

Reviewing The Evidence On Dietary Diversity Scores And Nutrient Adequacy Among Women In Low- And Middle-Income Countries

Manasa C, Shravya M, Syeda Farha S

Department of Nutrition and Dietetics, JSS Academy of Higher Education and Research, Karnataka, Mysuru.

ABSTRACT

Dietary diversity is a critical component of a healthy diet, essential for ensuring adequate nutrient intake and preventing diet-related diseases; however, women, particularly in low- and middle-income countries (LMICs), often face challenges in accessing diverse and nutrient-rich foods, leading to micronutrient deficiencies, exacerbated by socioeconomic factors, cultural environments, and food insecurity. This review aims to analyze the impact of dietary diversity and food security on women's health, focusing on micronutrient adequacy among women of reproductive age (WRA) in LMICs, and explores effective methods for assessing dietary diversity and nutrient intake. The scope of this review includes studies conducted in LMICs, utilizing methodologies such as 24-hour dietary recalls and food frequency questionnaires to assess dietary diversity and nutrient adequacy. It examines the intake of key micronutrients like iron, zinc, calcium, and vitamins among WRA, and the implications of food insecurity on their nutritional status. Greater dietary diversity is associated with improved nutrient intake and overall health, especially for women of reproductive age. Addressing food insecurity and promoting nutrition-sensitive interventions are crucial for enhancing women's health, supporting healthy pregnancies, and reducing maternal risks. Further research and interventions are needed to mitigate the disproportionate impact of poor dietary diversity and food insecurity on women's well-being.

Keywords: Dietary diversity, nutrient adequacy, women's health, food security, micronutrient intake.

Introduction

Dietary diversity

The number of different foods or food groups consumed over a given reference period which in this study was 24 hours. Dietary diversity is a key aspect of a healthy diet and is internationally recognized as an important indicator of dietary quality. A diverse diet leads to better nutrient intake and reduces the risk of diet-related diseases. Factors such as cultural environment, socioeconomic status, dietary habits, and individual nutritional recommendations can all influence the quality of a person's diet. ^[1]

Nutrient adequacy

The ability of a diet to meet the recommended nutrient intakes. Many nutrition experts agree that eating a balanced

and nutritious diet is the best way to get all the essential vitamins and minerals our bodies need. Unfortunately, women in areas with limited resources often struggle to access diverse and nutrient-rich foods, putting them at risk of deficiencies. These women typically rely on monotonous diets that lack variety, making it difficult for them to get the nutrients they need to stay healthy. Despite this, there's surprisingly little data on the nutritional needs of women in developing countries, and what's available often only represents small groups of people rather than the broader population. This lack of information makes it harder to address the issue and ensure these women get the nutrients they need. ^[2]

Food security

Food security refers to a situation where everyone, at all times, has reliable and consistent access to enough nutritious, safe food that supports a healthy and active life. This

^{*}Corresponding author.

E-mail address: syedafarhas@jssuni.edu.in

Received 27-06-2025; Accepted 04-08-2025

Copyright @ Journal of Food and Dietetics Research

(acspublisher.com/journals/index.php/jfdr)

includes having food that meets both physical needs and food preferences, making sure it is available, accessible, and affordable for people across various contexts. Food security is typically broken down into two main components: **availability** and **accessibility**. Availability refers to having an adequate amount of food, while accessibility is about ensuring people have the resources (like income, transportation, and distribution networks) to obtain that food. When there's a lack of either food availability or access, it can lead to food insecurity, where individuals and households are unable to consistently secure enough nutritious food to support their well-being.^[3]

Impacting

Millions of people around the world struggle with limited dietary options, and it's often the poorest families who suffer the most. Women, especially those of childbearing age, are particularly vulnerable to nutrient deficiencies that can impact their health. Unfortunately, we don't know enough about the specific nutritional challenges women face, making it harder to find solutions. Research shows that women often have less control over resources within their households, which can lead to unequal access to nutritious food and a disproportionate burden of food insecurity. This can have serious consequences for their well-being and health.^[4]

Overcome

Eating a variety of foods is crucial for getting the nutrients our bodies need. Research shows that people who eat diverse diets tend to have higher intakes of essential vitamins and minerals. A diet rich in different foods helps protect against malnutrition, especially for vulnerable groups. Studies have found that people with more diverse diets have better nutritional health, including improved growth and development in children. On the other hand, limited dietary options can lead to poor nutrient intake, particularly in areas with limited resources. Food insecurity is a pressing global issue, affecting over 250 million people who struggle to access enough nutritious food. To address this, promoting diverse eating habits through initiatives like home gardening, nutrition education, and school feeding programs can be effective and adaptable solutions. By supporting nutrition-sensitive agriculture, we can improve household diets and reduce food shortages.^[5]

Dietary diversity and nutrient adequacy are crucial for women's health, especially during the reproductive years, as they support healthy pregnancies and reduce maternal risks. Food insecurity limits access to nutritious foods, contributing to anemia, poor pregnancy outcomes, and long-term health issues. Empowering women through food

access, education, and nutrition support is essential to improving health for both mothers and children.^[6,7,8]

Methodology

A literature review was carried out of studies involving the several low- and middle- income countries found dietary diversity to be a strong predictor of nutrient adequacy among women of reproductive age. Greater diversity was linked to better intake of iron, zinc, calcium, folate, and vitamins, while poor diversity increased risks of anemia, deficiencies, and poor pregnancy outcomes.

Food insecurity and poverty further limited women's access to nutrient-rich foods, Highlighting the need to improve dietary diversity for better maternal health.

The keywords were used to search the articles that included "dietary diversity" or "reproductive age women's" or "nutrient adequacy" or "micronutrient adequacy" or "maternal nutrition" or dietary diversity assessment" or "food frequency questionnaire" or "household food insecurity" or "poverty and maternal dietary intake" or "livelihood and food access" or "food insecurity scales". The searched database included Google Scholar, ScienceDirect, PubMed, Springer, ResearchGate, National institutes of Health, BMC nutrition, Frontiers, Food and Agricultural organization, CABI digital library, International Journal of Community Medicine and Public Health, MDPI, The National Medical Journal of India, Mattioli 1885 Journals, BMC of women Health. Meta- analyses, research studies and review articles were included and published in English language.

Dietary diversity impacting on women health.

A woman's diet plays a significant role in their overall health, especially during her reproductive years. Eating a variety of foods ensures she gets the necessary nutrients, vitamins, and minerals to support their menstrual cycle, fertility, pregnancy, and ability to nurse their baby. A diverse diet can help regulate their periods, reduce the risk of anemia and other deficiencies, and promote a healthy pregnancy and motherhood experience. On the other hand, a limited diet can lead to health complications and nutrient deficiencies, making it essential for women to focus on consuming whole, nutrient-rich foods. By prioritizing dietary diversity, women can take a proactive approach to supporting their reproductive health and well-being.^[12]

Prevalence of dietary diversity

In India, a significant portion of children aged 6-23 months lack dietary diversity, with studies showing that over 77%

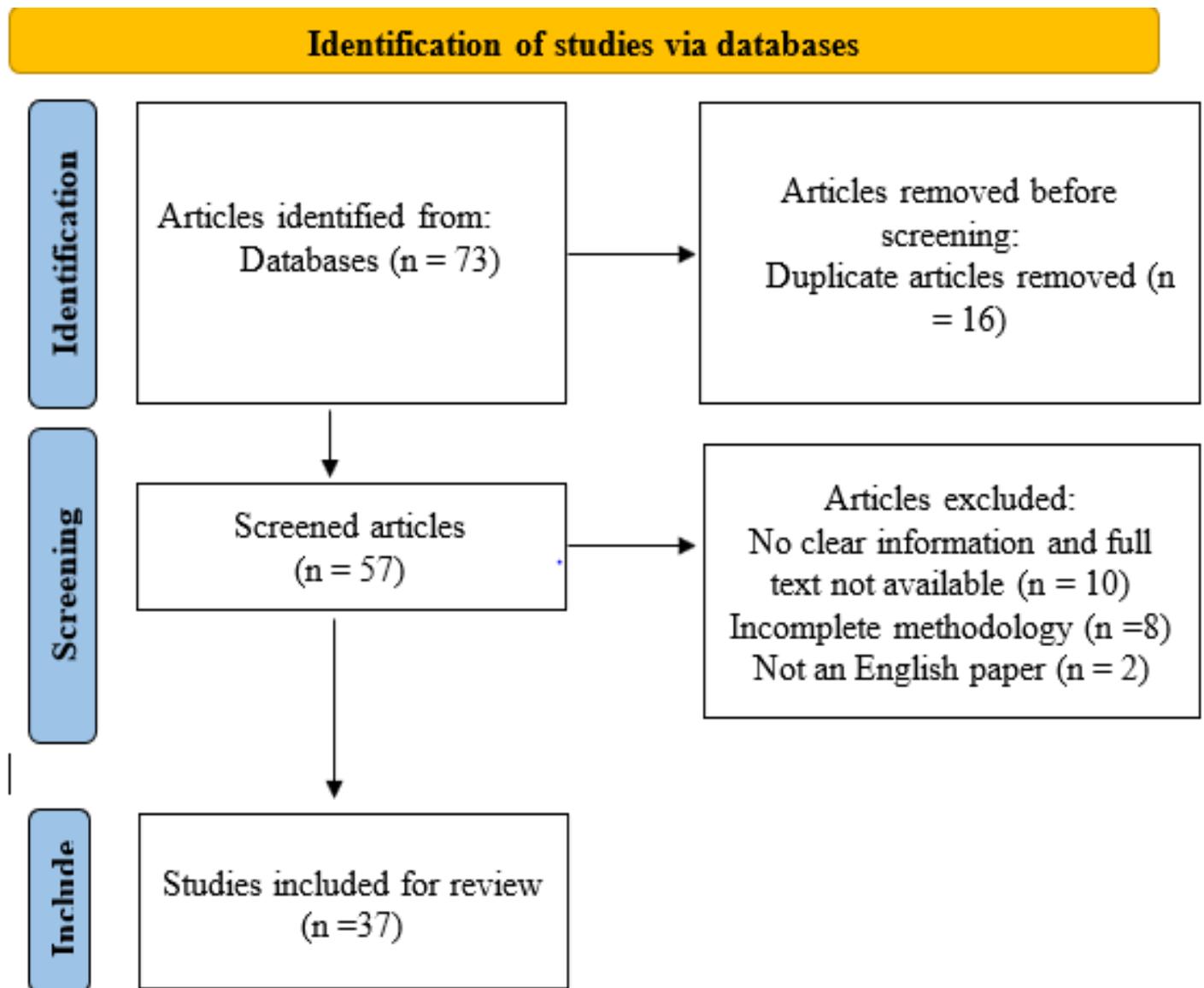


Figure 1: Flow diagram of the research design

fail to meet the World Health Organization's (WHO) recommended standards, particularly in the central region. Participants in the study reported consuming a variety of foods, with cereals (100%), other vegetables (94.3%), legumes and nuts (69.3%), vitamin A rich vegetables and tubers (60.7%) and fish and seafood being the most consumed food groups. Organ meats (2.9%), Flesh meats (7.9%) and vitamin A rich fruits (5%) were the least consumed food groups among the female handloom workers.^[13]

Methods To Assess Dietary Diversity

1) The MDD-W is a dichotomous indicator developed by the Food and Agriculture Organization (FAO) to assess

whether women of reproductive age have consumed at least five out of ten predefined food groups in the previous 24 hours. This serves as a proxy for micronutrient adequacy. In a 24-hour dietary recall, a participant sits down with an interviewer who asks them to recall everything they ate and drank in the past 24 hours. This conversation helps gather detailed information about their eating habits, which can be used to assess their nutrient intake and overall dietary health. By combining this information with data on the nutritional content of different foods, healthcare professionals can get a clearer picture of a person's diet and identify areas for improvement.^[14]

A FFQ is a tool used to track how often people eat certain foods or food groups over a set period, like a month or year. It can ask about portion sizes or just frequency, giving a snapshot of eating habits.^[15]

2) There are various studies shown in nutrient and dietary diversity among women like - A recent study in rural Odisha looked at the diets of nearly 1,000 women aged 15-49. The findings showed that less than half of these women were eating a diverse enough diet. But here's the good news: women who did eat a variety of foods had a lower risk of mild anemia - about 30% lower. While dietary diversity didn't seem to have a significant impact on moderate or severe anemia, it's still an important step towards better health. By focusing on a balanced diet, women can take control of their nutritional well-being.^[16]

A study of pregnant women living in slums in Pune revealed some concerning findings. Out of 454 women, only about 36.5% were eating a diverse enough diet. Most of their diets were heavy on cereals but lacked essential nutrients like iron, zinc, and folate. The study also found that women from families with higher education and income levels, as well as those having fewer children, were more likely to have better diets. These findings highlight the need for nutrition support and education, especially for vulnerable populations.^[17]

A study of over 3,600 households in rural India uncovered a concerning trend: women tend to eat fewer food groups than other family members. This disparity is particularly noticeable when it comes to nutrient-rich foods like dairy, meat, and fruits and veggies high in vitamin A. These findings highlight the persistent inequalities in food distribution within households, with women often getting the short end of the stick. By recognizing and addressing these disparities, we can work towards more equitable and healthier diets for everyone.^[18]

Other's studies also included men's and children's like - During the surplus season (April-August), households have a feast. They've just harvested their crops like rice, maize, and beans, which they can sell to buy other tasty food items like meat, milk, sugar, and fish. With this income, their typical day might start with a warm breakfast of black or milk tea paired with rice, ugali (a stiff porridge made from maize, sorghum, or millet flour), boiled tubers, or nuts. And get this - they might even enjoy rice, ugali with fish or meat for lunch and dinner, But the picture changes drastically during the shortage season (September-March). From mid-November to March, households in Bahi and Mbarali face long periods of food scarcity. Some families struggle to get more than one meal a day, and its often-plain carbohydrate-heavy foods like ugali, cassava, and rice. It's a tough time, and the lack of diversity in their diet is noticeable. This fluctuation highlights the challenges these communities face in maintaining a consistent and balanced diet throughout the year.^[19]

To assess dietary diversity among children aged 6-23 months, we used the World Health Organization's guide-

lines for Infant and Young Child Feeding (IYCF). The National Family Health Survey-4 collected data on the food groups consumed by children over the past 24 hours, with trained investigators interviewing mothers using structured questionnaires. We categorized foods into seven groups: grains, roots, and tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin A-rich fruits and veggies; and other fruits and veggies. A dietary diversity score (DDS) was calculated based on the number of groups consumed, ranging from 0 (no food groups) to 7 (all food groups). A child met the minimum dietary diversity (MDD) requirement if they consumed at least four food groups the day before.^[20]

Prevalence of food insecurity

Out of the 140 participants, 96.4% were found to be food insecure. About 33.57% expressed anxiety and uncertainty about their household's food supply, while 57.8% felt that the quality of the food they were consuming was insufficient. Additionally, 18.97% reported experiencing inadequate food intake.^[21]

Household food insecurity

One of the most fundamental needs we all share as humans is the need for enough food. In fact, having access to enough nutritious food was officially recognized as a basic human right at the World Food Summit in Rome in 1996. This declaration marked a significant shift in global thinking, representing decades of growing international commitment to ending hunger. By asking the series of related questions that compose the Food Insecurity Experience Scale (FIES), it is possible to classify respondents at different levels of severity: "food secure" (those who answer "no" to all the questions about food insecurity-related experiences) or "food insecure" along a continuum of food insecurity severity as shown in the (Table 1). Measuring food insecurity globally and accurately each year will help track progress toward development goals, identify trends at the global, regional, and national levels, and support decision-making at the country level. The Voices of Hungry project (VOH) aims to explore the feasibility of using the FIES to provide timely and valid information regarding the degree of severity of food insecurity in populations world-wide. FAO has identified the FIES as the tool with the greatest potential for becoming a global standard capable of providing comparable information on food insecurity experience across countries and population groups to track progress on reducing food insecurity and hunger.^[22]



Figure 2: Food insecurity

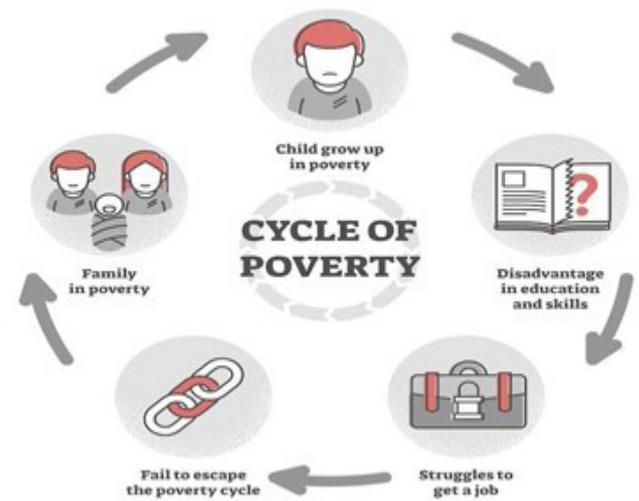


Figure 3: Household Poverty

Table 1: Food Insecurity Experience Scale [23]

| | Standard label | Question wording |
|---|----------------|--|
| 1 | WORRIED | During the last 12 MONTHS, was there a time when You were worried you would not have enough food to eat because of a lack of money or other resources? |
| 2 | HEALTHY | Still thinking about the last 12 MONTHS, was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources? |
| 3 | FEWFOODS | Was there a time when you ate only a few kinds of foods because of a lack of money or other resources? |
| 4 | SKIPPED | Was there a time when you had to skip a meal because there was not enough money or other resources to get food? |
| 5 | ATELESS | Still thinking about the last 12 MONTHS, was there a time when you ate less than you thought you should because of a lack of money or other resources? |
| 6 | RANOUT | Was there a time when your household ran out of food because of a lack of money or other resources? |
| 7 | HUNGRY | Was there a time when you were hungry but did not eat because there was not enough money or other resources for food? |
| 8 | WHOLEDAY | During the last 12 MONTHS, was there a time when you went without eating for a whole day because of a lack of money or other resources? |

Household poverty

In recent years, international research agencies and institutions have, based on evidence suggested a transformational change in the rate of poverty decline in India. Both in terms of income and decline of chronic poverty as also in terms of multi-dimensional poverty, the performance of India over the last two decades has attracted global attention. Out of 17 Sustainable Development Goals (SDGs), to which India is committed, the first two are “ending poverty in all forms and hunger”. SDG1 is, by 2030 to reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions. [24]

Association Between Dietary Diversity and Nutrient Intake or Adequacy

This study provides valuable insight by comparing two diversity measures in a regression analysis. It reveals that the DDS, which is based on food groups, is a stronger predictor of nutrient adequacy than the Food Variety Score (FVS), which focuses on individual foods. In other words, expanding the variety of food groups in the diet has a more significant impact on nutrient adequacy than simply increasing the number of different foods. An additional study, conducted in Ghana and Malawi, is probably the only one that documents only weak, and in some cases

negative, associations between diversity and certain nutrients.^[25]

The other side of diet quality is the quantitative aspect—how much of each nutrient a person is actually getting. This includes making sure their diet meets the recommended daily intake for essential nutrients like iron, folic acid, and calcium. A lack of these nutrients can lead to serious health problems like anemia and osteoporosis, which can increase the risk of maternal health issues, including complications during pregnancy. In many parts of the world, especially in low-income countries, women are at high risk of micronutrient deficiencies, a condition known as “hidden hunger.” This is particularly common among women who follow mostly plant-based diets, which often lack the right balance of vitamins and minerals.^[10]

The dietary micronutrient intake of WRA in LMICs. These studies were conducted in various LMICs, including India, Vietnam, Congo, Ethiopia, South Africa, Bangladesh, Nigeria, Brazil, Lebanon, and Zambia. Most studies collected 24-hour dietary recall data, although two studies—one in India and another in Vietnam used FFQ. In total, these studies included 29,573 women (ranging from 152 to 11,029 participants) with an average age of 28.51 years. The intake of different micronutrients among WRA is depicted as the percentage of the EAR.^[26,27]

Iron

Iron deficiency is a widespread health issue that disproportionately affects women, largely due to menstruation, pregnancy, and dietary habits. The consequences can be far-reaching. For one, iron deficiency can leave you feeling chronically fatigued, making everyday tasks and exercise more challenging, which in turn can impact your work performance. Moreover, even without anemia, low iron levels can affect cognitive function, impairing memory, attention, and learning. For pregnant women, the stakes are even higher: iron deficiency can increase the risk of preterm delivery, low birth weight, and developmental issues in babies. By understanding these risks, women can take proactive steps to prioritize their health and well-being.

Excessive iron buildup has been linked to several health concerns. For instance, high levels of heme iron intake and elevated serum iron have been associated with a higher risk of breast cancer. Additionally, iron overload can affect bone health, leading to decreased bone mineral density and a greater risk of osteoporosis. Furthermore, excess iron can cause oxidative stress, which may accelerate skin aging and make skin more susceptible to UV damage. By being aware of these potential risks, women can take steps to maintain a healthy balance of iron in their bodies.^[28]

Zinc

For pregnant women, zinc deficiency is particularly worrisome. In some areas, like rural Ethiopia, over half of pregnant women are zinc deficient, with levels dropping further as pregnancy progresses. This can have serious implications for both mom and baby. Similarly, adolescent girls are also vulnerable to zinc deficiency, which can affect cognitive function and even taste perception. Research has shown that supplementing with zinc can improve plasma zinc levels and boost cognitive performance. By addressing zinc deficiency, women can take a crucial step towards protecting their health and well-being.

While zinc is an essential nutrient, it's possible to have too much of a good thing. Taking excessive amounts of zinc can lead to some unpleasant side effects, like nausea, vomiting, stomach cramps, and diarrhea. If you overconsume zinc over time, it can even cause more serious issues, such as a copper deficiency, anemia, and a weakened immune system. Additionally, some research suggests that extremely high zinc intake might affect reproductive health, with one study finding a link between high dietary zinc and an increased risk of endometriosis. As with anything, finding the right balance is key to staying healthy.^[29]

Calcium

When it comes to bone health, not getting enough calcium can lead to weaker bones, making osteoporosis and fractures more likely, especially after menopause. But that's not all - low calcium levels can also cause muscle cramps, numbness, and tingling sensations. Some research suggests that chronic calcium deficiency might even contribute to high blood pressure and other heart health issues. Additionally, calcium deficiency has been linked to conditions like premenstrual syndrome (PMS) and polycystic ovary syndrome (PCOS), highlighting the importance of adequate calcium intake for overall health and well-being. By prioritizing calcium-rich foods and supplements, women can take a proactive approach to protecting their health.

Some research suggests that extremely high calcium intake might increase the risk of heart attack and stroke, although more studies are needed to confirm this link. Additionally, excessive calcium can lead to kidney stone formation by causing high levels of calcium in the urine. And if they are taking too much calcium, they might experience constipation or even interfere with their body's ability to absorb other essential minerals. As with anything, finding the right balance is key to staying healthy.^[30]

Vitamin A

When pregnant women don't get enough vitamin A, they can experience serious health issues, like night blindness,

anemia, and a weakened immune system that makes them more prone to infections. In fact, a study found that about 27% of pregnant women in northeastern Brazil had a sub-clinical vitamin A deficiency, with 2.9% experiencing night blindness. Globally, it's estimated that around 19 million pregnant women are affected by vitamin A deficiency, which can increase the risk of maternal mortality. Vitamin A plays a crucial role in immune function, vision, and fetal development, so ensuring adequate intake is vital for both mom's and baby's health.

If pregnant women consume extremely high amounts of vitamin A, especially during early pregnancy, it can increase the risk of birth defects. Additionally, excessive vitamin A intake has been linked to a higher risk of osteoporosis and hip fractures in postmenopausal women. Even taking vitamin A at levels slightly above the recommended daily amount can lead to subclinical toxicity, causing issues like elevated liver enzymes and lipid levels. As with any nutrient, finding the right balance is crucial to staying healthy.^[31]

Vitamin C

If they are not getting enough vitamin C, they might experience a range of issues. In severe cases, a deficiency can cause scurvy, which can leave them feeling fatigued, anemic, and struggling with bleeding gums and poor wound healing. For pregnant women, low vitamin C levels can increase the risk of complications like low birth weight and pre-eclampsia, particularly in low-income settings. By prioritizing vitamin C-rich foods, women can help protect their health and well-being.

If they are taking more than 2,000 mg of vitamin C per day, they might experience gastrointestinal problems like diarrhea, nausea, and stomach cramps. Additionally, excessive vitamin C intake can increase the risk of kidney stone formation in some people. Some studies have also raised concerns that high-dose vitamin C supplementation (over 1,000 mg per day) might be linked to a higher risk of breast cancer, although more research is needed to confirm this. As with any supplement, it's essential to find a safe and effective dose.^[32]

Thiamin

If thiamine levels are low, women may experience serious health issues, such as beriberi, Wernicke's encephalopathy, or even heart problems. This can be particularly concerning for new mothers. Moreover, thiamine deficiency can also affect breastfed babies, putting them at risk of developing infantile beriberi - a condition that can be

fatal if not treated promptly. By prioritizing thiamine-rich foods, women can help protect their health and their baby's well-being.

For women with PCOS, taking thiamine supplements has been linked to improved mental health and fertility. In one study, women who took 300 mg of thiamine daily for four weeks experienced reduced symptoms of anxiety, insomnia, and depression, as well as improved overall health. Notably, more women in the thiamine group also tested positive for pregnancy. Additionally, thiamine has been found to alleviate symptoms of PMS, such as fatigue, mood swings, and sleep disturbances. By incorporating thiamine into their routine, women may find relief from these common issues.^[33]

Riboflavin

For pregnant women, a riboflavin deficiency can increase the risk of anemia by affecting iron metabolism. Riboflavin also plays a role in reducing the risk of PMS symptoms - the more riboflavin, the fewer symptoms. Additionally, low riboflavin levels have been linked to neurological issues, depression, and anxiety. As women age, getting enough riboflavin may even help keep their minds sharp and reduce the risk of cognitive decline. Some research suggests that adequate riboflavin intake might also have protective benefits against cervical cancer. By focusing on riboflavin-rich foods, women can take care of their overall health.

Adequate riboflavin intake has been linked to a lower risk of cervical cancer, with optimal levels ranging from 1.2 to 2.4 mg per day. Riboflavin may also play a role in slowing down cellular aging, as higher intake has been associated with longer telomere length in middle-aged and older women. Additionally, riboflavin has been shown to support brain health, reducing the risk of cognitive impairment in older adults. Women who consume more riboflavin may also experience fewer symptoms of PMS, and it's especially crucial for pregnant and breastfeeding women to get enough riboflavin to support their baby's development. By prioritizing riboflavin-rich foods, women can take care of their overall health and well-being.^[34]

Folate

In a study of urban Indian women, about 24% of those in early pregnancy were found to be folate deficient. Factors like having multiple pregnancies and limited education played a big role. So, what are the risks? Folate deficiency can increase the chance of neural tube defects in babies if they're not getting enough folate around the time of conception. It can also cause anemia, leading to fatigue and weakness. Furthermore, low folate levels have been linked

to complications during pregnancy, such as low birth weight and preterm delivery. By prioritizing folate-rich foods, women can take steps to protect their health and their baby's well-being.

High folic acid intake can mask vitamin B12 deficiency symptoms, which can lead to serious neurological problems if left untreated. Some research also suggests that excessive prenatal folic acid might affect DNA methylation and potentially increase the risk of neurodevelopmental disorders in children. Furthermore, elevated folate levels may weaken the immune system by reducing natural killer cell activity. There's also some concern that high folate levels might be linked to a higher cancer risk, although more research is needed to confirm this. As with any nutrient, finding the right balance is key to staying healthy.^[35]

Pyridoxine

A deficiency can impact mood, leading to irritability, depression, and confusion. In severe cases, it can also cause neurological symptoms like numbness and tingling in the hands and feet. Skin issues like seborrheic dermatitis, glossitis, and cheilitis are also common. For pregnant women, low vitamin B6 levels can increase the risk of preterm birth and early pregnancy loss. And in infants, a deficiency can even cause seizures that can be treated with pyridoxine. By prioritizing vitamin B6-rich foods, women can help protect their overall health and well-being.

High doses of vitamin B6 have been linked to nerve damage, causing symptoms like numbness and tingling. In some cases, even relatively low doses (around 6 mg/day) can cause problems. During pregnancy, excessive vitamin B6 intake has been associated with adverse outcomes, including miscarriage and fetal demise. Additionally, high doses (around 450-600 mg/day) can suppress lactation in new mothers. Other potential side effects include burning sensations, tingling, and loss of coordination. As with any supplement, it's crucial to find a safe and effective dose.^[36]

Cobalamin

During pregnancy, a cobalamin (B12) deficiency can increase the risk of gestational diabetes, pregnancy loss, and birth defects like neural tube defects. Low B12 levels have also been linked to depression, including postpartum depression. Furthermore, a deficiency may contribute to metabolic issues like insulin resistance and obesity. When it comes to reproductive health, B12 plays a crucial role - a deficiency may affect fertility and increase the risk of complications like low birth weight and preterm delivery. By prioritizing B12-rich foods or supplements, women can take steps to protect their health and well-being.

High vitamin B12 intake, especially when combined with high vitamin B6, may increase the risk of hip fractures in postmenopausal women. Additionally, older women with elevated B12 levels may be at higher risk of cardiovascular mortality. Some people may also experience symptoms like acne, palpitations, anxiety, and insomnia due to excessive supplementation. As with any supplement, it's essential to find a balanced approach to get the benefits without overdoing it.^[37]

One of the recent article is published on the topic of "Dietary Intake and Milk Micronutrient Levels in Lactating Women with Full and Partial Breastfeeding" hence, the outcome result was shown as Thirty-four women participated; 19 were classified as full breastfeeding and 15 as partial breastfeeding. Mean levels of calcium, copper, iron, and zinc in human milk were 243, 0.2, 0.2, and 1.56 mg/L, respectively. The prevalence of zinc deficiency (plasma zinc < 10.7 $\mu\text{mol/L}$) was 11.8%. No lactating women had iron deficiency. Nutrient intakes were lower than the recommended amounts in 38%–70% of participants, and were not correlated with corresponding nutrient levels in human milk. Multiple linear regression showed significant association between zinc levels in human milk and plasma for lactating women with full breastfeeding ($\beta = 0.034$, 95% confidence interval [0.003, 0.067], $p = 0.040$).^[38]

Conclusion

For women, especially those in their childbearing years living in lower-income countries, eating a wide variety of foods is really important for their health. Unfortunately, many women in these areas find it hard to get enough different kinds of healthy foods, which means they might not get all the vitamins and minerals they need. Things like their financial situation, cultural norms, and not having enough food available can make this even worse.

The review points out that when women eat a more diverse diet, they tend to get more nutrients and are generally healthier. This is especially important for having healthy pregnancies and lowering risks for mothers. Researchers use tools like asking women what they ate in the last 24 hours or how often they eat certain foods to understand how diverse their diets are and if they're getting enough nutrients. Dealing with the lack of consistent access to food through programs that also focus on nutrition is key to improving women's health. More research and action are needed to lessen the bigger impact that limited food choices and food shortages have on women's well-being.

Reference

- Tchuente, T.B.R., Hagbe, P. V., Eyenga, E. F., Dibacto, K. R. E., Joë, N. D., Youovop, F. J. A., ... & Oben, J. E. (2024). Dietary diversity and food security status among cameronian adults living in semi-urban areas: a cross-sectional study. *Food and Nutrition Sciences*, 15(7), 548-564.
- Torheim, L. E., Ferguson, E. L., Penrose, K., & Arimosnd, M. (2010). Women in resource-poor settings are at risk of inadequate intakes of multiple micronutrients. *The Journal of nutrition*, 140(11), 2051S-2058S.
- Mahmudiono, T., Andadari, D. P. P. S., & Segalita, C. (2020). Difference in the association of food security and dietary diversity with and without imposed ten grams minimum consumption. *Journal of public health research*, 9(3), 1736. <https://doi.org/10.4081/jphr.2020.1736>
- Chakona, G., & Shackleton, C. (2017). Minimum Dietary Diversity Scores for Women Indicate Micronutrient Adequacy and Food Insecurity Status in South African Towns. *Nutrients*, 9(8), 812. <https://doi.org/10.3390/nu9080812>
- Jones, A. D., Shrinivas, A., & Bezner-Kerr, R. (2014). Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data. *Food Policy*, 46, 1-12.
- Seid, A., et al. (2019). Maternal dietary diversity and micronutrient adequacy during pregnancy and related factors in East Gojjam Zone, Northwest Ethiopia. PubMed: <https://pubmed.ncbi.nlm.nih.gov/31092223>
- Kavle, J. A., et al. (2018). Food insecurity and nutritional status of preconception women in a rural population of North Karnataka, India. BMC Reproductive Health: <https://reproductive-health-journal.biomedcentral.com/articles/10.1186/s12978-018-0535-2>
- Chivwara, M., et al. (2021). Enhancing nutrition knowledge and dietary diversity among rural pregnant women in Malawi: a randomized controlled trial. BMC Pregnancy and Childbirth: <https://bmcpregnancychild-birth.biomedcentral.com/articles/10.1186/s12884-021-04117-5>
- Johnson, C. M., Sharkey, J. R., Lackey, M. J., Adair, L. S., Aiello, A. E., Bowen, S. K., Fang, W., Flax, V. L., & Ammerman, A. S. (2018). Relationship of food insecurity to women's dietary outcomes: a systematic review. *Nutrition reviews*, 76(12), 910-928. <https://doi.org/10.1093/nutrit/nuy042>
- Gil, Á., de Victoria, E. M., & Olza, J. (2015). Indicators for the evaluation of diet quality. *Nutricion Hospitalaria*, 31, 128-144. <https://doi.org/10.3305/nh.2015.31.sup3.8761>
- Apprey, C., Addae, H. Y., Boateng, G., Aduku, L. E., & Annan, R. A. (2025). Dietary diversity and nutrient adequacy among women in Bosomtwe District, Ghana. *Maternal & child nutrition*, 21(1), e13757. <https://doi.org/10.1111/mcn.13757>
- Islam, M. H., Nayan, M. M., Jubayer, A., & Amin, M. R. (2023). A review of the dietary diversity and micronutrient adequacy among the women of reproductive age in low- and middle-income countries. *Food science & nutrition*, 12(3), 1367-1379. <https://doi.org/10.1002/fsn3.3855>
9. Nair, D., & Muley, A. (2024). Food security and dietary diversity patterns amongst female handloom workers: a cross-sectional study from Kerala, India. *Discover Food*, 4(1), 23.
- Gibson, R. S., & Ferguson, E. L. (2015). An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries.
- Willett, W. (2013). *Nutritional epidemiology*. 3rd edn Oxford University Press.
- Jin, Y., Talegawkar, S. A., Sedlander, E., DiPietro, L., Parida, M., Ganjoo, R., Aluc, A., & Rimal, R. (2022). Dietary Diversity and Its Associations with Anemia among Women of Reproductive Age in Rural Odisha, India. *Ecology of food and nutrition*, 61(3), 304-318. <https://doi.org/10.1080/03670244.2021.1987230>
- Deshpande, S., Mandlik, R., Khadilkar, A. V., Bhawra, J., & Kinnunen, T. I. (2024). Micronutrient deficiency, dietary diversity, and sociodemographic and lifestyle determinants of dietary diversity among pregnant slum-dwelling women in Pune, India. *BMC nutrition*, 10(1), 108. <https://doi.org/10.1186/s40795-024-00915-0>
- Gupta, S., Sunder, N., & Pingali, P. L. (2020). Are Women in Rural India Really Consuming a Less Diverse Diet?. *Food and nutrition bulletin*, 41(3), 318-331. <https://doi.org/10.1177/0379572120943780>
- Ochieng, J., Afari-Sefa, V., Lukumay, P. J., & Dubois, T. (2017). Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. *PLoS one*, 12(12), e0189022.
- Saha, J., Chouhan, P., Malik, N. I., Ghosh, T., Das, P., Shahid, M., ... & Tang, K. (2023). Effects of Dietary Diversity on Growth outcomes of Children aged 6 to 23 months in India: evidence from National Family and Health Survey. *Nutrients*, 15(1), 159.
- Nair, D., & Muley, A. (2024). Food security and dietary diversity patterns amongst female handloom workers: a cross-sectional study from Kerala, India. *Discover Food*, 4(1), 23. <https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-022-03588-5> Minimum dietary diversity and associated

- factors among lactating mothers in Haryana, India: a community based cross-sectional study Shumayla Shumayla, E. M. Irfan, Nishtha Kathuria, Suresh Kumar Rathi*, Shobhit Srivastava and Sunil Mehra
- FAO. (2017). The food insecurity experience scale: measuring food insecurity through people's experiences.
- Gaur, S. (2020). Poverty Measurement in India
- Ruel M. T. (2003). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *Food and nutrition bulletin*, 24(2), 231–232. <https://doi.org/10.1177/156482650302400210>
- Nunn, R. L., Kehoe, S. H., Chopra, H., Sahariah, S. A., Gandhi, M., Di Gravio, C., Coakley, P. J., Cox, V. A., Sane, H., Shivshankaran, D., Marley-Zagar, E., Margetts, B. M., Jackson, A. A., Potdar, R. D., & Fall, C. H. D. (2019). Dietary micronutrient intakes among women of reproductive age in Mumbai slums. *European Journal of Clinical Nutrition*, 73(11), 1536–1545. <https://doi.org/10.1038/s41430-019-0429-6>
- Nguyen, P. H., Nguyen, H., Gonzalez-Casanova, I., Copeland, E., Strizich, G., Lowe, A., Pham, H., Truong, T. V., Nguyen, S., Martorell, R., & Ramakrishnan, U. (2014). Micronutrient intakes among women of reproductive age in Vietnam. *PLoS One*, 9(2). <https://doi.org/10.1371/journal.pone.0089504>
- Benson, C. S., Shah, A., Stanworth, S. J., Frise, C. J., Spiby, H., Lax, S. J., Murray, J., & Klein, A. A. (2021). The effect of iron deficiency and anaemia on women's health. *Anaesthesia*, 76 Suppl 4, 84–95. <https://doi.org/10.1111/anae.15405>
- Pathak, P., Kapil, U., Kapoor, S. K., Dwivedi, S. N., & Singh, R. (2003). Magnitude of zinc deficiency among nulliparous nonpregnant women in a rural community of Haryana State, India. *Food and nutrition bulletin*, 24(4), 368–371. <https://doi.org/10.1177/156482650302400407>
- North American Menopause Society (2001). The role of calcium in peri- and postmenopausal women: consensus opinion of The North American Menopause Society. *Menopause* (New York, N.Y.), 8(2), 84–95. <https://doi.org/10.1097/00042192-200103000-00003>
- Radhika, M. S., Bhaskaram, P., Balakrishna, N., Ramalakshmi, B. A., Devi, S., & Kumar, B. S. (2002). Effects of vitamin A deficiency during pregnancy on maternal and child health. *BJOG : an international journal of obstetrics and gynaecology*, 109(6), 689–693. <https://doi.org/10.1111/j.1471-0528.2002.01010.x>
- Ravindran, R. D., Vashist, P., Gupta, S. K., Young, I. S., Maraini, G., Camparini, M., Jayanthi, R., John, N., Fitzpatrick, K. E., Chakravarthy, U., Ravilla, T. D., & Fletcher, A. E. (2011). Prevalence and risk factors for vitamin C deficiency in north and south India: a two-centre population-based study in people aged 60 years and over. *PloS one*, 6(12), e28588. <https://doi.org/10.1371/journal.pone.0028588>
- Moti, M., Amini, L., Haghani, H., & Nateghi, M. R. (2024). The Effects of Thiamine Supplementation on General Health and Infertility Treatment Outcomes in Women with Polycystic Ovary Syndrome: A Triple-Blinded Randomized Placebo-Controlled Clinical Trial. *International journal of fertility & sterility*, 18(2), 128–134. <https://doi.org/10.22074/ijfs.2023.1972708.1398>
- Dricot, C. E. M. K., Erreygers, I., Cauwenberghs, E., De Paz, J., Spacova, I., Verhoeven, V., Ahannach, S., & Lebeer, S. (2024). Riboflavin for women's health and emerging microbiome strategies. *NPJ biofilms and microbiomes*, 10(1), 107. <https://doi.org/10.1038/s41522-024-00579-5>
- Bhide, P., & Kar, A. (2019). Prevalence and determinants of folate deficiency among urban Indian women in the periconception period. *European journal of clinical nutrition*, 73(12), 1639–1641. <https://doi.org/10.1038/s41430-018-0255-2>
- Paluszny, A., & Qiu, S. (2023). Vitamin B6 Toxicity Secondary to Daily Multivitamin Use: A Case Report. *Cureus*, 15(11), e48792. <https://doi.org/10.7759/cureus.48792>
- Zacharias, B. S., Upendra, S., & Dumbre, D. (2025). From Micro to Macro: Understanding the Far-Reaching Consequences of B12 Deficiency on Women's Health. *Public health nursing* (Boston, Mass.), 42(2), 1115–1131. <https://doi.org/10.1111/phn.13525>
- Dumrongwongsiri, O., Chongviriyaphan, N., Chatvutininun, S., Phoonlabdacha, P., Sangcakul, A., Siripinyanond, A., & Suthutvoravut, U. (2021). Dietary intake and milk micronutrient levels in lactating women with full and partial breastfeeding. *Maternal and Child Health Journal*, 25, 991–997.