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Research Paper

Determinants of Low Birth Weight among Children Aged 0 to 59 Months in Ethiopia

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Abstract: *Low birth weight is one of the critical issues in Ethiopia that causes many babies short- term and long-term health consequences and tend to have higher mortality and morbidity. This study was aimed to examine and identify the determinants of low birth weight among children aged 0 to 59 months in Ethiopia. The Ethiopian Demographic and Health Survey (EDHS) data was used. The analysis is based on the 7358 of those women who had complete information. Multiple logistic regression and multilevel logistic techniques were used for data analysis. The results show that educational status of mothers, mother's age at first birth, wealth index, sex of child, type of birth, anemia status of mothers, maternal nutrition status, and number of antenatal care during pregnancy were important determinants of baby's size at birth in Ethiopia. Children born from low income, not educated, anemic, no or less antenatal visit, low BMI and teenage mothers have higher risk of having small birth size. Female infants and multiple birth infants were disproportionately associated with small size at birth. The random intercept model revealed that there was a significant variation in baby's size at birth across regions. The Random coefficient model used to investigate whether individual level covariates vary across regions showed that baby's size at birth varies across regions, and regional level random effects of wealth index factor, number of antenatal care visit during pregnancy and maternal nutritional status of mothers were found to be significant in explaining variations for baby's size at birth across the regions of Ethiopia.*

Keywords: Small size at birth, low birth weight, risk factors, logistic regression, multilevel analysis.

1. Introduction

One of the poor outcomes of pregnancy that has caught the attention of the World Health Organization (WHO) is low birth weight. Low birth weight is defined as weight at birth less than 2,500 grams or 5.5 pounds at birth after full term of pregnancy. Approximately every ten seconds, an infant from a developing country dies from a disease or infection that can be attributed to low birth weight [1]. Globally, World Health Organization estimates that 26 million low birth weight infants are born each year, constituting 17% of all births, nearly 95% of them in the developing world. The level of low birth weight in developing countries (16.5%) is more than double the level in developed regions (7%) [2].

Infants born with low birth weight or small size at birth suffer from extremely high rates of morbidity and mortality from infectious disease. Low birth weight infants are 2 times more likely to die during their first 28 days of life than normal birth weight infants [2]. Low birth weight is also associated with impaired immune function, inhibited growth and cognitive development, high risks of developing acute diarrhea or pneumonia. In addition, in long term, developmental outcomes of low birth weight tend to have higher rates of subnormal growth, illnesses and neurodevelopment problems. Besides these a baby with low birth weight can develop bleeding in brain, leading to learning or behavioral problems later in life. There is also evidence that LBW or its determinant factors are associated with a predisposition to higher rates of diabetes, cardiac disease and other future chronic health problems [4]. Low birth weight is one of the critical issues in Ethiopia that causes many babies short- term and long-term health consequences and tend to have higher mortality and morbidity. Every single day, Ethiopia loses thousands of under-five year's olds [5]. This may be associated with the incidence of low birth weight, thus making the country the highest under-five mortality in the whole world.

Previous studies on determinants of low birth weight in Ethiopia have found that multiple gestations, mothers residing in the urban setting, who delivered before 37 weeks of gestation, had weight loss, and who did not receive additional diet during pregnancy [6] and first time delivery, lack of antenatal care follow up and being HIV positive [7] were significantly associated with the incidence of low birth weight. The results of hospital-based studies in communities where a substantial proportion do not have access to modern health facilities are subject to selectivity bias and cannot be generalized to the entire population.

This paper examines factors associated with low birth weight in Ethiopia based on the 2011 EDHS data by taking into consideration various socio- demographic and maternal factors. It is important to note that information on birth weight is not available for the majority of births in Ethiopia; hence, the baby's size at birth is used instead. The reliability of reported information on the size of baby at birth is assessed in preliminary analysis.

2. Materials and Methods

2.1. Data Collection

The source of data for this study is the 2011 Ethiopian Demographic and Health Survey (EDHS) which is obtained from Central Statistics Agency (CSA). It is the third survey conducted in Ethiopia as part of the worldwide Demographic and Health Survey Project. The 2011 Ethiopia Demographic and Health Survey was designed to provide estimates for the health and demographic variables of interest for Ethiopia as a whole. For this study data from the mother's recall from children's questionnaires of the 2011 EDHS was used. Information on household socio-economic status, women's characteristics and births occurring five years preceding the survey were provided in the questionnaire. A total of 11654 who had birth in the five years preceding the survey were eligible. However, the analysis is based on the 7358 of these women that had complete information.

2.2. Variables Included in the Study

The response variable for this study was the size of baby at birth. However, as birth weight information for the majority of births in Ethiopia were not available, information on mothers' reporting of the size of their babies at birth was used as a proxy for birth weight information. The birth sizes were reported as 'very large', 'larger than average', 'average', 'smaller than average' and 'very small'. A binary response variable Y for the occurrence of small size at birth defined as:

$$\boldsymbol{Y} = \begin{cases} 0\text{: } child\ has\ small\ size\ at\ birth & (smaller\ than\ average\ and\ very\ small) \\ 1\text{: } child\ has\ large\ size\ at\ birth & (average, larger\ than\ average\ and very\ large \end{cases}$$

was generated from the data. Since mother's reports of size of babies at birth may be unreliable due to the possibility of personal biases and possible systematic errors, measurement error is likely to be most critical for the 'size of baby at birth variable'. The distribution of information on 'size of baby at birth' was examined against 'birth weight' information, for cases where birth weight information was available, in order to assess the reliability of 'size of baby' information. The result is displayed in table 1.

Table 1: The Distribution of Reported Size of Baby at Birth By Birth Weight, EDHS 2011

	N	Mean	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
Very large	165	4473.54	4353.15	4593.92
Larger than average	152	3569.87	3501.19	3638.54
Average	641	3117.86	3083.88	3151.83
Smaller than average	95	2353.63	2291.41	2415.86
Very small	64	1744.05	1577.44	1910.65
Total	1117	3235.91	3186.74	3285.09

The distribution of the 'size of baby's at birth' information by the median birth weights or the 95 percent confidence intervals for mean birth weights presented in table 1 suggest that the reporting of baby's size at birth is fairly reliable.

Factors presumed to be associated to low birth weight and selected from the birth registers include: number of antenatal care visit during pregnancy, anemia level, maternal nutritional status, socio-economic status of mothers. The maternal nutritional position is captured by her weight for height score and height and overall economic position by the household wealth status. Other mothers' characteristics included are her age at birth, preceding birth interval, educational attainment, marital status, family planning method used, religion, place of residence, and region of residence. Characteristics related to children like sex of the child, type of birth and birth order is also included in this study.

2.2 Methodology

Multiple logistic regressions were used to model the relationship between the presence of low birth weight and its predictors. Logistic Regression is a widely used multivariate statistical method for analysis of data with categorical outcome variables. The conditional probabilities that the outcome of interest is present, i.e. the probability of a live child being born small, given the independent variables $X_1\ to\ X_P$, β_0= the constant of the equation and, β_i = the coefficient of the i^{th} predictor variable can be written as:

$$\mathrm{P}(\mathrm{Y} = 1/\mathbf{x}) = \ \pi(\mathbf{x}) = \frac{e^{(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_p X_p)}}{1+e^{(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_p X_p)}}$$

The transformation of $\pi(\mathbf{x})$ that result in a function which is linear in the parameters is the logit transformation defined in terms of $\pi(\mathbf{x})$ as:

$$\text{logit}[\pi(\mathbf{x})] = \ln\left(\frac{\pi(\mathbf{x})}{1-\pi(\mathbf{x})}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p$$

Maximum likelihood method is used for estimating the parameters of the model.
Multilevel logistic regression analysis was also used to control for a complex sampling design and analyze factors associated with 'baby's size at birth' because of the hierarchical nature of the data set. It allows for a correct calculation of standard errors and also a more interesting insight into variation between higher level units.

3. Results and Discussion

The total number of children covered in this study is 7358 of which 6013(81.7%) reside in rural areas and the rest 1345 (18.3%) reside in urban centers. The proportion of boys and girls is almost equal; 3922 (53.3%) were males and 3436 (46.7%) were females. The proportion of multiple births is only 116 (1.6%).

3.1. Prevalence of Small Size Babies

Overall, 32.1% of the 7358 births within the age of five years preceding the 2011 EDHS were reported to be small or very small at birth while 68.8% of them have larger size at birth.

Table 2 shows the prevalence of small size of baby at birth (low birth weight) by key characteristics of the child, mother, and household among children whose mothers were interviewed. The size of a child at birth varies by its place of residence. Among children who resided in urban and rural areas, 14.4% and 85.6% respectively were having small size at birth.

Moreover, the proportion of small size of a baby at birth varied from one region to the other. The highest prevalence of small size baby was observed in Amhara (16.1%) followed by Afar (13.7%), Oromia (11.7%) and Tigray (11.2%) while the lowest prevalence was recorded in Addis Ababa (4.5%) followed by Harari (5.5%).

It can also be observed from table 2 that the highest proportion of small birth size child was observed for children whose mothers have no education (72.2%) and whose socioeconomic status was low (55.2%). Higher proportions of small baby's size at birth were observed among children of mothers with no antenatal visit (61.1%) as compared to children of mothers with antenatal care visits of 5 and above (10.4%). 72.3 % of children born from anemic woman have small sizes.

Table 2: Prevalence of low birth weight at birth within different categories of explanatory variables, EDHS 2011

		Size of child at birth				
		Large size		**Small size**		
Variables	**Categories**	**Count**	**%**	**Count**	**%**	**total**
	15-19	249	5	153	6.6	402
	20-24	970	19.3	545	23.4	1515
	25-29	1565	31.1	619	26.5	2184
	30-34	982	19.5	418	17.9	1400
Age of mother	35 and above	1259	25.1	598	25.6	1857

Variables	Categories	Size of child at birth				
		Large size		Small size		
		Count	%	Count	%	total
Region	Tigray	566	11.3	262	11.2	828
	Afar	377	7.5	319	13.7	696
	Amhara	536	10.7	375	16.1	911
	Oromia	793	15.8	274	11.7	1067
	Somali	327	6.5	178	7.6	505
	Ben-gumuz	469	9.3	174	7.5	643
	SNNP	775	15.4	237	10.2	1012
	Gambela	382	7.6	200	8.6	582
	Harari	275	5.5	112	4.8	387
	Dire Dawa	301	6	121	5.2	422
	Addis Ababa	224	4.5	81	3.5	305
Place of residence	Urban	1010	20.1	335	14.4	1345
	Rural	4015	79.9	1998	85.6	6013
Mothers education	No education	3245	64.6	1684	72.2	4929
	Primary	1441	28.7	556	23.8	1997
	Secondary and above	339	6.7	93	4	432
Wealth index	Low	2222	44.2	1288	55.2	3510
	Medium	807	16.1	375	16.1	1182
	High	1996	39.7	670	28.7	2666
Religion	Orthodox	1756	34.9	790	33.9	2546
	Muslim	2064	41.1	1103	47.3	3167
	Protestant	1049	20.9	376	16.1	1425
	Others	156	3.1	64	2.7	220
Sex of child	Male	2832	43.6	1090	46.7	3922
	Female	2193	56.4	1243	53.3	3436
Marital status	Married	4584	91.2	2099	90	6683
	Divorced/separated/widowed	441	8.8	234	10	675
Type of birth	Single	4959	98.7	2283	97.9	7242
	Multiple	66	1.3	50	2.1	116
Birth order	1	906	18	498	21.3	1404
	2-3	1837	36.6	827	35.4	2664
	4-5	1103	22	466	20	1569
	6 and above	1179	23.5	542	23.2	1721
Parity	1	897	17.9	496	21.2	1390
	2-3	1565	31.1	715	30.6	2280
	4 and above	2563	51	1125	48.2	3688
Birth interval	< 24 months	1093	21.8	476	20.4	1569
	24-36 months	1408	28	618	26.5	2026
	> 36 months	1618	32.2	741	31.8	2359
	First birth	906	18	498	21.3	1404
Age at first birth	Below 15	411	38.3	161	37.7	572
	15-19k	2688	53.5	1292	55.4	3980
	20 and above	1926	8.2	880	6.9	2806

Variables	Categories	Size of child at birth				
		Large size		Small size		
		Count	%	Count	%	total
Body mass index	Underweight	1254	25	692	29.7	1946
	Normal	3414	67.9	4960	66.3	4960
	Overweight/obese	357	7.1	452	4.1	452
Anemia level	No anemic	3919	78	1686	72.3	5605
	Anemic	1106	22	647	27.7	1756
Number of antenatal care visit	None	2639	52.5	1425	61.1	4064
	Only one	208	4.1	114	4.9	322
	2 to 4	1372	27.3	552	23.7	1924
	5 and above	806	16.1	242	10.4	1048

3.2. Risk Factors for Small Size at Birth: Multiple Logistic Regression Analysis

The multiple logistic regression analysis identified geographical region, wealth index, mother's education, type of birth, sex of child, mother's age at first birth; body mass index, anemia and number of antenatal care visit as significant determinants of baby's size at birth. The results are displayed in Table 3 below.

Table 3: Multiple logistic regression analysis of the association between low birth weight of a baby and its potential predictors, EDHS 2011

Maximum Likelihood Estimates							Exp(β)	95%C.I. for Exp(β)	
Covariate	Category	β	S.E.(β)	Wald	Df	Sig.		Lower	Upper
Mothers' Age	Overall			12.559	4	.014*			
	15-19	0.041	0.156	0.068	1	0.794	1.042	.767	1.415
	20-24	0.105	0.105	0.985	1	0.321	1.110	.903	1.365
	25-29	-0.118	0.083	2.018	1	0.155	.888	.755	1.046
	>35	0.104	0.08	1.684	1	0.194	1.110	.948	1.299
Region	Over all			94.201	10	0.000*			
	Tigray	0.253	0.154	2.699	1	0.100	1.288	.952	1.743
	Amhara	0.488	0.139	12.357	1	0.000*	1.628	1.241	2.137
	Afar	0.584	0.147	15.829	1	0.000*	1.793	1.345	2.391
	Oromia	-0.133	0.136	0.961	1	0.327	.875	.670	1.143
	Somali	0.135	0.148	0.831	1	0.362	1.144	.856	1.529
	Ben-Gumuz	-0.139	0.147	0.897	1	0.344	.870	.652	1.161
	SNNP	-0.191	0.155	1.528	1	0.216	.826	.610	1.119
	Gambela	0.309	0.166	3.468	1	0.063	1.361	.984	1.884
	Harari	0.17	0.16	1.118	1	0.290	1.185	.865	1.623
	Addis Ababa	0.485	0.187	6.746	1	0.009*	1.625	1.126	2.344
Mothers' education level	Over all			6.423	2	0.040*			
	No education	0.313	0.141	4.922	1	0.027*	1.368	1.037	1.803
	Primary education	0.192	0.138	1.925	1	0.165	1.212	.924	1.589
Religion	Over all			9.648	3	0.022*			

Maximum Likelihood Estimates							Exp(β)	95%C.I. for Exp(β)	
Covariate	**Category**	**β**	**S.E.(β)**	**Wald**	**Df**	**Sig.**		**Lower**	**Upper**
	Orthodox	-0.056	0.175	0.103	1	0.748	.945	.670	1.333
	Muslim	0.175	0.171	1.044	1	0.307	1.191	.852	1.665
	Protestant	-0.066	0.164	0.16	1	0.69	.936	.678	1.293
Wealth index	Over all			27.178	2	0.000*			
	Poor	0.357	0.069	27.042	1	0.000*	1.430	1.249	1.636
	Medium	0.257	0.084	9.332	1	0.002*	1.293	1.097	1.525
Parity	Over all			12.7	2	0.002*			
	1	0.394	0.112	12.306	1	0.000*	1.483	1.190	1.849
	2-3	0.143	0.08	3.205	1	0.073	1.154	.987	1.350
Type of birth	Multiple	-0.675	0.197	11.706	1	0.001*	1.964	1.334	2.890
Sex of child	Female	0.406	0.052	61.365	1	0.000*	1.500	1.355	1.660
Age at first birth	Over all			6.775	2	0.036*			
	<15	0.267	0.104	6.649	1	0.010*	1.306	1.306	1.600
	15-19	0.247	0.113	4.75	1	0.029*	1.280	1.025	1.598
BMI	Over all			6.775	2	0.034*			
	Underweight	0.333	0.135	6.134	1	0.013*	1.396	1.072	1.817
	Normal	0.239	0.128	3.502	1	0.061	1.270	.989	1.632
Anemia level	Anemic	0.154	0.062	6.196	1	0.013*	1.166	1.003	1.132
Number of ANC	Over all			16.663	3	0.001*			
	None	0.366	0.097	14.082	1	0.000*	1.441	1.191	1.745
	1	0.319	0.15	4.517	1	0.034*	1.375	1.025	1.845
	2-4	0.191	0.099	3.721	1	0.054	1.210	.997	1.468
	Constant	-1.5	0.335	20.089	1	0.000*			

*significant ($p< 0.05$)

Results from the multiple logistic regression analysis showed that children whose mothers reside in the Afar, Amhara, and Addis Ababa were respectively 79.3%, 62.8% and 62.5% more likely to be small size at birth as compared to those from the reference category (Dire Dawa), controlling for other variables in the model.

The model revealed also that children whose mothers had no formal education were 32.8 % more likely to be small size at birth as compared to those with educational level of secondary and above. The likelihood of being small size at birth was 43% and 29.3% higher for children from poor and medium families than those from the rich families, respectively, controlling for other variables in the model.

Mothers of parity 1 were 1.483 more likely to bear small birth size infants than mothers with parity 4 or more when other factors entered in the model were controlled for. Maternal age at first birth is also a significant factor relating to size of baby at birth. The risk of children being born small size at birth for teenage mothers is 1.306 times the risk for mother's older than 20 years at first birth. Female infants were 1.5 times more likely to have small birth size as compared with their male counterparts (OR=1.5; $p<0.0001$).

The most salient determinant of low birth weight, after controlling for other covariates, is multiple-birth status. Multiple-birth children are 1.964 times more likely to have a small birth size or low birth weight than singleton births (OR = 1.866; p<0.001).

Number of antenatal care visits also has a statistically significant association with baby's size at birth. The odds of being small size at birth was 1.441 and 1.375 times higher for mothers who had no antenatal care visit and only one visit during pregnancy than those from mothers 5 and above antenatal visit during pregnancy, respectively, controlling for other socio-demographic variables in the model.

The logistic model also showed that the likelihood of being small birth size or low birth weight was highly significant for lower maternal BMI. Malnourished or underweight mothers (BMI <18.5 kg/m^2) are 1.396 times more likely to give small birth size infants compared with overweight (BMI >25 Kg/m^2) mothers.

After adjustment for other factors, the variables, mother's age, religion, place of residence, marital status, preceding birth interval and birth order of the child appeared to have no significant effect on determining the baby's size at birth.

3.3 Risk Factors for Small Size at Birth: Multilevel Logistic Regression Model

In the multilevel analysis, a two-level structure is used with regions as the second-level unit and women as the first-level unit. The nesting structure is women within regions that resulted in a set of 11 regions with a total of 7358 women. A chi-square test statistic was applied to assess heterogeneity between regions. The test yielded χ^2= 169.901, P < 0.0001. Thus, there is evidence for heterogeneity among regions with respect to size of baby's at birth.

Table 4: Results for Fixed and Random Effects of Random Coefficient Model, EDHS 2011

SB	**Coef.**	**Std. Err.**	**Z**	**P>z**	**[95% Confidence Interval]**	
Age						
30-34(ref.)						
15-19	0.0214558	0.156243	0.14	0.891	-0.284774	0.3276856
20-24	0.0950234	0.105295	0.9	0.367	-0.11135	0.3013973
25-29	-0.123199	0.083242	-1.48	0.139	-0.286349	0.039952
35 and +	0.1028222	0.080239	1.28	0.2	-0.054443	0.2600872
Religion						
Others(ref.)						
Orthodox	-0.010725	0.174896	-0.06	0.951	-0.353514	0.3320646
Muslim	0.1916417	0.169472	1.13	0.258	-0.140517	0.5238005
Protestant	-0.075599	0.164763	-0.46	0.646	-0.398528	0.2473295
Education						
Secondary+(ref.)						
No education	0.3088323	0.14058	2.2	0.028*	0.033301	0.5843636
Primary	0.1794235	0.13793	1.3	0.193	-0.090915	0.4497621
Wealth						
rich(ref.)						
Poor	0.3681598	0.074859	4.92	0.000*	0.2214394	0.5148802

SB	Coef.	Std. Err.	Z	P>z	[95% Interval]	Confidence
Medium	0.2574851	0.085144	3.02	0.002*	0.0906065	0.4243637
Parity						
4 and +(ref.)						
1	0.412601	0.112347	3.67	0.000*	0.1924056	0.6327963
2-3	0.1554011	0.079989	1.94	0.052	-0.001374	0.3121765
Single birth	-0.666365	0.19713	-3.38	0.001*	-1.052732	-0.279997
Female	0.406096	0.051742	7.85	0.000*	0.3046837	0.5075083
Age at birth						
>20(ref.)						
<15	0.2388747	0.113186	2.11	0.035*	0.017034	0.4607153
15-19	0.2610822	0.103496	2.52	0.012*	0.0582337	0.4639307
BMI						
Overweight(ref.)						
Underweight	0.3266011	0.134026	2.44	0.015*	0.0639143	0.589288
Normal	0.2326347	0.127232	1.83	0.067	-0.016735	0.482004
Anemia						
Anemic(ref.)						
No anemic	-0.155844	0.061609	-2.53	0.011*	-0.276595	-0.035094
ANC						
5 and+(ref.)						
None	0.3443314	0.095947	3.59	0.000*	0.1562794	0.5323835
1	0.3017101	0.14895	2.03	0.043*	0.0097732	0.5936471
2-4	0.1712431	0.097387	1.76	0.079	-0.019632	0.3621177
_cons	-1.604993	0.325037	-4.94	0.000*	-2.242055	-0.967932

*significant (p<0.05)

Table 5: Level-2 covariance matrix

Random effect	***Estimates***	***S.E.***	***Z***	***p-value***	***[95%. CI.]***	
var(Wealth)	0.0560416	0.029507	1.9	.028*	0.019975	0.157289
var(BMI)	0.0652815	0.037426	1.74	.040*	0.014666	0.208376
var(Anc)	0.0168095	0.009741	1.73	.042*	0.005399	0.052337
var(_cons)	0.082544	0.041136	2	.022*	0.031081	0.21922
cov(Wealth,BMI)	0.0273841	0.024435	1.12	0.131	-.0 05074	0.075276
cov(Wealth,ANC)	0.025359	0.012217	2.08	.019*	0.001415	0.049303
cov(ANC,BMI)	-0.00586	0.007633	-0.77	0.221	-0.02082	0.009099
cov(Wealth,_cons)	-0.1362266	0.072795	1.87	.031*	-0.2789	0.006449
cov(BMI,_cons)	-0.0757584	0.070347	1.07	0.14	-0.21364	0.062119
cov(ANC,_cons)	-0.0787503	0.042797	1.83	.030*	-0.16263	0.00513
Deviance	8770.39					
AIC	8838.39					
BIC	9055.3					

LR test vs. logistic regression: chi2 (6) = 68.40 Prob> chi2 = 0.0000

In general, the results of the multilevel logistic regression (in table 4 and 5) suggest that there exist differences in the birth size of children among the regions in Ethiopia. Also, the effects of wealth index, BMI and antenatal care have a significant variation on baby's size at birth among region.

3.4 Discussion

The results of this low birth weight risk factors study of children 0-59 months in Ethiopia based on the Ethiopian Demographic and Health Survey (EDHS 2011) data using multiple logistic regression and multilevel logistic regression techniques were in general consistent with most previous studies in terms of the risk factors of small birth size.

Concerning the regional disparity children born in Amhara, Afar and Addis Ababa were at a higher risk of small birth size than children who born in Dire Dawa. The observed high risk of small birth size in these regions may be attributed to differences in nutrition, socio-economic, health care service, and other cultural and life style differences among women.

Maternal education appears to be a very important determinant of the baby's size at birth in this study. The risk of small size at birth is significantly higher for children whose mothers have no education than children whose mothers have secondary and higher level of education. These findings are similar to the results of other studies [8, 9]. Low educated mothers with low income and without permanent employment are more frequently malnourished, have unhealthy habits (like alcohol consumption), chronic diseases and inadequate prenatal care and this in turn related with mother delivering small birth size infants.

This study revealed that socio economic status of mother's is also one of the important determinant factors of baby's size at birth in Ethiopia. Infants born from poor and medium income households are at a higher risk of small birth size than infants born from rich households. Woman's socioeconomic condition during her developmental age affects her pregnancy outcomes and this works through her reproductive efficiency and anthropometry which is developed prior to her pregnancy. Also her socioeconomic condition during pregnancy affects her motivation to seek antenatal care and good nutrition which affects her pregnancy outcome.

Mother's age at first birth was found to be one of the important determinant factors of baby's size at birth in Ethiopia. Mothers giving first birth at age <15 years and 15 to 19 years are more likely to bear small birth size infants than adult mothers (>=20 years). This finding was consistent with the finding of Mawabu and Ipadeola et al. [10, 11].

Consistent with the study by Siza [12], this study indicated that mothers who are anemic are significantly vulnerable to small birth size than those who had not anemic. Many studies indicated that malnutrition is a major problem causing low birth weight in newborns, especially in developing countries. Pregnant women who are undernourished are at greater risk of LBW [9, 12-14]. In line with this, the main finding of this study showed that low weight mothers (BMI <18.5 Kg/m^2) gave the highest proportion (60.4%) of small size infants as compared to overweight mothers (BMI>=25 Kg/m^2). This suggests that maternal nutrition is the most important determinant of the baby's size at birth in Ethiopia. It has a direct causal impact on the incidence of small size at birth. This study also showed that multiple births was a higher risk factor for low birth weight as compared to single birth infants.

The number of antenatal care is the most important determinant of low birth weight; women who had 4 and above antenatal care gave birth to higher birth weight babies as compared to mothers who received less than 4 antenatal care visit.

The results of the multilevel modeling also showed that, there was reasonable consistency between these two models with respect to the important factors such as mother's education, mother's socioeconomic status, parity, sex of child, type of birth, age at first birth, BMI, anemia and ANC.

An interesting finding in multilevel model was that there exist considerable differences in baby's size at birth among the different regions in Ethiopia. Further investigation of such regional variations should be properly explored so as to provide more insightful information for policy makers.

4. Conclusions

The results of this study showed that mother's education, socioeconomic status of mothers, parity, sex of child, type of birth, and mother's age at first birth, body mass index, anemia and number of antenatal care visit are all important determinant factors of small size at birth or low birth weight. Also, there exist considerable differences in baby's size at birth among regions. However religion, mother's age, place of residence, preceding birth interval and marital status were not significant factors of baby's size at birth in Ethiopia, a result which is not in line with some literature.

The successful usage of birth size as a proxy for birth weight implies that in the absence of birth weight information in DHS surveys for future studies, analyses can be carried out on size at birth information.

For further research on LBW or small baby's size at birth in this country, it is recommended that other factors be considered, such as gestational age, tetanus toxoid injection, timing of antenatal care visit and others maternal risk factors that are not identified in the present study due to missing or none responses from the EDHS 2011 data.

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