

# A study of the dietary intakes by the pre-pregnancy body mass index in pregnant women

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## Summary

The authors analyzed the difference in weight gain and nutrition, according to the BMI before pregnancy. They divided 91 subjects into BMI group 1 (normal weight) and BMI group 2 (overweight) before pregnancy. In general, the BMI before pregnancy did not influence weight gain but, in the BMI group 2, the intakes of all of cholesterol, total fatty acids, vitamin B12, iron, and copper were significantly higher. Neither group exhibited sufficient intake of vitamin B1, vitamin B2, niacin, vitamin B6, folic acid, calcium, magnesium, iron, or zinc. Pre-pregnancy weight management and nutrition during pregnancy is very important.

**Key words:** Body mass index; Diet; Nutritional status; Pregnant women.

## Introduction

Lifetime health depends on the intrauterine environment in a crucial period for the development of tissues and organs during pregnancy [1]. The determining factors of prenatal environment include the age, pre-pregnancy body mass index (BMI) and nutrition status, weight increase, and lifestyles in pregnancy of a pregnant woman [2]. Especially the pregnant woman's BMI at the prenatal stage is known as a factor used to predict the BMI of a fetus during his or her childhood and adolescent period, and a pregnant woman's level of fat cell is reported to have an influence on the initial stage of developing fat cell of a fetus [3]. Also, since the nutrition level of a pregnant woman has a high influence on the growth and development of a fetus and the insufficient nutrition may negatively affect the health of a fetus up to his or her adulthood, it is very important for a woman to be on a proper diet before and during pregnancy in order to have both mother and fetus maintain good health [4]. Currently in Korea, first-time pregnant women are older and women become more obese due to the westernized diet and lifestyles. According to the Korea National Health and Nutrition Examination Survey (KNHANES) conducted in 2011, the incidence of obesity of women of childbearing age from 19 to 39 years old is high at 10.1% [5], while the analysis conducted by the National Health Insurance Corporation between 2010 and 2012 reported that 23.8% of obese women (BMI greater than 25) who had suffered from gestational diabetes during her first pregnancy developed diabetes in eight years after delivery. It

demonstrated that in Korea with low birth rates and the increased age of women at first birth, it is essential for women of childbearing age to focus on good healthcare efforts such as obesity control and nutritional care before as well as during pregnancy. Therefore this study aimed to identify if there was any difference in the gestational weight gain and nutrition according to pre-pregnancy weight while utilizing the findings as basic data to develop a nutritional care plan adequate for domestic circumstances.

## Materials and Methods

This study was conducted in pregnant women who agreed on participation after listening to detailed explanations about the purpose of this study, out of those who visited the Department of Gynecology at a university hospital for regular prenatal checkups from July to October in 2013. Individual interviews with a researcher were carried out and their heights and weights were measured. Age, pre-pregnancy weight, gestational age, and gestational weight gain were investigated. As for the nutrient intakes, the detailed three-day intakes was recorded using a 24-hour retrospective method and the average daily nutritional intakes was analyzed using Can-Pro 4.0 (Korean Nutrition Society, Seoul, Korea). The intake of dietary supplements was not included. Data of a total of 91 pregnant women were used. They were classified into BMI group 1 (normal weight group, 18.5-22.9 kg/m<sup>2</sup>, n=55) and BMI group 2 (overweight group,  $\geq 23.0$  kg/m<sup>2</sup>, n=36) based on the pre-pregnancy level according to the WHO Asia-Pacific Criteria for BMI [6], and compared to the Dietary Reference Intakes for Koreans [7], according to the individual gestational age to assess the appropriacy of nutrient intake during pregnancy. The outcome of this study was analyzed using SPSS Statistics Software

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Table 1. — General characteristics and nutrient intakes of the subjects.

	BMI 1 (n=55)	BMI 2 (n=36)	p-value
Age (years)	32.8 ± 3.9 <sup>1)</sup>	33.5 ± 4.3	0.492
High-risk pregnant women	17 (30.9) <sup>2)</sup>	14 (38.8)	0.287
Gestational age (weeks)	22.8 ± 10.3	26.3 ± 8.9	0.123
Height (cm)	161.7 ± 5.6	159.3 ± 7.3	0.087
Weight (kg)	59.8 ± 8.2	72.6 ± 10.5	0.001**
Pre-pregnancy weight (kg)	53.3 ± 5.2	65.9 ± 10.2	0.003**
Weight increase (kg)	6.6 ± 5.8	6.7 ± 6.3	0.974
Energy (kcal)	1683.3 ± 524.8	1720.7 ± 608.0	0.542
Carbohydrates (g)	251.7 ± 78.7	257.3 ± 87.7	0.947
Protein (g)	63.9 ± 23.2 (104.4 ± 42.4) <sup>3)</sup>	66.9 ± 26.6 (102.9 ± 47.7)	0.710 (0.279)
Fat (g)	48.6 ± 23.2	48.6 ± 26.1	0.896
Total cholesterol (mg)	285.9 ± 183.2	311.3 ± 237.3	0.033*
Total fatty acid (mg)	26.1 ± 15.7	29.0 ± 22.5	0.027*
Saturated fatty acid (mg)	8.5 ± 6.9	9.7 ± 7.4	0.941
Monounsaturated fatty acid (mg)	10.0 ± 7.9	11.8 ± 10.1	0.415
Polyunsaturated fatty acid (mg)	8.6 ± 6.5	8.5 ± 5.9	0.662
Dietary fiber (g)	18.9 ± 8.1	20.8 ± 9.4	0.573
Vitamin A (μg RE)	825.3 ± 724.4 (114.6 ± 100.6)	755.8 ± 502.6 (92.6 ± 67.8)	0.238 (0.232)
Vitamin D (μg)	3.0 ± 2.6	3.5 ± 5.0	0.054
Vitamin E (mg)	14.6 ± 6.9	16.2 ± 8.9	0.177
Vitamin K (μg)	180.6 ± 202.9	172.1 ± 145.6	0.297
Vitamin C (mg)	115.3 ± 86.5 (104.8 ± 51.8)	92.8 ± 71.2 (84.6 ± 66.3)	0.447 (0.439)
Vitamin B <sub>1</sub> (mg)	1.2 ± 0.5 (77.9 ± 34.1)	1.1 ± 0.6 (75.4 ± 40.1)	0.508 (0.372)
Vitamin B <sub>2</sub> (mg)	1.2 ± 0.62 (77.5 ± 38.5)	1.2 ± 0.6 (76.4 ± 43.0)	0.809 (0.504)
Niacin (mgNE)	14.5 ± 6.7 (80.7 ± 37.0)	15.6 ± 8.2 (87.4 ± 45.4)	0.276 (0.236)
Vitamin B <sub>6</sub> (mg)	1.4 ± 0.6 (65.9 ± 29.7)	1.7 ± 1.9 (79.3 ± 40.6)	0.050 (0.049*)
Folic acid (μg)	447.7 ± 204.0 (77.2 ± 33.9)	423.0 ± 182.3 (70.5 ± 30.4)	0.867 (0.414)
Vitamin B <sub>12</sub> (μg)	6.7 ± 4.7 (258.8 ± 181.4)	9.5 ± 8.3 (365.9 ± 320.8)	0.004** (0.031*)
Pantothenic acid (mg)	4.4 ± 1.6	4.9 ± 2.5	0.104
Calcium (mg)	507.5 ± 256.6 (54.6 ± 27.6)	551.9 ± 260.6 (60.6 ± 30.5)	0.695 (0.859)
Phosphorus (mg)	977.9 ± 341.1 (139.7 ± 48.7)	1019.3 ± 465.3 (148.6 ± 71.7)	0.118 (0.054)
Sodium (mg)	3717.8 ± 1668.6	3934.1 ± 1882.7	0.959
Potassium (mg)	2609.8 ± 1093.4	2787.3 ± 1230.6	0.354
Magnesium (mg)	84.5 ± 43.9 (26.4 ± 30.3)	87.0 ± 80.2 (27.4 ± 18.5)	0.649 (0.726)
Iron (mg)	14.5 ± 8.2 (60.2 ± 30.2)	18.4 ± 19.0 (77.3 ± 79.1)	0.040* (0.097)
Zinc (mg)	10.3 ± 4.6 (98.7 ± 43.7)	9.3 ± 3.3 (82.2 ± 31.9)	0.561 (0.540)
Copper (mg)	1.1 ± 0.4 (113.9 ± 48.3)	1.3 ± 0.8 (143.0 ± 88.5)	0.019* (0.009**)
Iodine (mg)	352.5 ± 673.4	541.2 ± 875.4	0.132
Selenium (mg)	86.7 ± 33.8 (146.9 ± 57.1)	96.7 ± 45.0 (168.3 ± 86.7)	0.070 (0.034*)

<sup>1)</sup> Mean ± SE; <sup>2)</sup> Number of subject (%); \*, \*\*statistically significant.<sup>3)</sup> KDRIs RI, Korean dietary reference intakes (recommended intake).

Ver. 18.0; the average value and standard deviation were calculated, and the difference in nutrient intakes according to pre-pregnancy BMI was analyzed using an independent *t*-test. Each value was tested at the significance level of  $p < 0.05$ .

## Results

### General characteristics of pregnant women according to BMI

The mean age of all subjects was  $33.1 \pm 4.2$  years, and the percentage of high-risk pregnant women aged over 34 years was slightly higher in the BMI group 2. The mean gestational age was  $24.2 \pm 9.9$  weeks, which was around the second trimester, while the mean weight and pre-pregnancy weight were significantly higher in the BMI group 2. However, the mean increase of weight by pregnancy period was  $6.6 \pm 6.1$  kg, which means no difference was found in weight increase according to BMI.

### Status of nutrient intake of pregnant women according to BMI

No difference in major nutrient and cellulose intakes including carbohydrates, protein, and fat was found between two groups, but the intake of total cholesterol and total fatty acid was significantly higher in the BMI group 2. The intakes of vitamins and minerals was mostly similar between two groups, but the intake of vitamin B<sub>12</sub> ( $p < 0.01$ ), iron ( $p < 0.05$ ), and copper ( $p < 0.05$ ) was significantly higher in the BMI group 2.

### Appropriacy of nutrient intake of pregnant women according to BMI

To assess the appropriacy of nutrient intakes by nutrient type, comparison with the Dietary Reference Intakes for Koreans was conducted. The deficient nutrients of the recommended intake (RI) out of a total of 16 nutrients included ten nutrients in BMI group 1 (vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, niacin, vitamin B<sub>6</sub>, folic acid, calcium, magnesium, iron, and zinc) and 11 nutrients in BMI group 2 (vitamin A, vitamin C, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, niacin, vitamin B<sub>6</sub>, folic acid, calcium, magnesium, iron, and zinc). Especially, the intake of calcium, magnesium, and iron was substantially low. Looking at the difference according to BMI, the intake of vitamin B<sub>6</sub> ( $p < 0.05$ ), vitamin B<sub>12</sub> ( $p < 0.05$ ), copper ( $p < 0.01$ ), and selenium ( $p < 0.05$ ) was significantly higher in the BMI group 2.

## Discussion

These days, as women of childbearing age have been polarized into those wanting to be thin and those getting obese due to an imbalanced diet, the nutritional imbalance of women in their childbearing period is emerging as a problem [8], and the weight before and during pregnancy and nutrient intakes are reported by a number of researches as important factors that affect pregnancy out-

comes. The Institute of Medicine (IOM) suggested recommendations on the gestational weight gain according to pre-pregnancy BMI [9]. Comparison to the results of this study showed that the gestational mean weight gain of all BMI groups 1 and 2 was appropriate. Compared to the results of other domestic studies, the intake of energy and three major nutrients by the subjects was slightly less than that of Lee *et al.* [10] However, no difference was found in the overall fat intake between two groups, yet it was noticeable that the intake of total fatty acid was significantly higher in BMI group 2 than in BMI group 1. This can be interpreted that fat may have an effect on BMI according to qualitative intake. Compared to the RI by nutrient for pregnant women, the intake of nutrients such as vitamin B<sub>6</sub>, vitamin B<sub>12</sub>, copper, and selenium showed significant difference between two groups. The commonly deficient nutrients in two groups were vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, niacin, vitamin B<sub>6</sub>, folic acid, calcium, magnesium, iron, and zinc, which accounted for about two-thirds of 16 nutrients having the RI. Furthermore although those with higher BMI had most nutrients, the intake of major nutrients such as vitamin C, folic acid, and zinc which are essential during pregnancy, was lower in the BMI group 2 than the BMI group 1.

This study has limitations that the pregnancy outcomes according to pre-pregnancy BMI or the blood composition according to gestational nutrient intakes were not examined, but discovered that it is very important for BMI group 2 out of women of childbearing age to have early nutritional care. It is also necessary to develop screening tools or individualized nutrition education programs in order to determine the nutrient intakes by women in childbearing years and in pregnancy.

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