Original Article

Effect of Nutritional Education on Pregnant Women's Anthropometric Measurements and Newborn Health: A Randomized Controlled Trial

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Abstract
Background: A healthy-balanced diet and adequate energy intake during pregnancy prevent many diseases and complaints in during pregnancy, while ensuring physical and mental growth and development of the fetus.
Aims: This research aimed to analyze nutritional levels of pregnant women registered to family health centers in Amasya city center in Turkey with the Nutrition Information System (BeBIS 8.0) software, a valid and reliable one, and to evaluate effects of nutrition training given according to analysis results and Turkey Nutrition Guide on anthropometric measurements of pregnant women and newborn health.
Method: Data for this a randomized controlled trial were obtained from pregnant woman living in a city center in Turkey between December 20th, 2019 and May 20th, 2021.
Those who met the inclusion criteria were randomly assigned to either intervention (n = 20) or control (n = 16) groups. Study data were collected using a participant information form, risk assessment and anthropometric measurements form, and daily nutrition record form. Mann Whitney U test and Chi square test were used for categorical data, since it did not show normal distribution in the evaluation between groups.
Results: It was determined that no difference was found between the groups in terms of total weight gained during pregnancy, newborn birth weight, delivery type and ideal weight to be gained during pregnancy according to BMI. A statistically significant correlation was found between having problems in the postpartum period and weight gain according to BMI (p=0.04). It was determined that 87.5% of those who had problems gained less or more weight during pregnancy. A statistically significant relationship was found between the state of having problems in the postpartum period and the type of delivery (p=0.02).
Conclusions: Nutrition and weight gain during pregnancy change delivery type, so they affect maternal and newborn health. Some changes were observed in the dietary habits of the pregnant women in the intervention group. Dietary habits for pregnant women should be monitored at more frequent intervals throughout the entire pregnancy.

Keywords: Pregnancy, Nutrition, Nutrition Training, Newborn, Energy, Macronutrient, Micronutrient, RCT.

Introduction

In order to eat a healthy and balanced diet, it is necessary not to take the energy that our body needs with a single nutrient, but to take a sufficient amount of all the nutrients necessary for the renewal and functioning of the body (Aydin, 2017; Turkish Nutrition Guide (TNG), 2015). Micro and macronutrient amounts such as energy, protein, fat, carbohydrates, vitamins and minerals that individuals should take during babyhood, childhood or old age differ during the period, as well as these amounts of nutrients that should be taken during pregnancy vary according to age and daily activity level (TNG, 2015). Basal metabolism during pregnancy increases by 20% of normal

value (Uzdil & Ozenoglu, 2015) and energy needs increase by 300 kcal/day compared to non-pregnant women (Yuzbir, 2001). In the second and third trimester, this need increases even more and varies between 340-452 kcal/day. In this process, where many changes are experienced, both the growth and development of the fetus and the healthy and balanced nutrition and energy intake and weight control are issues that must be considered during the mother's childbirth and postpartum recovery process (ACOG, 2013; TNG, 2015).

The mother's healthy and balanced diet affects not only her own health, but also the growth and development of the fetus, as well as the health and birth weight of the newborn. A healthy balanced diet and adequate energy intake during pregnancy affects pregnancy complications, physical and mental growth and development of the fetus, as well as the occurrence of chronic diseases in the newborn's adulthood (Hakli, 2015; Karaagaoglu & Eroglu-Samur 2015; TNG, 2015; Ho et al., 2016; Koenig, 2017; Buyukuslu et al., 2019; Kangalgil et al., 2018). At the same time, the baby's health and birth weight are also affected by the age of the mother and father, weight gained during pregnancy, and socioeconomic disadvantages that prevent adequate nutrition and benefit from health services (Kadanali et al., 1994).

Since pregnant women and women constitute a risky group of society, it is important to provide healthy and balanced nutrition training to the society (Bhanbhro et al., 2020). There are national and international studies on eating or lifestyle habits of pregnant women in the literature (Yargic et al., 2014; Hakli, 2015; Buyukuslu et al., 2019; Guler et al., 2019). But there is none which analyses all the food and beverages consumed by pregnant women in the last three days using the Nutrition Information System (BeBIS 8.0) software and giving individual nutrition training to pregnant women according to the results of this analysis (BeBIS, 2010). Therefore, this research was carried out to analyze nutritional levels of pregnant women with BeBIS program, and to evaluate effects of nutrition training given according to the results of the analysis on anthropometric measurements of pregnant women and neonatal health. The results of the study are expected to provide basic data for programs to be organized for improving the nutritional levels of pregnant women and positive effects of nutrition on pregnant and neonatal health.

Method

Type of the Study: This interventional study was a randomized controlled trial, with experimental and control groups. This research is design type with recurrent measurement (3rd month and end of childbirth).

Location and Period of the Study: The research was conducted between December 20th, 2019 and May 20th, 2021 at the three most populated family health centers in Amasya province in Turkey.

Population and Sample of the Study: The population of the research consisted of 103 pregnant women who were enrolled in family health centers at the time of the research and met the criteria for inclusion. Being in second or third trimesters of pregnancy, not being a high-risk pregnant woman, not having a diagnosed physical or mental illness that would prevent participation in the research and volunteering to participate in the research constituted the criteria for participating in the study.

In calculating the sample size; the sample size was set at 32 (intervention = 16, control = 16) using the G-power 3.1.9.2 program, taking an impact size of 0.540 ($\alpha = 0.05$) and power (1β) = 0.80 at a confidence interval of 95% (Cohen, 1988). Similar studies conducted previously to calculate the effect size were taken as examples (Hange et al., 2017). According to the effect size, the total number of samples for both groups was 32 pregnant. The experimental and control groups were determined as a total of 40 pregnant women, thinking that there may be ones who quit the research. The sample consisted of 20 pregnant experimental and 20 pregnant control groups selected by computer-aided randomization method. However, in the control group, there were 4 pregnant women whose pregnancy ended and decided to stop working. The research was completed with 20 in the experimental group and 16 in the control group (Figure 1).

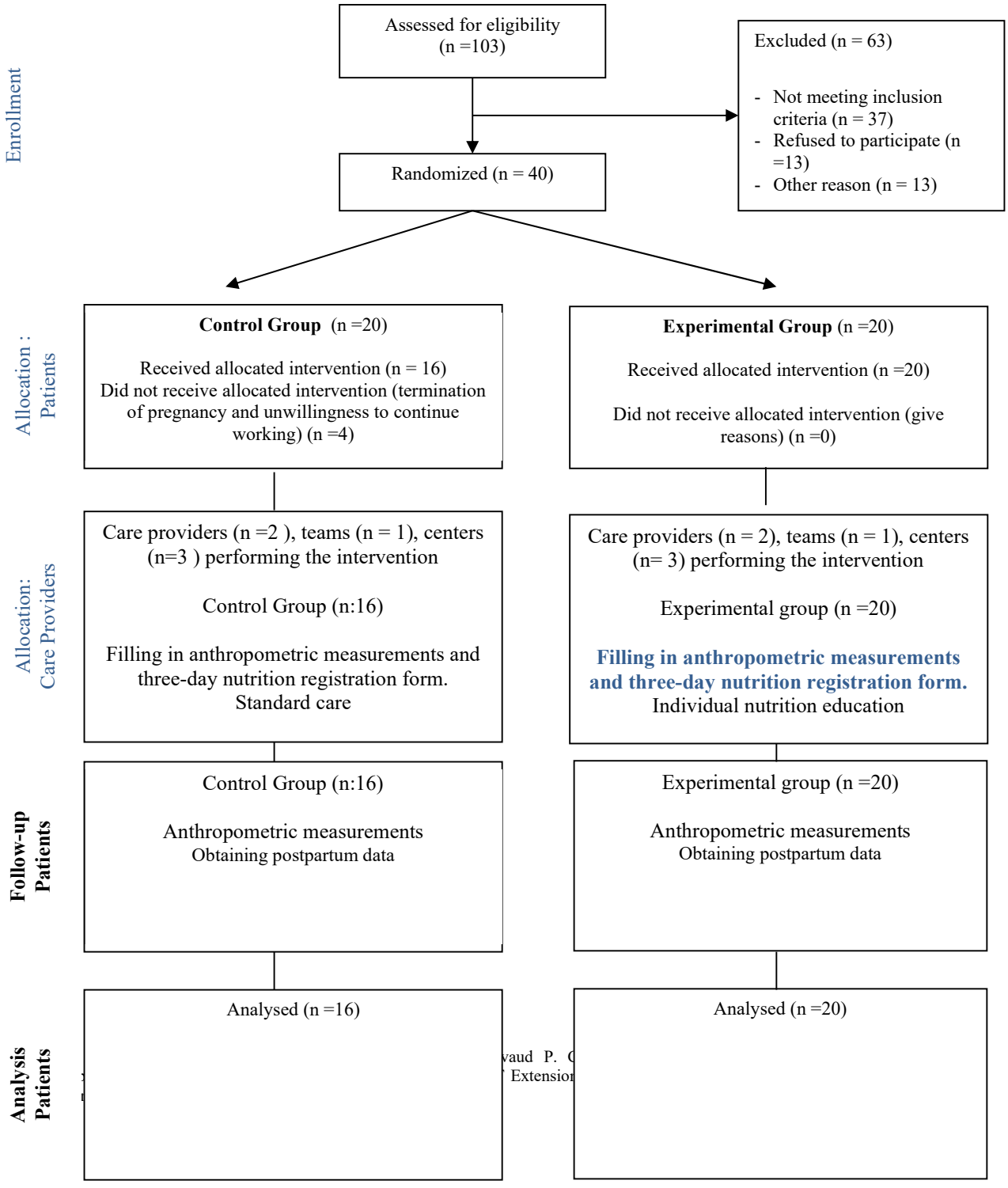

Figure 1- CONSORT Flow Diagram

Data Collection Tools: The data of the study were collected with a participant information form which includes questions about socio-demographic information of the pregnant women, risk assessment and anthropometric measurements form, and daily nutrition record form.

Participant Information Form: This is a questionnaire consisting of 10 questions, which developed based on the relevant literature by the researchers, this form includes pregnant women's socio-demographic information such as age, educational, income status and profession, and questions related to pregnancy.

Risk Assessment and Anthropometric Measurements Form: In this form, which was developed by the researchers based on the relevant literature and consisted of 19 questions, height, weight and blood pressures of pregnant women and their consumption frequency of cereals, fruits, vegetables, ready-made food, fast food, frozen, fried food, meal skipping status, meal skipping reasons, smoking status and physical exercise were measured, recorded and evaluated by the researchers.

Procedure of the Study: Data collection forms were applied by the researchers in family health centers on days suitable for pregnant women. Height-weight and blood pressure measurements of the pregnant women were made with a floor scale with a height meter without shoes. After the measurements, all food and beverages consumed by the pregnant women for three days were recorded retrospectively in the nutrition record form by the researchers. Filling in the forms took approximately 20 minutes per day (pre-test).

Intervention: According to the nutrition registration form, the data were analyzed in the BeBIS (8.0) software. According to the results of the analysis and according to TNG, both individual nutrition training (20 minutes in family health center) was given to the pregnant women in the experimental group and a nutritional recommendation list including the foods they should consume and their amounts was given. No intervention was applied to the control group pregnant women. Anthropometric measurements were repeated at the third month and postpartum after the training. In addition, detailed information about the newborn was obtained.

Data Analysis: Statisical Package for Social Science for Windows (SPSS 21.0) was used in this research to resolve, investigate and analyse the data. In data analysis, ordinal variables were evaluated as arithmetic mean and standard deviation, minimum and maximum. The data were analysed with Mann-Whitney U test and Chi square test, and the level of significance was determined as $p<0.05$. Daily energy and nutrient intakes of the pregnant women were defined separately for each pregnant woman in the computerized BeBIS (8.0) software using the nutrition registration form, and then analysed and compared with the recommended levels according to TNG.

Ethical Considerations: Ethical consent was obtained from the Science Ethics Committee of Amasya University (06.01.2020-E.490) and the Institutional consent from the Provincial Health Directorate of Amasya (22.11.2019- 11092) in order to conduct the research. Mothers who met the inclusion criteria were informed about the research and written consent was obtained from those who accepted.

Results

Mean age of all participants was 26.44±5.39 years. The mean BMI of the participants was 24.07±4.37 and they gained an average of 14.91±6.18 kilograms during pregnancy. Table 1 shows the personal characteristics of the experimental and control groups.

It was also found that 62.5% (10) of the pregnant women in the control group and 75% (15) in the experimental group did not receive any information about having a healthier pregnancy before it. Almost all of the control group with 93%(15) and 85% (17) of the experimental group were not enrolled in a pregnant school.

Many of the pregnant women in the experimental (%75 (15)) and control groups (%62.5 (10)) did not use folic acid before pregnancy, but almost all of them in both groups used vitamin pills (control %, 87.5 (14), experimental %95.0 (19)). Pregnant women are seen to skip lunch and snacks. It is seen that 43.8% (7) of the control group skipped lunch and 43.8% (7) skipped snacks,

while 40% (8) of the experimental group skipped lunch and 35% (7) skipped snacks. Reasons for skipping meals included not being able to find time, not feeling hungry, and nausea.

Table 2 shows the evaluation results with the BEBIS program according to the nutritional habits of the experimental and control groups

Comparison of the control and experimental groups with total weight gained during pregnancy, birth weight of the newborn, weight to be gained during pregnancy according to BMI and mode of delivery are given in Table 3. No statistically significant relationship was found between them.

Four pregnant women were reported to experience cardiac and hypertensive conditions, and four newborns experienced jaundice and respiratory distress during the postpartum period. It was observed that the number of people experiencing problems was equal in the experimental and control groups. A statistically significant relationship was found between the state of having problems in the postpartum period and the mode of delivery all of them (p=0.02). All those who had problems gave birth by cesarean section.

A statistically significant correlation was found between having problems in the postpartum period and weight gain according to BMI all of pregnant women (p=0.04). It was found that 87.5% of those who had problems gained less or more weight during pregnancy.

Table 1. Descriptive Characteristics of Experimental and Control Groups

		Control Group		Experimental Group	
		Mean±SD		Mean±SD	
Age		28.38±3.72		24.90±6.08	
Height		162.06±5.05		159.95±6.71	
Weight before Pregnancy		65.31±10.20		60.30±15.06	
BMI		24.84±3.52		23.45±4.94	
Total Weight Gain During Pregnancy		16.06±6.67		14.00±5.76	
Pregnancy Number		2.56±0.96		1.7±1.17	
Pregnancy week at first appointment		13.37±4.74		11.95±4.69	
		n	%	n	%
Educational Status	**Primary**	5	31.25	5	25.00
	High School	6	37.50	8	40.00
	University	5	31.25	7	35.00
Employment	**Employed**	6	37.50	4	20.00
	Unemployed	10	62.50	16	80.00
Income	**Bad**	1	6.30	0	0
	Average	9	56.30	8	40.00
	Good	6	37.40	10	50.00
	Very good	0	0	2	10.00

Overall Health	**Very bad**	2	12.50	0	0
	Bad	9	56.30	1	5.00
	Average	4	25.00	2	10.00
	Good	1	6.30	14	70.00
	Very good	0	0	3	15.00
Total		16	100	20	100

Table 2. Basic Food Groups, Vitamin and Mineral Averages According to BeBIS Results of Experiment and Control Groups Before the Intervention

	Control Group	**Experimental Group**	**Recommended Values for Pregnant Women***
	Mean±SD	**Mean±SD**	
Consumed Energy (Kcal)	1909.21±33.87	1892.55±277.56	2100**
Protein (g)	54.45±24.26	49.61±14.10	51,5
Protein %	17.62±4.01	14.40±2.70	12
Fat (g)	46.63±17.45	56.51±19.59	59.2
Fat %	33.31±7.86	34.80±7.32	30
Carbohydrate (g)	150.71±70.52	183.09±74.35	248.9
Carbohydrate %	49.00±10.30	50.80±7.33	58
Fiber (g)	16.51±6.82	20.83±9.76	25.0
Polyunsaturated Fat	8.68±4.42	12.16±7.97	-
Vitamin A (µg)	1231.47±562.95	1015.11±539.24	700.0
Carotene	3.89±2.60	3.16±2.41	-
Vitamin E (mg)	9.30±3.52	10.74±5.56	11.0
Vitamin B1 (mg)	0.65±0.19	0.78±0.28	1.4
Vitamin B2 (mg)	1.16±0.47	1.04±0.50	1.4
Vitamin B6 (mg)	1.25±0.76	1.04±0.40	1.9
Folate	249.00±75.28	276.33±101.18	600 mcg**
Vitamin C (mg)	139.02±118.34	127.99±61.65	155.0
Sodium (mg)	2758.61±1243.06	2740.39±912.27	1500
Potassium (mg)	2447.01±1074.33	2115.22±812.69	4700
Calcium (mg)	802.01±345.85	712.83±331.60	950
Magnesium (mg)	231.22±98.50	229.67±77.38	300
Phosphorus (mg)	911.33±388.31	830.95±298.52	550

Iron (mg)	7.46±3.65	8.15±3.21	16
Zinc (mg)	7.47±3.74	7.37±3.99	11.6

*** Reference intervals of the BeBIS program for pregnant women with moderate activity**
**** TNG, 2015**

Table 3. Comparison of Control and Experimental Groups with Newborn Birth weight and Pregnancy Weight and Delivery Type

		Control Group	Experimental Group	U	Z	P*
		Mean±SD	Mean±SD			
Total weight gained during pregnancy		16.06±6.67	14.00±5.76	118.50	-1.32	0.18
Newborn birth weight		3410.62±551.08	3270.50±469.12	138.00	-0.70	0.48
				X^2	df	P**
Pregnant woman's intake during pregnancy according to BMI	**Less or more**	%68.80 (11)	%45.00 (9)	2.03	1	0.19
	Normal	%31.2 (5)	%55.00(11)			
Delivery Type	**Normal**	%18.70 (3)	%45.00 (9)	2.75	1	0.09
	Caesarean section	%81.30 (13)	%55.00 (11)			

*** Mann Whitney U test ** Chi-square Test**

Discussion

In the study, no difference was found between the groups in terms of total weight gained during pregnancy, newborn birth weight, delivery type and ideal weight to be gained during pregnancy according to BMI. The mean weight gained during pregnancy was 14.0±5.8 kg in the experimental group and 16.0±6.7 kg in the control group. Although it is not statistically significant, the total weight gained in the experimental group is lower than that of the control group. Normal weight gain during pregnancy according to BMI is higher in the experimental group. In line with this research, mean total weight gained during pregnancy was 14.9±6.8kg in the research of Buyukuslu et al. (2019); and in that of Kangalgil et al. (2018), it was 11.2±4.9 kg for pregnant women. Enough weight gain according to BMI during pregnancy is possible through energy consumption, macro and micronutrients at a recommended level, and this gain is also effective on the birth weight and height of the newborn as well as health of the mother (Hakli, 2015; Akan, 2011; TNG, 2015; Uzdil & Ozenoglu, 2015). In addition, pregnant women with normal weight gain generally have fewer problems than those with more or less (Karaagaoglu and Eroglu-Samur 2015). In order to prevent undesirable consequences of inadequate and unbalanced nutrition during pregnancy, optimal nutrition should be provided and daily energy and nutritional requirements should be met at recommended level (Morrison & Regnault, 2016; Buyukuslu et al., 2019). The facts that most of the pregnant women did not receive training on healthy nutrition before, distribution of daily micro and macro nutrient intake rates, individual nutrition education in the study being suitable but not continuous in terms of consumption of nutrients, compliance of the pregnant women to the nutrition training given in the research and various factors affecting all these conditions may have affected the results. Additionally, it was found in the research that individuals with less or more weight gained during pregnancy according to BMI experienced problems in the postpartum period. This may be due to the fact that all of

the pregnant women who had problems gave birth by cesarean section. In the literature, it is reported that excess weight gained during pregnancy causes birth problems such as cesarean section and postmaturation, and risky situations for mother and baby (Akan, 2011; Uzdil & Ozenoglu, 2015).

In the research, majority of the control group consumed three meals a day, half of the experimental group consumed 4 or more meals a day, majority of the experimental group frequently and that of the control group sometimes skipped meals, the most skipped meal in both groups was lunch, and the reasons for skipping meals were not finding time, not feeling hungry and sleeping. Contrarily, Akan (2011) reported that ¾ of the pregnant women consumed 2 meals a day, 75% of the pregnant women skipped the morning meal, rate of those who skipped lunch was 0.9%, and consuming the main courses and skipping meals also changed according to trimesters. Unusan et al. (2017) reported that the frequency of skipping at least one of the main courses and snacks was 60.8%, and the most common reason for skipping meals was not feeling hungry (43.8%). In parallel with our research, Akac (2021) reported that 73% of the pregnant women did not skip meals, and those who skipped meals missed the lunch most frequently with 16%. Care should be taken to eat a healthy and regular diet without skipping three main courses during pregnancy. When the mother is malnourished during pregnancy, the baby gets what she needs from the mother and various birth complications may arise. In this research, it is thought that most of the pregnant women skip lunch because they are housewives and wake up late in the morning. If pregnant women have health problems such as nausea, cravings, vomiting, and heartburn that will cause skipping meals, the number of meals should be increased and the amounts should be reduced, so that nutritional problems in pregnant women can be eliminated (Akan, 2011).

According to TNG, energy intake should be at least 1800 kcal in individuals with low energy intake during pregnancy and 45-65%, 10-35% and 20-35% of daily energy should be provided from carbohydrates, proteins and fats, respectively. In addition, the recommended amount for pregnant women over the age of 19 is 2100 calories, and 300 calories should be added per day for the 2nd and 3rd trimester of pregnancy (TNG, 2015). In the research, mean amount of energy in the experimental group was 1892.5±277.5 and it was 1909.2±33.8 in the control group, and the ratio of energy from carbohydrates of the experimental group was 50%, from fat 34% and from protein 14%, within the recommended ranges, however, mean amount of energy intake according to the age period and activity level of both groups is below the recommended level according to TNG. Similarly to the results of the research, in the research of Buyukuslu et al. (2019) with pregnant women, mean of energy was 1894kcal/day; it was 1860 in the study of Garipagaoglu et al. (2007) with pregnant women; and 1544 in the study of Fujita et al. (2015) in Japan, and mean of energy intake of pregnant women was insufficient. Pregnancy is a period in which energy need increases with regard to normal lifetime and determining the energy needs of a pregnant woman is calculated by taking into consideration the anthropometric measurements, period of pregnancy and health conditions (Uzdil and Ozenoglu, 2015).

Even though daily energy need changes from person to person, an average of such need increases compared to pre-pregnancy lifetime. Nausea and vomiting, observed in the earlier stages of many pregnancies, may cause a decrease in the energy to be taken (Aydin, 2014; Yabaci, 2019). Insufficient calory amounts may be linked to differences in such factors as nutritional necessities, age, level of physical activity, family characteristics, socio-cultural and economic factors, lifestyle, psychology and genetic structure.

Conclusion and Suggestions: Nutrition and weight gain during pregnancy change delivery type, so they affect maternal and newborn health. Nutrition education should be an essential part of prenatal care. ınforming women on nutrition starting from the preconception period is fundamental. Especially midwives and nurses should give individual counseling in pregnant women on nutrition in order to reduce complications and risks that may occur.

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