RESEARCH ARTICLE

Undernutrition and its associated factors among pregnant mothers in Gondar town, Northwest Ethiopia

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Abstract

Background

Regardless of significant gains and signs of progress in the last decades, maternal undernutrition remains a major public health concern in Ethiopia. Supporting the progress of interventions being taken in the country with evidence might be important to keep the sustainability of the government effort. We aimed at determining the extent of undernutrition and its associated factors among pregnant mothers in Gondar town, Northwest Ethiopia.

Method

A community-based cross-sectional study was conducted by including 940 selected pregnant mothers through a cluster sampling. A face-to-face interview was administered to pregnant mothers at a household level. We collected data using an Online Data collection kit (ODK) and the collected data was directly downloaded from the Google Cloud platform and finally imported to Stata 14 for further analysis. A multivariable logistic regression model was fitted to identify factors associated with undernutrition. A crude and adjusted odds ratio with their 95% confidence interval was calculated to declare the association and its significance. Model fitness was assured through the Hosmer and Lemeshow goodness of fit test and model classification accuracy.

Result

14.4% (95%CI: 12.3–16.7) of pregnant mothers were undernourished. After adjusting for the main covariates; as the age of the pregnant mothers increases the odds of being undernourished decreases by 10% (AOR: 0.90; 95%CI: 0.87–0.95) and having a poor marital condition (AOR: 2.18; 95%CI: 1.03–4.59) increased the odds of undernutrition. The risk of undernutrition was also decreased by 43% among those pregnant mothers who consumed coffee sometimes (AOR: 0.57; 95%CI: 0.36–0.89) as compared to daily consumers.
Conclusion
A significant proportion of pregnant mother were undernourished. Integration of nutritional interventions with maternity health services would be highly important to improve the nutritional status of the mothers. It is also important to counsel pregnant mothers about a consequence of frequent coffee drinking during their pregnancy.

Background
Globally, malnutrition is an important health concern, predominantly in under-five children and pregnant women. The World Health Organization (WHO) classifies malnutrition as the greatest threat to public health [1] and every country is facing serious challenges from malnutrition [2, 3]. In spite of extensive global economic growth in recent decades, maternal undernutrition is highly prevalent in most countries in south-central and southeastern Asia and Sub-Saharan Africa [3–6].

Ethiopia is one of the countries with a high burden of maternal and child undernutrition. Though, maternal undernutrition has declined over the past 16 years, from 30% in 2000 to 22% in 2016, Ethiopia is still among countries with a high burden of maternal malnutrition [7]. Specifically, two institution based cross-sectional studies conducted in Amhara region reported a prevalence rate of undernutrition ranging from 16% to 29.8% that also showed a significant geographic variation [3, 8].

Maternal undernutrition in the low and middle-income countries is an underlying cause for a 3.5 million mother’s deaths and disabilities due to physical and mental effects of poor dietary intake in the earliest months of life [7, 9, 10]. Previous studies have established that undernourished pregnant women suffer from a combination of chronic energy deficiency that leads them to have a low birth weight (LBW), preterm and unsuccessful birth outcomes [11–13].

Regardless of a significant gains and signs of progress in the last decade, maternal undernutrition still remains a major public health problem in Ethiopia [3, 14]. The government of Ethiopia has developed a revised national nutrition program in 2016 to address the double burden of malnutrition in pregnant and lactating women [1, 10, 15]. Even though a progress of this program implementation needs to be supported with a continuous evidence through research, a limited institution based studies that lack an important variables crucial for prioritizing, designing and initiating intervention programs have been conducted [8]. The objective of this study was, therefore, to assess the magnitude of undernutrition at the community level by including an important variables among pregnant women living in Gondar town.

Methods
Study setting, design, and population
We conducted a cross-sectional study from June 15 to July 30, 2018, on pregnant mothers in their second and third trimester of pregnancy who are living in Gondar Town. Gondar town is located in the Northern part of Amhara regional state at a distance of 747 km away from Addis Ababa and 170 km from Bahir Dar (the regional capital city). Gondar town has a total population of 333,103 and an expected number of pregnant women in the town is estimated to be 11,225 in which at least 8,913 of them are living in urban kebeles (clusters) in 2017/2018. Pregnant women who were living in a randomly selected urban kebeles were considered as the study population.
Sample size and participant recruitment

A cluster sampling was used to reach the study participants. On the first stage, five urban clusters from 12 urban clusters were selected by lottery method and on the second stage, a house to house census of pregnant mothers found in the six selected clusters was conducted. The required sample size was determined in Epi Info 7 by using a single and double population proportion formula. A parity variable from a study conducted to determine undernutrition in Gondar referral hospital [8] was used to determine a sample size for our study assuming 80% power, 95% confidence level, an odds ratio of 2.25, proportion of undernutrition in those women’s with no previous birth as 11.62%, proportion of undernutrition among pregnant mothers with >4 births as 22.8%, cluster effect of 2, and a 10% non-response rate. Our double population proportion formula yielded the higher sample size of 858. However, because of the nature of the cluster sampling, 940 pregnant mothers were actually found and included in the study.

Data collection

An interviewer-administered Amharic version of the questionnaire was used to collect the required information from the study participants. The online data collection kit (ODK) application was used to collect and manage data to improve its quality. The prepared questionnaire was designed on the excel spreadsheet, converted to XLSForm online, and checked for its validity using Enketo. The validated form was downloaded and uploaded on a Lenovo tab 7 ODK application. The data storage place for the project was created on the Google cloud platform. The data collectors sent the collected data to the online created data storage system and the principal investigator directly downloaded the data from the system.

Maternal nutrition was assessed using a Mid Upper Arm Circumference (MUAC) and categorized as undernutrition (MUAC < 22) and normal (MUAC ≥ 22) [8, 16]. Maternal depression and anxiety were measured by using an Edinburgh Postnatal Depression Scale (EPDS) revised for Ethiopian context [17]. A mother was considered as depressed if she had a total measurement scale of > 12. Anxiety was measured by using the third, fourth, and fifth scale on EPDS and a mother with a total scale of > 6 was classified as having anxiety symptoms [18]. Social support was assessed by using the Oslo Social Support Scale (OSSS-3) and pregnant mothers who scored nine and above were labeled as having “Good” social support and those scored below nine were labeled as having “Poor” social support [19].

Husband support was assessed by a question “My husband helps me a lot” with the options: “Always (5)”, “Most of the time (4), “Some of the time (3)”, “Rarely (2)”, and “Never (1)”. Coffee consumption was assessed based on the number of days the mother consumed coffee in a week. Those who have been consuming coffee one to three days per week were considered as consuming coffee sometimes, those reported consuming coffee every day as daily drinkers, and those have not been drunk before as non-drinkers. A marital condition was also assessed based on mother’s perspective regarding their marital situation in a day to day life and if the marital situation is loving and easy going without conflict and disagreement was considered as “Bad” and if not it was considered as “Good”. Physical activity of the mother was assessed by a question “Have you practice physical activity such as brisk walking, dancing, gardening, and usual housework for at least three hours/week” and their answer was documented as “Yes” and “No” [20]. Food access for the last three months was assessed by a single question: “In the last three months, have you ever worried that your household would not have enough food?” a standard question which has been used for assessing the level of food inaccessibility in a household.
The data collection tool was first prepared in English, translated into Amharic and backtranslated to English to check for its consistency before administration. Nine trained BSc. nurses were recruited, trained, and collected the data through a house to house survey. The principal investigator and one additional recruited field supervisor supervised the overall data collection activity.

Data analysis
A data that was collected online was downloaded from the Google Cloud Platform and imported to the Stata 14 for further analysis. Data were checked and re-checked for completeness before importing and further cleaning was done by running frequencies. Mean, median, proportion/percentage, interquartile range, standard deviations, and exploratory analysis were conducted to understand the nature of the data. Preliminary findings were presented using tables. A bi-variable and multivariable logistic regression model was fitted to identify factors associated with undernutrition. Adjusted odds ratio with its 95% confidence interval was computed to test for statistical significance. Model adequacy was checked using the Hosmer and Lemeshow goodness of fit test (p-value = 0.59) and a classification accuracy (85.6%).

Ethical consideration
The University of Gondar Institutional Review Board ethics committee approved this study. A support letter was obtained from the University of Gondar Research and Community Service to the Gondar town health office and respective districts. Participants of the study were informed about the purpose, objectives and their right to participate or not participate in the study. Privacy and confidentiality of the study participant were ensured by not using a personal identifier. Written informed consent was obtained from the study participants in order to be part of the study. Pregnant mothers who were seriously ill during a house to house data collection time were referred to Gondar University Specialized Hospital and those found severely malnourished were also counseled about proper nutrition.

Result
Socio-demographic and maternal characteristics of the participants
A total of 940 pregnant mothers participated in the study. Most of the study participants were married 899 (95.6%). Majority of the study participants 900 (95.7%) were adults with a mean age and standard deviation of 26.6 (±4.59) years. Six hundred seventy-two (71.5%) of the study participants were housewife’s while 751(79.89%) of them were Orthodox Christianity followers. Likewise, 632(69%) reported their marital condition as “Good” and half of the study participants, 472 (50.2%), had low income. Five hundred ninety-two (62.98%) and 890 (94.7%) of the participants were in their 2nd trimester and had access for at least one ANC visit in their current pregnancy, respectively. (Table 1)

Nutrition and psychosocial health-related characteristics of the study participants
The prevalence of undernutrition among pregnant mothers using MUAC measurement was 14.4% (95%CI: 12.3–16.7). Mothers who had depression and anxiety based on EPDS score were 87(9.26%) and 112(11.91%), respectively. Reviewing the status of participants’ social support showed that 747(79.47%) of the pregnant mothers had good social support and parallel to this, 693 (75.2%) of the participants witnessed that their husband supported them always or most of the time. Among the participated pregnant mothers, 872(92.8%) were leveled their
health condition as “Good” and most of them, 921 (97.98), were reported as they were doing physical activity. In addition, 396 (42.2%), of the pregnant mothers explained that they have cups of coffee in a daily bases. (Table 2)
Factors associated with undernutrition

On a multivariable binary logistic regression analysis, after adjusting for other co-variables, the age of the mother, marital condition, and coffee drinking had a significant association with nutritional status of pregnant mothers. Accordingly, as the age of the pregnant mothers increases by one year, the odds of undernutrition decreases by 10% (AOR: 0.90; 95%CI: 0.87–0.95). Those pregnant mothers who had a bad marital condition (AOR: 2.18; 95%CI: 1.03–4.59) were 2.18 times more likely to be undernourished than those mothers who had a good marital condition. Mothers who drink coffee one to three days per week were 43% less likely to develop under-nutrition as compared to pregnant mothers who drink coffee daily. (Table 3)
Table 3. Factors associated with nutritional status of pregnant mothers in Gondar town, northwestern Ethiopia, 2018.

| Variable                              | Nutritional status | COR 95%CI                      | AOR 95%CI                      |
|---------------------------------------|--------------------|--------------------------------|--------------------------------|
| Age of the mother                     |                    |                                |                                |
|                                       | Under-nutrition    | Normal                         |                                |
|                                       | 135                | 805                            | 0.91(0.87,0.95)                | 0.90(0.87,0.95)*               |
| Marital status                        |                    |                                |                                |
| Married                               | 125                | 774                            | 1.99(0.95,4.17)                |                                |
| Divorced/separated                    | 10                 | 31                             | 1                              |                                |
| Marital condition from a wife’s perspective |                |                                |                                |
| Good                                  | 124                | 777                            | 1                              | 1                              |
| Bad                                   | 11                 | 28                             | 2.46(1.19,5.07)                | 2.18(1.03,4.59)*               |
| Household income                      |                    |                                |                                |
| Low                                   | 79                 | 393                            | 1                              |                                |
| Medium                                | 47                 | 328                            | 0.71(0.48,1.05)                |                                |
| High                                  | 9                  | 84                             | 0.53(0.26,1.10)                |                                |
| Type of pregnancy                     |                    |                                |                                |
| Planned                               | 107                | 675                            | 1                              |                                |
| Unplanned                             | 23                 | 114                            | 1.50(0.67,3.34)                |                                |
| Unwanted                              | 5                  | 16                             | 4.04(1.13,14.43)               |                                |
| Mothers education                     |                    |                                |                                |
| No formal education                   | 21                 | 106                            | 1.39(0.75,2.58)                |                                |
| Grade 1–8                             | 45                 | 198                            | 1.59(0.95,2.68)                |                                |
| Grade 9–12                            | 42                 | 311                            | 0.95(0.57,1.59)                |                                |
| Diploma and above                     | 27                 | 190                            | 1                              |                                |
| Difficult to access food in the last three months |                |                                |                                |
| Yes                                   | 11                 | 41                             | 1.65(0.83,3.30)                |                                |
| No                                    | 124                | 764                            | 1                              |                                |
| Depression                            |                    |                                |                                |
| Yes                                   | 14                 | 73                             | 1.16(0.63,2.12)                |                                |
| No                                    | 121                | 732                            | 1                              |                                |
| Anxiety                               |                    |                                |                                |
| Yes                                   | 15                 | 97                             | 1.20(0.61,1.95)                |                                |
| No                                    | 120                | 708                            | 1                              |                                |
| Anxiety x Depression                  |                    |                                |                                |
|                                       | P-value (0.63)      |                                |                                |
| Husband support                       |                    |                                |                                |
| Always                                | 96                 | 597                            | 1                              |                                |
| Some of the time                      | 24                 | 154                            | 0.97(0.59,1.56)                |                                |
| Rarely/Never                          | 15                 | 54                             | 1.73(0.94,3.18)                |                                |
| Parity                                |                    |                                |                                |
| 0                                     | 63                 | 295                            | 1                              |                                |
| 1                                     | 38                 | 257                            | 0.69(0.45,1.07)                |                                |
| 2–8                                   | 34                 | 253                            | 0.63(0.40,0.98)                |                                |
| Coffee drinking                       |                    |                                |                                |
| Daily                                 | 65                 | 331                            | 1                              |                                |
| Sometimes (1–3 times per week)        | 34                 | 283                            | 0.61(0.39,0.95)                | 0.57(0.36,0.89)*               |
| Never                                 | 36                 | 191                            | 0.96(0.61,1.45)                | 0.96(0.61,1.50)                |

*significance at p-value <0.05

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Discussion

Maternal nutrition prior to and during pregnancy play a central role in determining the long-term health and nutritional effect of both the mother and her growing fetus [9, 21]. Maternal undernutrition is highly prevalent in low and middle-income countries [7, 9, 10] and Ethiopia as one of these countries has been significantly affected by the burden of undernutrition. We conducted a cross-sectional study to identify the burden and associated factors of undernutrition among pregnant mothers residing in an urban setting. The burden of maternal undernutrition in Gondar town was 14.4%. This finding was similar to the study conducted in the same place with the current study that reported 16.2% [8]. The insignificant discrepancy might be due to the study setup, the current study was community-based while the previous was an institution based study, as institution-based studies might overestimate the true magnitude of the problem.

Compared to our finding, a lower prevalence of undernutrition was reported in Wondo Genet (9.2%) [22] that used a different cut off value with our study; they have used a MUAC < 21 cm while we have used a MUAC < 22 cm. The other possible source of discrepancy might be the term of pregnancy, we have included women in their second and third trimester while they have included all terms as pregnancy term could advance nutritional depletion. Likewise, three studies reported from Sudan [23], Nigeria [24] and Lebanon [25] have reported a relatively lower prevalence than ours and the possible reason might be the use of different measurement in addition to different socio-demographic nature of the study area; they have used BMI while we used MUAC.

On the contrary, the prevalence reported in the current study was far lower than a prevalence reported in Southern Nations Nationalities and People Region (SNNPR) 71.15% [26], Sidama, Southern Ethiopia (31.4%) [27], Gambella 28.6% [28], rural Eastern Ethiopia 19.8% [29] and Rayitu Woreda, Oromia 24% [14]. These studies were conducted in rural areas unlike ours that exclusively conducted in urban area.

Age of the mother, marital condition, and coffee drinking were showed a statistically significant association with undernutrition of pregnant mothers. Based on this study, the age of pregnant mothers was found conversely associated with the nutritional status of mothers. As the age of the mother increased by one year her risk of undernutrition decreases by 10% and it is consistent with a study conducted in southern Ethiopia [27], Lebanon [25] and Bangladesh [30]. This is because young mothers, apart from insufficient development of their reproductive system and their need of nutrition for their growing body, they are often remarkably surrounded by unfavorable nutritional conditions [21, 25, 31].

A marital condition was found to be an important predictor of pregnant mothers’ nutritional status. The probability of being undernourished was 2 times higher among pregnant mother who had a bad marital condition as compared to those mothers who had a good marital condition. A bad marital condition that explained as dissatisfaction in a marital relationship would affect a support or care that the mother should get from her partner and this could indirectly affect her nutritional condition.

We found that a frequent coffee drinking increased the risk of undernutrition. Pregnant mothers who none-frequently drink coffee were 43% less likely to develop malnutrition compared to those reported daily consumption of coffee. This is scientifically evidenced that moderate caffeine intake (300 mg/day) or taking about three cups of coffee is probably not harmful to pregnant mothers [32, 33] but taking a large amounts of caffeine may cause nutrient depletion and interfere with nutrient absorption [32–34]. In Ethiopian culture, coffee ceremony is conducted at least two times in a day (morning and night) and at each ceremony a minimum of three cups of coffee are taken right after meals and this would most affect nutrient.
absorption. Similar to other studies [35, 36], undernutrition was failed to have a significant association with depression and anxiety scale of pregnant mothers.

As a limitation; a cross-sectional nature of the study might affect the establishment of a causal relationship between identified risk factors and undernutrition as all the identified exposures/risk factors have a probability to change overtime; fail to incorporate a dietary diversity score as a risk factors of undernutrition might have also introduced a residual confounding problem.

Conclusion

Although undernutrition in pregnant mothers in this study was found to be lower as compared to other similar studies, it should be considered as a major public health problem as undernutrition in pregnancy plays a key role for enhancing maternal health and child development.

Our study also identified pregnant mothers at higher risk of being malnourished: younger age, those with a poor marital condition, and those reported a frequent coffee drinking.

The prevention of maternal undernutrition is a long-term investment and it requires a multi-sectoral collaboration and coordination between national and international organizations. Consequently, the concerned governmental and the existing non-governmental bodies shall strengthen their coordinated effort towards improving maternal nutrition by giving due consideration to pregnant mothers in younger age and those having a problem with their partner. Dual counseling service for the pregnant mothers and her partner during the antenatal care service might also helpful to enhance the support that the mother got to improve her nutritional status. The mothers shall also be counseled about the effect of frequent coffee consumption to their fetus and their health.

Supporting information

S1 Table. English version questioner to assess underweight and its associated factors in Gondar Town, Northwest Ethiopia.

S2 Table. Amharic version questioner to assess underweight and its associated factors in Gondar Town, Northwest Ethiopia.

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References

1. Salunkhe AH, Pratinidhi A, Kakade SV, Salunkhe JA, Mohite VR, Bhosale T. Nutritional status of mother and gestational age: Online Journal of Health and Allied Sciences. 16 (4) (no pagination), 2017. Article Number: 2. Date of Publication: 01 Oct 2017.

2. Neggers Y. Epidemiology of Malnutrition: Maternal and Child Malnutrition. Journal of Gynecology and Neonatal Biology. 2016; 2(2):0-.

3. Nana A, Zema T. Dietary practices and associated factors during pregnancy in northwestern Ethiopia. BMC pregnancy and childbirth. 2018; 18(1):183. https://doi.org/10.1186/s12884-018-1822-1 PMID: 29801471

4. Tang AM, Chung M, Dong K, Terrin N, Edmonds A, Assefa N, et al. Determining a global mid-upper arm circumference cutoff to assess malnutrition in pregnant women. Food and Nutrition Technical Assistance. 2016.

5. Duru CB, Iwu AC, Uwakwe KA, Diwe KC, Nnebue CC, Merenu IA, et al. Prevalence and Determinants of Adolescent Malnutrition in Owerri, Imo State, Nigeria.

6. Bain LE, Awah PK, Geraldine N, Kindong NP, Siga Y, Bernard N, et al. Malnutrition in Sub–Saharan Africa: burden, causes and prospects. Pan African Medical Journal. 2013; 15(1).

7. Loudyi FM, Kassouati J, Kabiri M, Chahid N, Kharbach A, Aguenaou H, et al. Vitamin D status in Moroccan pregnant women and newborns: reports of 102 cases. The Pan African medical journal. 2016; 24.

8. Kumera G, Gedle D, Abelel A, Feyers F, Esthet F. Undernutrition and its association with socio-demographic, anemia and intestinal parasitic infection among pregnant women attending antenatal care at the University of Gondar Hospital, Northwest Ethiopia. Maternal health, neonatology and perinatology. 2018; 4(1):18.

9. Black R, Bhutta Z, Bryce J, Morris S, Victora C. The Lancet’s Series on Maternal and Child Undernutrition. The Lancet. 2013; 2013:1–12.

10. FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA. NATIONAL NUTRITION PROGRAM 2016–2020. 2016.

11. Acharya SR, Bhatta J, Timilsina DP. Factors associated with nutritional status of women of reproductive age group in rural, Nepal. Asian Pac. J. Health Sci., 2017; 4(4):19–24.

12. Hasan M, Sutradhar I, Shahabuddin A, Sarker M. Double Burden of Malnutrition among Bangladeshi Women: A Literature Review. Cureus. 2017; 9(12).

13. Abdel RA R Afifi Ali, DK Talkhan H. Pregnancy outcome and the effect of maternal nutritional status. Journal of the Egyptian Society of Parasitology. 2013; 43(1):125–32. PMID: 23697021

14. Gebre B, Biadgglign S, Taddesse Z, Legesse T, Letebo M. Determinants of malnutrition among pregnant and lactating women under humanitarian setting in Ethiopia. BMC Nutrition. 2018; 4(1):11.

15. FAO, IFAD, UNICEF, WFP, WHO. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. 2018.

16. Bye A, Shawe J, Stephenson J, Bick D, Brima N, Micail N. Differences in pre-conception and pregnancy healthy lifestyle advice by maternal BMI: Findings from a cross sectional survey. Midwifery. 2016; 42:38–45. https://doi.org/10.1016/j.midw.2016.09.013 PMID: 27744203

17. Hanlon C, Medhin G, Alem A, Araya M, Abdulahi A, Hughes M, et al. Detecting perinatal common mental disorders in Ethiopia: validation of the self-reporting questionnaire and Edinburgh Postnatal Depression Scale. Journal of affective disorders. 2008; 108(3):251–62. https://doi.org/10.1016/j.jad.2007.10.023 PMID: 18055019

18. Nguyen TN, Faulkner D, Allen S, Hauck YL, Frayne J, Rock D, et al. Managing pregnant women with serious mental illness: using the Edinburgh Postnatal Depression Scale as a marker of anxiety and depressive symptoms. Australian & New Zealand Journal of Psychiatry. 2010; 44(11):1036–42.

19. Nosikov A, Gudex C. Development of a common instrument for mental health. EUROHIS: Developing common instruments for health surveys. 2003; 57:35.

20. World Health Organization. Global recommendations on physical activity for health. 2011. Genf: WHO Press Google Scholar. 2010.
21. Symington EA, Baumgartner J, Malan L, Zandberg L, Ricci C, Smuts CM. Nutrition during pregnancy and early development (NuPED) in urban South Africa: a study protocol for a prospective cohort. BMC pregnancy and childbirth. 2018; 18(1):308. https://doi.org/10.1186/s12884-018-1943-6 PMID: 30041623

22. Kuche D, Singh P, Moges D, Belachew T. Nutritional status and associated factors among pregnant women in Wondo Genet District, Southern Ethiopia. JFSE. 2015; 5:85–94.

23. Elmugab il A, Rayis DA, Abdelmageed RE, Adam I, Gasim GI. High level of hemoglobin, white blood cells and obesity among Sudanes e women in early pregnancy: a cross-sectional study. Future science OA. 2017; 3(2):FSO182. https://doi.org/10.4155/fsoa-2016-0096 PMID: 28670473

24. Adinma J, Umeononihu O, Umeh M. Maternal nutrition in Nigeria. Tropical Journal of Obstetrics and Gynaecology. 2017; 34(2):79–84.

25. Zghelib C, Matta J, Sacre Y. Evaluation of Food Behaviour and Nutritional Status of Pregnant Women Resident in Keserwan. J Preg Child Health. 2017; 4(331):2.

26. Sonko A. Assessment of dietary practice and anthropometric status of pregnant women in Aleta Chuko Woreda Southern Nations, Nationalities and People's Region/SNNPR/, Ethiopia. J Epidemiol Public Health Rev. 2016; 1(1):1–9.

27. Regassa N, Stoecker BJ. Contextual risk factors for maternal malnutrition in a food-insecure zone in southern Ethiopia. Journal of biosocial science. 2012; 44(5):537–48. https://doi.org/10.1017/S002193201200017X PMID: 22716940

28. Nigatu M, Gebrehiwot TT, Gemeda DH. Household Food Insecurity, Low Dietary Diversity, and Early Marriage Were Predictors for Undernutrition among Pregnant Women Residing in Gambella, Ethiopia. Advances in Public Health. 2018; 2018.

29. Kedir H, Berhane Y, Worku A. Magnitude and determinants of malnutrition among pregnant women in eastern Ethiopia: evidence from rural, community-based setting. Maternal & child nutrition. 2016; 12 (1):51–63.

30. Hossain B, Sarwar T, Reja S, Akter M. Nutritional status of pregnant women in selected rural and urban area of Bangladesh. J Nutr Food Sci. 2013; 3(4):1–3.

31. Abasizadeh S, Hemati Z, Deris F. Prevalence of malnutrition during pregnancy and associated factors in women of Ardal County in 2012–2013. International Journal of Epidemiologic Research. 2016; 3(1).

32. Da Mota Santan a J. Alves de Oliveira Queiroz V., Monteiro Brito S., Barbosa Dos Santos D., Marlucia Oliveira Assis A. Food consum ption patterns during pregnanc y: A longitudinal study in a region of the north east of Brazil. Nutr. Hosp. 2015; 32:130–8 . https://doi.or g/10.3305/ nh.2015.32.1.8970 PMID: 26262707

33. Wolde T. Effects of caffeine on health and nutrition: A Review. Food Science and Quality Management. 2014; 30:59–65.

34. Prenkert M, Ehnfors M. Growth data of underprivileged children living in rural areas of Chin State, Burma/Myanmar, compared to the WHO reference growth standards: an observational study. BMJ open. 2016; 6(1):e009119. https://doi.org/10.1136/bmjopen-2015-009119 PMID: 26787249

35. Dalky HF, Qandil A, Alqawasmi AA. Factors Associated With Undernutrition Among Pregnant and Lactating Syrian Refugee Women in Jordan. Global Journal of Health Science. 2018; 10(4):58.

36. Lukose A, Ramthai A, Thomas T, Bosch R, Kurpad AV, Duggan C, et al. Nutritional factors associated with antenatal depressive symptoms in the early stage of pregnancy among urban South Indian women. Maternal and child health journal. 2014; 18(1):161–70. https://doi.org/10.1007/s10995-013-1249-2 PMID: 23440491