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# The effect of maternal food consumption habits to the neonatal outcomes, blood biochemical parameters and nutrient elements: A cross-sectional study

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**Abstract**

Optimal nutrition during prenatal, antenatal and postnatal period is one of the most desired conditions for the healthy birth of new generations and proper care of mother. The aim is to evaluate the effect of each maternal food consumption habit and supplementary intakes to the neonatal outcomes, blood biochemical parameters, macronutrient and micronutrient composition of body and address sufficient healthcare during antenatal care in a middle-income region. A group of 77 women at 3rd months postpartum were asked to complete the 43 items dietary questionnaire. Among all the women, 44 of them completed the questionnaire properly. The results of the questionnaire were evaluated by a nutrient database program (BeBiS software program) designed to evaluate nutrient elements of the human body. The blood biochemical parameters of all the patients were analyzed. The socio-demographic features, neonatal outcomes and maternal-neonatal anthropometric measurements were noted. The mean infant's 3rd month height was statistically significantly higher in walnut consumed group 3-4 days a week (mean =66.57 ± 2.07 cm; CI: 95%) than in the non-consumed group (63.25 ± 2.08 cm; CI: 95%) (p =0.021). The mean weight gain was 10.94 ± 5.16 kg (CI 95%) in walnut non-consumed group and 18.43 ± 6.50 kg (CI 95%) in consumed group 3-4 days a week which is statistically significantly different (p =0.012). Iodine level was significantly statistically higher in the egg consumed group 5-7 days a week than the non-consumed group as secondary outcome (2.80 ± 0.24; 2.15 ± 0.64 respectively, p=0.022). The walnut consumption was related to the greater weight gain during pregnancy and the increase in infant's height. Although, optimal weight gain is essential to maintain physiological well-being during pregnancy, we should consider the positive effect of walnuts on infant's development.

**Keywords:** BeBIS, dietary questionnaire, pregnancy, maternal nutrition, neonatal development

## 1. Introduction

Pregnancy is an important period in which both a healthy fetal development is required, and many maternal physiological changes are observed. Optimal nutrition during prenatal, antenatal, and postnatal period is one of the most desired conditions for the healthy birth of new generations and proper care of mother (1). As well as intrauterine environment, placental factors, and genetic conditions; the nutrition of pregnant women also has effects on fetal development such as birth weight, head circumference and birth height (2). On the contrary, maternal malnutrition is known to increase both maternal and fetal morbidity and mortality rates such as chronic diseases, iron or vitamin deficiencies, neurological developmental disorders throughout infant's life and maternal metabolic diseases such as diabetes and obesity (3). Thus, women need to regulate her nutrition habits starting from preconception and there are antenatal programs to improve the nutrition quality during pregnancy.

There are some studies conducted with certain food groups such as vegetables and fruits which have been associated with birth weight and birth height (4). In addition, there are many supplements regularly recommended for use in pregnancy such as folic acid, omega 3 and vitamin D. Folate is necessary for cell division and tissue growth and acting role in nucleotide biosynthesis, amino acid metabolism and several methylation reactions (5) (6). Folic acid supplementation during pre-conception and first trimester pregnancy period is recommended to prevent neural tube defects and improve child cognitive developments (6). Omega 3 intake is also associated with the reduced risk of preterm birth, low birth weight and need of neonatal intensive care (7). Vitamin D intake and daily sunlight exposure during pregnancy improves the pregnancy outcomes by preventing preterm birth, preeclampsia, gestational diabetes, and asthma (8).

There is lack of research which evaluates the benefit of each food consumption habit and each supplement intake on neonatal outcomes; maternal micronutrient and macronutrient status; maternal hematological and biochemical blood parameters. Therefore, the aim of this study is to evaluate the potential effect of each maternal food consumption habit and supplementary intakes to the neonatal outcomes and to address sufficient antenatal care in terms of nutrition in a middle-income region.

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## 2. Materials and Methods

A cross sectional single center study was performed with women in puerperium who were undergoing regular antenatal visits during their pregnancy in Giresun University Women and Children Research and Education Hospital between January, 2020 and March, 2021. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards; all patients agreed written informed consent. The study approved by local ethical committee (Decision number: 18/04.03.21).

**Table 1.** Demographic and anthropometric characteristics

| Characteristic | Mean ± SD (n=44) | Std error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|
| | | | Lower | Upper | | |
| Age (n) | 29.07 ± 6.87 | | | | 19 | 36 |
| BMI (kg/m²) | 24.48 ± 4.01 | 0.60 | 23.26 | 25.70 | 19.53 | 36.73 |
| Weight gained during pregnancy (kg) | 13.66 ± 5.52 | 0.83 | 11.98 | 15.34 | 1.00 | 28.00 |
| Birth weight (kg) | 3.32 ± 0.58 | 0.87 | 3.15 | 3.50 | 2.05 | 4.38 |
| Birth height (cm) | 50.31 ± 2.09 | 0.31 | 49.68 | 50.95 | 45.00 | 53.00 |
| Current birth height (cm) | 64.32 ± 2.61 | 0.39 | 63.52 | 65.11 | 59.00 | 70.00 |
| Head circumference (cm) | 41.76 ± 1.27 | 0.19 | 41.38 | 42.15 | 39.00 | 44.50 |
| Daily energy intake (kcal) | 1935.96 ± 597.22 | 90.03 | 1754.38 | 2117.53 | 712.42 | 3334.05 |

A total of 77 women were included to the study and 44 of them completed the required questionnaires properly. Patients have got involved to the study in their 3rd month after birth. Inclusion criteria included single healthy term births that were over >38 weeks of gestation, had not need to stay in the intensive care unit and exclusively breastfed neonates. Exclusion criteria included multiple gestations, adolescent pregnancies (age<18), advanced age pregnancies (age>36), maternal eating disorders (Anorexia Nervosa, Bulimia etc.), maternal chronic diseases (Celiac Disease, Diabetes Mellitus, Chronic Hypertension etc.), smoking and alcohol consumption.

The survey was totally two parts, including firstly 9-items questionnaire as sociodemographic and pregnancy related features, secondly 34 items questionnaire as nutrition habits and pregnancy related features.

Sociodemographic and pregnancy related features as body mass index (BMI), maternal age, gestational week at birth, weight gain during pregnancy, birth weight, infant's head circumference, birth height and infant's current height were asked by using 9-item questionnaire. Anthropometric measurements were taken by researchers as individual height measurement with 1 mm interval wall-mounted height meter and body weight with 100gr weight sensitive Sinbo Sbs 4429 during their routine antenatal and postnatal visits. BMI was calculated according to the Center for Disease Control and Prevention's criteria (9).

Secondly, all participants were asked to fill the detailed 34-item nutrient habits and pregnancy-related features questionnaire that evaluates attitudes about food consumption frequency for red meat, chicken meat, fish, egg, legume, milk and milk products, nuts, fruits, vegetables, walnut, hazelnut and supplements intake as Folic acid, Omega 3, Vitamin D and sunlight exposure. The nutrient habits questionnaire was evaluated by the nutrient database program (BeBiS software program; Turkish version of Bebispro for Windows, Stuttgart, Germany) designed to evaluate daily intake estimates of various nutrients by the food consumption frequencies which reflects the antenatal period of intake (10). BeBiS is a software program that contains the data more than 20,000 foods and reports nutritional elements such as calories, protein, carbohydrate, fat, vitamins, minerals, amino acids, fatty acids, and antioxidants.

All women's hemoglobin (hgb), hematocrit (hct), platelet (plt), lactate dehydrogenize, sodium, potassium, chloride, calcium, C reactive protein, triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH), vitamin D, uric acid, total protein, albumin, globulin, total bilirubin, direct bilirubin, indirect bilirubin, alkaline phosphatase, aspartate aminotransferase levels were also analyzed with autoanalyzer Cobas 6000 (Roche Diagnostics).

### 2.1. Statistical analysis

Calculations were performed using SPSS statistical software package 17.0 (IBM). The required sample size calculated as 39 with a 5% margin error. Cronbach's alpha and inter item correlation matrix were calculated for reliability statistics. ANOVA, Friedman's test and Chi-square test were used to analyze the differences between individuals and items. Tukey's test for nonadditivity was done as a post hoc test. P <0.05 was used to determine statistical significance.

**Table 2.** Comparison of clinical characteristics of daily nuts consumption

| Consumption type | Frequency | N | Weight gain during pregnancy (kg) | | | Current height (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Nuts | None | 3 | 22.63 ± 2.87 | 9.00 ± 7.94 | 2.61 ± 0.50 | 41.33 ± 0.58 | 48.00 ± 2.00 | 62.33 ± 1.53 | 1623.19 ± 476.41 |
| | 1-2 | 17 | 25.25 ± 3.85 | 13.82 ± 4.22 | 3.45± 0.59 | 42.16± 0.96 | 50.47 ± 2.35 | 64.47 ± 2.53 | 1845.47 ± 583.34 |
| | 3-4 | 10 | 23.22 ± 3.03 | 18.00 ± 5.54 | 3.46 ± 0.49 | 41.58 ± 1.31 | 50.90 ± 1.79 | 66.50 ± 2.22 | 2034.81 ± 609.02 |
| | 5-7 | 14 | 24.84 ± 4.93 | 11.36 ± 4.78 | 3.23 ± 0.56 | 41.50± 1.62 | 50.21 ± 1.81 | 63.00 ± 2.11 | 2042. 23 ± 645.21 |
| | Total | 44 | 24.48 ± 4.01 | 13.65 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.616 | 0.071 | 0.853 | 0.618 | 0.051 | 0.352 | 0.566 |
| Walnut | None | 16 | 24.30 ± 4.93 | 10.94 ± 5.16 | 3.23 ± 0.58 | 41.80 ± 0.89 | 49.94 ± 2.26 | 63.25 ± 2.08 | 1798.57 ± 596.00 |
| | 1-2 | 14 | 25.60 ± 3.77 | 14.14 ± 5.08 | 3.30 ± 0.61 | 41.48 ± 1.70 | 50.21 ± 2.01 | 64.79 ± 2.61 | 2125.13 ± 586.51 |
| | 3-4 | 7 | 24.10 ± 3.84 | 18.43 ± 6.50 | 3.61 ± 0.56 | 42.00 ± 0.50 | 51.00 ± 2.31 | 66.57 ± 2.07 | 2211.54 ± 635.25 |
| | 5-7 | 7 | 22.99 ± 1.73 | 14.14 ± 2.61 | 3.28 ± 0.57 | 42.00 ± 1.66 | 50.71 ± 1.80 | 63.57 ± 2.99 | 1596.04 ± 402.52 |
| | Total | 44 | 24.48 ± 4.01 | 13.66± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.558 | **0.020** | 0.556 | 0.765 | 0.682 | **0.025** | 0.107 |
| Hazelnut | None | 5 | 23.98 ± 4.21 | 12.80 ± 5.22 | 3.06 ± 0.66 | 41.80 ± 0.84 | 49.20 ± 2.28 | 63.20 ± 2.17 | 1750.56 ± 432.50 |
| | 1-2 | 19 | 24.80 ± 3.91 | 13.37 ± 4.19 | 3.33 ± 0.55 | 41.98 ± 1.13 | 50.11 ± 2.10 | 64.05 ± 2.30 | 1866.35 ± 616.10 |
| | 3-4 | 10 | 25.06 ± 4.56 | 13.50 ± 7.95 | 3.41 ± 0.62 | 41.50± 1.41 | 50.70 ± 2.26 | 65.20 ± 3.49 | 2254.12 ± 743.59 |
| | 5-7 | 10 | 23.54 ± 3.97 | 14.80± 5.77 | 3.36 ± 0.61 | 41.58± 1.63 | 50.90± 1.79 | 64.50 ± 2.46 | 1842.74 ± 396.79 |
| | Total | 44 | 24.48 ± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.95 ± 597.22 |
| | p | | 0.863 | 0.881 | 0.623 | 0.861 | 0.334 | 0.393 | 0.293 |

Bold values indicate statistically significant difference ($p < 0.05$)

## 3. Results

Seventy-seven postpartum women 3rd month after birth participated in the study. Thirty-three of them failed to complete the questionnaire properly and were excluded. A total of 44 participants were evaluated. Demographic and anthropometric features were given in Table 1.

Daily nuts consumption and daily food consumption of participants were shown in Table 2 and Table 3, respectively. There was no statistically significant relationship between red meat, chicken meat, fish, egg, legume, milk and milk products, nuts, fruits, vegetables, hazelnut consumption and pregnancy related features such as BMI, weight gain during pregnancy, infant's birth weight, birth height, birth head circumference, current head circumference, current height, and daily energy intake ($p > 0.05$). Also, the significant relationship was not stated between these consumption groups and nutrition elements or blood biochemical parameters.

The statistically significant relationship between walnut consumption and weight gain during pregnancy (p=0.012), infant's current height has been shown as primary outcome (p=0.021) (Table 2). Sixteen out of 44 women did not consume walnut at all, 14 of them consumed 1-2 days a week, seven of them consumed 3-4 days a week and seven of them consumed 5-7 days a week (Table 4). The mean level of weight gain during pregnancy was statistically significantly lower in non-consumer group (mean = 10.94 ± 5.16 kg; CI 95%) than in the consumed group 3-4 days a week (Mean = 18.43 ± 6.50 kg; CI 95%) (p =0.012) (Table 4). The mean level of infant's current height was 63.25 ± 2.08 cm (CI: 95%) in non-consumer group and 66.57 ± 2.07 cm (CI: 95%) in the consumed group 3-4 days a week which is statistically significantly different (p=0.021) (Table 4). Mineral, pantothenic acid, folic acid, free folic acid, and sodium levels were significantly higher in the walnut consumed group 1-2 days per week than the non-consumed group (p = 0.010; p= 0.028; p= 0.017; p= 0.008; p=0.018 respectively) (Table 4). In biochemical parameters, serum C-reactive protein was found to be higher in those who consumed a handful of walnuts, compared to those who consumed half or 1 whole walnut per day according to the daily amount of walnut consumption (CRP =9.45 ± 0.35 vs. 8.75 ± 0.30 mg/dl; p=0.011). There was no significant difference in other biochemical parameters (p>0.05).

Iodine mean level found 2.15 ± 0.65 µg in non-consumed group and 2.80 ± 0.24 in 5-7 days a week consumed group (CI: 95%). Iodine level was significantly statistically higher in the egg consumed group 5-7 days a week than the non-consumed group as secondary outcome (2.80 ± 0.24; 2.15 ± 0.64 respectively, p=0.022) (Table 5).

There was no statistically significant relationship between the intake of folic acid, vitamin D or omega 3 supplements with pregnancy outcomes, micronutrient, or biochemical parameters (p >0.05).

## 4. Discussion

In this cross-sectional study, we assessed the relation of food consumption during pregnancy using the validated BEBIS program and found that red meat, chicken meat, fish, egg, legume, milk and milk products, nuts, fruits, vegetables, hazelnut consumption was not related to the BMI, weight gain during pregnancy, neonatal outcomes, and blood biochemical parameters. Specifically, we found that only the walnut consumption during pregnancy was associated with greater weight gain and higher chance of increase in infant's height. Surprisingly, serum C-reactive protein was higher in those who consumed higher amounts of walnut per day according to the daily amount of walnut consumption, although there was no such a relation with other biochemical parameters. Additionally, iodine level is the most important factor for neurological development of infants and this data have confirmed the significant effect of egg consumption on iodine level (11).

**Table 3**. Comparison of clinical characteristics of daily food consumption

| Consumption type | Frequency | N | Weight gain during pregnancy (kg) | | | Current height (cm) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Meat | None | 13 | 24.29± 4.54 | 13.92± 6.96 | 3.29 ± 0.48 | 41.67± 1.52 | 50.08 ± 2.10 | 64.00± 1.73 | 1922.39± 517.29 |
| | 1-2 | 21 | 24.75 ± 4.22 | 13.14 ± 5.76 | 3.29 ± 0.63 | 41.78± 1.10 | 50.33 ± 2.29 | 64.38 ± 3.02 | 1945.25± 714.53 |
| | 3-4 | 9 | 24.48± 3.07 | 14.22 ± 2.54 | 3.33 ± 0.57 | 41.72± 1.39 | 50.44 ± 1.81 | 64.33 ± 2.87 | 1924.53 ± 487.67 |
| | 5-7 | 1 | 21.31 | 16.00 | 4.31 | 43.00 | 52 | 67.00 | 2019.98 |
| | Total | 44 | 24.48± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.31 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.871 | 0.927 | 0.402 | 0.806 | 0.846 | 0.752 | 0.998 |
| Chicken | None | 14 | 24.09± 2.93 | 13.07 ± 4.99 | 3.29 ± 0.38 | 41.76 ± 1.29 | 50.29 ± 1.73 | 63.71 ± 1.38 | 1772.78 ± 424.06 |
| | 1-2 | 21 | 23.83 ± 3.75 | 13.52 ± 5.90 | 3.29 ± 0.69 | 42.06 ± 1.25 | 50.24 ± 2.45 | 64.95 ± 3.14 | 1963,32 ± 674.61 |
| | 3-4 | 7 | 27.79± 5.81 | 13.43 ± 5.06 | 3.38 ± 0.65 | 40.64± 0.85 | 50.86 ± 1.86 | 63.71 ± 2.98 | 2055.07 ± 598.32 |
| | 5-7 | 2 | 22.45± 0.19 | 20.00 ± 7.07 | 3.58 ± 0.63 | 42.50± 0.71 | 49.50 ± 2.12 | 64.00 ± 1.41 | 2373.95 ± 993.47 |
| | Total | 44 | 24.48± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.129 | 0.195 | 0.873 | 0.074 | 0.736 | 0.871 | 0.379 |
| Fish | None | 25 | 24.87± 4.74 | 12.80 ± 4.93 | 3.31 ± 0.45 | 41.94± 1.28 | 50.20 ± 1.91 | 64.08 ± 2.40 | 2061.61 ± 621.87 |
| | 1-2 | 13 | 23.43± 2.04 | 14.69 ± 6.30 | 3.48 ± 0.73 | 41.73 ± 1.42 | 50.85 ± 2.30 | 64.92 ± 2.87 | 1781.23 ± 625.43 |
| | 3-4 | 5 | 24.36 ± 3.95 | 13.60 ±6.11 | 2.90 ± 0.70 | 40.90 ± 0.55 | 49.40 ± 2.61 | 64.00 ± 3.54 | 1719.95 ± 324.05 |
| | 5-7 | 1 | 29.02 | 22.00 | 3.76 | 42.20 | 51.00 | 64.00 | 18816.13 |
| | Total | 44 | 24.48± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.506 | 0.351 | 0.255 | 0.423 | 0.591 | 0.814 | 0.464 |
| Egg | None | 3 | 26.04± 4.22 | 12.00 ± 3.46 | 3.60 ± 0.50 | 41.67± 1.53 | 50.00 ± 2.0 | 62.67 ± 3.21 | 1863.96 ± 336.74 |
| | 1-2 | 2 | 26.17 ± 3.87 | 11.00 ± 1.41 | 3.47 ± 0.29 | 41.75 ± 0.35 | 51.00 ±1.41 | 64.50 ± 0.71 | 1641.23 ± 182.67 |
| | 3-4 | 5 | 23.65± 1.58 | 16.20 ± 2.39 | 3.40 ± 0.61 | 41.90 ± 1.43 | 50.40 ± 1.67 | 64.80 ± 3.70 | 2022.67 ± 588.38 |
| | 5-7 | 34 | 24.36± 4.31 | 13.59 ± 6.05 | 3.28 ± 0.6 | 41.75± 1.31 | 50.29 ± 2.24 | 64.38 ± 2.51 | 1946. 89 ± 638.68 |
| | Total | 44 | 24.48 ± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.834 | 0.585 | 0.883 | 0.995 | 0.920 | 0.693 | 0.829 |
| Milk and milk products | None | 1 | 25.54 | 10.00 | 3.07 | 42.0 | 48.0 | 59.0 | 1619.49 |
| | 1-2 | 1 | 23.44 | 12.00 | 3.67 | 42.0 | 52.0 | 64.0 | 1512.06 |
| | 3-4 | 4 | 28.99± 5.33 | 15.25± 12.09 | 3.72 ± 0.49 | 42.18 ± 0.62 | 51.50 ± 1.29 | 64.75 ± 2.50 | 1770.98 ± 199.09 |
| | 5-7 | 38 | 24.00± 3.72 | 13.63± 4.78 | 3.28 ± 0.59 | 41.71 ± 1.35 | 50.21 ± 2.13 | 64.42 ± 2.57 | 1972.80 ± 631.98 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | 44 | 24.48 ± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935. 95 ± 597.22 |
| | p | | 0.121 | 0.845 | 0.462 | 0.910 | 0.363 | 0.231 | 0.758 |
| Fruits | 1-2 | 2 | 24.49± 1.48 | 11.00 ± 4.14 | 3.37± 0.42 | 42.00± 0.00 | 50.00 ± 2.83 | 61.50 ± 3.54 | 1565.78± 75.96 |
| | 3-4 | 5 | 23.55± 1.27 | 15.40 ± 8.50 | 3.17 ± 0.69 | 41.50 ± 1.94 | 49.80 ± 2.86 | 65.60 ± 3.65 | 2468.21 ± 884.01 |
| | 5-7 | 37 | 24.61± 4.34 | 13.57 ± 5.25 | 3.34 ± 0.58 | 41.78 ± 1.22 | 50.41 ± 2.01 | 64.29 ± 2.38 | 1884.04 ± 537.88 |
| | Total | 44 | 24.48± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.927 | 0.501 | 0.879 | 0.845 | 0.912 | 0.067 | 0.074 |
| Vegetab les | 3-4 | 2 | 21.78± 0.74 | 21.00 ± 5.66 | 3.63 ± 0.70 | 42.00± 0.00 | 50.50 ± 3.54 | 66.00 ± 1.41 | 3026.00 ± 71.33 |
| | 5-7 | 42 | 24.61 ± 4.06 | 13.31 ± 5.34 | 3.31 ± 0.58 | 41.75± 1.30 | 50.31 ± 2.07 | 64.24 ± 2.64 | 1884.04 ± 559.67 |
| | Total | 44 | 24.48 ± 4.01 | 13.66 ± 5.52 | 3.32 ± 0.58 | 41.76 ± 1.27 | 50.32 ± 2.09 | 64.32 ± 2.61 | 1935.96 ± 597.22 |
| | p | | 0.336 | 0.053 | 0.457 | 0.789 | 0.901 | 0.358 | 0.007 |

Bold values indicate statistically significant difference ($p < 0.05$)

**Table 4.** Weekly walnut consumption's multiple comparison analysis

| | Frequency A | Frequency B | Mean difference (A-B) ± Std error | Sig. | 95% Confidence Interval *Lower Bound* | *Upper Bound* |
|---|---|---|---|---|---|---|
| BMI | None | 1-2* | -1.29 ± 1.48 | 0.82 | -5.27 | 2.68 |
| | | 3-4* | 0.21 ±1.84 | 0.99 | -4.72 | 5.13 |
| | | 5-7* | 1.31 ±1.84 | 0.89 | -3.61 | 6.23 |
| | 1-2 | 3-4 | 1.50 ±1.88 | 0.86 | -3.53 | 6.52 |
| | | 5-7 | 2.60 ± 1.88 | 0.51 | -2.42 | 7.63 |
| | 3-4 | 5-7 | 1.10 ± 2.17 | 0.96 | -4.70 | 6.91 |
| Weight gain during pregnancy (kg) | None | 1-2 | -3.21 ± 1.86 | 0.32 | -8.18 | 1.77 |
| | | 3-4 | -7.49 ± 2.30 | **0.01** | -13.65 | -1.33 |
| | | 5-7 | -3.21 ± 2.30 | 0.51 | -9.37 | 2.96 |
| | 1-2 | 3-4 | -4.29 ± 2.35 | 0.28 | -10.58 | 2.01 |
| | | 5-7 | 0.00 ± 2.35 | 1.00 | -6.29 | 6.29 |
| | 3-4 | 5-7 | 4.29 ± 2.71 | 0.40 | -2.98 | 11.55 |
| Birth weight (kg) | None | 1-2 | -0.07 ± 0.21 | 0.98 | -0.64 | 0.50 |
| | | 3-4 | -0.38 ± 0.27 | 0.50 | -1.09 | 0.34 |
| | | 5-7 | -0.04 ± 0.27 | 0.99 | -0.76 | 0.67 |
| | 1-2 | 3-4 | -0.31 ± 0.27 | 0.67 | -1.03 | 0.42 |
| | | 5-7 | 0.03 ± 0.27 | 1.00 | -0.70 | 0.75 |
| | 3-4 | 5-7 | 0.33 ± 0.31 | 0.72 | -0.51 | 1.17 |
| 2nd head circumference (cm) | None | 1-2 | 0.32 ± 0.48 | 0.91 | -0.95 | 1.60 |
| | | 3-4 | -0.20 ± 0.59 | 0.99 | -1.78 | 1.38 |
| | | 5-7 | -0.20 ± 0.59 | 0.99 | -1.78 | 1.38 |
| | 1-2 | 3-4 | -0.52 ± 0.06 | 0.82 | -2.13 | 1.09 |
| | | 5-7 | -0.52 ± 0.60 | 0.82 | -2.13 | 1.09 |
| | 3-4 | 5-7 | 0.00 ±0.69 | 1.00 | -1.86 | 1.86 |
| Birth height (cm) | None | 1-2 | -0.28 ± 0.78 | 0.98 | -2.36 | 1.81 |
| | | 3-4 | -1. 06 ± 0.96 | 0.69 | -3.64 | 1.52 |
| | | 5-7 | -0.77 ± 0.96 | 0.85 | -3.36 | 1.81 |
| | 1-2 | 3-4 | -0.79 ± 0.98 | 0.85 | -3.42 | 1.85 |
| | | 5-7 | -0.50 ± 0.98 | 0.96 | -3.14 | 2.14 |
| | 3-4 | 5-7 | 0.29 ± 1.14 | 0.99 | -2.76 | 3.33 |
| Current height (cm) | None | 1-2 | -1.54 ± 0.88 | 0.32 | -3.90 | 0.83 |
| | | 3-4 | -3.32 ± 1.09 | **0.02** | -6.25 | -0.39 |
| | | 5-7 | -0.32 ± 1.09 | 0.99 | -3.25 | 2.61 |
| | 1-2 | 3-4 | -1.79 ± 1.12 | 0.39 | -4.78 | 1.21 |
| | | 5-7 | 1.21 ± 1.12 | 0.70 | -1.78 | 4.21 |
| | 3-4 | 5-7 | 3.00 ± 1.29 | 0.11 | -0.46 | 6.46 |
| Daily energy intake (kcal) | None | 1-2 | -326.56 ± 210.18 | 0.42 | -889.93 | 236.81 |
| | | 3-4 | -412.97 ± 260.26 | 0.40 | -1110.58 | 284.64 |
| | | 5-7 | 202.53 ± 260.26 | 0.86 | -495.08 | 900.14 |
| | 1-2 | 3-4 | -86.41 ± 265.86 | 0.99 | -799.02 | 626.20 |
| | | 5-7 | 529.09 ± 265.86 | 0.21 | -183.53 | 1241.70 |
| | 3-4 | 5-7 | 615.50 ± 306.99 | 0.20 | -237.35 | 1438.35 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Mineral (g) | None | 1-2 | -5.11 ± 1.69 | **0.02** | -9.64 | -0.59 |
| | | 3-4 | -5.87 ± 2.09 | **0.04** | -11.47 | -0.27 |
| | | 5-7 | -1.64 ± 2.09 | 0.86 | -7.25 | 3.96 |
| | 1-2 | 3-4 | -0.75 ± 2.13 | 0.98 | -6.47 | 4.97 |
| | | 5-7 | 3.47 ± 2.13 | 0.38 | -2.25 | 9.19 |
| | 3-4 | 5-7 | 4.22 ± 2.46 | 0.33 | -2.38 | 10.83 |
| Pantotenic acid (mg) | None | 1-2 | -2.05 ± 0.69 | 0.03 | -3.91 | -0.20 |
| | | 3-4 | -1.70 ± 0.86 | 0.21 | -4.00 | 0.59 |
| | | 5-7 | -0.61 ± 0.86 | 0.90 | -2.92 | 1.69 |
| | 1-2 | 3-4 | 0.35 ± 0.88 | 0.98 | -1.99 | 2.70 |
| | | 5-7 | 1.44 ± 0.88 | 0.37 | -0.90 | 3.79 |
| | 3-4 | 5-7 | 1.09 ± 1.01 | 0.70 | -1.62 | 3.80 |
| Folic acid (µg) | None | 1-2 | -46.65 ± 15.27 | **0.02** | -87.59 | -5.71 |
| | | 3-4 | -45.18 ± 18.91 | 0.10 | -95.88 | 5.52 |
| | | 5-7 | -15.39 ± 18.91 | 0.85 | -66.08 | 35.31 |
| | 1-2 | 3-4 | 1.47 ± 19.32 | 1.00 | -50.32 | 53.26 |
| | | 5-7 | 31.26 ± 19.32 | 0.38 | -20.52 | 83.05 |
| | 3-4 | 5-7 | 29.79 ± 22.31 | 0.55 | -30.00 | 89.59 |
| Free folic acid (µg) | None | 1-2 | -39.13 ± 11.56 | **0.008** | -70.11 | -8.15 |
| | | 3-4 | -37.29 ± 14.31 | 0.059 | -75.66 | 1.07 |
| | | 5-7 | -15.63 ± 14.31 | 0.696 | -53.99 | 22.73 |
| | 1-2 | 3-4 | 1.84 ± 14.62 | 1.00 | -37.35 | 41.02 |
| | | 5-7 | 23.50 ± 14.62 | 0.39 | -15.68 | 62.69 |
| | 3-4 | 5-7 | 21.67 ± 16.88 | 0.58 | -23.58 | 66.92 |
| Sodium (mg) | None | 1-2 | -1205.40 ± 462.36 | 0.60 | -2444.71 | 33.91 |
| | | 3-4 | -1577.98 ± 572.53 | **0.04** | -3112.59 | -43.38 |
| | | 5-7 | -283.33 ± 572.53 | 0.96 | -1817.94 | 1251.28 |
| | 1-2 | 3-4 | -372.59 ± 584.84 | 0.92 | -1940.20 | 1195.03 |
| | | 5-7 | 922.07 ± 584.84 | 0.40 | -645.54 | 2489.68 |
| | 3-4 | 5-7 | 1294.66 ± 675.31 | 0.24 | -515.47 | 3104.78 |

*times a week. Bold values indicate statistically significant difference (p <0.05)

**Table 5**. Comparison of micronutrients characteristics of daily egg consumption

| | Frequency A | Frequency B | Mean difference (A-B) ± Std error | *P* value | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | *Lower Bound* | *Upper Bound* |
| Vitamin D (µg) | None | 1-2* | -0.11 ± 0.95 | 1.0 | -2.66 | 2.44 |
| | | 3-4* | -1.18 ± 0.76 | 0.42 | -3.22 | 0.87 |
| | | 5-7* | -1.28 ± 0.63 | 0.19 | -2.97 | 0.40 |
| | 1-2 | 3-4 | -1.07 ± 0.87 | 0.62 | -3.41 | 1.27 |
| | | 5-7 | -1.17 ± 0.76 | 0.42 | -3.21 | 0.86 |
| | 3-4 | 5-7 | -0.11 ± 0.50 | 0.99 | -1.44 | 1.23 |
| Vitamin K (µg) | None | 1-2 | -43.57 ± 185.3 | 0.96 | -540.25 | 453.11 |
| | | 3-4 | -100.37 ± 148.24 | 0.91 | -497.71 | 296.97 |
| | | 5-7 | -145.25 ± 122.25 | 0.64 | -472.94 | 182.45 |
| | 1-2 | 3-4 | -56.80 ± 169.83 | 0.99 | -512.01 | 398ç41 |
| | | 5-7 | -101.67 ± 147.69 | 0.90 | -497.55 | 294.20 |
| | 3-4 | 5-7 | -44.87 ± 97.22 | 0.97 | -305.47 | 215.73 |
| Total folic acid (µg) | None | 1-2 | -19.97 ± 92.32 | 0.99 | -267.43 | 227.50 |
| | | 3-4 | -63.45 ± 73.86 | 0.83 | -261.42 | 134.53 |
| | | 5-7 | -83.27 ± 60.91 | 0.53 | -246.54 | 80.00 |
| | 1-2 | 3-4 | -43.48 ± 84.62 | 0.96 | -270.29 | 183.33 |
| | | 5-7 | -63.30 ± 73.59 | 0.83 | -260.55 | 133.94 |
| | 3-4 | 5-7 | -19.82 ± 48.44 | 0.98 | -149.66 | 110.02 |
| Free folic acid (µg) | None | 1-2 | -4.83 ± 32.91 | 0.99 | -93.05 | 83.39 |
| | | 3-4 | -4.87 ± 26.33 | 0.99 | -75.45 | 65.70 |
| | | 5-7 | -17.67 ± 21.71 | 0.85 | -75.87 | 40.54 |
| | 1-2 | 3-4 | -0.04 ± 30.16 | 1.00 | -80.89 | 80.82 |
| | | 5-7 | -12.83 ± 26.23 | 0.96 | -83.15 | 57.48 |
| | 3-4 | 5-7 | -12.79 ± 17.27 | 0.88 | -59.08 | 33.49 |
| Vit B12 (µg) | None | 1-2 | 2.07 ± 1.90 | 0.70 | -3.02 | 7.16 |
| | | 3-4 | 0.19 ± 1.52 | 0.99 | -3.88 | 4.26 |
| | | 5-7 | 1.81 ± 1.25 | 0.48 | -1.54 | 5.17 |
| | 1-2 | 3-4 | -1.89 ± 1.74 | 0.70 | -6.54 | 2.79 |
| | | 5-7 | -0.25 ± 1.51 | 0.99 | -4.31 | 3.81 |
| | 3-4 | 5-7 | 1.63 ± 0.99 | 0.37 | -1.04 | 4.30 |
| Iodine (µg) | None | 1-2 | -0.50 ± 0.28 | 0.31 | -1.28 | 0.28 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 3-4 | -0.12 ± 0.26 | 0.11 | -1.33 | 0.09 |
| | | 5-7 | -0.65 ± 0.21 | **0.02** | -1.22 | 0.08 |
| | 1-2 | 3-4 | -0.12 ± 0.26 | 0.97 | -0.83 | 0.59 |
| | | 5-7 | -0.15 ± 0.21 | 0.89 | -0.72 | 0.42 |
| | 3-4 | 5-7 | -0.03 ± 0.17 | 0.99 | -0.51 | 0.45 |
| Mono unsaturated fatty acid (g) | None | 1-2 | 1.28 ± 17.18 | 1.00 | -44.78 | 47.34 |
| | | 3-4 | -9.11 ± 13.75 | 0.91 | -45.96 | 27.73 |
| | | 5-7 | -6.77 ± 11.34 | 0.93 | -37.16 | 23.62 |
| | 1-2 | 3-4 | -10.39 ± 15.75 | 0.91 | -52.61 | 31.82 |
| | | 5-7 | -8.05 ± 13.70 | 0.94 | -44.76 | 28.66 |
| | 3-4 | 5-7 | 2.34 ± 9.02 | 0.99 | -21.82 | 26.51 |
| Poly unsaturated fatty acid (g) | None | 1-2 | 7.83 ± 7.34 | 0.71 | -11.84 | 27.50 |
| | | 3-4 | 10.52 ± 5.87 | 0.29 | -5.21 | 26.25 |
| | | 5-7 | 7.97 ± 4.84 | 0.37 | -5.00 | 20.95 |
| | 1-2 | 3-4 | 2.69 ± 6.72 | 0.98 | -15.33 | 20.72 |
| | | 5-7 | 0.14 ± 5.85 | 1.00 | -15.53 | 15.82 |
| | 3-4 | 5-7 | -2.55 ± 3.85 | 0.91 | -12.87 | 7.77 |
| Omega 3 (g) | None | 1-2 | 2.80 ± 2.12 | 0.55 | -2.87 | 8.48 |
| | | 3-4 | 2.26 ± 1.69 | 0.55 | -2.28 | 6.80 |
| | | 5-7 | 1.70 ± 1.40 | 0.62 | -2.04 | 5.45 |
| | 1-2 | 3-4 | -0.54 ± 1.94 | 0.99 | -5.75 | 4.66 |
| | | 5-7 | -1.10 ± 1.69 | 0.91 | -5.63 | 3.42 |
| | 3-4 | 5-7 | -0.56 ± 1.11 | 0.96 | -3.54 | 2.42 |
| Omega 6 (g) | None | 1-2 | 3.47 ± 6.35 | 0.95 | -13.54 | 20.48 |
| | | 3-4 | 7.25 ± 5.08 | 0.49 | -6.36 | 20.86 |
| | | 5-7 | 5.03 ± 4.19 | 0.63 | -6.19 | 16.25 |
| | 1-2 | 3-4 | 3.79 ± 5.82 | 0.92 | -11.80 | 19.38 |
| | | 5-7 | 1.56 ± 5.06 | 0.99 | -11.99 | 15.12 |
| | 3-4 | 5-7 | -2.22 ± 3.33 | 0.91 | -11.15 | 6.70 |
| Biotin | None | 1-2 | 2.32 ± 18.62 | 1.00 | -47.58 | 52.23 |
| | | 3-4 | -3.51 ± 14.89 | 0.99 | -43.44 | 36.41 |
| | | 5-7 | -10.34 ± 12.28 | 0.83 | -43.27 | 22.59 |
| | 1-2 | 3-4 | -5.84 ± 17.06 | 0.98 | -51.57 | 39.90 |
| | | 5-7 | -12.66 ± 14.84 | 0.83 | -52.44 | 27.12 |
| | 3-4 | 5-7 | -6.83 ± 9.77 | 0.90 | -33.01 | 19.36 |

*times a week. Bold values indicate statistically significant difference ($p < 0.05$)

The relation between maternal nutrition and fetal development has been well defined previously (12). Malnutrition during pregnancy is the important risk factor for adverse perinatal outcomes such as fetal growth restriction, low birth weight and increased morbidity (13, 14). Hajianfar et al. compared three identified major dietary patterns, a western dietary pattern, a traditional dietary pattern, and a healthy dietary pattern (2). Although the healthy and traditional dietary patterns did not show remarkable association, the western dietary pattern was associated with significant improvement in low-birth-weight infant's rates which may be attribute to a higher intake of desserts and sweets, sugar, saturated fat, potato and pizza in this dietary pattern (OR 0.80, 95%(CI) (0.34-1.93), P < 0.01) (2). Unlike our study, they did not analyze the foods individually, they evaluated the whole diet. Additionally, their data did not support any relation between maternal dietary patterns and neonatal height (OR 0.80, 95% (CI) (0.34-1.85), P< 0.93) (2).

Guzel et al. investigated the relation between maternal amino acid levels and pregnancy outcomes with the same nutrition database program (BeBiS software program, Bebispro for Windows, Stuttgart, Germany) in two different groups as reproductive aged women (n:130) and adolescents (n:39) (10). They found that the lower amino acid levels were related with low birth weight and preterm delivery in adolescents (p<0.05) (10). In our study, nutritional survey was carried out in the postpartum 3rd month and only healthy term deliveries with maternal age over 18 were included to standardize the population. We could not confirm the correlation of amino acid levels with pregnancy outcomes in any type of food consumption group.

Our study differs from findings of previous studies showing that high adherence to walnut consumption during pregnancy may improve the neonatal outcomes. As far as we know, there is not any study about maternal walnut consumption in the literature. In our study, walnut consumption significantly increases the infant's height and weight gain during pregnancy. The National Academy of Medicine recommends 11.5 to 16 kg weight gain for BMI 18.5 to 24.9 kg/m2 individuals (15). In this study, 3-4 times a week walnut consumed group has significantly unfavorable weight gain as 18.43 ± 6.50 kg (p=0.02). In a randomized controlled trial, Rock et al. compared the weight reduction diets and found that walnut enriched reduced energy diet can provide weight loss like a standard diet, but this type of diet also has benefits to lower cardiovascular disease risk factors (16). Assaf-Balut et al. investigated the consumption of virgin olive oil and nuts (especially pistachios) in normal pregnancies and observed similar gestational weight gain between consumed and non-consumed groups (p=0.713) (17). Jang et al. followed infant's growth up to 6 month and documented that maternal vitamin C intake was related positively with the abdominal circumference of the fetus and infant birth length (18). Ramon et al. determined the correlation of increased maternal vegetable consumption with birth height whereas Loy et al. investigated that both vegetable and fruits consumption have significant effects on birth length (4, 19).

Iodine is an important micronutrient that plays role during thyroid hormone synthesis (11). Adequate iodine intake during pregnancy is essential for maternal health, fetal neurodevelopment and sufficient cognitive levels which are common issues affecting public health and population intellectual capacity (20, 21). Dietary iodine necessities are increasing 50% during pregnancy because human chorionic gonadotropin (hCG) acts like thyroid stimulating hormone (TSH) and binds to the TSH receptors. High estrogen concentrations during pregnancy lead the increasing levels of thyroid binding globulin, thus more triiodothyronine (T3) and thyroxine (T4) production is required to maintain free T3 and free T4 levels. Fetus supplies the thyroid hormone maternally, especially as T4 through the placenta and converts into T3 for fetal growth and brain development. The U.S Institute of Medicine suggests overall dietary and supplement iodine intake as 150 µg/day during preconceptional period, 220 µg/day during gestation and 290 µg/day during lactation (22). Recently, American Thyroid Association emphasizes the importance of dietary iodine intake instead of its supplements (23). Previous studies recommended fish, iodized salt consumption, some type of breads and milk products since they have proved that these products can avoid the iodine deficiency (24). There are also studies which have longer follow-up periods for years to investigate the effect of iodine intake to the neurological development of offspring's (25). In this study, the sufficient iodine intake was only shown in egg consumption group, but no immediate effects of iodine on pregnancy outcomes and infant's anthropometry were observed.

Strengthen of this study was the using of BEBIS software program which provides a comprehensive assessment of the nutritional intake. The program captures all types of usual food items consumed by participants and estimates micronutrient and macronutrient values. So, it overcomes the difficulty of determinative effect of specific nutrient as part of the whole diet. This program was offered to be a consistent measure of diet quality in Turkey (10).

Limitation of the study was the small cohort of postpartum women who accepted to fill out the dietary questionnaire. Furthermore, the food consumption and supplementary intake habits may change according to the geographical region, country welfare and personal income. Several physiological changes occur even during normal pregnancies and lactation, so it is difficult to provide standardization in nutrition studies conducted with women in puerperium

Sufficient macronutrient and micronutrient status are necessary to develop healthy offspring and to maintain maternal well-being. In this study, the walnut consumption was related to the greater weight gain during pregnancy and the increase in infant's height. Although, optimal weight gain is essential to maintain physiological well-being during pregnancy, we should consider the positive effect of walnuts on infant's development. Further studies with larger cohort are needed to demonstrate our findings.

**Conflict of interest**
The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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## References

1. Parker HW, Tovar A, McCurdy K, Vadiveloo M. Associations between pre-pregnancy BMI, gestational weight gain, and prenatal diet quality in a national sample. PloS one. 2019;14(10):e0224034. PubMed PMID: 31626677. Pubmed Central PMCID: 6799919.

2. Hajianfar H, Esmaillzadeh A, Feizi A, Shahshahan Z, Azadbakht L. Major Maternal Dietary Patterns during Early Pregnancy and Their Association with Neonatal Anthropometric Measurement. BioMed research international. 2018; 2018:4692193. PubMed PMID: 29955602. Pubmed Central PMCID: 6000839.

3. Hajianfar H, Esmaillzadeh A, Feizi A, Shahshahan Z, Azadbakht L. The Association Between Major Dietary Patterns and Pregnancy-related Complications. Archives of Iranian medicine. 2018 Oct 1;21(10):443-51. PubMed PMID: 30415552.

4. Ramon R, Ballester F, Iniguez C, Rebagliato M, Murcia M, Esplugues A, et al. Vegetable but not fruit intake during pregnancy is associated with newborn anthropometric measures. The Journal of nutrition. 2009 Mar;139(3):561-7. PubMed PMID: 19158218.

5. Bailey LB, Stover PJ, McNulty H, Fenech MF, Gregory JF, 3rd, Mills JL, et al. Biomarkers of Nutrition for Development-Folate Review. The Journal of nutrition. 2015 Jul;145(7):1636S-80S. PubMed PMID: 26451605. Pubmed Central PMCID: 4478945.

6. McNulty H, Rollins M, Cassidy T, Caffrey A, Marshall B, Dornan J, et al. Effect of continued folic acid supplementation beyond the first trimester of pregnancy on cognitive performance in the child: a follow-up study from a randomized controlled trial (FASSTT Offspring Trial). BMC medicine. 2019 Oct 31;17(1):196. PubMed PMID: 31672132. Pubmed Central PMCID: 6823954.

7. Middleton P, Gomersall JC, Gould JF, Shepherd E, Olsen SF, Makrides M. Omega-3 fatty acid addition during pregnancy. The Cochrane database of systematic reviews. 2018 Nov

15;11:CD003402. PubMed PMID: 30480773. Pubmed Central PMCID: 6516961.

8. Wagner CL, Hollis BW. The Implications of Vitamin D Status During Pregnancy on Mother and her Developing Child. Frontiers in endocrinology. 2018; 9:500. PubMed PMID: 30233496. Pubmed Central PMCID: 6127214.

9. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC Growth Charts for the United States: methods and development. Vital and health statistics Series 11, Data from the National Health Survey. 2002 May (246):1-190. PubMed PMID: 12043359.

10. Guzel AI, Cinar M, Erkilinc S, Aksoy RT, Yumusak OH, Celik F, et al. Association between adverse perinatal outcomes and amino acid levels measured with nutrient questionnaire in adolescent pregnancies. Journal of the Chinese Medical Association: JCMA. 2016 Jun;79(6):335-9. PubMed PMID: 27071985.

11. Zhao W, Li X, Xia X, Gao Z, Han C. Iodine Nutrition During Pregnancy: Past, Present, and Future. Biological trace element research. 2019 Mar;188(1):196-207. PubMed PMID: 30218312.

12. Mehta SH. Nutrition and pregnancy. Clinical obstetrics and gynecology. 2008 Jun;51(2):409-18. PubMed PMID: 18463470.

13. Shaw GM, Wise PH, Mayo J, Carmichael SL, Ley C, Lyell DJ, et al. Maternal prepregnancy body mass index and risk of spontaneous preterm birth. Paediatric and perinatal epidemiology. 2014 Jul;28(4):302-11. PubMed PMID: 24810721.

14. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Lancet. 2013 Aug 3;382(9890):452-77. PubMed PMID: 23746776.

15. In: Rasmussen KM, Yaktine AL, editors. Weight Gain During Pregnancy: Reexamining the Guidelines. The National Academies Collection: Reports funded by National Institutes of Health. Washington (DC)2009.

16. Rock CL, Flatt SW, Barkai HS, Pakiz B, Heath DD. Walnut consumption in a weight reduction intervention: effects on body weight, biological measures, blood pressure and satiety. Nutrition journal. 2017 Dec 4;16(1):76. PubMed PMID: 29202751. Pubmed Central PMCID: 5715655.

17. Assaf-Balut C, Garcia de la Torre N, Duran A, Fuentes M, Bordiu E, Del Valle L, et al. A Mediterranean Diet with an Enhanced Consumption of Extra Virgin Olive Oil and Pistachios Improves Pregnancy Outcomes in Women Without Gestational Diabetes Mellitus: A Sub-Analysis of the St. Carlos Gestational Diabetes Mellitus Prevention Study. Annals of nutrition & metabolism. 2019;74(1):69-79. PubMed PMID: 30554220. Pubmed Central PMCID: 6425818.

18. Jang W, Kim H, Lee BE, Chang N. Maternal fruit and vegetable or vitamin C consumption during pregnancy is associated with fetal growth and infant growth up to 6 months: results from the Korean Mothers and Children's Environmental Health (MOCEH) cohort study. Nutrition journal. 2018 Nov 12;17(1):105. PubMed PMID: 30419900. Pubmed Central PMCID: 6231254.

19. Loy SL, Marhazlina M, Azwany YN, Hamid Jan JM. Higher intake of fruits and vegetables in pregnancy is associated with birth size. The Southeast Asian journal of tropical medicine and public health. 2011 Sep;42(5):1214-23. PubMed PMID: 22299448.

20. Zimmermann MB. Iodine deficiency. Endocrine reviews. 2009 Jun;30(4):376-408. PubMed PMID: 19460960.

21. Zimmermann MB. Iodine deficiency in pregnancy and the effects of maternal iodine supplementation on the offspring: a review. The American journal of clinical nutrition. 2009 Feb;89(2):668S-72S. PubMed PMID: 19088150.

22. Trumbo P, Yates AA, Schlicker S, Poos M. Dietary reference intakes: vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Journal of the American Dietetic Association. 2001 Mar;101(3):294-301. PubMed PMID: 11269606.

23. Alexander EK, Pearce EN, Brent GA, Brown RS, Chen H, Dosiou C, et al. 2017 Guidelines of the American Thyroid Association for the Diagnosis and Management of Thyroid Disease During Pregnancy and the Postpartum. Thyroid: official journal of the American Thyroid Association. 2017 Mar;27(3):315-89. PubMed PMID: 28056690.

24. Chittimoju SB, Pearce EN. Iodine Deficiency and Supplementation in Pregnancy. Clinical obstetrics and gynecology. 2019 Jun;62(2):330-8. PubMed PMID: 30829881.

25. Manousou S, Johansson B, Chmielewska A, Eriksson J, Gutefeldt K, Tornhage CJ, et al. Role of iodine-containing multivitamins during pregnancy for children's brain function: protocol of an ongoing randomised controlled trial: the SWIDDICH study. BMJ open. 2018 Apr 10;8(4):e019945. PubMed PMID: 29643159. Pubmed Central PMCID: 5898322.