a data set containing 7,216 individual records of children born in 2015 in the Haifa Bay area in Israel, the analysis revealed an excess low birth weight rate in residential areas located close to petrochemical industries and a protective effect of seashore proximity and elevation above the sea level on the low birth weight rate (Svechkina, Dubnov, & Portnov, 2018). Yitshak-Sade et al. (2016) aimed to evaluate the independent association of birth weight with meteorological and air pollution exposures during pregnancy, in addition to individual, parental and household risk factors, among the Bedouin-Arab population in Southern Israel. Findings suggest that although exposure to high levels of temperature were associated with lower birth weight, the contribution of poor household environment indicators to birth weight reduction was substantially higher.

III. METHODOLOGY

The preceding section reviewed the literature on the determinants of low birth weight, both from developing and developed economies. It facilitated to unearth the variables, the conceptual framework, and the analytical technique that best suits the context of this research. Hence the methodology of the research is discussed in this section.

Conceptual Framework

To identify the determinants of low birth weight in Sri Lanka, a conceptual framework is developed based on the review of literature. In understanding the determinants of low birth weight, one should control for constant and varying maternal, socio-economic and environmental factors that potentially affect the birth weight of the child (Kramer, 1987; Noor, Kural, Joshi, Pandit, & Patil, 2015). Accordingly, the conceptual framework groups the determinants of low birth weight into three broad categories; socio-economic determinants, maternal determinants and environmental determinants. The socio-economic determinants include geographical location, wealth quintile, ethnicity and household size. Maternal determinants include mother's age at birth, mother's education, gestational age at birth, birth order, new-born's sex, mother's height and body mass index single and multiple births, type of delivery and antenatal care received. Environmental determinants include temperature and the climatic seasons. Another critical determinant of low birth weight as identified in literature is the altitude of the household's geographical location in which the mother resides. However, the Demographic Health Survey 2016 has not determined the exact location of the household via the Global Positioning System. Hence, the altitude as a determinant is excluded from the analysis.

Based on the review of literature, the direction in the relationship of the independent variables with the dependent variable is conceptualised in the following manner. On the geographical location, the odds of reporting a low birth weight is higher for children born in estate sectors compared to their counterparts from urban and rural sectors. On wealth quintile, the odds of reporting a low birth weight is low for children born to wealthier families and vice versa. The odds of reporting a low birth weight is also determined by the ethnicity of the mother. Diverse ethnic groups reflect dissimilar socio-cultural, norms, beliefs and habits that in turn influences mother and hence the birth weight of the child. Therefore, the odds of reporting low birth weight would vary from one ethnicity to another. On size of the household, the odds of reporting a low birth weight is higher for larger families compared to smaller families. On maternal age at birth, the odds of reporting a low birth weight considerably reduces with the age of the mother. On birth order, the odds of reporting a low birth weight is higher for the first child born while it reduces with each consecutive childbirth. On mother's education, the odds of reporting a low birth weight is higher for less educated mothers compared to their counterparts with higher levels of education. On gestational age, the odds of reporting a low birth weighted child is higher for preterm babies as compared full term babies. On the sex of the new-born, the odds of reporting a low birth weight is higher for the girl child compared to their male counterparts. On single and multiple births, the odds of reporting a low birth weight is higher for children of multiple births, compared to single births. The odds of reporting a low birth weight is lower for mother's that are tall and that reports a higher body mass index. On delivery type, mother's that opt for normal delivery reports lower odds of having a low birth weight, as compared to caesarean delivery. Mothers that reports a higher level of antenatal care visits and reports intake of iron, calcium, folic acid, and vitamins are expected to report lower odds of low birth weight compared to their counterparts who has not. Children born to high temperatures are expected to have higher odds of low birth and vice versa. The odds of reporting a low birth weight varies with the season in which the child is born, and the odds of low birth could be higher or lower depending on the season.

Analytical Technique

A critical aspect of a research is to identify the most suitable analytical technique. Although simple to estimate and use, the linear probability model has many drawbacks. One disadvantage is that the fitted probabilities could be less than '0' or greater than '1' and the partial effect of any explanatory variable is constant. These limitations of the linear probability model can be overcome using a binary response model.

As the study proposes to estimate the determinants of low birth weight and given that the outcome variable is a binary dependent variable taking value of 1 if the birth weight is <2,500gms and 0 otherwise, the appropriate model to use in the case of this research is the binomial logit model. In the logistic model, the log-odds for the value labelled "1" is a linear combination of one or more independent variables; the independent variables can each be a binary variable or a continuous variable. The logit model engaged for this piece of research is as follows;

$$\log\left(\frac{Pij}{1-Pij}\right) = \alpha Xij + \beta Yij + \delta Zij + \mu i$$

where Pij is the probability that the child i of mother j has low birth weight, and Xij is a vector of maternal factors that determines low birth weight of a child, while α is the corresponding coefficient. Yij is a vector of socio-economic factors that determines low birth weight of a child, while β is the corresponding coefficient. Similarly, Zij is a vector of environmental factors that determines low birth weight of a child, while δ is the corresponding coefficient. The model considers all child births to the mother preceding 5 years to the survey from 2016. The estimation results are presented in two models (Table 2). Model 1 presents the estimates for all children born to a woman preceding 5 years of the survey, leading to 7,799 observations. Model 2 presents the estimates for the last child born to a woman, leading to 6,730 observations as data on antenatal care has been captured in the survey only for the last child born to the women in the survey.

Data

Data for socio-economic and the maternal variables is derived from the Demographic and Health Survey 2016 conducted by the Department of Census and Statistics of Sri Lanka. This data includes information on maternal and child health, reproduction and fertility preferences, family planning, evaluation of maternal and child health services, women's status, and knowledge and behaviour regarding HIV/AIDS and other sexually transmitted diseases. The Demographic and Health Survey 2016 uses a multistage stratified area probability sample design. The survey uses a two-stage stratified sampling design. At the first stage, 2,500 Census Blocks were selected as primary sampling units. At the second stage, 12 housing units were selected from each primary sampling unit selected as the secondary sampling unit from all strata except from the strata of the districts in Western Province (i.e. Colombo, Gampaha and Kalutara). In these districts, 10 housing units were selected from each selected primary sampling unit. A total of 28,800 housing units were selected for the survey. Two-stage stratification was utilized for this survey, which involves stratifying the population by district at the first level and then by Urban, Rural and Estate within each district. The total sample of 2,500 Census Blocks (primary sampling units) were allocated by districts and then by sectors using the proportional allocation method and some adjustments considering the proportion of eligible respondents by each district. At the first stage, a stratified sample of primary sampling units was selected with probability proportional to size: in each stratum, a sample of Census Blocks was selected independently with probability proportional to the measure of size of the Census Block. In the selected primary sampling units, the list of households was updated ensuring that all and each household/dwelling were listed separately. At the second stage, a fixed number of households was selected by equal probability systematic sampling in the selected primary sampling units (Department of Census and Statistics, 2016a). The survey collected birth weight data from all eligible women aged 10 to 49 years and for all living children born to them in the previous 5 years (year 2011 or later). In the Demographic Survey 2016, interviewers had been trained in the procedures to obtain birth weight from the Child Health Development Record for all children who were born since January 2011 up to the date of the interview in 2016. Several potential sources of bias including missing birth weights and duplication of child records were identified in the data. Accordingly, the missing childbirth weights were left out, while duplicated child records were corrected. Apart from socio-economic and maternal variables, environmental variable on temperature was captured by district for 2016 from the Statistical Abstract (Department of Census and Statistics, 2016b). Seasons were identified as per the Department of Meteorology, Sri Lanka.

Variables

The main outcome variable for this study is birth weight. The dependent variable is a binary indicator of low (<2,500g) versus other birth weight, with low birth weight coded '1', and '0' otherwise. The term low birth weight refers to an absolute weight of <2,500g regardless of gestational age and is usually applied to livebirths only (Cutland et al., 2017). The explanatory variables included in the analysis is based on the conceptual framework developed subsequent to a painful review of literature and presented accordingly in table 1.

Regression Diagnostics

A critical aspect of specifying an econometric equation is the selection of correct independent variables to be included in the model (Studenmund, 2001). In respect of this research, all variables with a theoretical support was included in the model except where data was not available as in the case of the altitude of the household, pre-pregnancy weight, physical activity, exposure to air pollution, and pregnancy related complications. The Goodness-of-fit testing also indicated that the final model presented was well calibrated (Lemeshow & Hosmer, 1982). Several measures were undertaken to detect multicollinearity. A correlation matrix was drawn to identify the variables that were strongly related, and the econometric treatment administered accordingly.

Table 1: Model explanatory variables

Socio-economic variables	
Geographical location	
Urban	=1 if urban; =0 if otherwise
Rural	=Base category
Estate	=1 if estate; =0 if otherwise
Wealth quintile	
Lowest	=1 if lowest; =0 if otherwise
Second	=Base category
Middle	=1 if middle; =0 if otherwise
Fourth	=1 if fourth; =0 if otherwise
Highest	=1 if highest; =0 if otherwise
Ethnicity	
Sinhala	=1 if Sinhala; =0 if otherwise
Sri Lanka Tamil	=1 if Sri Lanka Tamil; =0 if otherwise
Indian Tamil	=1 if Indian Tamil; =0 if otherwise
Muslim	= Base category
Other ethnicity	=1 if other ethnicity; =0 if otherwise
Number of household members	
ln_hhnumber	Natural log of the total number of household members
Maternal variables	
Mothers age at birth	
Age <20	=1 if <20 years of age; =0 if otherwise
Age >=20 & <=34	=Base category
Age >34	=1 if >34 years; =0 if otherwise
Birth order	
1	=1 if birth order is 1; =0 if otherwise
2	=1 if birth order is 2; =0 if otherwise
3	=1 if birth order is 3; =0 if otherwise
4+	=Base category
Mothers education	
No education	=1 if no education; =0 if otherwise
Primary	=1 if primary; =0 if otherwise
Secondary	=Base category
University	=1 if university; =0 if otherwise
Gestational age	
<=7 months	=1 if gestational age<=7 months; =0 if otherwise
8 months	=Base category
9 months	=1 if gestational age is 9 months; =0 if otherwise
10 months	=1 if gestational age is 10 months; =0 if otherwise
New born's sex	
Male	=Base category
Female	=1 if female; =0 if otherwise
Single & multiple births	
Single	=Base category
Multiple	=1 if multiple; =0 if otherwise
Mothers height/Body mass index	
ln_mother_height	Natural log of mother's height
ln_bmi	Natural log of mother's body mass index
Type of delivery	
Normal	=Base category
Caesarean & instrumental	=1 if caesarean or forceps or vacuum; =0 if otherwise
Antenatal care during pregnancy	
ln_visits	Natural log of total number of antenatal care visits
Iron	=1 if intake of iron capsules; =0 if otherwise
Calcium	=1 if intake of calcium tablets; =0 if otherwise
Folic	=1 if intake of folic acid; =0 if otherwise
Vitamins	=1 if intake of vitamins; 0 if otherwise
Environmental variables	
Temperature	
In_temp	Natural log of district temperature
Climatic season	
Season1	=1 if first inter monsoon (March-April); =0 if otherwise
Season2	=Base category
Season3	=1 if Inter monsoon (October–November); =0 if otherwise
Season 4	=1 if North East Monsoon (December-February); =0 if otherwise

Also, when adding and deleting independent variables to the model, the sensitivity of the changes in the specification was checked. In other words, when adding and deleting explanatory variables, significant changes in the values of coefficients of other explanatory variables were checked for severe multicollinearity.

IV. ESTIMATION RESULTS

The methodology of this research was presented in the previous section. This section is focused on presenting the estimated results. Accordingly, the binary logistic regression results are presented in table 2.

Mother's age at birth, wealth quintile, geographical location, ethnicity, mother's education, gestational age, birth order, the new-born's sex, mother's height and body mass index, multiple births, the type of delivery and the number of prenatal care visits were found to be independent predictors of low birth weight. The odds of reporting low birth weight were 20 percent higher for mothers aged >34 compared to the base category. Neonates that were born to the highest wealth quintile had lower odds of reporting low birth weight compared to their counterparts born to the second wealth quintile. Similarly, the odds of reporting a low birth weight was higher for neonates that were born to mothers in the lowest wealth quintile compared to the base category. While this is statistically significant in model 1, its significance seems to have disappeared in model 2. On the geographical location, babies from the estate sector were 46 percent more likely to report low birth weight compared to babies from the rural settings. On ethnicity, babies of the Indian Tamil origin were more likely to report low birth weight compared to its base category. The size of the household is negatively associated with the incidence of low birth weight, although the results are statistically insignificant in both models. The odds of a low birth weight were 84 percent higher for mothers with no education compared to the base category. Along the same lines, mothers with primary education was 34 percent more likely to record a low birth weight compared to the base category. While this is statistically significant in model 1, its significance seems to have disappeared in model 2. On gestational age at birth, children born in <=7 months had higher odds of reporting a low birth weight compared to its base category. The odds of reporting a low birth weight for full term babies were significantly lower than the base category. On birth order, the odds of reporting a low birth weight was higher for the first child born to a woman compared to the base category. Findings also revealed that the sex of the new-born to be significantly associated with low birth weight. Female neonates were 39 percent more likely to record a low birth weight compared to their male counterparts. Maternal height and body mass index are key determinants of low birth weight, and the relative risk of low birth weight reduced with the increase of mother's height and the body mass index. Between single and multiple births, the odds of reporting low birth weight were 21 times higher for multiple birth neonates compared to babies in a single birth. Regarding the delivery type, babies born via a caesarean delivery were 42 percent more likely to be have a low birth weight compared to babies that were born via normal delivery.

Table 2: Logit model estimation results

Variable	*Model 1 Odds ratio*	*Model 2 Odds ratio*
Geographical location		
Urban		*1.0360*
Estate		*1.4694***
Wealth quintile		
Lowest	*1.1886**	*1.1536*
Middle	*1.0071*	*1.0452*
Fourth	*0.8947*	*0.9713*
Highest	*0.5849****	*0.6136****
Ethnicity		
Sinhala	*1.0127*	
Sri Lanka Tamil	*0.8940*	
India Tamil	*1.4612**	
Other Ethnicity	*1.6151*	
Number of household members		
ln_hhnumber	*0.9217*	*0.9028*
Mothers age at birth		
Age <20	*1.2328*	*1.1807*
Age >34	*1.1995**	*1.1907**
Birth order		
1	*1.5103***	*1.6445***
2	*1.1951*	*1.2504*
3	*1.2118*	*1.2904*
Mothers education		
No education	*1.8416***	*1.6398*
Primary	*1.3471***	*1.1676*
University	*1.0956*	*1.1115*
Gestational age at birth		
<=7 months	*8.9307****	*7.7939****
9 months	*0.2067****	*0.1863****
10 months	*0.1720****	*0.1515****
New-born's sex		
Female	*1.3900****	*1.3963****
Single & multiple births		
Multiple	*20.6542****	*21.9140****
Mothers height/body mass index		
ln_mother_height	*0.0039****	*0.0023****
ln_bmi	*0.2417****	*0.2697****
Type of delivery		
Caesarean and instrumental	*1.4153****	*1.4204****
Antenatal care		
ln_visits		*0.7722***
Iron		*0.9013*
Calcium		*0.7536*
Folic		*0.7095*
Vitamins		*1.0925*
Temperature and climatic season		
ln_temp	*0.6278*	*0.6640*
Climatic season		
Season1	*0.9091*	*0.9491*
Season3	*0.9594*	*0.9238*
Season 4	*1.0523*	*1.0249*
Constant	$1.61e^{+17}$*****	$2.65e^{+18}$*****
Number of observations	*7799*	*6730*
Pseudo R-sq	*0.1310*	*0.1202*
Prob	*0.0000****	*0.0000****
**p<0.001, **p<0.05, ***p<0.01*		

The increasing numbers of antenatal care visits significantly reduced the odds of reporting a low birth weight. The model also tested the impact of the size of the household, the intake of iron, calcium, folic, vitamins during antenatal care period, temperature and the effect of the climatic seasons on low birth weight as argued in literature and found statistically insignificant.

V. CONCLUSION

The main objective of this study was to examine the determinants of low birth weight in Sri Lanka. The study was conducted based on the latest available Demographic and Health Survey 2016 conducted by the Department of Census and Statistics, which is the National Statistical Office. Given the nature of the outcome variable, the logit model was used as the analytical technique of the study. The independent variables were selected carefully based on theory and literature. Findings suggest that the age of the mother at the time of giving birth, wealth, residence, education of the mother, gestational age, birth order, sex of the child, ethnicity, height and body mass index of the mother, multiple delivery and the type of delivery and antenatal care visits to be statistically significant.

Sri Lankan women tend to pursue higher education and then enter the labour market. This results in many women postponing marriage and childbearing that ultimately increases their odds of having a low birth weight child. This brings out the need for more flexible labour market policies that enable women to balance their career while not postponing their marriage and childbearing. On the other hand, the odds of reporting a low birth weight is higher for mothers <20 years, although the results are not statistically significant. Therefore, adequate measures should be taken to delay or prevent teenage pregnancies as teenage mothers are not physiologically mature and may lead to low birth weight. The odds of reporting a low birth weight reduces with increasing levels of wealth. Therefore, it is important for implementing labour and economic policies that are more conducive for women that ultimately has a positive effect on their household economics. It also calls for revisiting the barriers for women to participate in the labour market. The odds of having a low birth weight is significantly high in the estate sectors. This question the effectiveness of economic policies and social protection schemes that have been targeted towards those in the estates and calls for a rapid re-assessment of those policies and their effectiveness. Education of the mother is critical as less educated mothers increases the odds of having a low birth weight child. As anticipated, preterm births are found to be a risk factor for low birth weight. Therefore, it is important that any gynaecological, medical or any other condition that causes premature delivery be identified in advance and addresses during pregnancy. The odds of reporting a low birth weight is higher for the first child and therefore the pre-pregnancy package for the mothers should be strengthened. Mother's height and body mass index has a significant influence on the incidence of low birth weight. In other words, as mother's height and body mass index increases, the odds of reporting a low birth weight reduces. The body mass index is an indication of the nutritional status of the mother. The nutritional status of the new-born ultimately depends on the nutritional status of the mother. A lower body mass index is usually caused due to food insecurity with poorer households.

This shows the importance of weight gain during pregnancy and proper screening to identify low body mass index of mothers. Maternal height is a marker for the nutritional conditions that the mother was born in and global evidence suggests that inter-generational effects have large impacts on low birth weight. Mother's that are expected to have multiple births should be identified in advance and special monitoring mechanisms should be installed so to ensure their health and nutritional levels. While delivery type does not determine the birth weight of the child, the study finds that odds of low birth weight were higher among mother's who underwent a caesarean delivery, as compared to a normal delivery. The odds of low birth weight were higher for mothers who reported lower antenatal care visits and vice versa. Antenatal care visits are very important for both the new-born and the mother as they provide chances for timely detection and intervention of feto-maternal problems and enable the mother to promote her health through counselling that she receives. On the other hand, mothers who attend antenatal care programs receive nutritional counselling to improve their dietary diversity that enables them for a better pregnancy outcome.

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