Review Article

A Review of the Impact of Food Insecurity, Undernutrition, and Influential Factors on Pregnant Women

Abstract

The purpose of this review is to examine the serious effects that undernutrition and food insecurity have on expectant mothers and to pinpoint important variables that may exacerbate these issues. Adequate nutrition is essential throughout pregnancy for the developing fetus's health and well-being as well as the mother's. Pregnant women, however, encounter obstacles in many regions of the world pertaining to food availability, access, and use, which can result in malnutrition and negative health effects.It has been discovered that there is a strong correlation between undernutrition in pregnant women and food insecurity, which is characterized as restricted or unclear access to enough safe and nutritious food. Maternal undernutrition can have far-reaching effects if essential minerals like iron, folate, calcium, and protein are not consumed in sufficient amounts. Pregnancy-related undernutrition raises the risk of low birth weight, premature delivery, developmental delays, and compromised immune system in both the mother and the unborn child.Pregnant women's undernutrition and food insecurity are caused by a variety of circumstances. A major part is played by socioeconomic variables like unemployment, poverty, and low levels of education. Cultural customs, poor maternal nutrition education, and restricted access to healthcare services all exacerbate the issue. In addition, food poverty can be made worse by conflicts, natural disasters, and climate change, which can also affect pregnant women's access to and availability of nutrient-dense food.

Keywords

Undernutrition, food insecurity, unborn, nutritional educationand *pregnant women's*

1. Introduction

Pregnancy is a time of rapid and profound physiological changes from the time of conception until birth(Aya*et al.,* 2019). Nutritional requirements increase during pregnancy to maintain maternal metabolism and tissue accretion while supporting foetal growth and development (Talla*et al.,* 2023).Pregnancy is a critical stage in which mothers need optimal nutrients of good qualities of food to support the developing fetus (Deyganto., *et al* 2021). An adequate supply of nutrients and oxygen for the mother to her fetus is one of the factors that are critical for fetal survival.Food insecurity can have detrimental effects on the physical and mental health of pregnant women.The health of mothers and children is significantly impacted by the complicated problem of food insecurity. An overview of the idea of food insecurity and its global prevalence among pregnant women is given in this section. It also emphasizes how critical it is to solve this problem in order to protect the health of expectant moms and their newborns.

The ability of the mother to provide nutrients for her baby depends upon the nutritional status, body size, and body composition of the mother and all of which are being established throughout the life of her fetus (Kembra*et al.,* 2023)). Pregnancy outcomes are significantly affected by nutrition, which is recognized as a key factor in both a healthy and successful pregnancy and the long-term health of the next generation (Nicole*et al.,* 2022). Malnutrition caused by inadequate maternal nutrition during pregnancy can have a negative impact on pregnancy outcomes, including low birth weight, premature delivery, fetal development failure, and an increased risk of prenatal and neonatal mortality and morbidity (Zohra *et al.,* 2021).

Undernutrition is an important public health issue particularly for vulnerable groups including children and women of childbearing age especially pregnant mothers (Dalky H*et al.,* 2018). Undernutrition is a serious global health problem. About 795 million people are undernourished mostly in low and middle-income countries and the problem is most critical during pregnancy (Prajakta Ganesh Joshi G and Jain S, Dubey V., 2017). Globally, undernutrition is contributing to the deaths of 3.5 million mothers and under 5 years of age children each year. It is estimated that 13 million children are annually born with IUGR (intrauterine growth retardation), 112 million are underweight secondary to undernutrition during pregnancy (Skinner *et al.*,2012). Food insecurity has been linked to a number of unfavorable health consequences, including

malnutrition, stunted growth, shortages in some micronutrients, and poor cognitive development in adolescent females, according a study by (Sisay 2020).

Maternal undernutrition during pregnancy and breastfeeding periods has adverse effects on child growth and development. This is because during this period, maternal nutrient needs increase and if they are not met, mothers may suffer from wasting which limits their ability to fully satisfy the needs of their infants (WHO 2017). Nutritious foods and diverse diets which are of good quality and sufficient quantity, are essential for children to meet their nutrient needs and support growth, especially during the first 1000 days of a child's life which are critical for optimal child growth, health and development (WHO 2017). In low income regions, low quality, monotonous diets based mainly on grains and lacking vegetables, fruits and animal-source foods, dominate the diets of many women and children, leading to both maternal and childhood malnutrition (Nti CA., 2014).

2. Literature review

2.1. Factors Influencing Food Insecurity among Pregnant Women

2.1.1. Effect of low Income and poverty levels Pregnant Women

Financial constraints may prevent women from seeking timely and regular prenatal check-ups, leading to missed opportunities for early intervention and increased risks for both maternal and fetal health (Janaki S andPrabakar S2024). Lower socioeconomic status is associated with decreased prenatal care (Janaki S andPrabakar S2024). During pregnancy, poor diets lacking in key nutrients – like iodine, iron, folate, calcium and zinc can cause anaemia, pre-eclampsia, haemorrhage and death in mothers (Aya *et al*,. 2019). They can also lead to stillbirth, low birthweight, wasting and developmental delays for children.

Food insecurity is common among pregnant women in low-income households, and it is associated with an increased risk of pregnancy complications and negative health outcomes for both the mother and the child (Amber *et al* 2022). Food insecurity is associated with an increased risk of pregnancy complications and mental and physical health outcomes (Fiona H et al,. 2022).Pregnancy and birth are the first of several definitive life events that shape health outcomes within the course of an individual's lifetime(Lire*et al.*, 2022). the impact of poverty on pregnancy and subsequent child health needs to be placed within the context of the cumulative influence of multiple adverse exposures directly and indirectly experienced by those living in poverty, often from one generation to the next(Halfon N and Hochstein M., 2002).

2.1.2. lack of Food Accessibility and Availability on Pregnant Women

Micronutrient deficits can have major health consequences for both the developing baby and the pregnant mother when there is a lack of consistent availability to nutrient-dense meals. For the fetus to develop normally and for the mother's general health, micronutrients like folate, vitamin B12, iron, folic acid, calcium, and other vitamins are necessary (Alison D et al 2016). Worldwide, there is a high prevalence of micronutrient deficiencies during pregnancy, especially in low-income nations where nutritional deficiencies are common due to poor diets (C. N. Purandare,. 2013). These deficiencies may result in low birth weight, premature delivery, and developmental problems for the unborn child throughout pregnancy. (C. N. Purandare,. 2013).For instance, a pregnant woman's lack in vitamin C may have detrimental effects on the

brain development of the fetus. Consequently, it is essential for pregnant women's health and wellbeing to have access to enough nourishing food, especially if they are living in low-income or disadvantaged circumstances.

2.1.3. Lack of Awareness of proper nutrition during pregnancy

Proper nutrition during pregnancy is crucial for the health and well-being of both the mother and the child. Pregnant women often lack adequate knowledge of nutrition needs and access to reliable nutrition information (Nicole E and Marshall, *et al,*. 2021). A poor pregnancy diet can result in nutritional deficiencies, which may impair fetal development and lead to health complications for the child. To maintain a healthy pregnancy, approximately 300 extra calories are needed each day, which should come from a balanced diet of protein, fruits, vegetables, and whole grains. Sweets and fats should be kept to a minimum.

A poor pregnancy diet can result in nutritional deficiencies, which may impair fetal development and lead to health complications for the child. However, education and nutritional support can play a crucial role in improving the nutritional awareness of pregnant women and promoting healthy eating during pregnancy(*Dennis Anderson-Villaluz., 2022*). Initiatives aimed at addressing barriers to nutritional pregnancy preparation and providing adequate support and resources to women of childbearing age have the potential to improve long-term health outcomes for future children (Parikh *et al,*.2021). It is essential to ensure that pregnant women have access to accurate and comprehensive information about the importance of proper nutrition during pregnancy to support their health and well-being, as well as that of their unborn child (Weijie Fang *et al,*. 2023).

2.2 Prevalence of Undernutrition among pregnant women

2.2.1 Inadequate dietary intake

Inadequate dietary intake among pregnant women is a concern as it can negatively impact maternal and offspring health outcomes. Insufficient consumption of food can result in insufficiencies of vital minerals as calcium, iron, vitamin D, folate, and omega-3 fatty acids. Both the mother's general health and wellbeing and the fetus's proper development depend on these nutrients (Yue Cheng*et al.,* 2009). Deficiencies can impair fetal growth, raise the likelihood of problems, and harm the mother's general health and immune system.

Pregnant women who consume inadequate nourishment may be more susceptible to problems like anemia, reduced immune systems, exhaustion, and increased infection susceptibility (Phnom Sukchan*et al* 2010). For example, the prevalence of inadequacy of nutrient intake in some studies was found to be as high as 86.8% for carbohydrates, 59.2% for protein, and 78.0% for fat (Nicole E and Marshall, et al,. 2021). Additionally, inadequate intakes of specific nutrients during pregnancy have been linked to poor maternal and infant outcomes, such as low birth weight and increased risks of various health conditions(Hagos DegefaHidru, *et al* 2020).

2.2.2Poor maternal education:

Inadequate maternal education may lead to a lack of knowledge on the significance of healthy eating during pregnancy. This may result in insufficient consumption of vital nutrients such as vitamins, iron, calcium, and folic acid. Inadequate consumption of nutrients can hinder the development of the fetus and raise the possibility of birth abnormalities, low birth weight, and other issues (Lim Z.X 2018). Maternal health issues may be exacerbated by ignorance of pregnancy diet. For instance, low iron consumption can result in iron-deficiency anemia, which can impair the pregnant mother's general health, energy levels, and level of weariness (Louis J. Muglia 2022). Making appropriate eating choices during pregnancy is greatly aided by maternal education. Expectant women might not know which foods to prioritize or steer clear of if they lack the necessary understanding (Franca Marangoni 2016). This may lead to an inadequate intake of vital nutrients and an over dependence on unhealthy processed foods that are rich in sugar, fats, and additives.

Unsatisfactory dietary instruction for mothers may raise their risk of gestational diabetes. Blood sugar elevation during pregnancy is the cause of this disease (Sara*et al.*, , 2021). Unbalanced blood sugar levels and an increased risk of this ailment might result from a lack of understanding about good eating practices and sufficient nutrition. Inadequate nutrition during pregnancy may have long-term effects on the mother and the unborn child. A child's chance of acquiring chronic illnesses such as obesity, diabetes, cardiovascular disease, and even mental health issues in later life might be raised by nutritional inadequacies experienced during pregnancy (Germaine 2008).

2.2.3 Cultural and social factors

Pregnant women's nutritional understanding and food habits are greatly influenced by cultural and societal variables (Elisabet , 2020). Studies reveal that a range of factors, such as sociodemographic traits, lifestyle-related elements, and pregnancy-related determinants, impact eating practices during pregnancy. Pregnant women's eating habits are significantly influenced by a number of factors, including socioeconomic status, age, education level, lifestyle, and religion (Manik 2021)).

Pregnant women's diets may not be as nutritionally adequate as they could be due to certain cultural customs and beliefs. Pregnant women may experience differences in the quality of their diets due to socioeconomic factors including geography and income level that might affect their availability to nutrient-dense foods (Elisabet , 2020). Undernutrition or insufficient nutrient intake during pregnancy may result from a dependency on processed and less nutritious foods in certain communities that have limited access to fresh fruits, vegetables, and other healthful food options because of a lack of supermarkets or farmers' markets (Manik 2021).

2.2.4. Geographical factors

Pregnant women who live in isolated or rural locations may experience food insecurity and undernutrition as a result of geographic considerations (Sagni Girma 2021). Fresh and healthy food access may be hampered by the scarcity of supermarkets, farmers' markets, and medical facilities in these communities. Long commutes and other obstacles to mobility can make it more difficult for expectant mothers to eat a varied and healthful diet. Preterm birth and low birth weight are two outcomes that can result from this, as well as higher chances of prenatal problems such gestational diabetes and high blood pressure (preeclampsia), which can be harmful to the health of both the mother and the fetus (Nicole E.*et al.*,2022).

2.3. Consequences undernutrition on pregnant women

Pregnant women are among the millions of people affected by undernutrition, a serious worldwide health concern. For the health and development of the expectant mother as well as the unborn child, proper diet is crucial during pregnancy (Zohra 2022). For the mother's and the unborn child's health and growth, proper nutrition is essential throughout pregnancy. On the

other hand, undernutrition during pregnancy can have serious repercussions that go beyond the first trimester (Zohra 2022).

2.3.1. Physical Consequences

Pregnant women who undernutrition may experience serious physical health problems (DeygantoGergito 2021). A lack of key nutrients that are required for overall health can arise from maternal malnutrition, which is caused by insufficient intake of essential nutrients such proteins, vitamins, and minerals. Pregnant women who are undernourished are more vulnerable to infections, have weakened immune systems, and are more likely to experience anemia and other nutrient-related deficits (Nigatu 2021). Undernutrition can also cause weight loss, exhaustion, weakness, and general physical ill health, which makes it difficult for expectant moms to cope with the demands of pregnancy and childbirth.

Studies show that undernourished women are more likely to develop metabolic diseases such gestational diabetes mellitus both before and during pregnancy (Alam 2021). Reducing the risks associated with undernutrition during pregnancy requires addressing maternal undernutrition through effective assessment, treatment, and interventions (Nisha I. 2021). Differences in maternal nutritional status occur throughout the world due to a variety of factors, including social determinants, food insecurity, and access to health services. The significance of nutrition treatments before and during pregnancy is highlighted by the critical role that maternal nutrition plays in maintaining favorable pregnancy outcomes and long-term health for both the mother and child ((Usha Ramakrishnan 2014).

2.3.2. Maternal Consequences

Pregnant women who are undernourished run serious hazards to the health of the fetus and the mother. Low birth weight babies are more susceptible to illnesses and early death when they are born to mothers who are undernourished (Abel Girma 2022). Negative birth outcomes, such as intrauterine growth restriction (IUGR), perinatal morbidities, and long-term mental and physical disabilities in infants, are linked to maternal undernutrition (Nana Chea 2023). Pregnancy-related undernutrition is influenced by a number of factors, including low height, inadequate nutritional understanding, and maternal iron deficiency anemia. Pregnancy-related problems like anemia, pre-eclampsia, hemorrhage, and even death can result from inadequate nutrition for mothers,

which is defined by diets deficient in important minerals like iodine, iron, folate, calcium, and zinc (D Taylor Hendrixson, MD 2024).

The risk of low birth weight and small for gestational age newborns is increased by preconception anemia and low preconception weight (Melissa F 2021). Improved delivery outcomes can result from pregnancy interventions that include numerous micronutrient supplements, balanced-energy protein supplements, and lipid nutrient supplements(Melissa F 2021). Maternal undernutrition must be addressed in resource-constrained locations with appropriate assessment, treatment, and interventions to reduce the hazards of undernutrition during pregnancy (Hoang Anh Nguyen 2018). The risk of metabolic diseases such gestational diabetes mellitus is increased in women who are undernourished both before and during pregnancy. To guarantee the best possible outcomes for mothers and their unborn children, maternal nutrition treatments must be prioritized from conception through pregnancy (Usha Ramakrishnan 2014).

2.3.3. Fetal Consequences

Maternal undernutrition during gestation reduces placental and fetal growth of humans (Bell A.W 2002). Available evidence suggests that fetal growth is most vulnerable to maternal dietary deficiencies of nutrients (e.g., protein and micronutrients) during the peri-implantation period and the period of rapid placental development**.** Undernutrition in pregnant women may result from low intake of dietary nutrients owing to either a limited supply of food or severe nausea and vomiting known as hyperemesis gravidarum (Snell L.H 1998). This life-threatening disorder occurs in 1–2% of pregnancies and generally extends beyond the 16th week of gestation (Snell L.H 1998).

Pregnant women may also be at increased risk of undernutrition because of early or closely-spaced pregnancies (King J.C2003). Since pregnant teenage mothers are themselves growing, they compete with their own fetuses for nutrients, whereas short interpregnancy intervals result in maternal nutritional depletion at the outset of pregnancy. Low birth weights and preterm deliveries in adolescent pregnancies are more than twice as common as in adult pregnancies, and neonatal mortality in adolescent pregnancies is almost three times higher than for adult pregnancies (King J.C 2003.)

2.4. The Impact of Food Insecurity on Pregnant Women

Lack of regular access to enough, safe, and nourishing food is known as pregnancy-related food insecurity, and it can have serious and wide-ranging effects for expectant mothers and their growing fetuses (Bronte-Tinkew 2007). Additionally, poor nutrition, stress, mental health problems, and insufficient availability to vital nutrients for the mother and the unborn child are all consequences of food insecurity.

2.4.1. Nutritional Deficiencies

Food insecurity during pregnancy has a significant effect on the nutrition of expectant mothers and the results of their pregnancies. It can result in insufficient intake of vital nutrients, raising the possibility of maternal malnutrition and problems (Amber Bastian 2022). Increased dietary intake of folic acid, iron, calcium, and protein is necessary for pregnant women in order to support the growing and developing fetus. Living in a food insecure household during pregnancy may increase risk of greater gestational weight gain, disordered eating, chronic disease and pregnancy complications (Laraia B 2010), while the impact of food insecurity on young children is particularly concerning given they are at a key stage of growth and development which can influence health during adolescence and even adulthood (Laraia 2013).

Infants residing in food insecure households are more likely to have poor health, be nutrient deficient and be hospitalized (Park 2009) with poor health and developmental challenges, including cognitive, linguistic, social, and emotional challenges being more common among food insecure children (Rose- 2006). While there are clear negative health outcomes for food insecure households with pregnant women and young children, the coping mechanisms employed by these households are not well understood. Studies have reported that mothers experiencing food insecurity are likely to engage in coping strategies such as delaying payments of bills, giving up services, selling or pawning possessions and diluting infant formula (Burkhardt M 2012).

2.4.2. Increased Risk of Gestational Complications

Food insecurity during pregnancy has been linked to a higher risk of gestational complications, including gestational diabetes and high blood pressure (preeclampsia) (Lara C. Kovell 2022). Pregnant women who lack access to an adequate and balanced diet are more prone to developing these conditions, which can have detrimental effects on both maternal and fetal health (Sourik Beltrán 2020). Research has shown that food insecurity is associated with reduced quality of life and psychosocial outcomes, such as increased depression and anxiety. Furthermore, food insecurity can be associated with an increased risk of pregnancy complications, including anemia and poor fetal growth. It is also associated with poor health outcomes for the baby, such as low birth weight and an increased risk of birth defects.

Federal nutrition programs, such as the Supplemental Nutrition Assistance Program (SNAP) and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), play a critical role in mitigating the physical and mental health consequences of food insecurity for pregnant women and their families(Rita Hamad 2019). It is important to identify women with food insecurity on their first pregnancy visit and take steps towards improving their health through allocating a family food basket and nutritional counseling and education. Further studies are needed to investigate the association between food insecurity during pregnancy and the incidence of pregnancy complications(Rameeza Kaleem 2020)

2.4.3. Adverse Birth Outcomes

Food insecurity during pregnancy is associated with adverse birth outcomes, including low birth weight and preterm birth (Kingsley Emwinyore Agho 2023). Research has shown that food insecurity is associated with an increased risk of specific birth defects, such as cleft palate, gestational diabetes, anemia, and pregnancy-induced hypertension (Fiona H. McKay 2022). Food insecurity is also associated with poor health outcomes for the baby, including increased risk of birth defects and poor developmental outcomes (Fiona, 2022). Pregnant women experiencing food insecurity have a higher risk of delivering infants with low birth weight, which increases the likelihood of developmental delays and long-term health issues(KRISTIN GOURLAY 2021). It is important to identify women with food insecurity on their first pregnancy visit and take steps towards improving their health through allocating a family food basket and nutritional counseling and education. Further studies are needed to investigate the association between food

insecurity during pregnancy and the incidence of pregnancy complicationsKRISTIN GOURLAY 2021).

2.4.4. Impact on Maternal Mental Health

Pregnant women's mental health can be significantly impacted by food insecurity (Mahdi Khoshgoo 2022). Maternal well-being can be negatively impacted by the tension and worry brought on by not knowing where their next meal will come from or by not being able to give herself and their unborn child enough nutrition (Mahdi Khoshgoo 2020). Studies have demonstrated the correlation between food hardship and elevated levels of anxiety and depression in expectant mothers, potentially exacerbating maternal health issues and the overall pregnancy experience (Barbara A. Laraia, 2022).Pregnant women who live in households where there is a lack of food may find it difficult to prepare or obtain food, and they may even run into financial difficulties, especially if they must take maternity leave from their jobs (KRISTIN GOURLAY 2021). In addition, they might have to decide how to divide up their household's meager food supplies so that the fetus and other family members can eat. For food-insecure pregnant women, such unpleasant encounters may generate a stressful atmosphere, which has been strongly associated with an increased risk of depression (KRISTIN GOURLAY, 2021).

3. Conclusion

Undernourishment and food insecurity have a significant effect on pregnant women's health and wellbeing as well as the growth and long-term consequences of their offspring. The negative consequences of not having enough access to a healthy diet during pregnancy are discussed in this article, including elevated chances of maternal death, low birth weight, preterm delivery, developmental delays, and compromised immune system.Pregnant women's undernutrition and food insecurity are caused by a number of important variables. Access to nutrient-dense food is significantly hampered by socioeconomic variables including poverty and low levels of education.

The issue is made worse by cultural norms, inadequate healthcare facilities, and inadequate information about maternal nutrition. Conflicts, natural disasters, and climate change can also make food poverty worse and make it more difficult for pregnant women to access and buy wholesome food.It takes a diverse approach to address pregnant women's food poverty and undernutrition. Agricultural production, income-generating ventures, and social safety nets for disadvantaged groups should be prioritized in the effort to increase overall food security. To improve their capacity to surmount these obstacles, women's emancipation, education, and access to healthcare services ought to be put first. Personalized treatments are essential for enhancing the health of mothers and their unborn children. Examples of these include nutrient counseling and supplementation.

4. References

1. Abel Girma Tilahun,* Dinaol Abdissa Fufa, and Rahel Dereje Taddesse Undernutrition and its associated factors among pregnant women at the public hospitals of Bench-Sheko and Kaffa zone, southwest Ethiopia. Published online 2022 May 2. doi: 10.1016/j.heliyon.2022.e09380
2. Alam Choudhury, V. Devi Rajeswari Gestational diabetes mellitus - A metabolic and reproductive disorder. Biomedicine & Pharmacotherapy. Volume 143, November 2021, 112183. https://doi.org/10.1016/j.biopha.2021.112183
3. Amber Bastian,[1] Courtney Parks,[2] Amy Yaroch,[2] Fiona H. McKay,[3] Katie Stern,[2] Paige van der Pligt,[1] Sarah A. McNaughton,[1] and Rebecca Lindberg[1,*] Factors Associated with Food Insecurity among Pregnant Women and Caregivers of Children Aged 0–6 Years: A Scoping Review. Nutrients. 2022 Jun; 14(12): 2407. Published online 2022 Jun 9. doi: 10.3390/nu14122407
4. Aya Mousa,[1,*] Amreen Naqash,[2] and Siew Lim. Macronutrient and Micronutrient Intake during Pregnancy: An Overview of Recent Evidence. Nutrients. 2019 Feb; 11(2): 443. Published online 2019 Feb 20. doi: 10.3390/nu11020443.
5. Aya Mousa,[1,*] Amreen Naqash,[2] and Siew Lim[1] Macronutrient and Micronutrient Intake during Pregnancy: An Overview of Recent Evidence. Nutrients. 2019 Feb; 11(2): 443. Published online 2019 Feb 20. doi: 10.3390/nu11020443
6. Bell A.W. Ehrhardt R.A. Regulation of placental nutrient transport and implications for fetal growth.*Nutr. Res. Rev.* 2002; 15: 211-230View in Article PubMedCrossrefGoogle Scholar.
7. Benjamin AllenJohnSaundersMalnutrition and undernutrition: causes, consequences, assessment and managementPublished:May 30, 2023DOI:https://doi.org/10.1016/j.mpmed.2023.04.004
8. Bronte-Tinkew J, Zaslow M, Capps R, Horowitz A, McNamara M. Food insecurity works through depression, parenting, and infant feeding to influence overweight and health in toddlers. *J Nutr*. 2007;137(9):2160–2165 [PubMed] [Google Scholar]
9. Brooks A.A. Johnson M.R. Steer P.J. Pawson M.E. Abdalla H.I. Birth weight: nature or nurture?.*Early Human Dev.* 1995; 42: 29-35View in Article Scopus (162)PubMedCrossrefGoogle Scholar
10. Burkhardt M., Beck A., Kahn R., Klein M. Are our babies hungry? Food insecurity among infants in urban clinics. *Clin. Pediatrics.* 2012;51:238–243. doi: 10.1177/0009922811426767. [PubMed] [CrossRef] [Google Scholar]
11. D Taylor Hendrixson, MDMark J Manary, MD. Indi Trehan, MD, MPH, DTM&H. L Lewis Wall, MD, DPhil. Undernutrition in pregnancy: Evaluation, management, and outcome in resource-limited areas. Feb 09, 2024.
12. Dalky H, Qandil A, Alqawasmi A. Factors associated with Undernutrition among pregnant and lactating Syrian refugee women in Jordan. Global J Health Sci. 2018;10(4):1–58.
13. DeygantoGergitoGelebo, Mathewos Alemu Gebremichael, Gistane Ayele Asale and DessalegnAjemaBerbada. Prevalence of undernutrition and its associated factors among pregnant women in Konso district, southern Ethiopia: a community-based cross-sectional study. Published: 12 July 2021

14. DeygantoGergitoGelebo, Mathewos Alemu Gebremichael, DessalegnAjemaBerbada, Prevalence of undernutrition and its associated factors among pregnant women in Konso district, southern Ethiopia: a community-based cross-sectional study. *BMC Nutrition* volume 7, Article number: 32 (2021), Published: 12 July 2021
15. Elisabet Fernández-Gómez,[1] Trinidad Luque-Vara,[1] Pablo José Moya-Fernández,[2] María López-Olivares,[3,*] Miguel Ángel Gallardo-Vigil,[4] and Carmen Enrique-Mirón[5] Factors Influencing Dietary Patterns during Pregnancy in a Culturally Diverse Society. Nutrients. 2020 Nov; 12(11): 3242. Published online 2020 Oct 23. doi: 10.3390/nu12113242
16. Franca Marangoni,[1,*] Irene Cetin,[2] Elvira Verduci,[3] Giuseppe Canzone,[4] Marcello Giovannini,[5] Paolo Scollo,[6] Giovanni Corsello,[7] and Andrea Poli. Maternal Diet and Nutrient Requirements in Pregnancy and Breastfeeding. An Italian Consensus Document. Nutrients. 2016 Oct; 8(10): 629. Published online 2016 Oct 14. doi: 10.3390/nu8100629
17. Germaine Miese-Looy, Jessica Rollings-Scattergood and Anna Yeung Long-term health consequences of poor nutrition during pregnancy. February 2008, SURG Journal 1(2):73-81, DOI:10.21083/surg.v1i2.421
18. Hoang Anh Nguyen Undernutrition during Pregnancy Submitted: 23 September 2018 Reviewed: 26 November 2018 Published: 09 January 2019. DOI: 10.5772/intechopen.82727
19. Janaki S andPrabakar S. Examining socioeconomic factors influencing maternal health in pregnancy Published online: 07 Feb 2024. https://doi.org/10.1080/10911359.2024.2310272.
20. Kefayat Chaman-Ara; MD1 , Sahar Sharif; MS2 & Mohammad Amin Bahrami; PhD. Challenges and Barriers to Pregnant Women's Nutrition: Policy Recommendations. eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2018; 3(2): 60-64 Website: jnfs.ssu.ac.ir.
21. Kembra Albracht-Schulte, Ángela García-González, Savanna Wilson and Jacalyn J Robert Mccomb. Nutritional Guidelines and Energy Needs During Pregnancy and Lactation for Active Women February 2023. DOI: 10.1007/978-3-031-15485-0_21
22. King J.C. The risk of maternal nutritional depletion and poor outcomes increases in early or closely spaced pregnancies.*J. Nutr.* 2003; 133: 1732S-1736SView in PubMedAbstractFull TextFull Text PDFGoogle ScholarArticle
23. Laraia B. Food insecurity and chronic disease. *Adv. Nutr.* 2013;4:203–212. doi: 10.3945/an.112.003277. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
24. Laraia B., Siega-Riz A., Gundersen C. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain, and pregnancy complications. *J. Am. Diet. Assoc.* 2010;110:692–701. doi: 10.1016/j.jada.2010.02.014. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
25. Lim Z.X.1 , Wong J.L.2 , Lim P.Y. 3 , Soon L.K.1. KNOWLEDGE OF NUTRITION DURING PREGNANCY AND ASSOCIATED FACTORS AMONG ANTENATAL MOTHERS. International Journal of Public Health and Clinical Sciences e-ISSN: 2289-7577. Vol. 5:No.1 January/February 2018
26. Lire Lemma Lab, Berhanu Debela's Lab, Abriham Shiferaw Areba, Arega Haile and Belayneh Genoro Abire . Factors Associated with Food Insecurity among Pregnant

Women in Gedeo Zone Public Hospitals, Southern Ethiopia February 2022. DOI: 10.1101/2022.02.16.22271073
27. Louis J. Muglia1,2* , Katrien Benhalima3 , Stephen Tong4,5 and Susan Ozanne6. Maternal factors during pregnancy infuencing maternal, fetal, and childhood outcomes. Muglia et al. BMC Medicine (2022) 20:418 https://doi.org/10.1186/s12916-022-02632-6
28. Manik Kadawathagedara, Namanjeet Ahluwalia, Marie-Noelle Dufourg, Anne Forhan, Marie Aline Charles, Sandrine Lioret, Blandine de Lauzon-Guillain. Diet during pregnancy: Influence of social characteristics and migration in the ELFE cohort. First published: 02 February 2021https://doi.org/10.1111/mcn.13140
29. Martin-Gronert MS, Ozanne SE. Maternal nutrition during pregnancy and health of the offspring. Biochem Soc Trans. 2006;34(5):779–82. https://doi. org/10.1042/BST0340779
30. Melissa F. Young;Usha Ramakrishnan, Maternal Undernutrition before and during Pregnancy and Offspring Health and Development. *Ann NutrMetab* (2021) 76 (Suppl. 3): 41–53. https://doi.org/10.1159/000510595.
31. Mellitus Kavita Kapura Anil Kapurb Moshe Hodc. Nutrition Management of Gestational Diabetes. Received: February 3, 2020 Accepted: July 2, 2020 Published online: February 1, 2021. Ann NutrMetab 2020;76(suppl 3):17–29. DOI: 10.1159/000509900
32. Nana Chea,[1] Yadessa Tegene,[1] Ayalew Astatkie,[1] and Mark Spigt[2] Prevalence of undernutrition among pregnant women and its differences across relevant subgroups in rural Ethiopia: a community-based cross-sectional study Published online 2023 Mar 10. doi: 10.1186/s41043-023-00358-6 PMCID: PMC10007751. PMID: 36899418. J Health PopulNutr. 2023; 42: 17.
33. Nicole E. Marshall, MD, Barbara Abrams, DrPH, RD, Linda A. Barbour, MD, MSPH, Patrick Catalano, MD, Parul Christian, DrPH, Jacob E. Friedman, PhD, William W. Hay, Jr, MD, Teri L. Hernandez, PhD, RN, Nancy F. Krebs, MD, MS, Emily Oken, MD, MPH, Jonathan Q. Purnell, MD, James M. Roberts, MD, Hora Soltani, PhD, MMedSci, RM, PGDip, PGCert, Jacqueline Wallace, PhD, DSc, and Kent L. Thornburg, PhD. The importance of nutrition in pregnancy and lactation: lifelong consequences. Am J Obstet Gynecol. 2022 May; 226(5): 607–632. Published online 2021 Dec 27. doi: 10.1016/j.ajog.2021.12.035.
34. Nigatu Regassa Geda Inequalities in maternal malnutrition in Ethiopia: evidence from a nationally representative data. *BMC Women's Health* volume 21, Article number: 3 (2021). Published: 02 January 2021
35. Nisha I. Parikh, Juan M. Gonzalez, Cheryl A.M. Anderson, Suzanne E. Judd, Kathryn M. Rexrode, Mark A. Hlatky, Erica P. Gunderson, Jennifer J. Stuart, Dhananjay Vaidya. Adverse Pregnancy Outcomes and Cardiovascular Disease Risk: Unique Opportunities for Cardiovascular Disease Prevention in Women: Originally published 29 Mar 2021https://doi.org/10.1161/CIR.0000000000000961
36. Nti CA. Dietary diversity is associated with nutrient intakes and nutritional status of children in Ghana. Asian J Med Sci. 2014;2(2):105–9.
37. Orr SK, Dachner N, Frank L, Tarasuk V. Relation between household food insecurity and breastfeeding in Canada. *CMAJ*. 2018;190(11):E312–E319 [PMC free article] [PubMed] [Google Scholar]
38. Park K., Kersey M., Geppert J., Story M., Cutts D., Himes J. Household food insecurity is a risk factor for iron-deficiency anaemia in a multi-ethnic, low-income sample of

infants and toddlers. *Public Health Nutr.* 2009;12:2120–2128. doi: 10.1017/S1368980009005540. [PubMed] [CrossRef] [Google Scholar]
39. Prajakta Ganesh Joshi G, Jain S, Dubey V. Nutritional status of pregnant women reporting at rural health training centre international. J Reprod Contraception Obstet Gynecol. 2017;6(9). Published online 2021 Dec 27. doi: 10.1016/j.ajog.2021.12.035.
40. Rose-Jacobs R., Black M.M., Casey P.H., Cook J.T., Cutts D.B., Chilton M., Heeren T., Levenson S.M., Meyers A.F., Frank D.A. Household Food Insecurity: Associations With At-Risk Infant and Toddler Development. *Pediatrics.* 2008;121:65–72. doi: 10.1542/peds.2006-3717. [PubMed] [CrossRef] [Google Scholar]
41. Sagni Girma, Fitsum Weldegebreal Undernutrition among Pregnant Women in Rural Communities in Southern Ethiopia. 2021
42. Sara T Mustafa, Olivia J Hofer, Jane E Harding, Clare R Wall, Caroline A Crowther. Dietary recommendations for women with gestational diabetes mellitus: a systematic review of clinical practice guidelines Nutrition Reviews, Volume 79, Issue 9, September 2021, Pages 988–1021, https://doi.org/10.1093/nutrit/nuab005. Published: 02 May 2021
43. Sehar Iqbal andnayat Ali. Maternal food insecurity in low-income countries: Revisiting its causes and consequences for maternal and neonatal health.
44. Sisay Demissew Beyene. The impact of food insecurity on health outcomes: empirical evidence from sub-Saharan African countries.BMC Public Health (2023) 23:338 https://doi.org/10.1186/s12889-023-15244-3
45. Skinner A-L. Pregnancy outcome in south Asian women: factors affecting diet and nutrition: University of Central Lancashire; 2012
46. Snell L.H. Haughey B.P. Buck G.Marecki M.A Metabolic crisis: hyperemesis gravidarum*J. Perinat. Neonat. Nurs.* 1998; 12: 26-37View in Article Scopus (22)PubMedCrossrefGoogle Scholar
47. Talla Widelock, Denney & Brian Brost. Pregnancy and Parturition: The Physical and Physiological Changes and Their Pathologies.First Online: 20 October 2023.
48. Tarasuk V. Household food insecurity with hunger is associated with women's food intakes, health and household circumstances. *J. Nutr.* 2001;31:2670–2676 doi: 10.1093/jn/131.10.2670. [PubMed] [CrossRef] [Google Scholar].
49. Usha Ramakrishnan [1], Beth Imhoff-Kunsch, Reynaldo Martorell Maternal nutrition interventions to improve maternal, newborn, and child health outcomes. Nestle Nutr Inst Workshop Ser . 2014:78:71-80. doi: 10.1159/000354942. Epub 2014 Jan 27.
50. World Health Organisation (WHO). Essential nutrition actions: improving maternal, newborn, infant and young child health and nutrition. Geneva: World Health Organisation; 2013. https://www.who.int/nutrition/publications/ infantfeeding/essential_nutrition_actions.pdf. Accessed 11 Nov 2017
51. Zohra S. Lassi, [1] Zahra A. Padhani, [2] Amna Rabbani, [2] Fahad Rind, [2] Rehana A. Salam, [2] and Zulfiqar A. Bhutta. Effects of nutritional interventions during pregnancy on birth, child health and development outcomes: A systematic review of evidence from low□ and middle□income countries. Campbell Syst Rev. 2021 Jun; 17(2): e1150. Published online 2021 Jun 21. doi: 10.1002/cl2.1150

52. Zohra S. Lassi, ... Zulfiqar A. Bhutta, Prenatal nutrition and nutrition in pregnancy: Effects on long-term growth and development. Early Nutrition and Long-Term Health (Second Edition), 2022