Determinants for low birth weight in Asmara, Eritrea: A maternity hospital-based study

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ABSTRACT

INTRODUCTION Weight at birth is a good indicator of the newborn's chances for survival, growth, long-term health, and psychosocial development. This maternity hospital-based study was done to determine factors affecting low birth weight (LBW) of neonates in Asmara, Eritrea.

METHODS A cross-sectional analytical study was used and a sample of 806 mother–neonate pairs who attended during the data collection period, were taken consecutively. Maternal and neonatal anthropometric measurements were taken; a standard questionnaire was utilized and maternal health card reviewed. Data were entered and cleaned in Statistical Package for Social Sciences (SPSS) version 25 and exported to Stata version 14 for data analysis. Simple and multivariable logistic regression, using the Backward Stepwise Likelihood Ratio (LR) method, was employed; crude and adjusted odds ratios along with 95% confidence interval (CI) were calculated, and the level of significance was set at 0.05.

RESULTS Out of all the variables, 9 variables were retained in the final model. These variables were: sex of the neonate, number of ANC visits, gravidity, pre-pregnancy utilization of modern family planning methods, pregnancy related illnesses during current pregnancy, current body weight, current body height, gestational age in weeks, and paternal employment status.

CONCLUSIONS Except for the sex of the neonate, all other variables could be considered as modifiable. It is therefore recommended that comprehensive ANC services should be strengthened and emphasis given to primigravida women to increase neonate birth weight.

ABBREVIATIONS ANC: antenatal care, DHS: demographic and health surveys, EIT: Eritrea Institute of Technology, EPHS: Eritrean population and health survey, FP: family planning, IUGR: intra- uterine growth retardation, LBW: low birth weight, LMP: last menstrual period, NBW: normal birth weight, NSO: National Statistics Office, PCA: principal component analysis

INTRODUCTION

Low birth weight (LBW) has been defined by the World Health Organization (WHO) as weight at birth of less than 2500 g[1], with the measurement being taken preferably within the first hour of life before significant postnatal weight loss has occurred[2]. It is now well-recognized that birth weight is a critical determinant of child survival, growth, and development, and a valuable indicator of maternal health, nutrition, and quality of life[3]. Globally, LBW infants are approximately 20 times more likely to die than heavier babies[4]. LBW results from preterm birth or due to intra-uterine growth retardation (IUGR) or both[5]. Among some of the consequences of LBW, which may result in substantial stress, are neurodevelopmental handicaps, congenital anomalies, and susceptibility to infections[6,7].

More than 20 million infants worldwide are born with LBW, of which 95.6% are in developing countries. LBW levels in Sub-Saharan Africa and Eastern Africa are around 15% and 13.5%, respectively. Among the more developed regions, North America averages 8%, while Europe has the lowest regional average at 6%[8].

In Eritrea, the health facility-based prevalence for LBW was reported as 7.6% in 2015[9]. In addition, reports released by the National Statistics Office (NSO) revealed that the prevalence of LBW in Eritrea declined from 21% in 1995 to 7% in 2010[10-12]. However, a report released by the United Nations Children's Fund (UNICEF) puts the LBW for Eritrea for 2008–2012 at 14%[13].

This study assessed the maternal, paternal, and neonatal factors associated with LBW babies, an important indicator of maternal and newborn health in Eritrea. In addition, the current changes in factors and the pathways through which they affect LBW babies due to recent changes in socioeconomic and demographic factors in Eritrea are not entirely understood. Hence, this study aimed to fill the gaps of earlier research on socioeconomic, demographic, nutritional, and maternal health aspects of LBW, to help the health planners and policy makers address this issue in Eritrea.

METHODS

Study design and data collection

This health facility-based cross-sectional analytical study was conducted at four maternity hospitals in Asmara, namely: Orotta National Maternity Referral Hospital, Edaga Hamus Maternal and Child Health Hospital, Biet Mekea Community Hospital, and Sembel public–private Hospital in Eritrea.

The study population comprised pairs of mothers and neonates who attended the maternity care services at hospitals in Asmara. The study units were mothers and their respective newborns available at the selected sites during the data collection period. Mothers with unknown last menstrual period (LMP), twin deliveries, and neonates with congenital anomalies were excluded from this study.

According to Vittinghoff and McCulloch, as cited by Conroy[14], at least five events per predictor variable were recommended in the analysis using multivariable logistic regression. Therefore, in this study, the maximum number of predictor variables considered was 14, achieved from 73 LBW neonates and 806 deliveries taken consecutively within one hour after delivery.

Ten data collectors and supervisors with health science education background were recruited. A three-day training was given on interviewing techniques, anthropometric measurement taking, and maternal health card reviewing. The data collection tools were pre-tested on 5% of the sample size, and based on the findings, modifications were made to the data collection tools and procedures.

Data were collected from 15 November 2017 to 31 January 2018. Eligible mothers were interviewed; ANC cards and medical records of mothers were reviewed; and maternal and neonatal anthropometric measurements were also taken.

After the proposal was approved by the College of Sciences, EIT, approval was sought and granted from the Ministry of Health (MOH), The Health Research Proposal Review and Ethical Clearance Committee. Permission was also secured from the Directors of the selected hospitals for the execution of the study in their respective health facilities. Verbal consent was secured from the research subjects after they were briefed on the research topic and purpose.

Statistical analysis

The collected data were field edited, entered, and cleaned on SPSS version 25, after which it was exported to STATA version 14 for data analysis. Descriptive analysis was utilized using frequencies and percentages, and means with standard deviations. In addition, crude odds ratios (ORs) and adjusted odds ratios (AORs) with 95% CIs were calculated using bivariate logistic regression analyses and multivariable logistic regression analysis, respectively. In building the final model, using the multivariable logistic regression analysis, a Backward Stepwise Likelihood Ratio (LR) method was employed, and six steps were passed until it stopped at the seventh iteration, retaining ten variables. The fitness of the model was tested using Hosmer- Lemeshow method and it was statistically not significant ($\chi^2(8)=10.69$, $p=0.2197$), which indicates that the model was well fitted for this data set. In all the analyses, the level of significance was set at 0.05.

In addition, principal component analysis (PCA) was employed to determine the socioeconomic position of the study subjects using the household wealth index as a proxy. Initially, 18 variables related to availability of durable household assets, housing characteristics, and type of fuel used for household cooking purposes were collected. These variables were standardized using means and standard deviations extracted from nationally representative data from EPHS 2010[12]. Finally, these values were multiplied by the factor weight calculated from EPHS 2010 and added together to form the socioeconomic position of the household, which was categorized into three levels.

RESULTS

Sociodemographic characteristics of the study participants

As indicated in Table 1, the prevalence rate for LBW in the selected maternity hospitals was 9.1% (95% CI: 7.1–11.0); and the mean (SD) birth weight (g) for all neonates, normal birth weight (NBW), and LBW, were 3143.6 (513.1), 3240.6 (421.7) and 2169.4 (279.9), respectively.

The majority (86.4%) of the mothers were in aged 20–35 years with a mean age of 27.7 years (SD=0.19). Around 97.3% of the mothers were from Zoba (administrative region) Maekel and 93% were married. The proportion of male neonates was almost equal to that of the females (males 51% vs females 49 %).

A proportion of 68% of the mothers and 78.3% of their partners had a high school education level. Almost three-fourths (78.4%) of the mothers were housewives, while 90% of their partners were employed. In addition, the

Table 1. Sociodemographic characteristics of the study participants by birth weight status, a cross-sectional analytical study, Asmara maternity hospitals, 2018 (N=806)

Characteristics	NBW		LBW		Total	
	n	%	n	%	n	%
Age (years)						
<20	29	80.6	7	19.4	36	4.5
20–35	634	91.1	62	8.9	696	86.4
>35	70	94.6	4	5.4	74	9.2
Zoba (administrative region)						
Maekel	714	91.1	70	8.9	784	97.3
Debub	12	85.7	2	14.3	14	1.7
Anseba	3	100	0	0.0	3	0.4
Debubawi Keih Bahri	1	50.0	1	50.0	2	0.3
Gash Barka	3	100	0	0.0	3	0.4
Marital status						
Married	691	91.9	61	8.1	752	93.3
Single	42	77.8	12	22.2	54	6.7
Sex of the neonate						
Male	386	93.5	27	6.5	413	51.2
Female	347	88.3	46	11.7	393	48.8
Maternal education level						
Junior and lower	229	89.8	26	10.2	225	31.6
Secondary and higher	504	91.5	47	8.5	551	68.4
Paternal education level						
Junior and lower	153	87.4	22	12.6	175	21.7
Secondary and higher	580	91.9	51	8.1	631	78.3
Maternal employment status						
Housewife	580	91.8	52	8.2	632	78.4
Employed	95	87.2	14	12.8	109	13.5
Self-employed	27	90.0	3	10.0	30	3.7
Unemployed	31	88.6	4	11.4	35	4.3
Paternal employment status						
Employed	661	91.2	64	8.8	725	90.0
Unemployed	34	81.0	8	19.1	42	5.2
Other	38	91.4	1	2.6	39	4.8
Socioeconomic status (SES)						
Low	226	86.9	34	13.1	260	32.3
Middle	248	91.5	23	8.5	271	33.6
High	259	94.2	16	5.8	275	34.1
Total	733	90.9	73	9.1	806	100

NBW: normal birth weight. LBW: low birth weight.

socioeconomic status of the participants was categorized into three levels: low, middle, and high.

Bivariate analyses on factors affecting LBW

As indicated in Table 2, taking mothers aged <20 years as the reference group, mothers aged 20–35 years and >35 years were 59% (OR=0.41; 95% CI: 0.17–0.96; p=0.041) and 76% (OR=0.24; 95% CI: 0.064–0.871, p=0.030) less likely to deliver LBW babies, respectively.

Married mothers were 70% less likely to deliver LBW

Table 2. Distribution of determinants for LBW, a cross-sectional analytical study, Asmara maternity hospitals, 2018 (N=806)

Variables	NBW	LBW	Total	OR (95% CI)[a]	p
	n (%)	n (%)	n (%)		
Maternal age (years)					
<20 ®	29 (80.6)	7 (19.4)	36 (4.5)	1	
20–35	634 (91.1)	62 (8.9)	696 (86.4)	0.41 (0.17–0.96)	0.041
>35	70 (94.6)	4 (5.4)	74 (9.2)	0.24 (0.06–0.87)	0.030
Marital status					
Married	691 (91.9)	61 (8.1)	752 (93.3)	0.30 (0.15–0.62)	0.001
Single ®	42 (77.8)	12 (22.2)	54 (6.7)	1	
Paternal employment status					
Employed	661 (91.2)	64 (8.8)	725 (90.0)	0.41 (0.18–0.93)	0.032
Unemployed ®	38 (97.4)	1 (2.6)	39 (4.8)	1	
Other	34 (81.0)	8 (19.0)	42 (5.2)	0.11 (0.013–0.94)	0.044
Socioeconomic status					
Low	226 (86.9)	34 (13.1)	260 (32.3)	2.44 (1.31–4.35)	0.005
Middle	248 (91.5)	23 (8.5)	271 (33.6)	1.50 (0.77–2.91)	0.229
High ®	259 (94.2)	16 (5.8)	275 (34.1)	1	
Number of ANC visits					
<4	164 (86.8)	25 (13.2)	189 (23.4)	1.81 (1.08–3.02)	0.024
≥4 ®	569 (92.2)	48 (7.8)	617 (76.6)	1	
Gravida					
Primigravida	179 (83.3)	36 (16.7)	215 (26.7)	3.01 (1.85–4.91)	0.0001
Multigravida ®	554 (93.7)	37 (6.3)	591 (73.3)	1	
Practised modern FP methods					
Yes ®	186 (97.9)	4 (2.0)	190 (23.6)	1	
No	547 (88.8)	69 (11.2)	616 (76.4)	5.87 (2.11–16.29)	0.001
Had illnesses during current pregnancy					
Yes	97 (84.3)	18 (15.7)	115 (14.3)	2.15 (1.21–3.81)	0.009
No ®	636 (92.0)	55 (8.0)	691 (85.7)	1	
Current body weight (kg)					
<50	184 (82.9)	38 (17.1)	222 (27.5)	3.24 (1.99–5.28)	0.0001
≥50 ®	549 (94.0)	35 (6.0)	584 (72.5)	1	
Body height (m)					
<1.50	10 (58.8)	7 (41.2)	17 (2.1)	7.67 (2.83–20.81)	0.0001
≥1.50 ®	723 (91.6)	66 (8.4)	789 (97.9)	1	
Current maternal MUAC (cm)					
<23	233 (85.7)	39 (14.3)	272 (33.7)	2.46 (1.51–3.99)	0.0001
≥23 ®	500 (93.6)	34 (6.4)	534 (66.3)	1	

Continued

Table 2. Continued

Variables	NBW	LBW	Total	OR (95% CI)[a]	p
	n (%)	n (%)	n (%)		
Duration of pregnancy (weeks)					
<37	17 (48.6)	18 (51.4)	35 (4.3)	13.78 (6.73–28.24)	0.0001
≥37 ®	716 (92.9)	55 (7.1)	771 (95.7)	1	
Sex of the newborn					
Male	386 (93.5)	27 (6.5)	413 (51.2)	0.53 (0.32–0.87)	0.012
Female ®	347 (88.3)	46 (11.7)	393 (48.8)	1	
APGAR score at 1 minute					
<7	7 (58.3)	5 (41.7)	12 (1.5)	11.65 (4.85–27.94)	0.0001
≥7 ®	726 (91.4)	68 (8.6)	794 (98.5)	1	
Total	**733 (90.9)**	**73 (9.1)**	**806 (100)**		

a Bivariate logistic regression analysis. APGAR: appearance, pulse, grimace, activity, and respiration. ® Reference categories. NBW: normal birth weight. LBW: low birth weight. MUAC: mid-upper arm circumference. FP: family planning.

compared to single mothers (OR=0.30; 95% CI: 0.15–0.62, p=0.001). Mothers whose partners were employed or categorized under 'other' (mostly living abroad) were 60% (OR=0.41; 95% CI: 0.18–0.93, p=0.032) and 90% (OR=0.11; 95% CI: 0.013–0.94, p=0.044) less likely to have LBW neonates than mothers living with an unemployed partner, respectively.

Mothers with low socioeconomic status were almost 2.4 times more likely to have LBW neonate compared to mothers with high socioeconomic status (95% CI: 1.31–4.53, p=0.005). However, the association between middle-level socioeconomic status and LBW was not statistically significant (p=0.229).

Mothers who visited the antenatal care (ANC) services less than four times during their recent pregnancy, primigravida mothers, and those who had illnesses during the current pregnancy, and those who did not utilize family planning (FP) services, were almost two times (OR=1.81; 95% CI: 1.08–3.02, p=0.024), three (OR=3.01; 95% CI: 1.85–4.91, p=0.001), six (OR=5.87; 95% CI: 2.11–16.29, p=0.001) and two (OR=2.15; 95%CI: 1.21–3.81, p=0.009) times more likely to have LBW, compared to their reference categories, respectively.

Mothers with mid-upper arm circumference (MUAC) measurement of <23 cm were found to be at a higher risk of delivering LBW neonates than women with MUAC measurement ≥23 cm (OR=2.46; 95% CI: 1.51–3.99, p=0.0001). A statistically significant association was found between mothers' body weight and LBW (OR=3.24; 95% CI: 1.99–5.28, p=0.0001) and also between body height and LBW (OR=7.67; 95% CI: 2.83–20.81, p=0.0001).

Male neonates were 47% less likely to be born with LBW relative to their female counterparts (OR=0.53; 95% CI: 0.32–0.87, p=0.012). Neonates with APGAR score <7 were around 12 times (OR=11.65; 95% CI: 1.58–3.33, p=0.0001) to be born with LBW than those with an APGAR score ≥7. Mothers whose duration of pregnancy was <37 weeks were around 14 times more likely to deliver LBW neonates in comparison to neonates born at ≥37 weeks of pregnancy (OR=13.8; 95% CI: 6.73–28.24, p=0.0001).

Multivariable analysis on factors affecting LBW

As shown in Table 3, mothers who delivered male neonates were 44% less likely to deliver LBW neonates than mothers who delivered female neonates (AOR=0.56; 95% CI: 0.32–0.98, p=0.043). The odds of delivering LBW infant for mothers who attended an ANC clinic <4 times during their current pregnancy and for a primigravida mother were 1.87 (95% CI: 1.03–3.39, p=0.041) and 2.58 (95% CI: 1.47–4.51, p=0.001) times, respectively, compared to women who attended an ANC clinic ≥4 times and multigravida women. It was also revealed that practising modern FP methods before the current pregnancy had a protective effect towards delivering LBW neonate (AOR=0.27; 95% CI: 0.09–0.78, p=0.016).

Maternal anthropometric measurements showed a statistically significant association with LBW. Mothers with postpartum body weight <50 kg were 2.7 times more likely to deliver LBW neonates than the mothers with body weight ≥50 kg (AOR=2.67; 95% CI: 1.53–4.65, p=0.001). Similarly, mothers with body height <1.5 m were 7.4 times more likely to deliver LBW compared to mothers with ≥1.5 m body height (OR=7.40; 95% CI: 2.50–21.85, p=0.0001) (Table 3).

The odds of delivering LBW neonate for mothers who had illnesses during their current pregnancy was around 2.5

Table 3. Distribution of determinants for LBW, a cross-sectional analytical study, Asmara maternity hospitals, 2018 (N=806)

Variables	AOR[a]	95% CI		p
		Lower	Upper	
Sex of the neonate				
Male	0.56	0.32	0.98	0.04
Female ®	1			
Number of ANC visits				
<4	1.87	1.03	3.39	0.04
≥4 ®	1			
Gravidity				
Primigravida	2.58	1.47	4.51	0.001
Multigravida ®	1			
Practised modern FP methods				
Yes	0.27	0.09	0.78	0.016
No ®	1			
Illnesses during pregnancy				
Yes	2.51	1.26	5.00	0.009
No ®	1			
Body weight (kg)				
<50	2.67	1.53	4.65	0.001
≥50 ®	1			
Body height (m)				
<1.50	7.40	2.50	21.85	0.0001
≥1.50 ®	1			
Duration of pregnancy (weeks)				
<37	11.15	4.93	25.24	0.0001
≥37 ®	1			
Paternal employment status				
Employed	0.33	0.13	0.84	0.021
Unemployed ®	1			
Other	0.12	0.01	1.1	0.060

a Multivariable logistic regression analysis. AOR: adjusted odds ratio. ® Reference categories. LBW: low birth weight. FP: family planning.

times (OR=2.51; 95% CI: 1.26–5.00, p=0.009) more likely than those who did not report any illnesses. Being a preterm was also found to be significantly associated with LBW (OR=11.15; 95% CI: 4.93–25.24, p=0.0001). Mothers whose partners were employed were almost 67% less likely to have LBW neonates than mothers with unemployed partners; this association was statistically significant (OR=0.32; 95% CI: 0.13–0.84, p=0.021). However, the association between neonates born with a father whose employment status was categorized under 'other' (mostly partners living abroad) and LBW was not statistically significant (Table 3).

DISCUSSION

Consistent with the previous studies conducted in Nigeria[15], Kenya[16], Ethiopia[17,18], and Algeria[19], this current study shows mothers who delivered male neonates were less likely to deliver one with LBW compared to mothers who delivered female neonates. However, this result was not consistent with the study in Gambia[20]. This inconsistency may be due to the study design, the sample size, or due to an unknown biological mechanism by which the sex of the fetus influences pregnancy.

In agreement with previous studies[17,21], the odds of delivering an LBW neonate were higher in a primigravida woman than in a multigravida woman. This can be explained, as discussed by Bernabe et al.[7], that the first pregnancy can be considered as an event where the uterine structure matures, which results in more negative birth outcomes, one of which is LBW. However, except for pregnancies greater than four, subsequent pregnancies will be with NBW.

In agreement to earlier studies in Brazil[21], Nepal[22] and Ethiopia[18], mothers who attended ANC clinic <4 times during their current pregnancy had a higher risk of delivering LBW neonates than those who attended ANC clinics more frequently. The effect of the frequency of ANC visits on LBW can be explained by the fact that women who attended the health facility more frequently might have been diagnosed early for pregnancy-related health problems and consequently received timely and appropriate medical management, nutritional counseling, and other health promotional interventions that could have had a positive impact on birth weight.

Similar to ANC service utilization, access to modern family planning methods could have a positive effect on fetal–maternal wellbeing by increasing the inter-pregnancy interval. Unlike the study by Ghebremedhin et al.[23] in Northern Ethiopia, mothers who ever used modern birth spacing methods prior to their current pregnancy were 73% less likely to have LBW compared to non-users.

Earlier studies on LBW demonstrated an association between maternal illnesses during pregnancy and LBW[23-26]. In our current study, mothers who had experienced illness during their recent pregnancy were also prone to have LBW neonates. Taking into consideration that ANC coverage was very high in this city, these health problems might have been left undiagnosed or diagnosed too late, which would have resulted in LBW of neonates.

It has been discussed by Ferraz et al.[21] and Bashar et al.[22] that postpartum body weight may be considered as an estimation for pre-pregnancy body weight. In this study, mothers with a body weight of <50 kg were more likely to deliver LBW babies than women with a body weight ≥50 kg. This finding is supported by similar studies conducted in Brazil[21], Nepal[22] and Pakistan[27]. The LBW attributed to the postpartum body weight of the mother might have occurred as a result of maternal nutritional deficiency that has occurred since childhood.

In contrast to findings in previous studies[23,28,29], maternal height was observed to have a significant association with LBW. Mothers whose recorded body height was <1.5 m were more at risk of giving birth to LBW neonates than their counterparts with body heights of ≥1.5 m, which was consistent with previous studies[22,27,30,31].

Numerous studies[16,17,23,32-34] have revealed the association between the duration of pregnancy in weeks at the time of delivery and LBW. Similar findings were observed in the bivariate analysis of this study in which mothers with duration of pregnancy at delivery <37 weeks were at a higher risk of delivering LBW compared to mothers who deliver at ≥37 weeks of gestation. This association could be explained by the fact that, as delivery time occurs prior the acceptable time, the weight of the infant decreases due to prematurity.

In this study, it was revealed that mothers whose partners were categorized under 'other' employment status (mainly partners living abroad) were less likely to deliver LBW than mothers living with unemployed partners. This finding was supported by results from earlier studies conducted by Fikree and Berenades[27]. It is a well-known that mothers whose partners are employed have more economic power that enables them to purchase the basic necessities they need during their pregnancy. However, the finding from the current study was inconsistent with the results of earlier studies by Demelash et al.[30], Sharma et al.[29], and Bener et al.[34]. These inconsistencies might have occurred as a result of methods used in the classification of paternal employment status and sample size taken.

Mothers with lower socioeconomic status were almost two times at risk of delivering LBW compared to their counterparts with high socioeconomic status. Numerous studies[3,19,33,35,36] that used similar or different methods in determining the effect of socioeconomic status on LBW obtained similar results. The lower socioeconomic status of the subjects might have influenced the outcome of their delivery negatively by possibly depriving them of attendance to maternal health services, besides minimizing their purchasing power for essential food items, which might have resulted in nutritional deficiency that, in turn, could have influenced the birth weight of the neonate negatively.

The risk of delivering a neonate with <7 APGAR score at 1 minute was much higher for a woman who delivered an LBW neonate than for a woman who delivered an NBW. The findings from studies conducted by Ghani et al.[19] and Muchemi et al.[16] are consistent with the findings of our study.

Strengths and limitations

This study was conducted with a relatively larger sample size, and the data collection was conducted by experienced healthcare professionals, which could be considered as strengths of this study. However, the study has some limitations. The first limitation is that since this study was conducted in health facilities, women who delivered at hospitals might have some characteristics that might be dissimilar from those of women who delivered at home, and hence, bias might have been introduced. The second limitation is the selected hospitals for the study. The three of the selected hospitals were national and regional referral hospitals, and women who came to these hospitals for delivery might have had some complications that might have influenced the results. Despite its limitations, we believe that this study made a significant contribution to the determination of the associated factors with LBW in Asmara, Eritrea.

CONCLUSIONS

The study has found nine variables independently associated with LBW in the final model. Except for the sex of the neonate, all other variables could be considered modifiable. These variables are closely related to health facility utilization, and nutritional and environmental factors that could be altered through short, medium, and long-term interventions.

It is therefore recommended that comprehensive and coordinated healthcare policies and measures to address these issues be taken to increase birth weight. The policies and measures should facilitate healthcare professionals to screen pregnant mothers for risk of LBW and to provide appropriate healthcare service through preventive, curative, and promotive health services.

REFERENCES

1. World Health Organization. International statistical classification of diseases and related health problems.10th Revision.5th Edition. WHO; 2016. Accessed December 23, 2023 https://icd.who.int/browse10/2016/en
2. Park K. Park's Textbook of Preventive and Social Medicine. 20th edition. Banarsidas Bhanot; 2009. Accessed December 23, 2023. https://milonm28.files.wordpress.com/2017/08/parks-preventive-social-medicine-23rd-ed.pdf
3. Roy S, Motghare DD, Ferreira AM, Vaz FS, Kulkarni MS. Maternal determinants of low birth weight at a tertiary care hospital. The Journal of Family Welfare. June 2009;55(1):79-82.
4. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. Bull World Health Organ. 1987;65(5):663-737.
5. Yadav H, Lee N. Maternal factors in predicting low birth weight babies. Med J Malaysia. 2013;68(1):44-47.
6. World Health Organization. Low Birth weight: country, regional and global estimates. WHO; 2004. Accessed December 23, 2023. https://www.who.int/publications/i/item/9280638327
7. Valero De Bernabé J, Soriano T, Albaladejo R, et al. Risk factors for low birth weight: a review. Eur J Obstet Gynecol Reprod Biol. 2004;116(1):3-15. doi:10.1016/j.ejogrb.2004.03.007
8. Committee to Study the Prevention of Low Birth Weight. Preventing Low Birth weight :Summary.Washington, DC: National Academy Press; 1985. Accessed December 23, 2023. https://nap.nationalacademies.org/read/512/chapter/2
9. Ministry of Health. Annual(2014) health service activity report MOH, HMIS, 2015. Accessed December 23, 2023. https://main.mohfw.gov.in/sites/default/files/5658789632541236.pdf
10. National Statistics Office. Demographic and Health Survey 1995. National Statistics Office; 1995. Accessed December 23, 2023. https://dhsprogram.com/pubs/pdf/FR80/FR80.pdf
11. The DHS Program. Demographic and Health Survey 2002. National Statistics and Evaluation Office and ORC Macro; 2003. Accessed December 23, 2023. https://dhsprogram.com/publications/publication-fr137-dhs-final-reports.cfm
12. Word Health Organization. Eritrea: population and health survey 2010. WHO; 2010. Accessed December 23, 2023. https://www.afro.who.int/publications/eritrea-population-and-health-survey-2010
13. UNICEF Statistics. UNICEF; 2021. Accessed December 23, 2023. https://www.unicef.org/media/116271/file/Eritrea-2021-COAR.pdf
14. Conroy RM. The RCSI Sample size handbook: a rough guide. May 2016 version. Accessed December 23, 2023. https://www.researchgate.net/profile/Ronan-Conroy/post/How-to-determine-sample-size2/attachment/5ad32dc14cde260d15d8dfa2/AS%3A615630885621761%401523789249864/download/Sample+size+2016.pdf
15. Olusanya BO, Ofovwe GE. Predictors of preterm births and low birthweight in an inner-city hospital in sub-Saharan Africa. Matern Child Health J. 2010;14(6):978-986. doi:10.1007/s10995-009-0528-4
16. Muchemi OM, Echoka E, Makokha A. Factors associated with low birth weight among neonates born at Olkalou District Hospital, Central Region, Kenya. Pan Afr Med J. 2015;20:108. doi:10.11604/pamj.2015.20.108.4831
17. Zeleke BM, Zelalem M, Mohammed N. Incidence and correlates of low birth weight at a referral hospital in Northwest Ethiopia. Pan Afr Med J. 2012;12:4.
18. Teclehaimanot N, Hailu T, Assefa H. Prevalence and factors associated with low birth weight in Axum and Laelay Maichew Districts, North Ethiopia: a comparative cross sectional study. International Journal of Nutrition and Food Sciences. 2014;3(6):560-566. doi:10.11648/j.ijnfs.20140306.21
19. Ghani AEA, Mai H, Demmouche A. Epidemiology of low birth weight in the town of Sidi Bel Abbes (West of Algeria): a case-control study. J Nutr Food Sci. 2014;4(278). Available from: doi:10.4172/2155-9600.1000278
20. Jammeh A, Sundby J, Vangen S. Maternal and obstetric risk factors for low birth weight and preterm birth in rural Gambia: a hospital-based study of 1579 deliveries. Journal of Obstetrics and Gynecology. 2011;1:94-103. Available from: doi:10.4236/ojog.2011.13017
21. Ferraz EM, Gray RH, Cunha TM. Determinants of preterm delivery and intrauterine growth retardation in north-east Brazil. Int J Epidemiol. 1990;19(1):101-108. doi:10.1093/ije/19.1.101
22. Bhaskar RK, Deo KK, Neupane U, et al. A case control study on risk factors associated with low birth weight babies in Eastern Nepal. Int J Pediatr. 2015;2015:807373. doi:10.1155/2015/807373
23. Gebremedhin M, Ambaw F, Admassu E, Berhane H. Maternal associated factors of low birth weight: a hospital based cross-sectional mixed study in Tigray, Northern Ethiopia. BMC Pregnancy Childbirth. 2015;15:222. doi:10.1186/s12884-015-0658-1
24. Goldenberg RL, Culhane JF. Low birth weight in the United States. Am J Clin Nutr. 2007;85(2):584S-590S. doi:10.1093/ajcn/85.2.584S

25. Maheswari K, Behera N. Maternal risk factors and outcome of low birth weight babies admitted to a tertiary care teaching hospital. Curr Pediatr Res. 2014;18(2):69-72.
26. Metgud CS, Naik VA, Mallapur MD. Factors affecting birth weight of a newborn--a community based study in rural Karnataka, India. PLoS One. 2012;7(7):e40040. doi:10.1371/journal.pone.0040040
27. Fikree FF, Berendes HW. Risk factors for term intrauterine growth retardation: a community-based study in Karachi. Bull World Health Organ. 1994;72(4):581-587.
28. Badshah S, Mason L, McKelvie K, Payne R, Lisboa PJ. Risk factors for low birthweight in the public-hospitals at Peshawar, NWFP-Pakistan. BMC Public Health. 2008;8:197. doi:10.1186/1471-2458-8-197
29. Sharma SR, Giri S, Timalsina U, et al. Low birth weight at term and its determinants in a tertiary hospital of Nepal: a case-control study. PLoS One. 2015;10(4):e0123962. doi:10.1371/journal.pone.0123962
30. Demelash H, Motbainor A, Nigatu D, Gashaw K, Melese A. Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia : a case-control study. BMC Pregnancy Childbirth. 2015;15:264. doi:10.1186/s12884-015-0677-y
31. Elshibly EM SG. The effect of maternal anthropometric characteristics and social factors on gestational age and birth weight in Sudanese newborn infants.BMC Public Health.2008;8(244). doi:10.1186/471-2458-8-244
32. Chen XK ,Wen SW,Fleming N,Demssie K,Rhoads GG,Walker M. Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. International Journal of Epidemiology.2007;36:368–373. doi:10.1093/ije/dyl284
33. Raghunath D, Kujur A, Dixit S, Seema S, Yadav S, Saroshe S. Multivariate analysis of the factors affecting low birth weight-a case-control study in a tertiary hospital of central India. Annals of Community Health (AoCH). 2016;4(3):18.
34. Bener A, Salameh KMK, Yousafazai MT, Saleh NM. Pattern of maternal complications and low birth weight: associated risk factors among highly endogamous women. International Scholarly Research Network (ISRN) Obstetrics and Gynecology. 2012. doi:10.5402/2012/540495
35. Barua A, Hazarika J, Dutta S. Correlates of low birth weight: a hospital-based study from Gangtok, India. Glob Pediatr Health. 2014;1:2333794X14562229. doi:10.1177/2333794X14562229
36 Spencer N, Bambang S, Logan S, Gill L. Socioeconomic status and birth weight: comparison of an area-based measure with the Registrar General's social class. J Epidemiol Community Health. 1999;53(8):495-498. doi:10.1136/jech.53.8.495

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DATA AVAILABILITY
The data supporting this research are available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS
ZA designed the study, prepared the data collection material, supervised the data collection process, analyzed the results, and prepared the manuscript. SK and GG participated in the proposal development and manuscript writing. ET and GA participated in the preparation of data collection material, supervised the data collection process, and participated in manuscript writing. All authors read and approved the final manuscript.

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