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DIET QUALITY AMONG PREGNANT WOMEN ASSOCIATED WITH FOOD SUPPLEMENTATION FROM THE WOMEN

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ABSTRACT

Adequate nutrition during pregnancy is considered one of the most influential factors affecting pregnancy outcomes. Diet during pregnancy is known to affect maternal and fetal metabolism in ways that have a profound effect on maternal health, fetal growth and development, and birth outcomes.

Diet quality is also considered a modifiable risk factor for the prevention of chronic diseases. Research clearly demonstrates that both over and undernutrition during pregnancy influence the neonatal birth weight and predisposes the child to the future development of chronic diseases such as obesity, coronary heart disease, stroke, type 2 diabetes, and hypertension. Thus, compelling data support the critical role of diet during pregnancy for healthy birth outcomes that warrant support and cautious monitoring.

KEYWORDS: Diet Quality, Pregnant Women, Food Supplementation.

INTRODUCTION

Diet indexes are based on theoretical assumptions about the effect of various components of the diet (foods and nutrients) on the health of individuals, which allow the evaluation and monitoring of the adherence to the diet in relation to nutritional recommendations.[1]

Their use requires specific adaptations according to the study population Evidence suggests that a diet high in vegetables, legumes, and fruits has better quality and, consequently, promotes positive outcomes for the health of the mother and the baby.[2]

Associated with these food groups and micronutrients of interest during the gestational period (iron, calcium, and folate), the adequate intake of omega-3 to favor the maternal and child health is also currently emphasized. Studies suggest that the higher intake of this nutrient in pregnancy is inversely associated with the risk of detrimental outcomes for the mother and baby.

Good maternal nutrition is important for the health and reproductive performance of women and the health, survival, and development of their infants.[3] Maternal malnutrition impairs pregnancy and increases maternal morbidity and mortality, leading to poor birth outcomes.[4] In developing countries, meeting basic food requirements is a problem consequently making it unlikely to meet nutrient needs in pregnancy from diet alone. This is because the diets are characterized by staple foods (cereals and legumes) with little or no foods of animal origin or a variety of fruits and vegetables and are therefore low in multiple micronutrients.

Requirements for energy-yielding macronutrients increase modestly compared with several micronutrients that are unevenly distributed in food. Protein quality in the diet is important as it determines the efficiency of protein utilization in the body.[5]

Some important micronutrients during pregnancy include iron, zinc, and folate. Diets of women from developing countries are low in iron content and bioavailability. The nutritional adequacy of dietary zinc depends on the amount in the foods, bioavailability, and absorption which is limited by high phytate diets.[6] Optimizing folate status from food sources alone has limitations due to the incomplete bioavailability of natural folates. Although maternal nutrient intake during pregnancy has been cited as an entry point to improving infant health and breaking the inter-generational cycle of malnutrition, few studies have been done in Kenya to assess the diet quality of pregnant women to ascertain their dietary patterns.[7]

Adequate nutrition during pregnancy is considered one of the most influential factors affecting pregnancy outcomes (King, 2003). Diet during pregnancy is known to affect maternal and fetal metabolism in ways that have a profound effect on maternal health, fetal growth and development, and birth outcomes. Diet quality is also considered a modifiable risk factor for the prevention of chronic diseases. Research clearly demonstrates that both over and undernutrition during pregnancy influence the neonatal birth weight and predisposes the child to the future development of chronic diseases such as obesity, coronary heart disease, stroke, type 2 diabetes, and hypertension.[8]

BACKGROUND

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was established in 1974, to improve nutrition during pregnancy for low-income women (with households' earnings at 185% of the federally-defined poverty level). Research has clearly demonstrated that both over and undernutrition during pregnancy influence neonatal birth weight and predispose the child to chronic diseases such as obesity, coronary heart disease, stroke, type 2 diabetes, and hypertension over the course of their lifespan.[9] Much of this knowledge stems from an original proposition by Barker, who suggested the 'fetal origins of adult disease', that theorized that adverse conditions in-utero alter organ structures and functions in ways that program body systems for disease later in life. More recent research has proposed that one of the most necessary factors needed to optimize fetal growth and organ development is the quality and quantity of maternal dietary intake during pregnancy.

The origin of heritable non-communicable diseases (NCD) such as diabetes, obesity, hypertension and cardiac diseases are increasingly attributed to nutrition during pregnancy. Scientists propose that intrauterine nutrient restrictions to the fetus may cause epigenetic modifications that permanently alter gene expression making the individual susceptible to developing NCDs across their lifespan. Furthermore, a growing body of evidence has clearly demonstrated in animal and human models that epigenetic alterations in the fetus are multigenerational, affecting the health status of future generations.[10]

In 2009 the WIC program issued food package updates focusing on more whole grains, fish options, yogurt as a milk substitute for women and children, and more fruits and vegetables for children. The WIC entirety of food groups offered are eggs, fruits and vegetables (fresh, frozen, or canned), whole grain cereal, beans, whole grain bread, peanut butter, fruit juice, low-fat milk, cheese, and fish (canned). Efforts to update the WIC food supplement ensued again in 2016-2017 when the National Academies of Sciences, Engineering, and Medicine published a review on WIC food packages and proposed a framework for revisions, called Review of WIC Food Packages: Improving Balance and Choice Final Report.[11] The report used the National Health and Nutrition Examination Survey (NHANES) 2005 – 2012 dataset that included dietary intake of WIC-eligible populations. The women (pregnant and breastfeeding) were combined into one group and inadequate intakes of calcium, copper, iron, magnesium, zinc, vitamin A, vitamin D, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, and protein were identified by estimated average requirements

(EAR).[12] The final report concluded that women (WIC eligible) participants had low or inadequate diet quality, in addition to sub-standard intakes of several nutrients, as well as excessive intake of other nutrients that could be addressed through additional changes to the WIC food package. The recommended adjustments to the WIC food supplement were to align it closer to the US Dietary Guidelines by increasing the dollar amount of the cash value voucher, add fish, and reduce the amounts of juice, milk, legumes, and peanut butter in all food packages for women and children to improve the balance of food.[13] A summary of the Maryland WIC food package, National Academies recommendations, and the U.S. Dietary Guidelines are described in Table 1. There are no systematic reviews of diet quality in the WIC program available in the literature. Few studies have been published that compared diet quality before and after WIC food package changes. The studies available primarily focused on children WIC recipients, not pregnant women.[14]

Whaley and colleagues (2012) included pregnant women in WIC as a sub-group of their study among postpartum women and caregivers of children and described increased consumption of fruits, vegetables, and whole grains, but did not measure diet quality. The findings from these studies suggest that the diet quality scores of the WIC food package today is not clearly apparent. Additional research and testing are necessary to study changes in the WIC food package and identify areas for improvement.[15]

Table 1

WIC Food Package Components by Current, Recommended, and Alignment to US Dietary Guidelines

Maryland WIC - Pregnant Women	NAS - Recommended WIC Food Package Changes for Pregnant Women**	US Dietary Guidelines 2015
Eggs, 1 dozen	Eggs, 1 dozen	Meats and poultry, 26 ounce/week
CVV for Fruit & Vegetable, $11 per month * (frozen or canned allowed)	CVV for fruit and vegetable, $15 per month	Fruit, 2 cup/day Vegetable, 2 ½ cup/day
Cereal – cooked or cold, 36 ounce, whole grain	No change	Whole grains, ≥3 ounce/day
Legumes, 1 pound dry Or 64 ounce canned	2 pounds every 3 months	Peas and beans 1 ½ cup/week
Bread, whole grain, rice, or tortillas, 1 pound	Whole grains, 16 – 24 ounces	Whole grains, ≥3 ounce/day
Peanut Butter, 18 ounce	Peanut Butter, 16 – 18 ounces every 3 months	Nuts, seeds, soy products, 5 ounce/week
Fruit Juice, 144 ounces	Fruit Juice, 64 ounces OR $3 increase CVV	Limit on calories from other uses, 270 kcal/day
Milk, 1% or fat free, 24 quarts (4.75 gallon)	Milk, 2% milk fat or less 16 quarts	Dairy– includes other forms, 3 cup/day
Cheese, 1 pound	Dairy/milk substitute	Dairy– includes other forms, 3 cup/day
Fish (canned), None	Fish (canned), 10 ounces every three months	Seafood, 8 ounces/week

*CVV=Cash value voucher, **NAS=National Academies of Science

Measuring Diet Quality

The examination of diet quality composite and components is frequently aligned to an investigator's research objectives. Thus, nutrition research lacks a broad consensus on measuring diet quality. While micronutrient (i.e. vitamin C, calcium) assessment is informative, evaluating dietary intake by food groups and macronutrients (i.e. fat or protein) as a reflection of diet quality is increasingly emphasized. A leading authority on nutrition, Harvard Professor Frank Hu, described three reasons for trending away from specific nutrient analysis. The "single nutrient" approach may be inadequate as it fails to account for the complicated interactions among nutrients in studies of free-living people (e.g. enhanced iron absorption in the presence of vitamin C).[16]

Second, the high level of inter-correlation among some nutrients (such as potassium and magnesium) makes it difficult to examine their separate effects, because the degree of independent variation of the nutrients is markedly reduced when they are modeled at the same time. Third, the effect of a single nutrient may be too small to detect, but the cumulative effects of multiple nutrients included in a dietary pattern may be sufficiently large to be detectable.[17]

These concerns informed the present study and led to changes in the direction from specific nutrients to evaluating food groups and diet quality. Several methods can be used to assess the extent of diet quality status. For example, the Diet Quality Index (DQI), Mediterranean Diet Score, Dietary Approach to Stop Hypertension (DASH) Diet Score, Alternative Healthy Eating Index, and Healthy Eating Index (HEI) are all validated measures.[18]

Across the indices, the Health Eating Index (HEI) was determined to be the most appropriate measure of diet quality for the present study because it is (a) the only measure that specifically measures conformance with US Dietary Guidelines, (b) also aligned with the WIC Program; and (c) updated every five years. The other diet quality measures were outdated with no regular cycle to update and did not align to US Dietary Guidelines. The HEI was developed to measure how well diets conform to US federal dietary guidance, namely the Dietary Guidelines for Americans. The original version of the HEI had ten food components that measured five major food groups (i.e. fruit, vegetable, grains), four nutrients recommended to be consumed in moderation (i.e. saturated fat and sodium), and a variety of foods.[19] The HEI was revised in 2008 to reflect the 2005 Dietary Guidelines for Americans, and scores were based on amounts of foods and nutrients consumed per intake of 1,000 kcal energy rather than on absolute amounts. The HEI was updated in 2013 and validated with 12 components to reflect the 2010 Dietary Guidelines for Americans. Most recently, the HEI-2015 was updated with 13 components to reflect distinction in the empty calorie's moderation component. Specifically, the empty calories component (called SoFAAS in 2005) was replaced with two discrete categories, saturated fat and added sugars; this change was designated to address the 2015 Dietary Guidelines recommendation to limit added sugars to less than 10% of caloric intake. Two additional changes were incorporated into the HEI-2015 – solid fats were replaced by saturated fatty acids and alcohol was removed from empty calories (still accounted for in total calories).[20]

Table 2

Healthy Eating Index Scoring Parameters

Component HEI-2010	Max Points	Standard for Maximum Score	Standard for Minimum Score of Zero	WIC Food Package (monthly allowance)
Adequacy				
Total Fruit	5	≥0.8 cup equivalent/1000 kcal	No Fruit	Fruit juice, 144 ounce
Whole Fruit	5	≥0.4 cup equivalent/1000 kcal	No Whole Fruit	Fruit & Vegetable $11/month total allowance
Total Vegetables	5	≥1.1 cup equivalent/1000 kcal	No Vegetables	(Included in $11)
Greens and Beans	5	≥0.2 cup equivalent/1000 kcal	No Dark Green Vegetables or Beans or Peas	(included in $11) & 1 pound dry or 64 ounce canned
Whole Grains	10	≥1.5 ounce equivalent/1000 kcal	No Whole Grains	Bread - Whole Grain, 1 pound & Cereal – cooked or cold, 36 ounce, whole grain
Dairy	10	≥1.3 cup equivalent/1000 kcal	No Dairy	Milk, 1% milk fat or less, 24 quarts Cheese, 1 pound
Total Protein Foods	5	≥2.5 ounce equivalent/1000 kcal	No Protein Foods	Eggs, 1 dozen
Seafood and Plant Proteins	5	≥0.8 ounce equivalent/1000 kcal	No Seafood or Plant Proteins	Seafood, none & Peanut Butter, 18 ounce
Fatty Acids	10	(PUFAs + MUFAs)/SFAs > 2.5	(PUFAs + MUFAs)/SFAs ≤ 1.2	
Moderation				
Refined Grains	10	≤1.8 ounce equivalents/1000 kcal	≥4.3 ounce equivalent/1000 kcal	
Sodium	10	≤1.1 g/1000 kcal	≥2.0 g per 1000 kcal	
Empty Calories	20	≤19% of energy	≥50% of energy	

RESULTS AND DISCUSSION

Only three studies and the expert panel report with 2 analyses met inclusion criteria for this review that required an evaluation of the diet quality of WIC-recipients to be central to the purpose. This small number is significant because it identifies the need for more research about diet quality and WIC food packages necessary to inform policymakers' decision-making about the efficacy of the program and cost-effective ways for further improvement. The study years of data collection varied and the publication dates were not indicative of direct changes to diet quality of WIC-recipients following the WIC food package changes in 2009. Two studies did compare diet quality scores pre and post the policy changes and increases in diet quality were reported.

The other studies used a combination of study data years that spanned before or after the program revisions and did not evaluate changes resulting in the implementation of the changes. In the WIC populations, diet quality scores are generally lower than the national average that is 59.[21]

However, the research on WIC food supplementation shows that while the diet quality is low, women and children enrolled in the WIC program score higher than those who are eligible but now enrolled and approach the mean score for the overall population. That finding demonstrates that WIC food supplementation positively influences diet quality among low-income women and children. When evaluating the efficacy of the WIC program, it is important to consider that it only provides a portion of the total diet. The upper range in diet quality scores reported in these studies is therefore remarkable and clearly demonstrates that WIC-participation improves dietary intake.[22]

This suggests that increased utilization of the WIC food packages for WIC-eligible groups would add a benefit that could appreciably reduce health disparities among low-income populations. Those benefits could be further increased by implementing the expert recommendations for revisions to the WIC food packages suggested in the National Academies report.[23] Computational assessment of those changes estimated increased diet quality scores for participating groups is similar to the last cycle of revisions and are cost neutral. Another consideration for this field of inquiry is how the nutritional intake data is collected. The most common means of capturing dietary intake in these studies was the 24-hour recall method. Traditional dietary intake assessment methods include food diaries, 24-hour food recall, and food frequency questionnaires.[24] The strengths of those measures are that they are cost-effective and timesaving for large epidemiological studies, however, there is growing criticism among the research community who attest that memory-based measures of dietary intake are pseudoscientific and inadmissible in scientific research. While they remain the most widely used data collection method, self-reported dietary intake poses several limitations for accurate measurement because they rely solely on participant recall that carries a high likelihood of biased reporting.[25] Evidence indicates that excessive consumption of these products is positively associated with obesity and chronic diseases.[26]

Studies also suggest that the consumption of ultra-processed foods has an impact on the cultural, social, environmental, political, and economic contexts. In addition, diets high in these foods are nutritionally unbalanced, as they present a higher content of total fat, saturated fat, cholesterol, sodium, and added sugars and lower content of fiber, protein, and some micronutrients.[27]

Another strength was the definition of the food groups using the energy density approach (servings/1,000 kcal), differing from the other previously proposed national dietary indexes for pregnant women. The inclusion of omega-3 is also a favorable point of the IQDAG. Studies suggest that the higher intake of this micronutrient in the gestational period is inversely associated with maternal depression, gestational diabetes, restricted intrauterine growth6, and deficits in neurocognitive development.[28]

According to studies, we verified that the quality of the diet was positive in relation to the consumption of legumes and vegetables since most pregnant women reached the maximum score for these components.

In Iraq, the consumption of legumes, especially bean-based preparations, is considered a marker of meal consumption (instead of the replacement for sandwiches) and thus of a healthier dieth. On the other hand, we observed that a low proportion of women reached the maximum score for the consumption of fresh fruits, intake of fiber, omega-3, calcium, folate, and iron, which indicates the poor quality of the diet in this aspect.[29] This finding corroborates with a previous national study, in which

pregnant women did not adopt a food intake that allowed them to reach their nutritional needs, especially regarding the intake of micronutrients.

We also observed that few pregnant women reached the maximum score for the limit of consumption of ultra-processed foods, an unfavorable characteristic of the quality of the diet given the adverse effects of these foods on the health of individuals.[30] Similar to the data of this study, high consumption of ultra-processed foods, such as soft drinks, crackers, and cookies, has also been found in a cross-sectional study carried out among pregnant women.

We highlight that the diet of the mother during pregnancy can play a fundamental role in the health of the mother-child binomial. Some evidence suggests that a better quality of the diet during pregnancy is associated with a lower risk of GD28, as well as fetal anomalies, including neural tube defects.[31]

On the other hand, specific deficiencies of micronutrients can cause low birth weight, maternal obesity, and hypertension during pregnancy. The IQDAG showed a significant correlation with the scores of all components, and we can observe the strong influence of the moderator component. Consistent with other studies, we verified a better quality of diet among older pregnant women.[32] with adequate BMI12, who reported practicing more physical activity, and who used dietary supplements.[33]

The underreporting of energy intake was estimated using the Goldberg formula8, which does not consider the physical activity of individuals and which presupposes the maintenance of body weight. Extreme values of energy intake (below or above acceptable levels) may be inherent to the gestational period, characterized both by restricted (from gastric symptoms) and high food intake (from increased appetite). In addition, we used the Estimated Average Requirement (EAR) values as a cut-off point for calcium, folate, and iron and we used the Adequate Intake (AI) for fiber and omega-315.[34]

The estimation of the adequacy of nutrients without specific EAR values (fiber and omega-3) is not recommended, and the probabilistic approach is the recommended method to estimate the adequacy of iron in women of childbearing age. However, we consider that this study proposed a relevant instrument to evaluate the quality of the diet of pregnant women, especially in the scenario of primary health care. The IQDAG was unprecedented in incorporating the recommendation on the moderation of the consumption of ultra-processed foods in a national index, thus allowing the evaluation and monitoring of the adherence of the diet of pregnant women in relation to the nutritional guidelines of the current Brazilian dietary guidelines.[35]

Unlike previous national indexes for pregnant women, we also considered the energy density approach in the definition of food groups. We found the highest index score among older and eutrophic women who reported a healthy lifestyle. In addition, our findings reinforce that strategies are needed to promote the consumption of fresh fruits, foods high in fiber, omega-3, calcium, folate, iron, and fresh or minimally processed foods among pregnant women.[36]

CONCLUSION

Diet is known to influence human metabolism in ways that have a profound effect on health; therefore, it is essential to have tools to accurately measure diet. Contemporary dietary intake assessment methods include food diaries, 24-hour food recall, and food frequency questionnaires that rely on self-reported memory-based dietary intake methods (MBM). The benefits of using these measures are that they are cost-effective and timesaving for large epidemiological studies. However, although MBMs are widely used, their reliance on participant recall inherently poses limitations for accurate measurement because they carry a high likelihood of inaccurate and/or biased reporting. Subsequently, these methods have attracted criticism from some scientists who regard them as wholly inadequate for accurate estimation of food value. Alternately, despite evidence that calls into question their suitability for use in research, proponents of MBM argue that in the absence of an alternative approach, they have to be acceptable. In addition, MBMs either capture dietary intake at a single point in time or retrospectively over longer periods, and that limits the ability to accurately capture the variability in the foods consumed over a period of time.

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