Determinants of Low Birth Weight Infants in Mekelle Zone, Tigray Region, Northern Ethiopia- Case-Control study

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Research

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Abstract

Background : Low Birth Weight is a public health problem in Ethiopian. This study aimed to identify its determinant factors in Mekelle Zone, northern Ethiopia.

Methods : Case control study design was employed on randomly selected 464 newborn. Baby measuring scale was used to weighing the newborn. Multivariable logistic regression was performed to identify the determinants factors, P < 0.05 and 95 % confidence level by using SPSS version 20 statistical software.

Results : Maternal age <20 years (AOR = 2.9, 95 % CI: 1.55, 5.47), income < 2500 Ethiopian birr (AOR = 3.5, (95 % CI: 1.57, 7.95), gestation < 37 weeks (AOR= 4, 95% CI: 2.18, 7.29), hypertension (AOR= 2.6, 95% CI: 1.15, 6.07), anemia (AOR= 3.2, 95% CI: 1.70, 6.17), didn't consume milk/week (AOR= 2.3, 95% CI: 1.02, 5.35), low dietary diversity (AOR = 2.8, 95% CI: 1.22, 6.19), MUAC < 23 cm (AOR = 2.1, 95% CI: 1.14, 4.04) were the identified determinants factors for low birth weight.

Conclusions : Maternal age, income, history of hypertension and anemia, milk consumption, dietary diversity and maternal MUAC were the determinants Therefore, employing multisectoral coordinated intervention is essential to ending low birth weight.

Background

Low Birth Weight (LBW), defined as a weight at birth less than 2.5 kg, remains as a public health problem in Ethiopia (1-4). More than 20 million LBW infants are born in each year globally. From these Asia and Africa hosted the grater majority; stands at 50 % and 22 %, respectively (3). In Ethiopia, the estimate of LBW prevalence is 14 %, however, in northeast part of the country it is around 40 %, which is four times greater than the WHO trigger level cut off pointes (2, 5). The prevalence would be worth bigger than these estimation's in Ethiopia, including the study area because, majority (85%) of women delivered at home that their new born are not weighed so then (6-8).

Evidence showed that being born with a LBW is a disadvantage for the infant. Babies weighing less than 2.5 kg were approximately 20 times more likely to be dying than their heavier counterparts (1). LBW infants are at higher risk of early growth retardation, infectious disease, developmental delay and death during infancy and childhood (9-11).

LBW has also association with long term consequences. Risk of chronic diseases such as high blood pressure, non-insulin dependent diabetes mellitus, coronary heart disease and stroke can increase for adults who born with LBW (12). Prevalence of cerebral palsy, hearing loss and visual impairment disorder are higher among adults born with LBW than none LBW (13). Moreover, LBW has association with low

schooling performance during childhood and adolescence, and with lower psychological and intellectual performance during adulthood (14).

Birth weight is a good summary measure of multifaceted public health problems that include long-term maternal malnutrition, ill health, and poor health care during pregnancy. This is a general senior of the current Ethiopia. Despite Ethiopia's great progress and improvement in health and nutrition over the past 30 years, poor health and nutrition in infant and child remains a persistent challenge (18, 19). There is a high rate of infant and child morbidity and mortality due to preventable causes like LBW; for instance, 1 in 15 children in Ethiopia dies before reaching age 5, and 7 in 10 of the deaths occur during infancy (5, 17). In addition, LBW has also economic burden that Ethiopia has financing around 572 Billon Birr in each year for LBW related health care (16).

Improving newborn and child health and nutrition is the top priority. As indicated in Health Sector Transformation Plan (HSDP), Ethiopia plans to end preventable child deaths by 2030. The targets set in the HSTP are in line with the global aspirations (17-18). However, by the current trend of improvement reduction Ethiopia will not achieve the target goals, unless employing aggressive, locally specific evidenced based interventions. Since, determinant factors for LBW differ across areas depending upon socio-demographic, socio-economic and cultural related characteristics of community (19).

In Ethiopia, employing evidence based intervention is necessary but not enough to tackle LBW in effective and efficient way. Customize the intervention to the local root causes is essential. Thus, this study aimed to identify determinants of LBW newborns in Mekelle Zone, Tigray region, northern Ethiopia, which is valuable for strategically addressing LBW in the study area.

Methods

Study Setting and Period: This study was conducted in Mekelle Zone, Tigray region, located 780 kilometers in north of Addis Ababa, the capital of Ethiopia. Mekelle zone has 7 sub cities with estimated population of 313, 975 (160,127 were males the rest 153,848 were females) people. Among females, 73,721 (48%) are in the reproductive age range (15-49 years). The estimated fertility rate of the study zone is 3.1% (20). Data collection was done from February- June, 2016.

Study Design and Population: Facility based unmatched case control study design was employed. Source population of the study was all registered live births that were born in all health facilities of Mekelle Zone, whereas, the study population was all registered live births that were born in the selected health facility. Mothers of the live birth were sources for information. The study included all singleton live births, but excluded those live births had having congenital anomalies and twin births.

Sampling Size Determination: Epi-Info 3.03.17 statistical software package was used to calculate the sample size. The assumptions taken were; 95 % confidence level ($Z\alpha/2 = 1.96$), 80 % power ($Z\beta = 0.84$) and case to control ratio of 1:3 ($r = 3$), the odds ratio 2 and the control group exposed (P_0) was 17 % for maternal age (21) and P_1 = exposed cases group

$$P_1 = \frac{P_0 \times OR}{1 + P_0 (OR-1)}$$

$$P = \frac{P_0 + rP_1}{r+1}$$

The formula was = $\frac{(r+1)\, pq\, (Z\alpha/2 + Z_\beta)^2}{r\,(P_1 - P_0)^2}$

The final sample size was 464 (116 cases and 348 controls).

Sampling Technique: Eighteen health facilities were found and giving delivery services in Mekelle Zone, twelve of them were taken randomly for this study. Population Proportion to Size (PPS) was used to allocate the calculated sample size in the selected health facilities. All live births that fulfill the inclusion criteria were recruited consecutively until getting the required sample (116 cases and 348 controls) in the selecting health facilities. Still births and twin births had excluded then used to replace by the next live births.

Data Collection Procedure, Instrument and Quality Improvement: Interviewer administered semi-structured questionnaire was used to collect socio-demographic, economic and health care and morbidity related information of study subjects. Single day 24 hour Women Dietary Diversity Scores (WDDS) and 7 days Food Frequency Questionnaire (FFQ) were used to assess dietary intake of mothers. WDDS has calculated; all foods and liquids consumed by the mother a day before the study was categorized into 9 food groups, then categorized as low (≤3), medium (4 - 6) and high (7-9) (22). Mid Upper Arm Circumference (MUAC) measuring tape was used to screen maternal nutritional status and value less than 23 cm were considered for undernourishment (23). Seca 354 baby scale was used for weighed the new born. To improve data quality; the questionnaire was translated to the local language Tigregna, data collectors and supervisors were trained on the overall data collection procedure, the detail MUAC and weight measure process, the questionnaire was pre-tested before the actual data collection, on spot checking of the data collection procedure was done, and the completeness of the questionnaire was checked every day and the overall data collection procedure was controlled by the principal investigators.

Data Analysis and Statistical Analysis: The questionnaire was coded and entered to Epi Data version 3.1, then transfers to SPSS version 20.0 software for analysis. Birth weight variable was dichotomized into

1=low birth weight (cases) and 0= normal birth weight (controls). Bivariate logistic regression was performed and variables with P < 0.25 were transported to multivariable logistic regression to identify determinants of low birth weight among newborns. Variables with P < 0.05 in multivariable logistic regression were taken as statistically significant and adjusted odds ratio with its 95% confidence interval was considered to see the association. Multi-collinearity test was done using variance inflation factor (VIF) to see the correlation between independent variables and no collinearity exists between them. Model goodness of the test was checked by Hosmer- Lemeshow goodness of the fit 0.72.

Ethical Clearance: Ethical clearance has obtained from the Ethical Review Committees of College of Health Sciences, Mekelle University. Support letter that was written by Mekelle University has used to communicate Tigray region health bureau, and similarly to all selected health facilities. Purpose, benefit and risk of the study have explained for each study participants then verbal consent was obtained before conduct the interview. Participates were involved voluntary and they have had the right to decline any time of the interviewing, if they not confortable. The data collection procedure was anonymous for keeping the confidentiality of the information.

Results

Socio-Demographic and Economic Characteristics

A total of 464 (116 cases and 348 controls) new born babies with their mothers were included for the study, which is 100 % response rate. Mother's age ranges 17- 48 years. Majority of mothers, 98 (84.5 %) of the cases and 278 (79.9%) of the control's were Orthodox Christian in religion. Regarding maternal marital states, 320 (92%) of control and 93 (80.2) of case were married. Educational levels of mothers, 22(19%) of cases and 38 (10.9%) of controls were illiterate (Table-1).

Health Care and Morbidity Related Characteristics

About, 90 (77.6%) among mothers of cases and 306 (87.9%) among mothers of controls reported their current pregnancy was planned. During pregnancy, 45(38.8%) among mothers of cases and 89(25.6%) mothers of controls had attended < 4 antenatal visits. Similarly, majority, 297(85.3%) mothers of controls and 82(70.7%) mothers of cases were supplemented iron folic acid. Around one third, 38(32.8%) among mothers of cases and 39 (11.2%) among mother of controls have had less than 37 weeks of gestational age. Hypertension during pregnancy, 15(12.9%) among mothers of cases and 23(6.6%) among mothers of controls were suffered. One fourth, 29(25%) among mothers of cases and 38(10.9) among mothers of controls have had anemia. Only, 7(6%) among mothers of cases and 14(4%) among mother of controls were diagnosed diabetics mellitus during their pregnancy (Table-2).

Dietary Practice and Nutritional Status of Mothers

All study participant mothers reported that they consume starches stable foods in daily bases. Dark Green Leafy Vegetables (DGLV), 21(18.10%) among mothers of cases and 95 (27.3%) among mothers of controls were consume 3-4 times/week. About, 10 (8.6%) among mothers of cases and 54(15.5%) among mothers of the controls were drank milk daily. Per 24 hr. dietary diversity score (DDS) showed that 42(36.2%) among mothers of cases and 84 (24.1%) among mothers of controls had low DDS whereas, 12(10.3%) among mothers of cases and 68(19.5%) among mothers of controls had high DDS. Maternal under nutrition status, 31(26.7%) among mothers of cases and 40 (11.5%) among mothers of controls were had MUAC < 23 cm (under nourished) (Table-3).

Determinants of Low birth weight

The result showed that odds of mothers in the age of 20 years and below were around 3 times higher to deliver LBW than those mothers in the age group of 21–35 years (AOR = 2.9, 95 % CI: 1.55, 5.47). The odds of mothers having monthly income less than 2500 Ethiopian Birr (ETB) were 3.5 times higher to deliver LBW as compared to mothers with monthly income of greater than six thousand (AOR = 3.5, (95 % CI: 1.57, 7.95). The odds of mothers with monthly income within 2501-4000 ETB were over 2.5 times higher to deliver LBW newborns as compared to mothers with monthly income of greater than six thousand (AOR = 2.6, (95 % CI: 1.10, 5.92). The odds of mothers who had less than thirty seven weeks of gestation were 4 times higher to deliver LBW than those who had thirty seven and above gestational age (AOR= 4, 95% CI: 2.18, 7.29) (Table-4).

Discussion

Newborn LBW is a public health problem in developing nations including Ethiopia, as well the study area (1-2,6-8). The condition has multiple short and long term adverse consequences; increased risk of morbidity and mortality immediately after birth and in early childhood, impaired cognitive and physical development of children's, and decrease work productivity of adults in later life (1). Preventing and controlling of LBW is therefore, the way forward to have healthy and productive future generation in Ethiopia. It is imperative to explore its determinant factors in various region or areas of the country for the employment of context specific aggressive intervention for stunning reduction of LBW. By this study; maternal age, family monthly income, gestational age, maternal hypertension, maternal anemia, dark green leafy vegetables intake, milk and milk products intake, WDDS and MUAC were the identified determinant factors that attributed to LBW newborn.

Maternal age; the odds of mothers in the age group of less than 20 years were around three times higher to deliver LBW newborns than those mothers in the age group of 21–35 years, which is in-line with study done in Tigray region, northern Ethiopia, 3.08 times, Bale zone, southern Ethiopia, 3.1 times, and India, 2.10 times, higher to give LBW newborn (21, 24 and 25). A systematic review meta-analysis also supported this funding, that is girl's pregnancy younger than 19 years have 50 % increased risk of giving LBW newborn (26). This situation happened may be due to adolescent pregnancy, which is a special

circumstance that has increased nutrient requirements and thus, in the growing adolescent there is a partition of growth in favor of her and at the cost of fetus. Especially, it is most important and true reason in developing countries, because of the common poor caring practice of maternal nutrition and health.

The odds of mothers with monthly income less than 2500 ETB were 3.5 times higher to deliver LBW newborns as compared to mothers with monthly income of greater than six thousand. The same token, those mothers with monthly income within 2501-4000 ETB were over two and half times higher to deliver LBW newborns as compared to mothers with monthly income of greater than six thousand. The present study agree with findings from India, Laos and Lahore; that was as per capita income of the family per month increases, the occurrence of low birth weight decrease or it was vice versa (27-29). This is due to the economic poverty that a cause for maternal malnutrition and poor health caring practices, which is the condition that can lead's to have LBW newborns (29).

The odds of mothers who had less than thirty seven weeks of gestational age were four times higher to deliver LBW newborn than those who had greater than thirty seven and above. It consistent with studies done in Tigray, northern Ethiopia and Bale zone, south eastern Ethiopia respectively (21, 32) and again, is supported by a research done in Malaysia (30). This could be due do preterm birth or intrauterine growth restriction; both are the commonest causes for the occurrence of LBW newborns.

Maternal medical conditions; the odds of mothers with hypertension during their current pregnancy were two and half times greater to deliver LBW than mothers without hypertension during pregnancy. The condition can lead to a LBW for the baby or premature delivery which poses additional health risks to the child (1), and it supported that hypertensive disorders might play a critical role in the incidence of LBW as studies conducted in Malaysia and china indicated (30,31). It is known that hypertension during pregnancy reduces placental blood flow that leads to decreased fetal growth or increased risk of intrauterine growth restriction and finally LBW baby occurred (32).

Another medical condition observed to have association with LBW is anemia; the odds of mothers with history of anemia during their current pregnancy were found to have above three times higher to deliver low birth weight than mothers without history of anemia. The finding agreed with studies carried out in Northern Ethiopia (21) and Nagpur city, Maharashtra (32). Thus, anaemia during gestation is associated with impaired fetal development, preterm delivery and low birth weight (34,35). It is well noted that anemia can be occurred due to deficiency of iron, folic acid, vitamin B_{12} and other essential nutrients, which has negative impact on rapidly growing fetus that leads LBW.

Low consumption of DGLV appeared to have positive relation with low birth weight; the odds of mothers who didn't take DGLV were more than two and half times higher to deliver low birth weight than those who took 3-4 times per week. The study agreed with finding from Iran; that was lower consumption of dark green leafy vegetables was significantly associated with increased risk of delivering low birth weight newborns (36). Beside, milk consumption has also association; the odds of mothers who didn't drink milk were 2.3 times greater to have a risk of delivering low birth weight baby than who took on daily bases.

The finding is consistent with study conducted in Denmark; milk intake during pregnancy was associated with higher birth weight (37), in Canadian; women's low milk intake tended to associated with lower mean birth weight (38) and in rural Ethiopia; the proportion of women consuming dairy, animal-source foods, fruits, and vegetables was higher in mothers who gave normal birth weight newborns than those who gave low birth weight newborns (39).

Similarly, the study showed that the odds of mothers who had less than four dietary diversity score were above two and half times higher to deliver low birth weight than those mothers who had greater than six dietary diversity score. It is agreed with findings from Northern Ghana (39). This is because high dietary diversity score is a proxy indictor of likely to have micronutrient adequacy. Thus, low dietary diversity can associated with micronutrients inadequacy like iron, zinc vitamin A and others that lead to occurred low birth weight newborns.

Maternal nutrition states significantly associated with low birth weight delivery; the odds of delivering low birth weight newborns among mothers who had less than twenty three centimeters (cm) were two times higher than the odds of mothers who twenty three and above. The present result was similar with findings from Ethiopia, India, Canada and Brazil (23, 41-43). This is the reason that maternal nutrition before and during pregnancy is the essential determinate factor for birth weights. Embryo and the fetus receive all their required nutrients directly from the mother; good maternal nutrition is therefore imperative for optimal prenatal development and growth (44).

Conclusion And Recommendations

This study revealed that maternal age, family monthly income, gestational age, hypertension, anemia, dark green leafy vegetables, milk and milk products, WDDS and MUAC were determinant factors for low birth weight in area. Multi-sectors collaborated intervention in particular, health, agriculture, and finance and educational sector should work together to tackle low Birth weight in the study zone.

Abbreviations

AOR: Adjusted Odd Ratio; COR; Crud Odd ratio; DGLV: Dark Green Leafy Vegetables; ETB: Ethiopian Birr; FFQ: Food Frequency Questionnaire; HSDP: Health Sector Transformation Plan of Ethiopia; LBW: Low Birth Weight; MUAC: Mid Upper Arm Circumference; WDDS: Women Dietary Diversity Scores; WHO: World Health Organization; VIF: Variance Inflation Factor.

Declarations

Ethics approval and consent to participate: Included in the document and the paper obtained from the Ethical Review Committees of College of Health Sciences, Mekelle University has attached in also.

Consent for publication: Not applicable because the manuscript does not include details, images, or videos relating to individual participants.

Availability of data and materials: All the required data has been included in the paper. If further is required, you can communicate me though my email,seoumer@yhoo.com.

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Author Contributions: All authors have been participated to conceive the study, collected and analyzed the data, wrote the first draft of the manuscript to final.

Competing interests: The authors declare that they have no competing interest.

Supporting information: S1file. Questionnaire for data collection. (Word document)

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Tables

Table 1: Socio Demographic and Economic characteristics of study participant's, Mekelle Zone, Tigray, Northern Ethiopia, February to June 2016 (N=464)

Variables		Birth weight			
		Cases (N=116)		Controls (N=348)	
		Frequency	Percent	Frequency	Percent
Age in year	≤20	32	27.6	38	10.9
	21-34	70	60.3	260	74.7
	≥35	14	12.1	50	14.4
Religion	Orthodox	98	84.5	278	79.9
	Others*	18	15.5	70	20.1
Marital statues	Married	93	80.2	320	92.0
	Separated	23	19.8	28	8.0
Educational levels	Illiterate	22	19.0	38	10.9
	Primary	15	12.9	40	11.5
	Secondary	20	17.2	69	19.8
	≥ High school	59	50.9	201	57.8
Occupation	House wife	62	53.4	172	49.4
	Daily laborer	17	14.7	28	8.0
	Merchant	21	18.1	81	23.3
	Employed	16	13.8	67	19.3
Husband education	Illiterate	20	17.2	52	14.9
	Primary	8	6.9	31	8.9
	Secondary	18	15.5	50	14.4
	≥ High school	70	60.3	215	61.8
Husband occupation	Employed	56	48.3	166	47.7
	Merchant	27	23.3	97	27.9
	Daily labor	33	28.4	85	24.4
Family size	≤3	50	43.1	160	46
	4-5	38	32.8	129	37.1
	>5	28	24.1	59	17

Monthly income in Ethiopian Birr	≤2500	54	46.6	100	28.7
	2501-4000	35	30.2	92	26.4
	4001-6000	15	12.9	76	21.8
	>6000	12	10.3	80	23

Others Muslim, catholic and protestant together*

Table 2: Health care and Morbidity Related Characteristics of Study Participants in Mekelle zone, Tigray, Northern Ethiopia, February to June 2016 (N=464)

Variables		Birth weight			
		Cases (N=116)		Controls (N=348)	
		Frequency	Percent	Frequency	Percent
Plan to current pregnancy	Yes	90	77.6	306	87.9
	No	26	22.4	42	12.1
Number of ANC	<4	45	38.8	89	25.6
	≥4	71	61.2	259	74.4
Iron folic acid(IFA)	Yes	82	70.7	297	85.3
	No	34	29.3	51	14.7
Gestational age	<37	38	32.80	39	11.20
	≥37	78	67.20	309	88.80
Birth interval	< 3	62	53.4	165	47.4
	≥ 3	54	46.6	183	52.6
Hypertension**	Yes	15	12.9	23	6.6
	No	101	87.1	325	93.4
Diabetes mellitus**	Yes	7	6	14	4
	No	109	94	334	96
Anemia	Yes	29	25	38	10.9
	No	87	75	310	89.1
Vaginal bleeding	Yes	8	6.9	15	4.3
	No	108	93.1	333	95.7

***Hypertension: includes chronic hypertension, gestational hypertension, pre-eclampsia and eclampsia.*

*** Diabetes mellitus (DM) ; includes pregnancy related and chronic diabetics*

Table 3: Dietary Habit and Nutritional Status of Study Participant's Mekelle zone, Tigray, Northern Ethiopia, February to June 2016 (N=464)

Variables		Birth weight			
		Cases (N=116)		Controls (N=348)	
		Frequency	Percent	Frequency	Percent
Vitamin A rich fruits and vegetables	3-4 times/week	24	20.7	98	28.2
	Weekly	70	60.3	193	55.5
	Never	22	19.0	57	16.4
Dark green leafy vegetables	3-4 times/week	21	18.1	95	27.3
	Weekly	60	51.7	202	58.0
	Never	35	30.2	51	14.7
Other fruits and vegetables	3-4 times/week	34	29.3	114	32.8
	Weekly	63	54.3	181	52.0
	Never	19	16.4	53	15.2
Red meat	3-4 times/week	13	11.2	57	16.4
	Weekly	44	37.9	140	40.2
	Never	59	50.9	151	43.4
Egg	3-4 times/week	11	9.5	46	13.2
	Weekly	40	34.5	134	38.5
	Never	65	56	168	48.3
Organ meat	Weekly	8	6.9	19	5.5
	Never	108	93.1	329	94.5
Legumes	Daily	11	9.5	25	7.2
	3-4 times/week	74	63.8	209	60.1
	Weekly	31	26.7	114	32.8
Milk and milk products	Daily	10	8.6	58	16.7

	3-4 times/week	18	15.5	82	23.6
	Weekly	23	19.8	101	29.0
	Never	65	56.0	107	30.7
Fats and oils	Daily	116	100	345	99.1
	3-4 times/week	0	0.0	3	0.9
W-DDS	Low	42	36.2	84	24.1
	Medium	62	53.4	196	56.3
	Adequate	12	10.3	68	19.5
MUAC	<23 cm	31	26.7	40	11.5
	≥23 cm	85	73.3	308	88.5

Table 4: **Determinants of low birth weight among new born of Mekelle Zone, Tigray region, Northern, Ethiopia,**

February to June 2016 (N=464)

Variables		Birth weight			
		Cases	Controls	COR(95% CI)	AOR(95% CI)
Age	≤20	32(27.6)	38(10.9)	3.1(1.82, 5.36)***	2.9(1.55, 5.47)**
	21-34	70(60.3)	260(74.7)	1	1
	≥35	14(12.1)	50(14.4)	1(0.54, 1.99)	0.9(0.45, 1.94)
Marital statues	Live together	93(80.2)	320(92.0)	1	
	Not live together	23(19.8)	28(8.0)	2.8(1.55, 5.14)***	
Educational levels	Illiterate	22(19.0)	38(10.9)	2.0(1.08, 3.59)*	
	Primary	15(12.9)	40(11.5)	1.3(0.66, 2.47)	
	Secondary	20(17.2)	69(19.8)	1.0(0.56, 1.76)	
	≥ High school	59(50.9)	201(57.8)	1	
Occupation	House wife	62(53.4)	172(49.4)	1.5(0.81, 2.80)	
	Daily labor	17(14.7)	28(8)	2.5(1.13, 5.73)*	
	Merchant	21(18.1)	81(23.3)	1.1(0.53, 2.24)	
	Employed	16(13.8)	67(19.3)	1	
Family size	≤3	50(43.1	160(46.0	1	

		)	)		
	4-5	38(32.8)	129(37.1)	0.9(0.58, 1.53)	
	>5	28(24.1)	59(17.0)	1.5(0.88, 2.63)	
Monthly income	≤2500	54(46.6)	100(28.7)	3.5(1.57, 7.95)**	3.5(1.57, 7.95)**
	2501-4000	35(30.2)	92(26.4)	2.6(1.10, 5.92)*	2.6(1.10, 5.92)*
	4001-6000	15(12.9)	76(21.8)	1.2(0.47, 3.03)	1.2(0.47, 3.03)
	>6000	12(10.3)	80(23)	1	1
Plan to current pregnancy	Yes	90(77.6)	306(87.9)	1	
	No	26(22.4)	42(12.1)	2.1(1.22, 3.62)**	
Number of ANC	>4	45(38.8)	89(25.6)	1.8(1.18, 2.88)**	
	≥4	71(61.2)	259(74.4)	1	
Iron folic acid(IFA)	Yes	82(70.7,)	297(85.3)	1	1
	No	34(29.3)	51(14.7)	2.4(1.47, 3.97)***	
Gestational age	<37	38(32.8)	39(11.2)	3.9(2.32, 6.44)***	4.0(2.18, 7.29)***
	≥37	78(67.2)	309(88.8)	1	1
Hypertension	Yes	15(12.9	23(6.6)	2.1(1.05,	2.6(1.15,

		)		4.17)*	6.07)*
	No	101(87.1)	325(93.4)	1	1
Anemia	Yes	29(25)	38(10.9)	2.7(1.59, 4.66)***	3.2(1.70, 6.17)***
	No	87(75)	310(89.1)	1	1
Dark green leafy vegetables	3-4 times/w	21(18.1)	95(27.3)	1	1
	Weekly	60(51.7)	202(58)	1.3(0.77, 2.34)	1.2(0.65, 2.35)
	Never	35(30.2)	51(14.7)	3.1(1.64, 5.88)***	2.7(1.26, 5.82)*
Milk and milk products	Daily	10(8.6)	58(16.7)	1	1
	3-4 times/w	18(15.5)	82(23.6)	1.3(0.55, 2.96)	1.2(0.47, 3.17)
	Weekly	23(19.8)	101(29)	1.3(0.59, 2.97)	1.2(0.49, 2.95)
	Never	65(56)	107(30.7)	3.5(1.68, 7.37)***	2.3(1.02, 5.35)*
DDs	Low	42(36.2)	84(24.1)	2.8(1.38, 5.8)**	2.8(1.22, 6.19)*
	Medium	62(53.4)	196(56.3)	1.8(0.91, 3.53)**	1.3(0.61, 2.84)
	High	12(10.3)	68(19.5)	1	1
MUAC	<23	31(26.7)	40(11.5)	2.8(1.66, 4.76)***	2.1(1.14, 4.04)*
	≥23	85(73.3)	308(88.5)	1	1

*COR (Crude Odds Ratio), AOR (Adjusted Odds Ratio); Significant *(P<0.05); strongly ** (P<0.01); very strongly ***(P ≤ 0.001) in bivariate and multivariable analysis*