Intrauterine growth restriction and its associated factors in South Gondar zone hospitals, Northwest Ethiopia, 2019

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Abstract

Background: After prematurity, intrauterine growth restriction (IUGR) is the second leading cause of perinatal mortality. IUGR has significant consequences in fetal, neonatal, and adult life. Currently, Ethiopia lacks information on IUGR’s prevalence and its determinants. This study aimed to assess the proportion of IUGR at birth and its associated factors.

Methods: A cross-sectional study was carried out among women who give birth in four hospitals of south Gonder zone from November 2018 to February 2019. Multi-stage sampling was applied to select the required samples. IUGR was assessed using a standardized cutoff percentile/mean for each measurement. Data were collected by trained MSc clinical midwives. Bi-variable and multivariable logistic analyses were deployed to identify the association.

Results: A total of 803 maternity women were participating in this study with a response rate of 95%. The proportion of IUGR 23.5% (95% CI: 20.7–26.6), low birth weight 13.3%, small-for-gestational-age 19.7%, and preterm birth 23.16%. Women who was unable to read and write, (AOR; 2.46, 95% CI: 1.02–5.92), total family size $\geq 7$ (AOR; 1.67, 95% CI: 1.04–2.66), maternal mid-upper arm circumference (MUAC) < 23 cm (AOR; 2.10, 95% CI: 1.39–3.01), body mass index (BMI) < 18.5 kg/m$^2$ (AOR; 2.57, 95% CI: 1.72–3.83), altitude > 3000 m (AOR; 1.89 95% CI: 1.19–3.01), small placental size (< 350 g) (AOR; 2.42, 95% CI: 1.67–3.54) and small-for-gestational-age (AOR; 1.94, 95% CI: 1.86–4.52) were the most predictors of IUGR.

Conclusions: IUGR was a major public health concern in this study. Women who were unable to read and write, small-for-gestational-age, maternal BMI < 18.5 kg/m$^2$, family size $\geq 7$, maternal MUAC < 23 cm, small placental size, and altitude > 3000 m were found the most predictor variables. Strengthen female education, nutritional intervention before and during pregnancy, and routine maternity care is critical. Further clinical follow-up research is essential which includes maternal, fetal, and placental gens.

Keywords: IUGR, Associated factors, Small for gestational age, Low birth weight

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Background

Intrauterine growth restriction (IUGR) is defined as the velocity of fetal growth less than the normal fetus growth potential for a specific neonate or it is the failure of the fetus to achieve its growth potential [1]. In the womb life or during the postnatal period an infant with birth weight or birth length below the 10th percentile is known as small for gestational age [2, 3]. IUGR is not synonymous with small- for- gestational- age (SGA), or fetal malnutrition (FM). Because the situation may exist with or without these conditions in any newborn [4]. The identification of IUGR is commonly made during the antenatal period; however, it can be detected during the newborn period immediately after delivery [5, 6] by using clinical examination [3, 7, 8], anthropometry index [9], and clinical assessment of nutritional status (CAN) score [4]. IUGR is a public health problem and noted to affect approximately 10–15% of pregnant women.

IUGR is observed in 23.8% of the newborn and approximately 30 million babies globally suffered from it every year. Closely, 75% of all exposed newborns were occurred in developing regions [10]. The prevalence of IUGR in Malawi and Karachi was around 21% [11, 12]. Screening of neonatal adverse birth outcomes including IUGR is very important for obstetricians and perinatologists. Because its effect is associated with perinatal morbidity and mortality [13], birth hypoxia, impaired neurodevelopment, a manifestation of the metabolic syndrome in adult life [14]. It also leads to early and late complications, increases significantly in newborn birth weight, length, and head circumference less than the 10th percentile. Next to prematurity, IUGR is the second leading cause of perinatal mortality which is still the huge problem of developing countries.

IUGR fetus has approximately five to ten-fold increased risk of dying in the womb, with up to 23 to 65 stillbirths [14, 15]. Around half of the preterm stillbirths and 25% of the term, stillbirths were growth-retarded [16]. The greatest incidence of intrauterine growth restriction in developing countries is multi-factorial and involves a complex collaboration between fetal, placental, and maternal factors even though the maternal factors are the most predominant causes [10, 17]. So far, data is not available in Ethiopia which focused on this public health significant issue. This study is vital to assess the prevalence of intrauterine growth restriction and associated factors especially the maternal and placental factors in Ethiopia. Showing the proportion and associated factors of IUGR is very critical. In addition to this, early intervention could be suggested to achieve the sustainable development goal of child health. And the study is important in Ethiopia that perinatal mortality is still very high. Besides, this study finding will be used as baseline data for clinicians to do prospective clinical research.

Methods

This study was carried out in the selected four Hospitals of South Gondar zone (three primary Hospitals which include: Nefas- Mewicha, Mekane Eyesus, and Addis Zemene), and one general Hospital (Debre Tabor). South Gondar is a Zone that belonged in the Ethiopian Amhara Regional state. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 2,051,738 and an increase of 16% over the 1994 census. In Ethiopia, even though there is a substantial increment of institutional delivery from 5% in 2005 to 48% in 2019, still greater than half (52%) of the women have been delivered at home [18]. As the 2018 South Gondar zone report, around 527,967 reproductive-age groups mother, and 87, 955 pregnant women were found in the zone. The zone has 8 Hospitals, 94 Health centers, and 378 Health posts. In each Health post, at least two Health extension workers are assigned.

The socioeconomic status of the population those attend in these four hospitals are almost similar even those the type of crop production and altitudes are different. All of the hospitals give similar services except Debre Tabor general hospital that serves as a referral center for private and governmental health institutions. Averagely 119, 293, 97, and 108 deliveries were conducted in 2 months in Nefas- Mewicha, Debre Tabor, Mekane Eyesus, and Addis Zemene Hospitals respectively.

The study was hospital-based and cross-sectional in design. The study took place from November 2018 to February 2019.

All pregnant women who delivered in South Gondar zone Hospitals and all pregnant women who delivered in south Gondar zone selected Hospitals were the source and study population respectively.

All women who give birth in the specified period (women who deliver within four-months) and singleton live-birth were included in the study. Whereas, women who couldn’t answer the intended questions because of illness and mental problems; mothers die because of complications of labor, referred to other higher health institutions, birth with incomplete placenta, and newborn with congenital abnormality were excluded.

The sample size was determined using the formula of a single population proportion with the assumption of the prevalence of intrauterine growth restriction 50% since there is no study in Ethiopia, Z a/2 = 1.96 with 95 confidence interval, 5% of marginal error, and design effect 2. Then, the final sample size with a10% non-response rate was 845.

The multi-stage sampling procedure was employed to select the required sample size. Since we can’t address all the hospitals, first of all, four of the hospitals (Addis Zemen, Nefas -Mewcha, Mekane-Eyesus, and Debre...
Intrauterine growth restriction (IUGR)
Assessed using a clinical examination of 10 typical features [3, 7, 8], anthropometric index like weight-length ratio [9], fetal growth ratio which is defined as the ratio of the observed birth weight to the mean birth weight for gestational age. The infant is classified as not growth restricted if the fetal growth ratio is between 0.9–1.1, mild growth-retarded if the ratio was 0.8–0.85, moderately growth-retarded if the ratio was between 0.75–0.8, and severely growth-retarded if the ratio was below 0.75 by using curve cutoff points [19, 20], neonatal ponderal index and body mass index (BMI) was calculated as a neonatal ponderal index (NPI) = 100x [birth weight (gram) / length (cm)³]; BMI=Birth weight (gram)/ length (cm)² [20, 21] and clinical assessments of nutritional status by using observation and a hands-on estimate of the loss of subcutaneous tissue and muscles (CAN) score [4] which is simple and rapid. We use the mean/ the cut values (percentiles) for each measurement in this study.

Small for gestational age (SGA): is defined as birth weight less than 10th centile for gestational age using weight percentile, length percentile, and head circumference percentile charts [22].

Clinical Assessment of Nutrition (CAN score): is a scoring system based on nine superficial readily detectable signs of malnutrition in the newborn baby [23].

Rapid assessment of gestational age at birth: gestational age derived from the total scores of skin texture (4 items), skin color (4 items), breast size (4items), and ear firmness (4 items) [6, 24]. But for this study gestational age was estimated by LMP (if she knows her LMP), if she didn’t know her LMP, we used ultrasound estimation during delivery, if two of them were impossible, we used a rapid assessment of gestational age estimation at birth.

Preeclampsia was defined gestational hypertension or postpartum hypertension, as defined above, developing for the first time after delivery with proteinuria (24-h urinary protein level of >300 mg, a spot urine protein: creatinine ratio of ≥300 mg/mmol creatinine, or urine dipstick protein level ≥2=1 g/l) or any multisystem complication of preeclampsia.

Household wealth status: is computed by principal component analysis from different variables such as the presence of own farmland, own toilet facility, bank account, mobile phone, electricity, the roof of the house with corrugated iron sheets, number of cows/oxen, horses/ mules/donkeys goats/sheep and chicken [25].

After reviewing the relevant literature, questionnaires were designed to include all possible variables that address the intent of this study.

Firstly, the questionnaire was developed in English and translated into the local language (Amharic). Finally, retranslated back into English to check the consistency. We prepared weight, height measuring instruments, and standardized charts/ cutoff points. For each Hospital four data collectors and 2 supervisors have participated.

To ensure the quality of data, training was given for all data collectors at each Hospital for 1 day on the over-all procedure of data collection by investigators and pediatrician supported with video. The questionnaire was pre-tested before the actual data collection time on 42 participants (5% of the sample). Weight, high, abdominal, chest and head circumference of the newborn baby was measured immediately after birth and recorded into the nearest decimals. Detailed examination of each baby carried out by data collectors.

The supervisors closely follow the day-to-day data collection process and ensure the completeness and consistency of the questionnaire administered each day. The collected data reviewed and checked for completeness before data entry.

Data clean up and cross-checking was done before analysis. Then, the collected data were checked for completeness, coded, and cleaned. This data was entered using EPI INFO -version 7 for windows statistical software. Then data were exported to SPSS version-20 for further analysis. Both descriptive and analytical statistical procedures were utilized. Only variables in binary screening had a p-value ≤0.2 considered in multivariable logistic regression.

Logistic regression analysis was applied to describe the functional independent predictors. Odds ratio (OR) with a 95% confidence interval (CI) was built to assess the strength of association between independent and dependent variables. For all, statistical significance was declared at p-value < 0.05.

Results
Socio-demographic characteristic of the respondents
Of all, 803 maternity women were participating in this study and obtaining a response rate of 95%. In this study, around two-thirds of 518 (64.5%) of the mothers were found in the age category of 20–29 years and only 308 (38.4%) of them were attending their education primary and above. Almost all 787 (98%) of the mothers were living in union with their husbands and around half 453 (56.4%) of the mothers were living with a total family size of three and less when we see the wealth status of the respondents, around half 412 (51.3%) and less.
than one forth 190 (23.7%) were found in the middle and better wealth quintile respectively. During their pregnancy time, 49 (6.1%) of the women have taken different medications (Table 1).

Maternal, newborn and placental factors
The majority 670 (83.4%) of the mother’s heights were ≥ 150 cm and greater than two-third 592 (73.7%) of their BMI was found > 18.5 kg/m². Greater than half 457 (56.9%) of the newborn’s sex was female, and the majority 696 (86.7%) of the newborn weight was > 2500 g (Table 2).

Maternal obstetric factor
Greater than half 461 (57.4%) of the mother’s pregnancy interval was < 24 months. Mothers who live within > 3000 m of the altitude above sea level was 443 (55.2%) and attended more than four ANC follow up was 411 (55.9%). The majority 645 (80.3%) of the mothers deliver appropriate gestational age (AGA) babies and their hemoglobin level ≥ 8 g/dl were 798 (99.4%) and had no chronic hypertension were 713 (88.8%) (Table 3).

Overall minimum, maximum, and mean of some maternal and newborn characteristics
The minimum age of the respondent in this study was 17 years; whereas the maximum was 46 with a mean ± standard deviation (SD) of 26.9 ± 5.3 years. The minimum and maximum heights of the mothers were 145 and 174 cm respectively, with a mean ± SD of 163 ± 9.3 cm. The minimum weight of the newborn was 1200 g; however, the maximum weight was 4600 g with a mean ± SD of 2768.6 ± 252.4 g (Table 4).

Factors associated with intrauterine growth restriction
Since risk factors for IUGR are interrelated, multivariable logistic regression analysis gives more meaningful results: maternal educational status, BMI, MUAC, family size, gestational age, and weight of the placenta were

Table 1 Socio-Demographic Characteristics of the Respondents in South Gondar Zone Hospitals, Northcentral Ethiopia, 2019

| Characteristics               | Frequency | Percent |
|-------------------------------|-----------|---------|
| Current maternal age (year)   |           |         |
| ≤ 19                          | 56        | 7.0     |
| 20–29                         | 518       | 64.5    |
| 30–39                         | 203       | 25.3    |
| ≥ 40                          | 26        | 3.2     |
| Maternal age during 1st pregnancy |         |         |
| < 20                          | 508       | 63.3    |
| ≥ 20                          | 295       | 36.7    |
| Educational status of the mother |         |         |
| Unable to read and write      | 222       | 27.6    |
| Able to read and write        | 273       | 34.0    |
| Primary                       | 81        | 10.1    |
| Secondary                     | 113       | 14.1    |
| College and above             | 114       | 14.2    |
| Maternal occupation           |           |         |
| Housewife                     | 496       | 61.8    |
| Farmer                        | 97        | 12.1    |
| Daily worker                  | 51        | 6.4     |
| Merchant                      | 159       | 19.8    |
| Marital status                |           |         |
| Married                       | 787       | 98      |
| Single                        | 6         | 0.7     |
| Divorced                      | 10        | 1.2     |
| Age of the husband /friend    |           |         |
| < 20                          | 12        | 1.5     |
| 20–29                         | 301       | 37.5    |
| 30–39                         | 354       | 44.1    |
| ≥ 40                          | 136       | 16.9    |
| Husband/friend educational status |       |         |
| unable to read and write      | 186       | 23.2    |
| able to read and write        | 215       | 26.8    |
| Primary                       | 66        | 8.2     |
| Secondary                     | 195       | 24.3    |
| college and above             | 141       | 17.6    |
| Husband /friend occupation    |           |         |
| Farmer                        | 307       | 38.2    |
| daily worker                  | 77        | 9.6     |
| Merchant                      | 219       | 27.3    |
| government employ             | 200       | 24.9    |
| Total family size             |           |         |
| 1–3                           | 453       | 56.4    |
| 4–6                           | 273       | 34.0    |
| ≥ 7                           | 77        | 9.6     |
found to be significant predictors of intrauterine growth restriction. Accordingly, the odds of having IUGR were 2 times higher among mothers who were unable to read and write than mothers who achieve their education college and above (AOR; 2.46, 95% CI: 1.02–5.92). The household contains a total family size of ≥7 were 2 times more likely experienced IUGR than household having a total family member of three and less (AOR; 1.67, 95% CI: 1.04–2.66). Mothers MUAC < 23 cm, BMI < 18.5 kg/m² and living in an altitude > 3000 m were 2 times more likely to deliver IUGR newborn compared to mother who had MUAC ≥23 centimetres (AOR; 2.10, 95% CI: 1.39–3.01), BMI ≥ 18.5 kg/m² (AOR; 2.57, 95% CI: 1.72–3.83) and living at an altitude < 2000 m (AOR; 1.89 95% CI: 1.19–3.01) respectively. Newborn babies exposed to SGA were experienced IUGR than babies had AGA (AOR; 1.94, 95% CI: 1.86–4.52). The odds of developing IUGR from placental weight < 350 g were 2 times as compared with the placental weight ≥ 350 g (AOR; 2.42, 95% CI: 1.67–3.54) (Table 5).

Discussions
Intrauterine growth restriction is a commonly faced circumstance in obstetrics, and not only, but it is also associated with perinatal morbidity and mortality. Consequently, it is indispensable to differentiate and diagnose it and take an instantaneous action [26]. As far as our knowledge is concerned, it is the first study in Ethiopia. In this study, therefore, we try to assess the prevalence of IUGR and its

| Characteristics                  | Frequency | Percent |
|----------------------------------|-----------|---------|
| Known chronic disease            |           |         |
| No                               | 776       | 96.6    |
| Yes                              | 27        | 3.4     |
| Height of mother                 |           |         |
| < 150 cm                         | 133       | 16.6    |
| ≥ 150 cm                         | 670       | 83.4    |
| Sex of the newborn               |           |         |
| Male                             | 346       | 43.1    |
| Female                           | 457       | 56.9    |
| Maternal BMI                     |           |         |
| < 18.5 kg/m²                     | 211       | 26.3    |
| ≥ 18.5 kg/m²                     | 592       | 73.7    |
| Weight of the newborn            |           |         |
| < 2500 g                         | 107       | 13.3    |
| ≥ 2500 g                         | 696       | 86.7    |
| Placental weight                 |           |         |
| < 350 g                          | 310       | 38.6    |
| ≥ 350 g                          | 493       | 61.4    |

Table 2 Maternal, Newborn and Placental Characteristics in South Gondar Zone Hospitals, Northcentral Ethiopia, 2019

| Characteristics                  | Frequency | Percent |
|----------------------------------|-----------|---------|
| Pregnancy interval               |           |         |
| < 24 months                      | 461       | 57.4    |
| ≥ 24 months                      | 325       | 40.5    |
| Maternal MUAC                    |           |         |
| < 23 cm                          | 247       | 30.8    |
| ≥ 23 cm                          | 556       | 69.2    |
| Preterm birth                    |           |         |
| No                               | 613       | 76.84   |
| Yes                              | 186       | 23.16   |
| Gestational age                  |           |         |
| SGA                              | 158       | 19.7    |
| AGA                              | 645       | 80.3    |
| Altitude                         |           |         |
| < 2000 m                         | 212       | 26.4    |
| 2000–3000 m                      | 148       | 18.4    |
| > 3000 m                         | 443       | 55.2    |
| Gravidity                        |           |         |
| ≤ 2                              | 358       | 44.6    |
| 3–4                              | 323       | 40.2    |
| ≥ 5                              | 122       | 15.2    |
| Hg after delivery                |           |         |
| < 8 g/dl                         | 5         | 0.6     |
| ≥ 8 g/dl                         | 798       | 99.4    |
| Chronic HPN                      |           |         |
| No                               | 713       | 88.8    |
| Yes                              | 90        | 11.2    |
| PPH                              |           |         |
| No                               | 786       | 97.9    |
| Yes                              | 17        | 2.1     |
| Anemia                           |           |         |
| No                               | 675       | 84.1    |
| Yes                              | 128       | 15.9    |
| Preeclampsia                     |           |         |
| No                               | 700       | 87.2    |
| Yes                              | 103       | 12.8    |
| ANC follow up                    |           |         |
| No                               | 68        | 8.5     |
| Yes                              | 735       | 91.5    |
| Total ANC                        |           |         |
| < 4 (including no ANC follow up) | 411       | 55.92   |
| ≥ 4                              | 324       | 44.08   |
| Torch infection                  |           |         |
| No                               | 785       | 97.8    |
| Yes                              | 18        | 2.2     |

Table 3 Obstetric factors of the Mothers in South Gondar Zone Hospitals, Northcentral Ethiopia, 2019

| Characteristics                  | Frequency | Percent |
|----------------------------------|-----------|---------|
| Pregnancy interval               |           |         |
| < 24 months                      | 461       | 57.4    |
| ≥ 24 months                      | 325       | 40.5    |
| Maternal MUAC                    |           |         |
| < 23 cm                          | 247       | 30.8    |
| ≥ 23 cm                          | 556       | 69.2    |
| Preterm birth                    |           |         |
| No                               | 613       | 76.84   |
| Yes                              | 186       | 23.16   |
associated factors in hospitals of the south Gondar zone, Ethiopia. The data from our study revealed that the prevalence of intrauterine growth restriction was 23.5%, and the rare of low birth weight, small for gestational age, and preterm birth was 13.3, 19.7, and 23.16% respectively. The prevalence of IUGR in this study was similar to other studies that were conducted in Karachi 24.4% [12] and Malawi 20.3% [11]. In Bolivia, a comparison study among people living in high altitude (> 3000 m) and low altitude, newborn babies delivered at high altitude weighted less weight, and also the prevalence of IUGR was 16.8, 95% CI: 14.9–18.6 and 5.9, 95% CI: 4.2–7.5 at higher and lower altitudes respectively [27].

The similarity of these studies might be due to the definition of IUGR and besides, the similarity in Malawi might be due to the study setting which means that both of them conducted in institutions immediately after delivery. However, in this study and Malawi, the studies didn’t include deliveries that took place at home. And our study was higher than the studies held in Brazil at different periods 14.8, 9.4, and 12% [28]. Its difference between this study and in Brazil might be due to the study period.

Generally, maternal educational status was the most significant predictor variables for maternal and child health in the world, similarly, in this study, it was one of the significant variables of IUGR (AOR; 2.46, 95% CI: 1.02–5.92) and it was supported by previous studies conducted in Latin America [29], India [30], and in Karachi (AOR;1.6, 95% CI: 1.0–2.7) [12]. This might be because, when a women’s educational level increases, she may be motivated to know health and risk factors, might have the interest to read and listen, watch any information sources, and make an informed decision about their health. Besides, women with some basic level of education can discuss more sensitive issues openly and had a better understanding of the complication associated with pregnancy.

Maternal body mass index is a substantial modifiable risk predictor for intrauterine growth restriction including low birth weight, preterm labor, and small for its gestational age. In this study, maternal Low body mass index (BMI) was a variable associated with intrauterine growth restriction (AOR; 2.57) and it was similar in the study done in Thiruvalla with a P-value < 0.001 [31], in developing region [32] and in Karachi (AOR; 2.6, 95% CI: 1.8, 3.7) [12].

High altitude acts as an independently, no interactively with other risk factors to reduce birth weight and mostly pregnancy-associated hypertension was more common at a higher altitude which leads to maternal and neonatal morbidity and mortality [33]. In Bolivia, all maternal, fetal, neonatal complications, including fetal distress (AOR; 7.3 95% CI: 3.9–13.6, hypertensive complications of pregnancy and risk of stillbirth (AOR: 6.0; 95% CI: 2.2–16.2) were more frequent at a higher altitude than lower altitude [27].

As a result, in this study high altitude is a factor of intrauterine growth restriction (AOR; 1.89). This is was in line with a study conducted in Colorado [34] and in Bolivia P-value, 0.001 [27]. IUGR was associated with placental weight in this study, infant borne with low placental weight (< 350 g) were experienced IUGR than placental weight > 350 g (AOR; 2.42). Its contribution is not only for IUGR but also for SGA according to Stanford Medical Center researchers [35] and maternal malnutrition and uteroplacental insufficiency during let pregnancy are usual causes for asymmetric IUGR while congenital infections acquired early in pregnancy have an association with symmetrical IUGR [17]. A comparison study in two cohorts of SGA and AGA showed that the placenta from SGA newborn infants was more likely
to have smaller weight and thinner umbilical cords than those from AGA neonates, further more this smaller placentas had a significant increase in uteroplacental malformation [35]. In this study besides other variables, households total family size \( \geq 7 \) was a significant variable for IUGR (AOR; 1.67). This might be due to the sharing

### Table 5 Binary and Multivariable Logistic Regression Analyses of IUGR among Women who Give Birth in South Gondar Zone Hospitals Northcentral Ethiopia, 2019

| Variables                          | IUGR     | COR       | AOR (95%CI) |
|------------------------------------|----------|-----------|-------------|
|                                    | Yes      | No        |             |
| **Educational status of the mother** |          |           |             |
| Unable to read and write           | 42       | 180       | 1.75 (1.03–2.95) | 2.46 (1.02–5.92) |
| Able to read and write             | 56       | 217       | 1.58 (0.96–2.60) | 2.39 (1.13–5.03) |
| Primary                            | 29       | 52        | 0.73 (0.40–1.34) | 1.01 (0.44–2.30) |
| Secondary                          | 29       | 84        | 1.18 (0.66–2.12) | 2.10 (0.94–4.10) |
| College and above                  | 33       | 81        | 1           |             |
| **Husband education**              |          |           |             |
| Unable to read and write           | 36       | 150       | 1.27 (0.75–2.17) | 0.67 (0.27–1.62) |
| Able to read and write             | 41       | 174       | 1.30 (0.77–2.18) | 0.78 (0.31–1.68) |
| Primary                            | 21       | 45        | 0.66 (0.34–1.25) | 0.71 (0.30–1.68) |
| Secondary                          | 58       | 137       | 0.72 (0.44–1.19) | 0.70 (0.36–1.34) |
| College and above                  | 33       | 108       | 1           |             |
| **Total family size**              |          |           |             |
| \( \leq 3 \)                       | 126      | 327       | 1           |             |
| 4–6                                | 46       | 227       | 1.36 (0.76–2.42) | 1.09 (0.50–2.38) |
| \( \geq 7 \)                       | 17       | 60        | 1.90 (1.30–2.77) | 1.67 (1.04–2.66) |
| **Gravidaity**                     |          |           |             |
| \( \leq 2 \)                       | 90       | 268       | 1           |             |
| 3–4                                | 72       | 251       | 1.18 (0.72–1.67) | 0.7 (0.39–1.24) |
| \( \geq 5 \)                       | 27       | 95        | 1.17 (0.82–1.67) | 0.64 (0.37–1.13) |
| **Maternal MUAC**                  |          |           |             |
| \(< 23 \text{ cm} \)               | 91       | 156       | 2.73 (1.94–3.82) | 2.10 (1.39–3.01) |
| \( \geq 23 \text{ centimetres} \)  | 98       | 458       | 1           |             |
| **Gestational age**                |          |           |             |
| SGA                                | 58       | 79        | 3.00 (2.03–4.42) | 1.94 (1.86–4.52) |
| AGA                                | 131      | 535       | 1           |             |
| **Placental weight**               |          |           |             |
| \(< 350 \text{ g} \)               | 94       | 141       | 3.32 (2.36–4.67) | 2.42 (1.67–3.54) |
| \( \geq 350 \text{ g} \)           | 95       | 473       | 1           |             |
| **Altitude**                       |          |           |             |
| \(< 2000 \text{ m} \)              | 39       | 173       | 1           |             |
| 2000–3000 \text{ m}                | 31       | 117       | 1.38 (0.89–2.17) | 1.38 (0.81–2.37) |
| \( > 3000 \text{ m} \)             | 119      | 324       | 1.63 (1.09–2.45) | 1.89 (1.19–3.01) |
| **BMI**                            |          |           |             |
| \(< 18.5 \text{ kg/m}^2 \)          | 77       | 134       | 2.46 (1.74–3.49) | 2.57 (1.72–3.83) |
| \( \geq 18.5 \text{ kg/m}^2 \)     | 112      | 480       | 1           |             |
| **Known chronic disease**          |          |           |             |
| No                                 | 179      | 597       | 1           |             |
| Yes                                | 10       | 17        | 0.51 (0.23–1.13) | 0.71 (0.28–1.80) |
of foods, inadequate intake due to a higher number of individuals, and the existence of food insecurity that may affect the nutritional status of the members as general, especially the mothers during pregnancy. Because pregnant mothers need additional nutritional supplementation during conception since they are the more vulnerable group for malnutrition. Nutritional intervention could help to increase maternal weight, in particular during pregnancy, and thereby reduce the risk attributable to low maternal weight.

Conclusions
In our knowledge, even though this study was the first study in the country, the prevalence of intrauterine growth restriction is a major Public Health concern. Maternal education, gestational age, BMI, family size in the household, maternal mid-upper arm circumference, placental weight, and altitude were found the most predictor variable. To avert intrauterine growth retardation, decreasing small for gestational age and increasing placental weight is very essential through additional nutritional supplementation during pregnancy. Because, when maternal weight increased, IUGR/ SGA will be substantially decreased.

Education is the core center of knowledge, so the government should address at least primary education for females. Health professionals including health extension workers shall have to counsel women about the importance of birth interval (interpregnancy interval), nutrition, and giving health care for women before (preconception care) and during pregnancy (antenatal care follow up) and nutritional intervention could help to increase maternal weight and thereby reduce the risk attributable to IUGR. The health care providers should give special attention to pregnant women living in high altitudes, critically to their weight (following pregnancy weight gain in each trimester). Obstetricians and perinatologist need to recognize the fetus(es) at risk of IUGR, to identify the modifiable risk factors and optimize the maternal systemic diseases. Further clinical follow-up research is essential which includes placental, maternal, and fetal gene.

Abbreviations
BMI: Body Mass Index; BP: Blood pressure; Cm: Centimeter; EDHS: Ethiopian demographic and health survey; GH: Gestational Hypertension; Kg: Kilogram; M: Meter; IUGR: Intrauterine growth restriction/restriction; IUM: Intrauterine mortality; MUAC: Mid-Upper Arm Circumference; PE: Preeclampsia; OR: Odds Ratio; SGA: Small-for-Gestational Age

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Authors' contributions
All stated authors DT, MT, AD, and SA were involved in this study from the inception to design, acquisition, analysis, and interpretation of data and drafting of the manuscript. All the authors read and approved the final manuscript.

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Availability of data and materials
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Ethics approval and consent to participate
Ethical clearance was obtained from Debre Tabor University, Research Ethical Review Committee. Then, a permission letter was obtained from each hospital administrators. Finally, written informed consent from each respondent.

Consent for publication
Not applicable for this section.

Competing interests
We declare that there is no competing interest with anyone else.

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