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Maternal dietary and nutritional characteristics as predictor of newborn birth weight in Jimma Town, Southwest Ethiopia, 2017

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Maternal nutrition plays a major role in influencing fetal growth and birth outcomes. It is a modifiable risk factor which drags a significant public health consideration to avert adverse birth outcomes, specially, in low and middle income countries. Suboptimal dietary and nutritional characteristics and low birth weight are prevalent in the present study setting. This study was conducted to assess the association of maternal dietary and nutritional characteristics and newborn birth weight among pregnant mother who delivered in health institutions. Institution based cross sectional study was conducted among 541 pregnant mothers who delivered in Health Institutions of Jimma Town from March 1st, 2017 to April 30th, 2017. Data were entered into EPI data version 3.1 and analyzed using SPSS for windows, version 20.0; SPSS. Bivariate analysis was used to assess the association between birth weight and list of independent variables and to test significance of the association at p-value <0.25 for multivariable linear regression. Multivariable linear regression model was used to recognize the important predictors by controlling for possible confounding variables and statistical significance was measured at p-value <0.05. Majority of newborns had normal birth weight (91.0%). The mean birth weight of the newborns was 3224.6 ± 438.5 grams while low birth weight was 2%. In Multivariable linear regression analyses, birth weight was found to have increased by 13.5 grams (β=13.5, P=0.04), for every centimeter increment in maternal mid-upper arm circumference (MUAC). Similarly, with each increase in parity of the mother an increase in birth weight increased by 96.81 grams (β=96.81, P=0.01) was observed. Wealth index was also found to have a positive association with birth weight (β=49.04, P=0.01). Maternal MUAC, parity and wealth index were found to have a positive association with birth weight. Intervention directed on nutrition of pregnant mothers through nutrition counseling should be the major priority in addition to economic measure.

Key words: Newborn birth weight, nutritional characteristics, mid-upper arm circumference.

INTRODUCTION

Maternal nutrition plays a key function in influencing fetal growth and birth outcomes. It is a changeable risk factor of public health significance in the effort to avert adverse birth outcomes, mostly among low-income populations (Abu-SaadK and Fraser, 2010). During pregnancy a woman wants good nutritional status for a healthy outcome. Women who have a poor nutritional status at conception are at higher risk of disease and death (World Health Organization (WHO) 2012). Optimal nutrition provided to the developing fetus is critical in achieving

appropriate fetal growth and development (Australian Government Department of Health and Ageing, National Health and Medical Research Council (NHMRC) 2013); Kaiser and Allen, 2002). For instance, a systematic review and meta-analysis of 90 dietary studies among pregnant women in low-income countries reported lower energy and fiber intakes than optimal recommendations (Blumfield et al., 2012a). Essential nutrients together with folic acid, iron, zinc, calcium, vitamin D, and essential fatty acids function to support bone development and brain development (Blumfield et al., 2013). It is obvious that intrauterine fetal growth is the placental supply of nutrients to the fetus reliant upon placental size and blood supply (Fowden and Forhead, 2004). Moreover, studies also have revealed direct relationships between placental size and birth weight (Mellor, 1983). Experimental restriction of placental growth (Thureen et al., 1992; Vatnick et al., 1991), food constraint (Lederman and Rosso, 1980), and low protein diets (Jansson et al., 2006; Rutland et al., 2007) resulted in reduced placental weight and distorted placental efficiency, leading to reduced birth weight and intrauterine growth restriction .

The timing of delivery of nutrients through the placenta is also crucial (Belkacemi et al., 2010). In pregnant sheep, severe under nutrition during the peri-conceptual episode led to preterm delivery Fowden and Forhead, 2004). Studies also indicated reduced the placental: fetal weight ratio (Heasman et al., 1998), undernutrition in early to mid-gestation (Faichney and White, 1987; McCrabb et al., 1991) and undernutrition in late gestation (Mellor and Murray, 1981) as an important factor for fetal and birth outcome. Pre-pregnancy body mass index and gestational weight gain are critical for optimal infant health (Kaiser and Allen, 2008; Yan, 2015). Successful weight gain modifications illustrate assure in dropping the risk of large for gestational age (LGA) which has subsequent risk of overweight, obesity, diabetes mellitus, malignancy, and other disorders afterward in life (Jessica et al., 2015) . The most hopeful results come from dietary pattern analysis, in which consumption of whole foods might be advantageous toward producing an infant of right birth weight (Harder et al., 2007).

Assessment of common practices of food intake during pregnancy informs the direction of preventative practice and interventions benefiting populations of pregnant women and their offspring. As a modifiable factor, dietary patterns may be more applicable to clinical and pregnant health interventions (Xuyang et al., 2016). Being born with low birth weight (LBW) is generally recognized as a disadvantage for the infant, increasing the risk of early growth retardation, fast catch up growth, infectious disease, developmental delay, and death during infancy and childhood (Edmund and Bahl, 2006; Marte et al., 2014; Englund et al., 2014; Okubo et al., 2012;). Earlier publications have shown that dietary practices characterized with nutrient-rich foods were linked with bigger birth size outcomes (Englund et al., 2014; Wolff and Wolff, 1995). This shows that proper dietary pattern during pregnancy is crucial for normal pregnancy outcome.

The present study is therefore anticipated to assess maternal dietary and nutritional characteristics as predictor of newborn birth weight among pregnant mother who delivered in health institutions in Jimma Town, South west Ethiopia.

METHODS AND MATERIALS

Study area and period, the study was conducted in the Oromia Region, Jimma Zone, Jimma Town, on all health institutions from March 1st to April 30th, 2017, which is located at 353 km South-West of Addis Ababa. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia, Jimma town has a total population of 120,960, of whom 60,824 are men and 60,136 women. There is 1 referral hospital, 1 district hospital, 4 public health centers, 1 NGO clinic and 2 private clinics providing antenatal care (ANC) and delivery services. Cross sectional study design was used for the study design. The source population was all mothers who delivered live child in all health institutions in Jimma Town during the study period.

Sample size determination and sampling procedure

Sample size was determined by considering the parameters of single population mean formula using standard deviation(σ) of birth weight (587.6gram) (43), n=522. Since the total number of source population from 1 year, Jimma Town Health Bureau report was 8482(<10,000), using a finite population correction formula to calculate the final sample size fn=492. Considering the 10% non-response rate the final sample was 541. The laboring mothers attended labour ward of all health institutions were recruited consecutively until the required sample size was achieved.

Sampling procedure

There are two hospitals (1 referral hospital, 1 district hospital), 4 public health centers, 1 NGO clinic and 2 private clinics are providing antenatal care (ANC) and delivery services. Proportional allocation of the sample to the size of women who gave birth in those public and private health institutions, based on number of deliveries prior to data collection (one year report) was made. Clients who fulfilled the inclusion criteria were recruited consecutively until the required sample size was achieved. Inclusion criteria mother who came with term gestational age (37 to 42 weeks) for delivery during data collection at health institution. Exclusion criteria, those mother who were critically ill or mentally ill or have problems of communication, those mothers with still birth and congenital anomalies, those mothers with multiple births and those mothers who has lost their upper extremities.

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Data collection methods and measurements

Data were collected by trained B.Sc. nurses and mid-wives using pre-tested structured questionnaire from mothers, from mother's cards (for obstetric and medical variables) and measure newborn birth weight and maternal mid-upper arm circumference (MUAC). For data collectors and supervisors were given training for two days about the objectives of the study, data collection instruments, data collection procedures and the ethical considerations by the principal investigator and an additional training for supervisor on data completeness and cross checking. The data collection was supervised by supervisors and by principal investigator daily. Pre-tested questionnaires were used to collect information from each study subject.

Anthropometry measurement

MUAC of the mothers was measured to the nearest centimeter with a non-stretchable tape on the left arm of the mother when right hand dominant. Newborn birth weight was measured to the nearest 10 g in Seca Digital Baby Scale Table. Calibration was done every morning with known objects in all data collection sites.

Household food insecurity measurement

To assess the household food insecurity status, household food insecurity access scale (HFIAS) measurement tool was used (Jennifer et al., 2007).

Food frequency questionnaire

This is used to calculate individual dietary diversity score by extra food group. For data quality management, a pre-test was conducted among 5% of the total sample size in order to assess its clarity, length, completeness and consistency. Before data collection, the questionnaires and consent form originally written in English was translated to the following local languages (Afaan Oromo and Amharic) and then back translated into English language for consistency and to facilitate understanding of the respondents. Data collectors and supervisors underwent training. For data processing and analysis, data were entered into Epidata version 3.1 and exported to SPSS versions 20 for analysis.

Data were presented using frequency tables; mean and standard deviations were presented for continuous variables. Bivariate linear regression model was run to identify independent candidate variables at p-value<0.25 for multivariable linear regression. Multivariable linear regression model was employed to categorize predictors of newborn birth weight at p-value<0.05 measured to be statistically significant. Principal component analyses were done and the household wealth index was ranked into tertiles.

Standard definitions and operational definitions

Term pregnancy

Gestational age at delivery ranging from 37 completed weeks to 42 completed weeks (Cunningham et al., 2014).

Household food insecurity

This is define as the inability to provide enough food for a healthy and active lifestyle for all household members.This was analyzed based on the criteria used in the HFIAS (Jennifer et al., 2007).

Inter-pregnancy interval

The time between the birth of the first born child and the conception of the second born child (Cunningham et al., 2014).

Antenatal care

This is the care received from healthcare professionals during pregnancy (Cunningham et al., 2014).

Parity

This refers to the number of deliveries after 28 completed weeks of gestation (Cunningham et al., 2014)

Under nutrition

This is MUAC of pregnant mother<23 cm.

Normal

This is MUAC of pregnant mother >23 cm.

Dietary practice

This is eating habit of the mothers during the time of their pregnancy.

No formal education

Those that are not going to school for the purpose of education which involves class room and provided by trained teachers.

Ethical consideration

The ethical clearance was taken from Jimma University ethical review committee of institute of health approved this research project. Permission was sought from all health institution administrative office to commence data collection. Written informed consent was obtained from individual mothers. Identifiers of the mothers were not incorporated in questionnaire and the data collected from mothers was used for research purpose only. Mothers were informed that their participation in the study is based on their willingness and refusal has no any health service consequence. For those mothers with low birth weight and high birth weight counseling was given.

RESULTS AND DISCUSSION

Among the total of 541 early postpartum women interviewed during the study period among deliveries in Jimma town health institutions, 10 were excluded as their data was incomplete, and the remaining 531 were analyzed (with response rate of 98.1%).

Socio-demographic characterstics

The mean age of study participants was ranged from 15 to 49 years with a mean (±sd) of 27 (±7) years and 245

Table 1. The socio-demographic characteristic of study among mother who gave birth in health institutions in Jimma Town, Southwest Ethiopia from March1 to April 30, 2017**.**

Variable		Frequency (n=531)	Percent/Mean±SD
Age of mother in years	15-24	195	36.8
	25-34	245	46.1
	35+	91	17.1
Residence	Urban	389	73.3
	Rural	142	26.7
Sex of the household head	Male	512	96.4
	Female	19	3.6
Marital status	Currently married	518	97.6
	Not married	13	2.4
Maternal occupation	Not employee	426	80.2
	Civil servant (employee)	42	7.9
Ethnicity	Oromo	395	74.4
	Amhara	63	11.9
	Others	73	13.7
Religion	Orthodox	111	20.9
	Protestant	48	9.0
	Muslim	372	70.1
Maternal education	No formal education	179	33.7
	Primary	211	39.7
	secondary and above	141	26.6
Paternal education	No formal education	113	21.3
	Primary	202	38.0
	Secondary and above	216	40.7
Wealth index	Low	31	5.8
	Medium	321	60.5
	High	179	33.7
Family size of the respondent	-	-	4.17±1.381

(46.1%) were in the age range of 25 to 34 years. Nearly 98% of women were currently married, 426 (80.2%) not employed, 395 (74.4%) Oromo, 372 (70.1%) Musilims, More than one third of the mothers 179 (33.7%) reported have no formal education and 389 (73.3%) were residing in urban areas. In 96% of the cases the head of the household were males and 216 (40.7%) of the husbands have educational level of secondary and above. The mean (±sd) - family size of the respondents were 4 ± (1) and the mean number of dependent household member is 1.9 ± (1.1). Nearly a third of the households are food insecure and 321 (60.5%) were in the medium wealth index tertile (Table 1).

Obstetric and medical factors

Less than three fourth (72.5%.) had inter-pregrance below 2 years and 146 (51.0%) had four and more antenatal care visits and 303 (57.1%) of women are para 2 to 4 while 205 (38.6%) are para 1. Seventy two percent of women gave birth to their last child with birth interval of less than two years. Regarding medical problems, 41

Table 2. Obstetrics and medical factors among mother who gave birth in health institutions in Jimma Town, Southwest Ethiopia from March 1 to April 30, 2017.

Variable		Frequency(n=531)	Percent
Inter pregnancy interval	<2 years	385	72.5
	≥2years	146	27.5
Number of antenatal visit	≤3	260	49.0
	4+	271	51.0
Parity	1	205	38.6
	2-4	303	57.1
	≥5	23	4.3
Birth order	1	205	38.6
	2	160	30.1
	3+	166	31.3
Hypertension disorders of pregnancy	Yes	41	7.7
	No	490	92.3
Diabetes	Yes	8	1.5
	No	523	98.5

(7.7%), 8 (1.5%) of women had hypertension disorders of pregnancy and diabetes, respectively (Table 2).

Maternal nutrition, newborn related and Women autonomy characteristics

Regarding maternal nutritional status using mid-upper arm circumference (MUAC), 247 (46.5%) of mothers are malnourished with MUAC of <23 and 284 (53.5%) are normal. Majority of women (89.1%) had Iron folate supplementation during antenatal care and 247 (46.5%) have not adhered (took 0 to 3 pills/week) to iron folate supplementation. With regard to the feeding status of the women during pregnancy, 156 (29.4%) had prohibition of some food items, 142 (26.7%) had strong desire to eat (craving), 119 (22.4%) were not taking additional meal, 185(36.1%) had low dietary diversity score, and 162 (30.5%) were food insecure.

Regarding women's freedom of movement, 429 (80.8%) seek permission to go outside home, 340 (64.0%) seek permission to go to market place, 387 (72.9%) permission to go to health institution. Maternal involvement in decision making regarding child sickness was 352 (66.3%), child schooling was 362 (68.2%), and child to whom to marry was 139 (26.2%). On the other hand maternal autonomy in conducting: Food purchase was 448 (84.4%), Big Item purchase was 133 (25.0%) and autonomy regarding family planning service utilization was 208 (39.2%). Nearly 49% of newborns were females and 272 (51.2%) were males. Majority of newborns are of normal weight in 483 (91.0%) with mean birth weight of 3224.6 ± 438.5 g (Table 3).

Predictors of newborn birth weight from multivariable linear regression analysis

All covariate variables with p-value <0.25 were chosen for multivariable linear regression analyses to identify the final predictors of birth weight. Multivariable linear regression analyses showed that after adjusting for dietary diversity score (DDS), age at first marriage and food insecurity, there is a positive association between maternal MUAC and birth weight, parity and birth weight, wealth index and birth weight of the new born. It was observed that for a centimeter increase in maternal MUAC, birth weight increased by 13.5 g (β=13.5, P=0.04). Similarly it has shown that with each increase in parity of the mother, birth weight increased by 96.81 g (β=96.81, P=0.01) and for a unit increase in wealth index birth weight increased by 49 g (β=49.04, P=0.01) (Table 4).

DISCUSSION

Birth weight is the most important indicator of survival of newborns during their early life and has been associated with morbidity and mortality at all ages within the human life span. Drivers of gaining each grams of a newborn weight should be well exploited. Accordingly, we have

Table 3. Maternal nutrition, newborn related and women autonomy among mother who gave birth in health institutions in Jimma Town, Southwest Ethiopia from March 1 to April 30, 2017.

Variable		Frequency(n=531)	Percent/Mean ± Sd
Maternal MUAC	Undernourished(<23cm)	247	46.5
	Normal(≥23cm)	284	53.5
Iron folate supplementation	Yes	473	89.1
	No	58	10.9
Adherence of iron folate supplementation	Not adhered(0-3 pills/week)	247	46.5
	Adhered(4-7 pills/week)	284	53.5
Food prohibition during pregnancy	Yes	156	29.4
	No	375	70.6
Dietary diversity score(DDS)	High Diversity	200	39.0
	Medium Diversity	128	25.0
	Low Diversity	185	36.1
Additional meal	Yes	412	77.6
	No	119	22.4
Hemoglobin level in g/dL	≤11	106	20.0
	>11	425	80.0
Freedom of Movement; seeking permission to go to	Outside home (yes)	429	80.8
	Market place (yes)	340	64.0
	Health institution (yes)	387	72.9
Maternal involvement indecision regarding child	Sickness (yes)	352	66.3
	Schooling (yes)	362	68.2
	To whom to Marry(yes)	139	26.2
Maternal Autonomy in conducting	Food purchase (the mother involved)	448	84.4
	Big Item Purchase (mother is involved	133	25.0
Autonomy regarding Family planning service Utilization	Yes	208	39.2
	No	323	60.8
Food insecurity	Food secure	369	69.5
	Food insecure	162	30.5
Newborn birth weight (Mean birth weight = 3224.61 ± 438.512)	<2500	11	2.0
	2500-3999.9	483	91.0
	4000+	37	7.0
Sex of newborn	Female	259	48.8
	Male	272	51.2

conducted the current study on 531 postpartum mothers attending health service institution in Jimma town. In general, these socioeconomic findings were comparable with studies conducted in Gondor and Wondogenet, and Haramaya District, Ethiopia (Mekonnen et al., 2015; Kuche et al., 2015; Assefa et al., 2012). Similarly the

Table 4. Multivariable linear regression model predicting birth weights among newborns delivered at health institutions of Jimma Town, Southwest Ethiopia March 1 to April 30, 2017.

Model	Unstandardized Coefficients		P	95.0% Confidence Interval	
	B	Std. Error		Lower Bound	Upper Bound
Maternal MUAC	13.498	6.625	0.042	0.483	26.514
Multiparity	96.813	35.479	0.001	27.107	166.518
Primiparous (Referent)	-	-	-	-	-
Wealth index	49.044	18.108	0.001	13.469	84.620
Age at first marriage(mother)	-10.078	6.940	0.147	-23.713	3.557
High_DDS	13.459	41.232	0.744	-67.549	94.468
Medium_DDS	-42.610	44.536	0.339	-130.109	44.890
Low DDS (Referent)	-	-	-	-	-
Food in security	-30.641	18.278	0.094	-66.551	5.269
Food secure (Referent)	-	-	-	-	-

Maximum VIF=1.452.

wealth strata in most of the studied mothers assumed was simillarto a study in eastern Ethiopia where majority are in poor to middle wealth index tertile (63.6%) (Assefa et al., 2012). In resource-poor settings, where individuals tend to have smaller amounts of subcutaneous fat, changes in Mid-upper arm circumference are more likely to reflect changes in muscle mass (Gibson, 2005).There existed alarming level of (46.5%) maternal under nutrition defined as Mid-upper arm circumference of < 23 cm among the study subjects. Though a comparable level of maternal undernutrition were reported from eastern Ethiopia (45%) (Assefa et al., 2012), the current finding is nearly two fold compared to USAID report on Ethiopia nutrition profile (25%) (United States Agency for International Development (USAID) (2016) and tenfold higher compared with the study conducted in Riyadh (4.4%) (Almurshed et al., 2007).

Micronutrients are essential for growth and maternal micronutrient shortage, as regularly observed in low-income countries, may be a significant cause of Intrauterine growth restriction (IUGR). Micronutrient insufficiency, may influence growth, cognition, and reproductive performance (Seshadri, 2001). Optimal nutrition during pregnancy is important for the health of both the mother and the baby. However, in many studies dietary intake during pregnancy is found to be suboptimal (Zakaria and Laribick, 2014; Blumfield et al., 2012b). This is in concord with different studies done in Ethiopia where maternal nutrition during pregnancy is generally poor because of different reasons. Among these are: 1/4 of women of reproductive age in Ethiopia are under-nourished and 17% are anemic, associated low birth weight, short stature, lower resistance to infections, and higher risk of illness and mortality (Central Statistical Agency (CSA), 2012; Ethiopia and ICF Macro., 2012; Ethiopia Demographic and Health Survey, 2011; United States Agency for International Development (USAID), 2016). On the other hand, study showed that good dietary practice was found to be low (40.1%) in Gondar during pregnancy (Mekonnen et al., 2015). In addition energy and most of the nutrients intakes of pregnant mother in Wando Genet district is also reported to be lower than recommended for pregnant mother (Kuche et al., 2015). The inadequate dietary pattern in our study is however by far very high compared to the above studies. This may be because of the seasonal difference in the under taking of the study or the disparity in geographical location.

In this study majority of newborns are of normal weight (91.0%) with mean birth weight of 3224.6 ± 438.5 g and only 2% of new borns are low birth weight. The low birth weight rate in this study is by far low compared to the previous studies in Ethiopia where the prevalence of low birth weight ranges from 15 to 20% of all births worldwide to 17.1% in Gondor to 22.5% in Jimma zone health facilities (Resolution World Health Assembly (WHA), 2012; World Health Organization (WHO) 2014; Berihun et al., 2012). On the other hand the 3224.6 ±438.5 mean birth weight of the newborn in this study is higher compared to previous studies 2976 ± 476 g in Gondor and 3094.9 ± 587.6 g in Tigray (Berihun et al., 2012; Tema, 2006; Meresa et al., 2015) and other african country (Mosha and Philemon, 2010). The reason why the mean birth weight is high and the low birth weight is low in this study might be the research is conducted on term pregnancies compared to the other studies where preterms are also included.

Furthermore, nearly three fourth of the mother are urban residents in this study incontrast to other studies where majority are rural residents which is found to be positively associated with birth weight. This is because urban residents are tought to have better education,

health information and access to health facilities for antenatal care which subsequently promotes birth weight (Kuche et al., 2015; Taddese et al., 2016). It was found that there is a positive association in multivariable linear regression analysis between (maternal MUAC, parity and wealth index) and birth weight after adjusting for dietary diversity score (DDS), age at first marriage and food insecurity. In this study it was observed that for a centimeter increase in maternal MUAC, birth weight increased by 13.5 g (β=13.5, P=0.04). Simillar positive association was observed in a study conducted in Brazil where for each centimeter increase in maternal MUAC, there was 45.52 increased in birth weight (Ricalde et al., 1998). Another study conducted in Ethiopia also showed that maternal MUAC of 23+ was positively associated with birth weight (Wado et al., 2014). This is because maternal MUAC of 23+ show maternal good nutrition during pregnancy which subsequently will contribute to maternal weight gain and increased birth weight. On the contrary women with low MUAC are at high risk of low birth weight.

In this study it is observed that with each increase in a parity of the mother, birth weight increased by 96.81 g (β= 96.81, P=0.01). Different Studies have shown that primiparous mother, gave birth to babies with lower birth weight compared to multiparous women (Muslimatun et al., 2002) and women with parity 2 and parity >3 were 30 and 81 % more likely to have babies weighing ≥2.5 kg compared to those with parity 1 (Alfred et al., 2016). The wealth index in this study is positively associated with birth weight (β=49.04, P=0.01). Study conducted in Bangladesh showed that children born in poor families were more likely to be LBW than children born in middle-class and rich families (Reazul et al., 2016). Further studies have shown that there is strong association between birth weight and socioeconomic status of the family (Alfred et al., 2016), family income was positively associated with birth weight (Muslimatun et al., 2002). This might be because low birth weight might be due to deprived maternal nutritional intake among mothers with lesser socioeconomic rank as created in other studies.

LIMITATION AND STRENGTH OF THE STUDY

Limitation of the study, since the study depends on self report there might be recall bias, especially for food frequency questionarries. Strength of the study inclusion of all health facilities given that delivery services in the town is strength of the study and the study used large sample size with response rate 98.1%.

CONCLUSIONS AND RECOMMENDATION

Majority of newborns are normal birth weight with mean birth weight and the percentage of low birth weight is very low. Maternal nutritional status using mid-upper arm circumference most of mothers are malnourished with MUAC of <23 and more than half of mothers are normal. No association between maternal dietary habit and newborn birth weight in this study, which need further investigation. The predictors of newborn birth weight were maternal MUAC, parity and wealth index.

This is significant because newborn birth weight is important determinant of newborn survival. Recommendations, the following points are recommended for the government, Ministry of health, Ministry of finance, JUMC, College of health sciences, Health office of Jimma Town and other responsible bodies, Nutrition counseling at antenatal care at all levels is essential for both maternal and newborn birth weight, and Improving socio-economic status by creating access to micro financing. Finally for researchers, further studies are highly recommended for the study of maternal dietary by considering biomarker tests to see the association with newborn birth weight and also future studies on underline, basic and immediate causes of maternal malnutrition in the study area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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