International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

REVIEW ARTICLE

DOI: 10.54448/ijn23210

Major clinical approaches to proper nutrition and lifestyle change during pregnancy: a systematic review

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E-mail: pmflima1@gmail.com
DOI: https://doi.org/10.54448/ijn23210
Received: 12-15-2022; Revised: 03-31-2023; Accepted: 04-04-2023; Published: 04-06-2023; IJN-id: e23210

Abstract

Having a healthy pregnancy with the birth of a healthy child is the goal of the entire process that involves this phase. Nutrology is important in this context to reduce the risk of future chronic diseases in the child and unfavorable outcomes for the pregnant woman and the fetus. Lifestyle change generates a positive impact on every phase of life in which it is carried out. But it is known that changes in parents at least 3 months before conception, during pregnancy, and breastfeeding are related to the improvement in the quality of gametes and the expression of healthy genes. Food consumption is increasingly far from ideal. There was an increase in the consumption of ultraprocessed foods and a decrease in natural foods. Thus, the recommended dietary intake is not achieved by a large part of the Brazilian population. Therefore, it is necessary to supplement mainly during pregnancy due to increased needs. Therefore, the present study carried out a concise systematic review to list the main clinical approaches to the effects of adequate nutrition and lifestyle changes in human pregnancy.

Keywords: Nutrology. Pregnancy. Nutritional aspects. Lifestyle.

Introduction

Pregnancy is a phase in a woman's life in which she is more concerned with food and a healthier lifestyle, thinking about her well-being and the good development of the child **[1]**. The diet has a great impact on the outcome of the pregnancy: positive if there is adequate food supplying the increased energy needs of the pregnant woman and the fetus or negative if the pregnant woman has suffered from malnutrition or overnutrition **[2]**.

In this sense, health professionals play an important role in monitoring anthropometric and laboratory tests, observing signs and symptoms resulting from nutritional deficiencies and excesses, providing guidance on dietary measures, and introducing supplements when necessary. The guidelines must be started before conception and followed during prenatal and postnatal care, thus facilitating a positive outcome **[1,2]**.

In this context, when the pregnant woman eats adequately and varied both macronutrients and micronutrients according to daily recommendations, supplementation with multivitamins may not be necessary. Therefore, supplementation is always used in a specific and individualized way. Iron and folic acid are two micronutrients that should be supplemented by all pregnant women. Folic acid more specifically should be started at least 3 months before conception. Therefore, many already start using it with the desire to get pregnant. Other supplements will depend on the pregnant woman's diet **[1-4]**.

As a result of good nutrition, adequate weight gain is observed. This gestational weight gain should follow the BMI of the period before pregnancy. If the gain is unsatisfactory, guidance measures and diet analysis should be taken by the health professional who accompanies this pregnant woman **[5,6]**.

Therefore, the present study carried out a concise systematic review to list the main clinical approaches to the effects of adequate nutrition and lifestyle changes in human pregnancy.

Methods

Study Design

The present study followed a concise systematic review model, following the systematic review rules - PRISMA (Transparent reporting of systematic review and meta-analysis: //www.prisma-statement.org/).

Search Strategy and Search Sources

The literary search process was carried out from September to November 2022 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, addressing scientific articles from various eras to the present day. The descriptors (MeSH Terms) were used: *Nutrology. Gestation. Nutritional aspects. Lifestyle*, and using the Boolean "and" between MeSH terms and "or" between historical discoveries.

Study Quality and Risk of Bias

Quality was rated as high, moderate, low, or very low for risk of bias, clarity of comparisons, accuracy, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analysis of randomized clinical trials, followed by randomized clinical trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument through the analysis of the Funnel Plot graph (Sample size versus Effect size), using Cohen's test (d).

Results and Discussion

Summary of Findings

As a corollary of the literary search system, a total of 124 articles were found that were submitted to the eligibility analysis and, then, 12 of the 44 final studies were selected to compose the results of this systematic review. The listed studies showed medium to high quality (Figure 1), considering in the first instance the level of scientific evidence of studies in types of study such as meta-analysis, consensus, randomized clinical trial, prospective and observational. The biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies showed homogeneity in their results, with X^2=98.4%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 16 studies with a high risk of bias and 32 studies that did not meet GRADE.

Figure 1. Flowchart showing the article selection process.

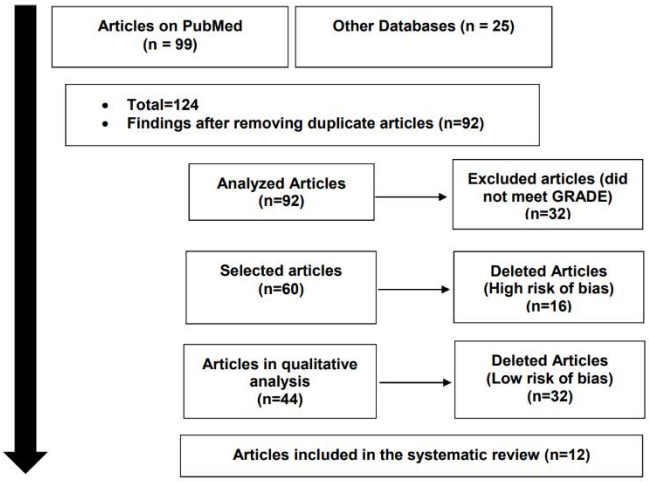
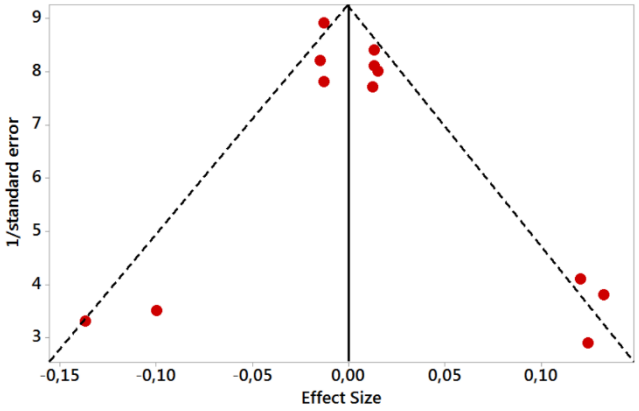


Figure 2 presents the results of the risk of bias of the studies through the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using the Cohen Test (d). Precision (sample size) was indirectly determined by the inverse of the standard error (1/Standard Error). This chart had a symmetrical behavior, not suggesting a significant risk of bias, both between studies with small sample sizes (lower precision) that are shown at the bottom of the chart and in studies with large sample sizes that are shown at the top.

Figure 2. The symmetrical funnel plot does not suggest a risk of bias among the small sample size studies that are shown at the bottom of the plot. High confidence and high recommendation studies are shown above the graph (n=12 studies).



Source: Own authorship.

Main Clinical Evidence

Pregnancy, a period of great physical and psychosocial changes for women, is marked by physiological adaptations in the pregnant woman's body. They affect the metabolism and functioning of maternal organs to provide adequate fetal growth and development **[1]**. In the cardiovascular system, there is an increase in heart rate associated with an increase in

cardiac output. With the peripheral vasodilation and the reduction of plasma proteins, mainly albumin, venous stasis and edema in the lower limbs are observed. There is also hemodilution and, consequently, physiological anemia. Thus, pregnant women often complain of dizziness, dyspnea, and fatigue **[1,2]**.

In the respiratory system, the growth of the fetus pushes the diaphragm, making lung expansion difficult and causing dyspnea. There is also greater consumption of oxygen (O2) and greater production of carbon dioxide (CO2), which are compensated by hyperventilation with more efficient expiration. In the digestive system, slow gastric emptying is observed, causing symptoms such as nausea, vomiting, gastroesophageal reflux, and intestinal constipation. By reducing gallbladder contraction, there may also be a discomfort when consuming fatty foods and more predisposition to the formation of cholelithiasis **[3,4]**.

In the urinary system, there is an increase in the glomerular filtration rate associated with physiological glycosuria. There is also an increase in the frequency of urination due to the mechanical pressure that the uterus exerts on the bladder and hormonal changes **[3]**. In terms of metabolism, there is an increase in the basal metabolic rate due to the needs of the fetus and the increase in maternal consumption. To maintain the supply of glucose to the fetus, body fat is mobilized for use as an energy source for the mother. Therefore, plasmatic levels of fatty acids and triglycerides are high. Although there is an increase in pancreatic beta cells, there is an increase in peripheral insulin resistance and, consequently, hyperglycemia and hyperinsulinemia. It is essential to monitor blood glucose and perform an oral glucose tolerance test to monitor and early diagnose gestational diabetes that can harm the proper development of the fetus **[4,5]**.

Also, psychological changes are associated with hormonal changes and sociocultural factors. The patient often feels pressured and judged, in addition to worrying about the new responsibility she has to come. She often still experiences conflicts with the child's parents at this time. Thus, manifestations such as anxiety, bulimia, excessive weight gain, emesis, and hyperemesis may be present **[6]**.

Having a healthy diet associated with physical activity and improving habits (predominantly plant-based diets, exercise, adequate amount of hours of sleep, stress control, moderation of alcohol use, abandonment of cigarette use, and emotional resilience) have a great positive impact on the health of all individuals at any stage of life in which it is adopted. But the first 1100 days of the pregnant woman's diet, 90 days before conception, 280 days of pregnancy, and the first two years of breastfeeding, which are equivalent to 730 days, are the most important in the process of development and human health. During this period, the development of the fetal organs, metabolic programming, and other processes will occur that will favor the child's future risk of chronic diseases such as obesity, diabetes, and cardiovascular diseases **[7,8]**.

Many studies also show that a good lifestyle of the mother and father at least 3 months before conception improves male and female germ cells before conception and modifies the development of the embryo and fetus **[1]**. Thus, the change in the genetic expression of the parents is transferred to the child, this is called epigenetic inheritance. This epigenetic inheritance may reduce the risk of the child developing some chronic diseases in adulthood. It is noteworthy that there is no change in the genetic material, but in the way, it is expressed **[2]**.

As there is a metabolic increase during pregnancy with greater consumption of some nutrients than others, there is a need for increased and adequate food intake of micronutrients and macronutrients. Thus, the consumed amount of each food group should increase as recommended by the Dietary Guidelines **[2]**. By offering the general population a daily diet divided into 3 to 6 meals a day with varied portions of vegetables, legumes, fruits, whole grains, dairy products, and proteins, the recommended daily intake for most nutrients is probably achieved. But during pregnancy, some nutrients are consumed in greater quantities, and supplementation is necessary if it is not enough just by increasing the consumption of foods rich in these nutrients **[9]**.

The diet, in most countries of the world, is richly composed of ultra-processed foods and products with low nutritional content. In addition, it does not reach the recommended intake of several nutrients. Data from the US National Health and Nutrition Examination Survey (NHANES) show that the world's population has consumed half of the total recommended amount of vegetables and dairy products for pregnant and lactating women2. And data from the Household Budget Survey (POF) for the 2008-2009 biennium, in Brazil, show that the recommended food consumption is not reached by 90% of the Brazilian population. Therefore, the Academy of Nutrition and Dietetics considers that micronutrient supplements are necessary for preconception, pregnancy, and breastfeeding **[1,2]**.

The increased metabolic rate during pregnancy can be assessed through calorimetry, bioimpedance, or formulas adjusted to the level of physical activity and

increased energy needs [3]. This increase in caloric intake varies between the trimesters of pregnancy and the body mass index (BMI) of the pregnant woman. Normally, in the first trimester of pregnancy, intake remains the same as in the pre-pregnancy period. Already in the second and third trimesters, most pregnant women will need to increase their caloric intake to promote adequate weight gain [4].

The addition of calories during the second and third trimesters of pregnancy varies according to the BMI of the pregnant woman in the period before becoming pregnant. If she was in the normal range of BMI, it is recommended to increase between 340 to 450 kcal per day. If the pregnant woman had a BMI below normal, she would add even more calories to gain adequate weight. If overweight, add around 260 to 360 kcal per day. And if she is obese, it may be necessary for her not to increase the number of calories to avoid weight gain during pregnancy [4]. According to the Ministry of Health, the daily recommendations for macronutrients can vary between 10-35% of protein, 20-35% of lipids, and 46-65% of carbohydrates, with an energy intake greater than 1800 kcal/day [2].

The recommended weight gain during pregnancy is also related to the woman's BMI before pregnancy. Since it corresponds to 9% due to the fetus, 14% due to breast enlargement, 23% due to fetal membranes and plasmatic fluid, 27% due to maternal fat deposits, and 27% due to plasmatic volume 6. Excess weight gain is associated with a risk of macrosomia, large for gestational age (LGA), cesarean delivery, pregnancy-related hypertension, and gestational diabetes. If the weight gain exceeds 0.68 kg per week, the professional needs to assess the pregnant woman's eating habits and the presence of pathological edema that may be associated with heart failure or nephropathy. Low gestational weight gain is associated with a higher risk of preterm and small-for-gestational-age (SGA) births [10].

For pregnant women who are overweight and/or obese with gestational weight gain below that recommended by the IOM, but with adequate fetal growth observed on ultrasound, it is not necessary to increase food intake [10,11]. Weight gain recommendations for Asian populations are different from the criteria for the Western population [11]. Concerning micronutrients, each stage of pregnancy requires a greater amount of specific nutrients. The main ones that should be consumed in greater quantities are folate, vitamin B6, vitamin B12, vitamin A, vitamin D, vitamin C, vitamin E, calcium, iron, zinc, copper, iodine, selenium, choline and omega 3 [12].

During consultations, the professional must perform laboratory evaluations, perform anthropometric assessments and observe clinical signs and symptoms of deficiency. According to the evaluation, make the supplementation. Multivitamins and minerals should be used by virtually all pregnant women, as a balanced and varied diet is not followed by most pregnant women and the world's population. Specific supplements will be prescribed as needed. But iron and folic acid must always be supplemented due to the high expenditure during pregnancy [12].

The World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and the World Food Program (WFP) have developed recommendations for micronutrient supplementation in low-income regions to prevent maternal malnutrition. The most common micronutrient deficiencies are iron, vitamin A, calcium, and zinc. Supplementation should begin when there is already a desire to become pregnant [1].

Furthermore, iron is related to hematopoiesis and there is an increase in its maternal need, especially in the 2nd and 3rd trimesters. Its deficiency causes iron deficiency anemia. For laboratory evaluation, ferritin is the main marker of maternal iron reserve status and its value must be greater than 30mg/dl. It is present in beef, poultry, fish, liver, beans, lentils, chickpeas, and dark green leaves. All pregnant women should take their supplements. In Brazil, a dose of 40mg/day of elemental iron is recommended up to 3 to 6 months after delivery. The WHO recommends a dose of 60mg/day of elemental iron for 6 months. There are several forms of iron presentation on the market that have different efficacy, absorption, and administration schedule [1].

Also, vitamin B9 or folic acid is responsible for the closure and development of the neural tube, erythropoiesis, conversion of amino acids - homocysteine and methionine - and DNA synthesis. Folate acquired through food is absorbed into enterocytes in 50% of what is ingested and is found in dark green leaves, asparagus, lentils, and chickpeas. The synthetic, present in multivitamins, has an absorption in the enterocytes of 100% of what is ingested. The daily requirement during pregnancy is 600mcg and supplementation is mandatory for all pregnant women. It is also recommended that supplementation be started whenever there is a desire to become pregnant or at least 3 months before conception. When there is a deficiency of methylfolate and methylcobalamin, there is an accumulation of homocysteine and this hyperhomocysteinemia is associated with atherosclerosis, deep venous thromboembolism, pulmonary thromboembolism,

cardiovascular disease, cancer, type 2 diabetes mellitus **[1,2]**.

Added to this, vitamin B12 or cobalamin acts in the maturation of red blood cells, in the metabolism of carbohydrates, lipids, and proteins, and the formation of the myelin sheath. It depends on intrinsic factors, hydrochloric acid and calcium to be absorbed in the ileum. In the case of bariatric surgery, alcoholism, celiac disease, atrophic gastritis, short bowel syndrome, and the use of metformin, its absorption may be impaired. Its low serum levels cause symptoms of tingling, changes in sensitivity, and weakness in the lower limbs. It is found in proteins of animal origin (offal, red meat, fish, poultry, eggs, and dairy products). The recommended intake during pregnancy is 2.6 mcg and 2.8 mcg during lactation. In vegan patients, its supplementation is mandatory due to the low concentration and absorption in vegetables **[5]**.

Also, choline or vitamin B8 is not present in multivitamins for pregnant women in Brazil. However, in the USA, the American Medical Association (AMA) already recommends choline in prenatal supplements **[9]**. It is part of the production of phosphatidylcholine lipoprotein — a component of all cell membranes. The daily recommendation is 450mg. The main source is eggs, but it can also be found in smaller amounts in broccoli, flaxseed, and almonds.

Furthermore, vitamin A or retinol is responsible for the fetal and maternal vision and the maintenance of the immune system. His daily recommendation is approximately 750mcg. Its sources are orange-yellow foods like carrots, red peppers, tomatoes, and also beef liver. Its excess - daily consumption greater than 7.5mg - is teratogenic, so it is recommended to guide pregnant women not to exaggerate the consumption of bovine liver. Its deficiency can cause night blindness, maternal or fetal death, infections, and congenital malformations. WHO recommends vitamin A supplementation in areas where more than 5% of women have had a history of night blindness in their pregnancy **[7]**.

Vitamin B6 or pyridoxine is responsible for the metabolism of protein and glucose, as well as the synthesis of neurotransmitters - serotonin, dopamine, and noradrenaline. It is used in the treatment of hyperemesis gravidarum and the prevention of preeclampsia. The daily recommendation is 1.9mcg. Vitamin B1 or thiamine is responsible for cellular, cardiovascular and fetal digestive tract development. Deficiency may occur in cases of alcoholism, malnutrition, frequent vomiting, and after bariatric surgery. Its deficiency is linked to birth defects, fetal death, and beriberi. The recommended daily intake during pregnancy and lactation is 1.4 mg **[10]**.

Vitamin C or ascorbic acid is responsible for stimulating maternal-fetal immune defenses and embryogenesis. It is recommended to use iron associated with vitamin C so that there is greater absorption of iron. The recommended daily intake is 83.3mg during pregnancy and 118.3mg during lactation. It is present in orange and acerola in large quantities **[11]**.

Vitamin D acts on calcium and phosphorus homeostasis for bone maintenance. Its synthesis is 90% by solar source. In food, there is a small amount. For prophylaxis, administer 1,000 to 2,000 IU per day to the pregnant woman. If the serum value is low, treatment during pregnancy should be with the use of 4,000 to 5,000 IU per day until reaching 40ng/mL. During lactation, supplement up to 6,000 IU per day. Do not use weekly doses in pregnant women as it will not absorb in sufficient quantity. Vitamin E stimulates the immune system and during pregnancy prevents miscarriage and neurological abnormalities of the fetus. Its daily recommendation is 15UI during pregnancy and 19UI during lactation **[12]**.

Calcium is responsible for muscle contraction, and insulin secretion, modulator of hormonal reactions, and has platelet activity. Its absorption depends on vitamin D, being more absorbed during pregnancy and lactation. Avoid consuming fiber, phytic acid, and oxalic acid because they reduce the absorption of calcium. The recommendation is 1150mg/day during pregnancy and breastfeeding. Its deficiency during pregnancy favors high blood pressure, pre-eclampsia, eclampsia, and premature delivery **[12]**.

Iodine is used in the synthesis of the hormones T3 and T4. Its deficiency during pregnancy is related to increased perinatal mortality, miscarriage and stillbirths, congenital anomalies, and mental retardation (cretinism). In pregnant women, it causes hypothyroidism, goiter, and thyroid hypertrophy. The daily recommendation is 220mcg for pregnant women and 290mcg for breastfeeding women. Iodine is mainly present in seafood. Due to the low consumption of seafood in non-coastal areas, Law No. 6,150/1974 makes it mandatory to iodize salt intended for human consumption. According to Anvisa, salt must be enriched with content equal to or greater than 15 milligrams of iodine per kilogram of salt, and must not exceed 45 milligrams per kilogram of salt. A recent problem is the withdrawal of white salt and replacement with Himalayan salt which does not contain iodine. Thus, cases of hypothyroidism due to iodine deficiency have increased. The pregnant woman should be aware

of this. The WHO and the United Nations Children's Fund (UNICEF) recommend iodine supplementation (250 micrograms daily) for pregnant women in countries where less than 20% of households have access to iodized salt **[2-4]**.

Zinc has antioxidant and immune functions. It is recommended to consume 11 mcg per day for pregnant women and 12 mcg per day for lactating women. But the WHO does not recommend its supplementation. For now, it is only done in research. Studies show that its deficiency may be related to spontaneous abortion, postpartum maternal hemorrhage due to atony, low birth weight, intrauterine growth retardation, premature birth, and delay in weight and height development in children **[6]**.

Omega 3 (EPA and DHA) are polyunsaturated fatty acids (PUFA) and have the function of preventing cardiovascular diseases and immunological diseases. During pregnancy, it acts in the formation of the fetal retina, improving children's vision, and in the development of the central nervous system, improving the child's psychomotor development. The recommendation is at least 200mg during pregnancy and the first 3 months of breastfeeding. For pregnant women, the main thing is DHA. It is found in salmon, sardines, chia, and flaxseed **[6]**.

WHO does not recommend supplementation of vitamins B6, C, D, and E in pregnancy because there is still no evidence of benefit from supplementation. The idea is to add foods rich in these nutrients to avoid deficiencies **[1]**. It is worth noting that food has better absorption than supplementation. So, if the pregnant woman manages to have a healthy and diversified diet, meeting the daily values of nutrients, it is not necessary to supplement most of the nutrients mentioned. In addition to good nutrition, empiric anthelmintic treatment of the mother should be carried out in areas where helminths are endemic and anemia is prevalent. It will impact reducing the frequency of anemia in pregnancy.

In this context, maternal malnutrition is directly related to poor placental development, fetal growth restriction, low birth weight, and premature delivery. The diagnosis can be made both by arm circumference and body mass index (BMI). Arm circumference reflects maternal fat stores and lean mass **[8]**. Sphere guidelines recommend that if the arm circumference is between 21 to 23 cm, the mother should be enrolled in supplementary feeding programs if it is less than 21 cm, the mother should be classified as a humanitarian emergency **[1,2]**.

Based on the BMI assessment, pregnant women with a BMI of less than 18.5 kg/m^2 are considered to have mild malnutrition. BMI below 16.0 kg/m^2 is considered severe malnutrition and has a high risk of low birth weight and premature birth. During the monitoring of malnourished pregnant women, the United Nations High Commissioner for Refugees (UNHCR) suggests arm circumference greater than 23 cm or BMI greater than 18.5 kg/m^2 as criteria for discharge from the feeding program. If the evolution of the pregnant woman's weight gain is unsatisfactory, even if she is eating properly, the existence of diseases such as HIV, tuberculosis, tumors, blood dyscrasias, and other chronic diseases should be evaluated **[1,8]**.

Conclusion

Pregnancy is a moment with physiological and metabolic changes of great importance for the development of the fetus. Good preconception, pregnancy, and lactation nutrition associated with lifestyle changes are predictive of better child health in childhood and adulthood. In this process, the role of the health professional is important to monitor whether the development is adequate. Adequate maternal intake of macronutrients and micronutrients can meet all recommended daily requirements and, in this case, it will not be necessary to supplement with multivitamins. Nutritional deficiencies are common, especially iron and vitamin D, and must be corrected before symptoms appear.

Acknowledgement

Not applicable.

Ethical Approval

Not applicable.

Informed consent

Not applicable.

Funding

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

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