

ORIGINAL ARTICLE**Prevalence and Predictors of "Small Size" Babies in Ethiopia: In-depth Analysis of the Ethiopian Demographic and Health Survey, 2011****Taddese Alemu^{1,2}, Melaku Umeta³****ABSTRACT**

BACKGROUND: *Low Birth Weight (LBW) babies account for nearly 80% of neonatal deaths globally. In Ethiopia, only 5% of them are weighed at birth. This study analyzes the prevalence and key proximate determinants of reported infant size, and its validity to use as a proxy indicator for low birth weight in the Ethiopian context.*

METHODS: *In-depth analysis of the Ethiopian Demographic and Health Survey dataset was conducted using representative data collected from all regions in the country. Considering reported fetal size at birth as an outcome variable, key predicting variables from socio-demographic, household, child and obstetric characteristics were employed for analyses. Chi-square test and multivariate logistic regression model were used to determine predictors at p value < 0.05 .*

RESULTS: *An average of 29.1% of Ethiopian babies were reported "small" at birth in 2011. Various variables from socio-demographic, household, child and maternal reproductive characteristics were identified as key predictors. Women who develop anemia and not attending antenatal care during pregnancy had 15% and 41% more risk of giving birth to the reported "small size" babies than their counterparts (AoR = 1.15, and 1.41, 95% CI (1.02, 1.64 and 1.06, 1.88) respectively. Maternal age at delivery, maternal literacy level, paternal educational status and presence of radio or television in the household and other factors were also other key predictors identified.*

CONCLUSION: *The prevalence of small size babies in Ethiopia is high but comparable to regional estimates of LBW. It is recommended that improving maternal nutritional and socio-economic status is a timely intervention to tackle the problem.*

KEYWORDS: *Prevalence, Small size, Validity*

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INTRODUCTION

Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams (1). Globally, more than 20 million infants are born with LBW. A larger proportion of them concentrating in Asia and Africa (2,3), LBW babies are more likely to experience physical and developmental health problems or die during the first year of life than are infants of normal weight. It is for this and other reasons that birth weight is considered as the single most important factor affecting neonatal and early neonatal mortality.

LBW is also closely associated with foetal and neonatal morbidity, inhibited growth, cognitive development and chronic diseases in life (2). LBW as indicator is also believed to be a good summary measure of a multifaceted public health problem that includes long-term maternal malnutrition, ill health, hard work and poor pregnancy health care (2,6).

Studies conducted locally and internationally show that conditions including gestational age, maternal age, regular antenatal checkup, mother's height, mother's weight, anemia, physical work, tobacco-chewing and history of abortion are significant determinants of LBW (7,8).

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In Ethiopia, recent estimate (9) shows that the prevalence of low birth weight is 11% and ranges high up to 28.3% in some areas (10–12). A hospital based study in North Ethiopia, Gondar (13), found that some 11.2% of babies were born with LBW, while a similar study in Southwest Ethiopia (Jimma) showed a higher (22.5%) prevalence. The other prospective community based study from Eastern (Kersa-Harer) Ethiopia estimated as high as (28.3%) LBW babies (12).

Though identifying and quantifying determinants of LBW has obtained greater attention, in resource poor settings like Ethiopia, there is critical shortage of consistent and explicit data on the prevalence and its predictors (14). A wise approach to the condition may be the use of alternative proxy indicators.

It is not uncommon to use alternative proxy indicators for measuring health events, during conditions of practical impossibility. For instance, due to the fact that maternal mortality is the worst performing health indicators in resource limited settings, the WHO uses the study of cases of women who nearly died but survived a complication during pregnancy, childbirth or postpartum (maternal near miss or severe acute maternal morbidity) as useful means to examine quality of obstetric care and evaluation of maternal mortality(15).

Experience from other settings shows that the use of maternal subjective assessment of baby size at birth was found useful predictor of objectively measured birth weight (16). Study from Nepal, a setting similar to Ethiopia, found that mothers' subjective assessments of birth weight had high positive and negative predictive values for LBW. It showed that 92.6% of the mothers were able to correctly identify whether the child was of average or above size, and six in every ten (61.3%) mothers identified that the child was small (16).

This prompts further and in-depth evaluation of the validity of this measure in other similar settings of the developing world, like Ethiopia, where access to vital registration and data on low birth weight are hardly available.

METHODS

Data source: This study used data from the third round Ethiopian Demographic and Health Survey (EDHS) conducted in 2011. The survey was

conducted in all regions of the country with representative samples. The details of the sample design, including the sampling framework and sample implementation and response rates are provided in the respective EDHS reports (www.measuredhs.com).

In the DHS, there are three core questionnaires (Household, Women and a Male questionnaires) and nine recode files. This way of recoding is done because of two outstanding reasons; to define a standardized file that would make cross-country analysis easier and to compare data with the World Fertility Surveys (WFS) to study trends. The recode files have five main and two additional digits. The first two digits of the file name correspond to the country code (e.g. ET for Ethiopia). The next two digits identify the unit of analysis (IR–Women, KR–Children, ...etc). The fourth digit identifies the DHS phase. The fifth digit identifies the data release number and the last two digits identify whether it is a rectangular (RT) or flat (FL) file; for the hierarchical file they are left blank.

In the current analyses, we used ETKR61FL.SAV recode data files, whereby ET stands for Ethiopia, KR for Kids (children), 6 for the year 2011, FL for flat file) for the analyses of the prevalence and proximate determinants of LBW. This means, we used the 2011 file of children under five to describe the validity, prevalence and key proximate determinants of small size babies in Ethiopia.

Study variables: The dependent variable is prevalence of small size babies at birth. This depends on subjective evaluation of the baby's size at birth by the mother. These potential predicting variables are categorized into four groups: socio-demographic, household, child characteristics and maternal obstetric/reproductive characteristics.

Socio-demographic variables: These groups of indicators consist of maternal socio-demographic characteristics. Among these, maternal age, educational status, literacy level, region, urban/rural residence, wealth status by quintiles are included for analyses.

Household variables: In this group, we included presence or absence of key household goods like electricity, radio, refrigerator, telephone and television. Other variables included in this category are relationship of respondents to the

household, access to improved toilet facilities and access to safe water supply.

Child characteristics: In this category, we selected child health and related characteristics such as child age, sex, birth weight, level of anemia and birth interval. We also included whether the child is alive or not during the interview and singleton versus twin pregnancy.

Maternal reproductive and obstetric variables: In this category, the following variables were included: level of maternal anemia, number of births last year/last five years, knowledge about the reproductive system indicated by awareness of the ovulatory cycle. In addition, other variables like number of living children, history of abortion, history of caesarean delivery, use of alcohol, cigarette/urret and addictive substances during pregnancy were also included.

Data analysis: This study employed a three-stage analysis. Uni-variate and bi-variate analyses were made to calculate validity, prevalence and associations between variables using chi-square, ANOVA and student t-test. Multivariate logistic regression analysis was used for the identification of final predicting variables for small size babies in Ethiopia. STATA 10 and SPSS version 20 softwares were used in both stages of the analysis.

Data quality assessment: The data quality assessment report highlighted its findings on misreporting, omission, and digit preference, which are common data quality problems observed in surveys and censuses in developing countries.

Ethical issues: This is a secondary data analysis requiring no direct data collection from human subjects. However, request to access datasets from measure DHS website was made, and the websites had allowed the same before analysis was made.

RESULTS

Data for a total of 11, 872 under five children was abstracted and included to this in-depth analysis. The maternal reported prevalence of small size babies at birth was 29.1%. Among these, 19.3% and 12.8% were reported as "very small" and "small" by their mothers or caretakers, respectively (**Figure 1**). On the other hand, a larger proportion (38.4%) of the babies were reported as "average sized" followed by "very large" (20.6%).

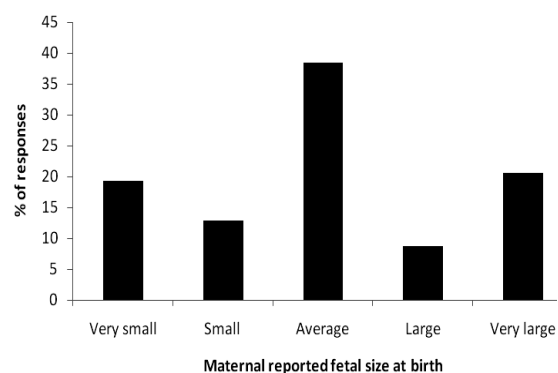


Figure 1 : Reported maternal size of infants at birth for Ethiopian children, EDHS 2011.

Table 1 shows that 68.9% of the mothers were able to correctly identify if the child was of average size or above. In the same way, more than four in every five (85.9%) of the mothers were also correctly reported if the baby was below average size (Table 1).

The prevalence of having small size babies varied inversely and significantly across maternal age groups. As the maternal age group increased from 15-19 to 45-49, the risk of having small size babies declined ($p < 0.05$) (**Table 2**).

Table 1: Test of concordance between the reported size at birth and recorded birth weight, EDHS 2011

Maternal subjective report of size at birth	Birth weight of the child	
	< 2500	≥2500
Greater than equal to average (Average, large and very large)	14.1	68.9
Small size babies (Very small and small)	85.9	31.1

Table 2: Determinants of small size babies by selected maternal socio-demographic characteristics, in Ethiopia, EDHS 2011.

Socio-demographic Characteristic	Baby Size at Birth		Crude OR (95% CI)	Adjusted OR (95% CI)
	Small No(%)	Non- Small No(%)		
Maternal Age				
15 - 19	182 (37)	310 (63)	1	1
20 - 24	782 (33.8)	1544 (66.2)	0.94(0.83, 1.05)	0.94 (0.76, 1.16)
25 - 29	1042 (27.5)	2743 (72.5)	0.78(0.70, 0.88)	0.70 (0.57, 0.86)*
30 - 34	626 (26.8)	1710 (73.2)	0.78(0.71, 0.88)	0.64 (0.52, 0.79)*
35 - 39	526 (28.9)	1292 (71.1)	0.78 (0.69, 0.89)	0.72 (0.58, 0.79)*
40 - 44	227 (29.4)	546 (70.6)	0.85 (0.74, 0.94)	0.68 (0.53, 0.87)*
45 - 49	73 (26.8)	199 (73.2)	0.90 (0.76, 1.07)	0.62 (0.44, 0.86)*
Residence				
Urban	367 (24.3)	1146 (75.7)	1	1
Rural	3101 (30.1)	7207 (69.9)	1.43 (1.32, 1.55)	1.32 (1.13, 1.54)*
Region				
Tigray	240 (32)	510 (68)	1	1
Afar	49 (40.5)	72 (59.5)	1.65 (1.32, 2.06)	0.90(0.62, 1.32)
Amhara	1067 (40.4)	1574 (59.6)	1.19 (1.08, 1.32)	1.20(0.72, 1.98)
Oromia	1301 (26.1)	3691 (73.9)	0.75 (0.68, 0.82)	1.23 (0.86, 1.76)
Somali	121 (33.2)	243 (66.8)	0.79 (0.67, 0.94)	0.67 (0.47, 0.95)*
Beng. Gumuz	34 (24.5)	105 (75.5)	0.78 (0.61, 1.08)	1.00 (0.67, 1.53)
SNNPR	568 (22.8)	1920 (77.2)	0.65 (0.59, 0.73)	0.63 (0.37, 1.07)
Gambella	13 (32.5)	27 (67.5)	0.72 (0.46, 1.13)	0.58 (0.40, 0.83)*
Hareri	8 (28.6)	20 (71.4)	0.70 (0.42, 1.17)	1.03 (0.46, 2.32)
Addis Ababa	55 (25.1)	164 (74.9)	0.63 (0.51, 0.78)	0.86 (0.35, 2.12)
Dire Dawa	11 (28.9)	27 (71.1)	0.69 (0.45, 1.06)	0.87 (0.39, 1.94)
Maternal Educ. Status				
No Education	2585 (31.6)	5603 (68.4)	1	1
Prim. Education	796 (24.8)	2419 (75.2)	0.75 (0.71, 0.80)	0.95 (0.83, 1.08)
Sec. Education	62 (23.6)	201 (76.4)	0.57 (0.49, 0.65)	1.04 (0.71 , 1.52)
Higher Education	26 (15.8)	139 (84.2)	0.42 (0.29, 0.59)	0.76 (0.48, 1.27)
Maternal Literacy level				
Can't read/write	2849 (31)	6384 (69)	1	1
R & W (partial)	255 (23.7)	819 (76.3)	0.82 (0.75, 0.89)	0.81 (0.68, 0.94)*
R & W (Fully)	326 (23.5)	1064 (76.5)	0.68 (0.63, 0.74)	0.78 (0.64, 0.95)*
Wealth Index				
Poorest (Q1)	938 (34.7)	1762 (65.3)	1	1
Poor (Q2)	774 (29.3)	1866 (70.7)	0.78 (0.69, 0.87)	0.65 (0.34, 0.04)*
Average (Q3)	778 (32)	1655 (68)	0.88 (0.78, 0.99)	0.35 (0.09, 0.65)*
Rich (Q4)	581 (25.7)	1684 (74.3)	0.65 (0.57, 0.73)	0.58 (0.27, 0.95)*
Richest (Q5)	397 (22.3)	1386 (77.7)	0.54 (0.47, 0.62)	0.22 (0.00, 0.50)*
Total	3468 (29.3)	8353 (70.7)		

**statistically significant (P < 0.001)

In terms of the maternal residential area, more mothers from the rural as compared to the urban settings reported a more (32%) risk of small size babies (AoR, 1.32; 95% CI, 1.13 -1.54). Similarly, having small size babies also varied across all regions in the country, although not statistically significant differences, except for Gambella and Somali regions. Compared to Tigray, mothers in these regions reported a 42% and 33% less risk (AoR = 0.58, 95% CI, (0.40, 0.83) and AoR = 0.67, 95% CI (0.47, 0.95)) of small size babies respectively (Table 2).

Maternal literacy level, not educational status, was also statistically associated with the size of babies at birth in Ethiopia. As the maternal literacy level improved from none to partially or fully able to read and write, the probability of having small size babies significantly declined by 19% and 22% (AoR = 0.81 and 0.78; 95% CI, (0.68, 0.94) and (0.64, 0.95)) respectively.

Regarding the household income (wealth status), an inverse but significant association was observed with giving birth to small size babies, which is a proxy indicator for LBW babies; i.e. the

better the wealth status of the household, the lesser the risk of having small size babies. Compared to the poorest (Q_1), mothers from the poor (Q_2), the middle (Q_3), the rich (Q_4) and the richest (Q_5) household reported a 35% (AoR, 0.65; 95% CI, 0.34 - 0.04), 65% (AoR, 0.35; 95% CI, 0.09-0.65), 32% (AoR, 0.58; 95% CI 0.27-0.95) and 78% (AoR, 0.22; 95% CI 0.00 -0.50) less risk of small sized babies at birth respectively (Table 2).

Table 3 presents the household variables analyzed for any potential association with infant size at birth. Accordingly, ownership of radio and

television were among the factors that had statistically significant association with the outcome variable of interest. Thus, families owning radio and television had a 26% (AoR, 1.26; 95% CI, 1.12 - 1.41) and a 2.05 fold (AoR, 2.05; 95% CI, 1.41, 2.96) increased risk of giving a small size babies than those who have neither. Although household variables like presence of electricity, ownership of refrigerator and access to safe water source or sanitation had varied risk level for small size babies, none of the appeared in the final logistic regression model.

Table 3: Prevalence and determinants of small size babies by selected household characteristics in Ethiopia, EDHS 2011

House-hold Characteristic	Baby Size at Birth		Crude OR (95%CI)	Adjusted OR (95% CI)
	Small No(%)	Non- Small No(%)		
Electricity in the HH				
No	3009 (30.3)	6936 (69.7)	1	1
Yes	345 (22.8)	1196 (77.2)	1.55 (1.42, 1.69)	1.02 (0.81, 1.27)
Radio in the HH				
No	2223 (31.8)	4776 (68.2)	1	1
Yes	1140 (25.4)	3356 (74.6)	1.29 (1.23, 1.36)	1.26 (1.12, 1.41)*
Television in the HH				
Yes	3233 (29.9)	7597 (70.1)	1	1
No	130 (19.7)	529 (80.3)	1.98 (1.68, 2.32)	2.05 (1.41, 2.96) *
Water Source				
Unsafe	1167 (27.5)	3083 (72.5)	1	1
Safe	2186 (30.4)	5007 (69.5)	1.11 (0.98, 1.25)	1.11 (0.98, 1.25)
Sanitation facility			1	1
Improved	1573 (31.6)	3410 (68.4)	0.99 (0.86, 1.16)	0.99 (0.86, 1.16)
Non-improved	385 (26.9)	1045 (73.1)		
Total	3353 (29.3)	8990 (70.7)		

*statistically significant

From child related characteristics/variables analyzed, the objectively measured birth weight appeared to be strongly associated with maternal the subjective evaluation of birth size at birth. Infants born with a birth weight of low (<2.5kg) were 12.09 times more likely to be correctly and validly reported the same by their mothers or care takers during the survey compared to those above 2.5kg (AoR, 12.09; 95% CI, (8.59, 17.02). Other variables in this category like child's sex, preceding birth interval, child's survival status (alive or dead) and twin birth were all eliminated in the final model (Table 4).

Among the maternal obstetric and reproductive characteristics included in the current analysis, anemia during pregnancy and antenatal care followup were found to be independent and useful predictors of having small size babies by mothers. Anemic mothers whose hemoglobin level was <11 during pregnancy had 15% more risk of giving small sized babies (AoR, 1.15; 95% CI, 1.02-1.64) than non-anemic mothers. In the same way, pregnant women not attending antenatal care (ANC) reported 40% higher risk of small size babies than the those who attended at least once during the immediate pregnancy (AoR, 1.41; 95% CI, 1.06-1.88) (Table 5).

Table 4: Prevalence and determinants of small size babies by selected Child characteristics in Ethiopia, EDHS , 2011

Child Characteristics	Baby Size at Birth		Crude OR (95%CI)	Adjusted OR (95% CI)
	Small No(%)	Non- Small No(%)		
Sex of the Child				
Male	1576 (25.7)	4560 (74.3)	1	1
Female	1892 (33.3)	3793 (66.7)	1.52 (1.45, 1.59)	2.14 (0.27, 16.57)
Child's Birth weight				
< 2500g	62 (45.3)	75 (54.7)	1	1
≥ 2500g	28 (5.8)	456 (94.2)	12.09 (8.59,17.02)	12.09 (8.59, 17.02)*
Preceding birth interval				
<12months	64 (29.9)	150 (70.1)	1	1
12 - 23 months	477 (27.3)	1269 (72.7)	0.77 (0.65, 0.91)	0.20 (0.002, 21.7)
24 - 35 months	914 (26.9)	2482 (73.1)	0.82 (0.69, 0.96)	0.28 (0.00, 14.91)
36 - 47 months	635 (28.9)	1564 (71.1)	0.89 (0.76, 1.05)	2.08 (0.04, 120)
48 - 59 months	270 (28.5)	679 (71.5)	0.90 (0.76, 1.07)	0.44 (0.00, 36.5)
≥ 60 months	329 (31)	732 (69)	0.84 (0.70, 1.00)	0.01 (0.00, 20.26)
Child's status				
Dead	194 (24.3)	606 (75.8)	1	1
Alive	3275 (29.7)	7747 (70.30)	1.20 (1.11, 1.30)	1.10 (0.01, 97.9)
Total	3353 (29.3)	8990 (70.7)		

*statistically significant

Table 5: Prevalence and Determinants of Small Size Babies by Selected Maternal Obstetric and Reproductive Characteristics in Ethiopia, EDHS, 2011

Maternal Reproductive & Obstetric Characteristic	Baby Size at Birth		Crude OR (95%CI)	Adjusted OR (95% CI)
	Small No(%)	Non- Small No(%)		
Anemia During pregnancy				
No	2690 (29.1)	6560 (70.9)	1	1
Yes	692 (31.7)	1493 (68.3)	1.29(1.02,1.64)	1.1 (1.02, 1.64)*
Ever had terminated pregnancy				
No	3082 (29.1)	7513 (70.9)	1	1
Yes	386 (31.5)	840 (68.5)	1.05(0.98,1.13)	1.07 (0.73, 1.56)
Current pregnancy wanted				
Yes (Then or latter)	286 (27.2)	764 (72.8)	1	1
No	32 (21.3)	118 (78.7)	1.05(0.98,1.13)	0.72 (0.52, 1.14)
ANC visit during pregnancy				
No	1523(33.9)	2971 (66.1)	1	1
Yes	1946(26.6)	5382 (73.4)	1.32(1.25,1.41)	1.41(1.06,1.88)*
Had Previous C/Section				
No	3434(29.5)	8213 (70.5)	1	1
Yes	34 (19.5)	140 (80.5)	1.69(1.32,2.19)	0.1 (0.002,8.96)

*statistically significant

DISCUSSION

Globally, over 58% of newborn infants are not weighed, and in Ethiopia it peaks as high as 95% (14,16). It will be a misleading evidence to measure the prevalence and incidence of low birth weight babies using this kinds of

non-representative (only 5%) of the measured birth weight depending on institutional data alone. Evaluating an alternative proxy indicator like mothers' subjective assessment of the size of babies at birth may be useful. Previous experiences from other low income countries across the globe, Nepal for example(16,17), shows that mothers were able to detect as high as 61.3% of low

birth weight and 92.6% of non-low birth weights correctly (15). In a very closer reporting, our currently analyzes showed that, Ethiopian women were also able to correctly report 68.9% of the non-low birth weight and 85.6% of the low birth weight infants, just considering only the 5% weighed babies at birth (18).

It was also learned that closer to the reports of other similar local studies (5,11,14,19), the overall prevalence of low birth weight (small size babies, in this case) has significantly declined from 33.4% to 27.9% and 29.3% between 2000 and 2011 (20,21). On the other hand, the level of the prevalence of small size babies is by far higher than the recorded low birth weight babies. For instance, in 2011, mothers reported that 29.3% of their babies were small in size as compared to only 11% of recorded low birth weight during the same period. This is mainly attributable to the fact that most of the small size babies are not reported to health systems as the overall institutional delivery is very small, and recording of vital events in the nation is very poor (14).

The above findings are consistent with other studies in the country conducted using actual birth weight data from the community setting within 24 hours (12). According to Nega *et al* (12), using a data collected from the community setting, a figure (28.3%) closer to the reported than to the recorded prevalence of low birth weight is obtained. This signifies that, in resource limited settings like Ethiopia, maternal subjective assessment of birth size is found useful and relatively reliable.

Among the key predictors of small size babies, maternal age, urban-rural residence, region, maternal literacy level and household wealth index (status) were among the socio-demographic characteristics which had association with the outcome variable under investigation. According to the responding mothers, risk of giving small size baby inversely decreased with increased maternal age, literacy level and wealth index. The same also diminishes for urban mothers by 32% as compared to their rural counterparts. This finding is concurrent to several other studies conducted locally (12) and internationally (23,24).

In the same way, access to media (ownership of electronics like radio or television) in the household are also associated with risk of small sized babies in the Ethiopian context. Access to mass media (radio and television) provides mothers with information on the benefits of pregnancy and child care services. This will enhance the health status of the unborn baby and in turn increases the demand for reproductive health services. Mothers from a household without a radio or a television reported a 26% and a twofold added risk of delivering small size babies (AoR = 1.26 and 2.05, 95% CI = (1.12, 1.41) and (1.41, 2.96) respectively. This finding is also consistent with the findings of other studies conducted in Africa and elsewhere (25,26).

A low birth weight child was seen to be 12.09 times more likely and accurately to be reported as small size by mothers. This re-proves the fact mentioned above that in the absence of measured birth weight, maternal estimate for the size of the baby is more likely to be consistent with the objective measure by baby scale. A similar finding is also obtained elsewhere (16).

Mothers who became anemic during their last pregnancy and those who didn't have any ANC followup had a 15% and 41% added risk of having small size babies (AoR = 1.15, 95% CI (1.02, 1.64) and 1.41(1.06, 1.88). This is consistent with several other findings (2,4,12,13,27,28) in that maternal nutritional condition in general and anemia during pregnancy as well as antenatal care followup during pregnancy are conclusively identified as being among the most important factors determining fetal size at birth or birth weight.

Generally, the national prevalence of LBW babies, as indicated here by reported small size, is high and comparable to findings of local studies. Promisingly, it has also showed a declining trend between 2000 - 2011. Yet, huge discrepancy between findings of institution based studies and the current reported birth weight as well as other cross-sectional community based studies was also observed. Results of the community based cross-sectional surveys at grass root (community) level reported a more closer value to the maternal subjective reports. This was mainly explained by variables from household, socio-demographic, child as well as maternal reproductive and obstetric sources.

Therefore, it is recommended that public health measures mitigating low birth weight in Ethiopia. Furthermore, in resource limited settings like Ethiopia, where measuring birth weight is expensive and hardly possible, it is useful to use maternal subjective reports of infant size at birth, rather than relying only on facility based records.

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