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# Dietary diversity, nutrient intake and nutritional status of pregnant women aged 18 - 45 years in developing countries. A systematic review

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**Abstract**
**Introduction:** Dietary diversity is essential for maternal health and pregnancy outcome. A diverse diet provides micronutrients essential for a health pregnancy and foetus. The first 1000 days are critical for child development. The aim of this research was to systematically review studies to determine the association of dietary diversity, nutrient intake and the nutritional status of the pregnant women.
**Methods:** The search for the articles included a search on Google scholar, PubMed and Freefull pdf using a pre-defined inclusion and exclusion criteria. The identified papers were 87. Reference lists of identified papers were also examined. The key words used nutrient intake, nutritional status and minimum dietary diversity score. Most of the articles identified were specifically about dietary diversity and how it determines nutritional status especially to pregnant women. All papers on dietary diversity and determinants in households were considered.
**Results:** A total of 87 articles were identified for screening. A total of 20 out of 87 identified were relevant to dietary diversity, nutrient intake and nutritional status of pregnant mothers aged 18-45 years. Dietary diversity is a proxy indicator of nutrient intake as demonstrated by a variety of studies. However, some studies reported insignificant relationship between maternal dietary diversity and nutritional status. Demographic and socio-economic status was demonstrated to influence dietary diversity despite disagreement from other studies.
**Conclusions:** Dietary diversity influences maternal nutritional status and pregnancy outcome. Public health nutrition interventions involving improving accessibility of affordable nutrient rich foods and fortification of common foods are needed to bolster efforts to improve maternal nutrition in developing countries.

**Keywords:** dietary diversity, nutrient intake, nutrition status, pregnant women, systematic review, developing countries

## Introduction
Adequate nutrient intake necessary for good nutrition has often been associated with food variety and diet quality of individuals [1]. Globally food and agricultural activities have intensified and diversified but food insecurity remains rampant [2]. Recently, development agencies have focused on the lack of dietary diversity as a critical impediment to the reduction of the high rates of malnutrition in developing countries [3, 4].
Increased dietary diversity is thought to increase the probability of a healthier diet and positive anthropometric outcomes, in Africa [5]. To ensure adequate nutrient intake dietary diversification has been recommended as one of the best strategies particularly among pregnant women who have increased nutrient requirements [6]. A study conducted in Bangladesh postulated women of reproductive ages is at high risk of micronutrient deficiencies, yet information on micronutrient deficiencies and dietary patterns among women is scarce [7]. Adequate nutrient intake during pregnancy is important if satisfactory birth outcome and optimal health of the mother is to be realized. In recent years, many studies have also demonstrated that dietary diversity is indeed associated with nutrient intake [8].
However, no study has systematically analyzed factors associated with dietary diversity amongst pregnant women. Understanding the relation of these factors is important in driving specific interventions and prioritizing dietary guidelines which could lead to a decline in undernutrition and reduce risk among expectant mothers. Therefore, the objective of this study was to establish the relationship between dietary diversity and maternal demographic factors, socioeconomic characteristics, nutrient intake and nutritional status among pregnant women aged 18-45 years.

## Methods
### Search strategy
This systematic literature review was conducted using the 2015 Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines. Literature was searched through Free full pdf, Google scholar and PubMed (Medline) database using the following key terms; dietary diversity, nutrient intake, nutrition status, pregnant women. The search covered only peer reviewed articles published between January 2007 and January 2017. Full text articles that met the inclusion criteria were thoroughly reviewed by the authors. With this criterion, 20 articles were accepted and reported in this review.

### Study selection
Non-peer reviewed research, review or commentaries were

excluded. Studies dating more than 15 years ago and, studies involving women below 18 years and more than 45 years were excluded. Studies around the globe were included if they (1) focused on dietary diversity and nutrient intake; (2) involved pregnant women aged 18 to 45 years; (3) determined the nutritional status of pregnant women; (4) examined the morbidity patterns of pregnant mothers; (5) were published between 2007 and 2017; (6) were published in a peer-reviewed journal; (7) were published in English language.

**Data extraction and quality assessment**

Data extraction was conducted using a standardized data collection form. The first author (NJ) extracted all publications by reading titles and abstracts. In the final screening phase, NJ read the full text of the remaining articles and retained studies that met the study inclusion criteria.

All data extraction and appraisals were independently reviewed by NJ and NA, and any disagreements between the two reviewers were settled through discussion and consensus. The following characteristics in the identified studies were recorded; first author, country of the study, study type, aim of the study, publication year, population studied, study design, sample size, and factors associated with dietary diversity, nutrient intake and nutrition status. Strengthening the reporting of observational studies in Epidemiology (STROBE) checklist was used to assess the quality of the studies reviewed.

**Results**

The literature search yielded 4,160 articles of which 87 were potentially relevant after screening title and abstract (fig.1). Out of these, 20 articles met the inclusion criteria. All included articles were written in English. Of the total of 20 included articles, 10 described dietary diversity studies, 4 described nutrition status studies, 1 dietary intake study, and 5 contained both dietary diversity and nutrition status data. The included studies originated from three continents (15 different countries). Most of the studies were conducted in the African and Asian countries and one each contained data from South America and North America. Sample sizes ranged from 133 to 2,809 participants. There was a substantial variation in population characteristics and methodological aspects in the identified studies.

The outcome of the review was summarized based on the objectives of the study:

- Household demographic and socio-economic characteristics among pregnant women
- Dietary diversity and nutrient intake among pregnant women.
- Nutritional status among pregnant women.

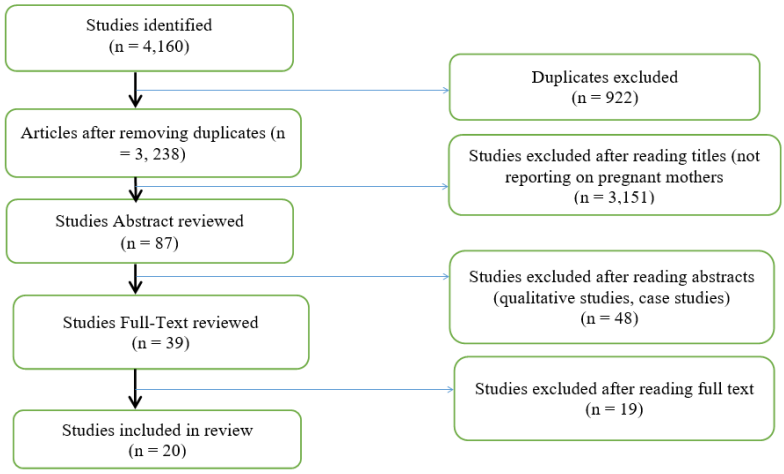


**Fig 1:** PRISMA overview of study identification and selection process

**Household demographic and socio-economic characteristics**

The results of this review indicate that education level, employment status, monthly income, land ownership and assets had a positive influence on dietary diversity [9, 10, 12]. Individual with secondary and tertiary education, employed and salaried reported higher odds of achieving minimum dietary diversity. A similar observation was also conveyed among households with heads with lower education levels in comparison with heads with higher education status or levels [10]. Similarly, household socio-economic and demographic characteristics such as household head gender, education levels, wealth quintile and source of food had statistically significant correlations with dietary diversity and nutrient intakes, male and female headed household 60.2 % and 39.8% respectively. The gender of the Household head had a significant association with dietary intake. Female headed households reported lower dietary diversity compared to male headed households. Male headed households reported higher dietary diversity compared to female headed households [10, 11]. The reviewed studies observed an association between marital status and dietary diversity. They reported a threefold increase in dietary diversity among the married compared to the unmarried. Several investigators have posited that there is a positive relationship existed between farm ownership and dietary diversity. Ownership of land (food production), wealth index, and household size, and livestock ownership, women freedom to travel to market, food storage facilities, and women literacy levels of nutritious foods recorded increased women dietary diversity score (WDDS) and reduced risk to food insecurity. Researchers observed that this association was higher in wealthier household [3, 7, 12, 13, 14, 15, 16]. Studies

conducted across eight developing countries reported a positive correlation between agricultural biodiversity and intake of diversified diets derived from farming [2, 15, 16]. This findings support the idea that dietary diversity may translate into individual and household dietary intake.

**Dietary diversity and nutrient intake among pregnant women**

A study conducted in Kenya, documented an association between dietary diversity and respondent nutritional status. Pregnant women nutritional status had a positive linear relationship with intake of diversified diet. This was noted after assessment of Middle Upper Arm Circumference (MUAC) and Hemoglobin levels [9]. In other studies, it was observed that a greater dietary diversity score in pregnant women had an association with infant birth weight. Dietary diversity was reported to be associated with weight again among pregnant women in second and third trimester of pregnancy. The study concluded that a diversified diet can help pregnant women gain desired weight [9, 13].

Most studies reported Household food production as the single most important determinant of dietary diversity, intake of nutritious food among women of low wealth index through increased access, stability and availability of food. Household food production was reported to improve accessibility to fresh vegetable and less susceptible to market forces [2, 11, 15, 16, 17]. Additionally, it was also documented that energy, protein and vitamin C intake met the Recommended Dietary Allowances (RDA). However, a study conducted in Sri Lanka reported nutrient intakes of calcium, iron; folate and vitamin A were below RDA. However, hemoglobin levels were normal among majority of the population [12].

**Nutritional status among pregnant women**

Most of the reviewed studies reported dietary diversity to be positively associated with the maternal nutrition status [8, 13, 18, 19, 20]. Maternal nutritional status was identified to greatly influence pregnancy outcomes and maternal susceptibility to diseases. Maternal undernutrition contributed to low birth weight newborns, prone to communicable diseases and contributes to deaths of newborns [18, 19, 20].

**Discussion**

According to the findings of this systematic review, reviewed studies reported socio-economic and demographic factors as one of the consistent factors influencing dietary diversity among the studied populations; which translated to nutrient intake and their nutritional status. The most common factor was the education levels. Low education level amongst the parents was identified as potential risk factor associated with poor nutritional status compared to individuals with secondary education and higher. It improves the household food consumption and food security levels of families. Similarly, a high father's education also translates to a higher household income level and food security [2, 3, 7, 9, 10-16]. Another factor that was consistent with other studies is that teenage pregnancies are strongly associated with numerous negative consequences of pregnancy [4].

Household with uneducated parents tend to have low income thus their purchasing power is limited to less nutritious foods mostly composed of cereals and starchy foods with minimal diversity and less consumption of fruits, vegetables rich in nutrients essential during pregnancy. This is in line with numerous studies in developing countries where the overall education level is low and poverty levels are high [9 – 12].

In our review, household heads gender was also associated with dietary diversity and nutrient intake. Studies showed that male headed households had a significantly higher score in dietary diversity and nutrient compared to female headed households [10, 11]. Additionally, they reported a threefold increase in dietary diversity among married in comparison to the unmarried individuals.

The review of the literature we carried out showed that low maternal BMI were reported to be associated with low dietary diversity score, poor nutrient intake and significantly influenced the pregnancy outcomes; higher maternal susceptibility to diseases and low birth weight newborns.

Ownership of farms and access to land was reported by several investigators to have a significant impact in dietary diversity in households. Ownership of land translated into food production, a higher dietary diversity score, improved food consumption and food security of households.

**Strengths and limitations**

The findings presented result from analysis of the comprehensive evidence available from across the world regarding dietary diversity, nutrient intake and nutrition status of pregnant women. Our broad inclusion criteria and systematic search provided data from 15different developing countries; 4 continents, which increases the heterogeneity of the included studies.

We do acknowledge that there are limitations in synthesizing the available literature, particularly reviewed mainly quantitative studies in comparison to qualitative studies. This limited the triangulation of findings and offer alternative explanations. Although included studies represented 15 countries, 8 (53%) of these provided data for the review were conducted in Africa, 5 (33%) were conducted in Asia, with only (2) 14 % from outside this continents. This lack of data is itself limits the extent to which the conclusions can be generalized worldwide.

**Conclusions**

This systematic review provides further evidence that dietary diversity is a good proxy indicator of the nutritional status of pregnant women. It also brings to fore issues related to resource-disadvantaged entities of the urban systems namely; females, poor households, and the non-educated that have food insecurity problems. It is clear, factors associated with dietary diversity, nutrient intake and nutrition status are multifactorial and interdependent. The findings highlights the high dietary diversity in the communities in Africa but, low consumption of foods rich in micronutrients such as fruits, milk and dairy products. Hence, there is need to employ a multi-strategy community based nutrition approach to improve maternal nutrition status. Such approach should include nutrition education and counseling in the nutritional value of different food groups, inexpensive food choices and food preparation methods to enable meet pregnancy related nutrient demands.

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**Author's contribution:** NJ and NA searched the literature and extracted data. NJ carried out the analysis and wrote the first manuscript. All authors discussed the data and interpreted the results. NJ and NA reviewed and edited the manuscript. All authors approved the final version and take full responsibility for the contents of the manuscript.
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