

## NUTRITIONAL VALUE OF DAILY FOOD RATIONS OF OVERWEIGHT AND NORMAL WEIGHT PREGNANT WOMEN

Agnieszka Bzikowska<sup>1\*</sup>, Aneta Czerwonogrodzka-Senczyna<sup>1</sup>, Agnieszka Riahi<sup>2</sup>, Halina Weker<sup>1</sup>

<sup>1</sup>Warsaw Medical University, Faculty of Health Science, Department of Clinical Dietetics, Warsaw, Poland

<sup>2</sup>Institute of Mother and Child, Department of Nutrition, Warsaw, Poland

### ABSTRACT

**Background.** Adequate nutrition and nutritional status during pregnancy are essential for mother's health and foetus development. Due to increased demands, pregnant women are vulnerable to inadequate nutritional status and paradoxically it may also affect overweight women.

**Objective.** The aim of the study was to evaluate energy and nutrients intake in the group of pregnant women in relation to nutritional standards and pre-pregnancy BMI.

**Material and methods.** The study included 90 women, during the third trimester of pregnancy, recruited from Warsaw antenatal classes. The anthropometric data gathered in the research were used to calculate BMI value before pregnancy. Pre-pregnancy BMI was categorised as: normal weight (BMI=18.5-24.9 kg/m<sup>2</sup>, n=47) and overweight (BMI ≥25.0 kg/m<sup>2</sup>, n=43). The assessment of women's nutrition was based on 3-days dietary record. Due to heterogeneous variances, differences between groups were assessed using *Mann Whitney U* test, p<0.05 was considered as significant.

**Results.** The mean intake of energy, protein, fat and carbohydrates in the overweight women were significantly higher than in healthy weight women (p<0.05). Most of the healthy weight women did not reach EAR standard for vitamin D (79.5%), whereas in overweight group it was 41.3%.

**Conclusions.** Despite the fact that intakes of energy and all nutrients were higher in overweight women than in normal weight ones, we observed that women in both groups had risk of insufficient supply of energy, iodine, potassium and vitamin D. For this reason, accurate nutritional assessment should be an integral part of obstetric care.

**Key words:** pregnancy, nutrition, daily food rations, pre-pregnancy BMI

### STRESZCZENIE

**Wprowadzenie.** Odpowiedni sposób żywienia i stan odżywienia kobiet w okresie ciąży ma kluczowe znaczenie dla zdrowia matki i prawidłowego rozwoju płodu. Ze względu na zwiększone zapotrzebowanie na określone składniki odżywcze, u kobiet ciężarnych istnieje większe ryzyko niedoborów pokarmowych. Paradoksalnie problem ten może dotyczyć również kobiet z nadmiarem masy ciała.

**Cel.** Celem badania była ocena spożycia energii i składników odżywczych w grupie kobiet ciężarnych z prawidłową i nadmierną masą ciała, w odniesieniu do norm żywienia.

**Material i metody.** Do badania włączono 90 kobiet w 3 trymestrze ciąży. Uzyskane dane antropometryczne wykorzystano do wyliczenia przed ciążowego wskaźnika masy ciała (BMI). Wartości wskaźnika BMI w przedziale 18.5-24.9 kg/m<sup>2</sup> zaklasyfikowano jako prawidłowe (n=47), a BMI ≥25,0 kg/m<sup>2</sup> jako zwiększone – kobiety z nadmiarem masy ciała (n=43). Oceny sposobu żywienia dokonano na podstawie 3-dniowego bieżącego notowania spożywanych posiłków i potraw. Ze względu na niejednorodność wariancji, do porównania grup wykorzystano nieparametryczny test U-Manna Whitneya, za poziom istotności statystycznej przyjęto p<0.05.

**Wyniki.** Wartość energetyczna oraz zawartość białek, tłuszczów i węglowodanów była znacząco wyższa w grupie kobiet z nadmiarem masy ciała (p<0.05). Ryzyko niewystarczającego spożycia witaminy D zaobserwowano u 79.5% kobiet z prawidłową masą ciała i 41.3% kobiet z nadmiarem masy ciała.

**Wnioski.** Pomimo tego, że w całodziennych racjach pokarmowych w grupie kobiet z nadmiarem masy ciała spożycie energii i składników odżywczych było wyższe w porównaniu z kobietami o prawidłowym stanie odżywienia, u kobiet z obu grup występowało ryzyko niedoboru energii, jodu, potasu i witaminy D. Z tego powodu ocena sposobu żywienia kobiet ciężarnych powinna być integralnym elementem opieki położniczej.

**Słowa kluczowe:** ciąża, żywienie, całodziennie racje pokarmowe, przed ciążowe BMI

\* **Corresponding author:** Agnieszka Bzikowska, Warsaw Medical University, Faculty of Health Science, Department of Clinical Dietetics, Erazma Ciołka str. 27, 01-445 Warsaw, Poland tel. +48 22 509-015-330, e-mail: zzc@wum.edu.pl

## INTRODUCTION

Women during pregnancy undergoes significant anatomical and physiological changes in order to nurture and accommodate the developing foetus. Those changes contribute to increased needs for energy and many nutrients [19]. Given that the foetus is dependent on the range of nutrients circulating in the mother's blood, adequate nutritional status before and during pregnancy seems to be very important. Poor dietary patterns are known to lead to pre-term delivery, shorter birth-length and foetus's neurodevelopmental problems [4].

Studies have showed that pre-pregnancy weight status (pre-pregnancy BMI-body mass index) and excess gestational weight gain (GWG) are significant risk factors for future overweight in both, mothers and children. Although adverse effects are associated with both too high and too low GWG, in many European countries (including Poland), weight gain during pregnancy is not routinely monitored [17, 18].

Nutrition is key modifiable factor associated with weight related outcomes in pregnancy. Evidence suggests that adequate nutrition during pregnancy is a key environmental factor that determines proper course of pregnancy and foetal development. What is more, large amount of studies confirm direct effects of maternal nutritional status on offspring adult health. [6, 12, 14, 21].

The aim of the study was to assess nutritional value of daily food rations of pregnant women in relation to nutritional standards and pre-pregnancy BMI.

## MATERIAL AND METHODS

In the study participated 90 women during the third trimester of pregnancy, recruited from Warsaw antenatal classes. The exclusion criteria of the study were: age under 18, health problems (eg. gestational diabetes mellitus, intrahepatic cholestasis of pregnancy, pregnancy induced hypertension), multiple gestation and following elimination diets (eg. gluten free diet).

All participants were asked about anthropometric parameters (height and pre-pregnancy body weight). The anthropometric data gathered in the research were used to calculate the body mass index (BMI) value before pregnancy ( $\text{kg/m}^2$ ). Pre-pregnancy BMI was categorised as: normal weight ( $\text{BMI}=18.5\text{-}24.9 \text{ kg/m}^2$ ,  $n=47$ ) and overweight ( $\text{BMI} \geq 25 \text{ kg/m}^2$ ,  $n=43$ ).

The assessment of women's nutrition was based on 3-days dietary record, including type and quantity of supplements. Sizes of declared food portions were verified using the "Album of Photographs of Food Products and Dishes"[20]. Collected data were used to estimate daily food rations (DFR). Energy and nutritional value of DFR (content of macronutrients, cholesterol, fatty acids, dietary fibre, minerals and vitamins) were calculated using Dieta 5.0 nutritional software [22].

For all tests,  $p < 0.05$  was considered as significant. All data were assessed for normality. Mean and standard deviation were reported for normally distributed data. Due to heterogeneous variances, differences between groups were assessed using independent sample *Mann-Whitney U* test. The statistical analysis was performed with Statistica software (version 10.0 PL).

## RESULTS

Table 1 shows the characteristics of examined women. Each woman's state of nutrition was assessed by means of pre-pregnancy body mass index (BMI). The majority of women (52%,  $n=47$ ) were in normal pre-pregnancy state of nutrition ( $\text{BMI}=18.5\text{-}24.9 \text{ kg/m}^2$ ) and 48% of them ( $n=43$ ) were overweight ( $\text{BMI} \geq 25.0 \text{ kg/m}^2$ ) The median age for normal weight women was 28.0 and for overweight women 29.0, differences were not statistically significant. There were significant differences between normal weight and overweight women with regard to anthropometric parameter (pre-pregnancy body weight) and indicator (pre-pregnancy BMI),  $p < 0.05$ .

Table 1. Characteristics of examined women

	Normal weight ( $n=47$ )		Overweight ( $n=43$ )		Mann-Whitney U test, p value
	Median	Interquartile range	Median	Interquartile range	
Age (years)	28.0	25.0-31.0	29.0	25.0-32.0	0.430
Height (cm)	1.65	1.60-1.70	1.65	1.60-1.70	0.778
Pre-pregnancy body weight (kg)	54.0	52.0-60.0	70.0	68.0-75.0	0.000*
Pre-pregnancy BMI ( $\text{kg/m}^2$ )	20.3	19.1-21.6	25.8	25.2-27.1	0.000*

\*- statistically significant differences

The median intake and interquartile ranges of energy were as follows: in the normal weight women 1490.7 kcal (1307.8-1675.5 kcal) and in the overweight women 1869.5 kcal (1524.0-2169.8 kcal). The risk of deficient energy intake was observed in 100% of women from both group. The median intake of macronutrients (protein, fat and carbohydrates) in the overweight women were significantly higher than in normal weight women ( $p < 0.05$ ). The consumption of vitamins and minerals in daily food rations was

diversified in examined groups. In both groups we observed insufficient intake of potassium. The risk of its deficient intake was observed in 96% of normal weight women and in 91% of overweight women. Daily food rations of normal and overweight women were too high in sodium, its median intake was 2323.1 mg (1930.1-2574.7 mg) and 2606.5 mg (2057.4-2904.0 mg), respectively. Most of the normal weight women did not reach EAR standard for vitamin D (79.5%), whereas in overweight group it was 41.3% (Table 2).

Table 2. The energy and nutrients intake in relation to Polish nutritional standards 2012 [9] in normal weight and overweight women

	Normal weight (n=47)		Overweight (n=43)		Mann-Whitney U test, p value	Nutritional standards EAR// RDA^/AI#
	Median	Interquartile range	Median	Interquartile range		
Energy (kcal)	1490.7	1307.8-1675.5	1869.5	1524.0-2169.8	0.004*	3125
Protein (g)	56.9	52.2-71.8	75.2	59.9-92.2	0.016*	44-78
Fat (g)	44.3	38.9-51.5	57.3	46.6-78.5	0.004*	88
SFA <sup>1</sup>	18.2	14.6-22.5	24.7	16.7-33.2	0.003*	-
MUFA <sup>2</sup>	16.9	14.5-19.0	21.4	17.7-29.6	0.008*	-
PUFA <sup>3</sup>	6.3	5.1-7.5	8.1	5.8-11.2	0.029*	-
Cholesterol (mg)	187.1	130.4-286.3	280.3	156.4-355.0	0.213	-
Carbohydrates (g)	227.1	187.3-252.0	270.0	203.1-309.4	0.015*	175^
Sucrose (g)	39.7	25.1-62.0	39.3	28.6-66.5	0.251	-
Dietary fibre (g)	16.5	13.6-20.2	19.5	15.4-23.3	0.289	-
Sodium (mg)	2323.1	1930.1-2574.7	2606.5	2057.4-2904.0	0.005*	1500#
Potassium (mg)	2662.1	2451.3-2926.2	3209.1	2758.0-4046.3	0.045*	4700#
Calcium (mg)	740.1	563.6-864.2	842.3	607.8-997.5	0.097	800
Phosphorus (mg)	1000.2	883.9-1127.2	1297.4	1023.1-1659.4	0.030*	580
Magnesium (mg)	247.4	197.0-301.6	319.0	242.9-400.7	0.059	300
Iron (mg)	9.6	7.6-47.8	41.3	10.6-70.6	0.033*	23
Zinc (mg)	8.2	6.4-23.3	23.3	8.8-32.8	0.047*	9.5
Iodine (µg)	85.5	65.2-103.3	101.6	75.5-123.2	0.327	160
Vitamin A (µg)	779.0	586.4-1340.5	1273.9	754.3-1539.9	0.045*	530
Vitamin D (µg)	2.0	1.3-10.7	7.3	1.6-12.4	0.079	10
Vitamin E (mg)	8.7	6.5-15.3	14.0	8.4-18.3	0.235	10
Vitamin B <sub>1</sub> (mg)	1.1	0.8-2.6	2.6	1.1-3.1	0.037*	1.2
Vitamin B <sub>2</sub> (mg)	1.8	1.4-3.0	2.7	1.6-3.7	0.153	1.2
Vitamin PP (mg)	16.5	10.9-30.6	30.8	15.2-37.0	0.045*	14
Vitamin B <sub>6</sub> (mg)	1.7	1.4-4.1	3.9	2.0-4.9	0.064	1.6
Vitamin C (mg)	151.9	94.4-200.6	222.9	135.2-292.8	0.026*	70
Vitamin B <sub>12</sub> (µg)	3.1	2.4-5.8	5.3	2.9-6.9	0.092	2.2
Folic acid (µg)	317.7	237.9-916.4	841.0	345.4-1111.3	0.008*	520

<sup>1</sup> SFA - Saturated Fatty Acids, <sup>2</sup> MUFA - Monosaturated Fatty Acid, <sup>3</sup> PUFA - Polysaturated Fatty Acids

EAR – Estimated Average Requirement, # - AI, Adequate Intake

^ – RDA, Recommended Daily/Dietary Allowance

\*Statistically significant differences

## DISCUSSION

Adequate nutrition and nutritional status during pregnancy are essential for maternal and child health. Due to increased demands, pregnant women are vulnerable to inadequate nutritional status. The imbalance between pre- and postnatal nutritional environments may accelerate abnormal postnatal growth and increase the risk of obesity and non-communicable diseases [7, 10].

Australian retrospective cohort study (n=87292) showed that the proportions of women in the normal and overweight pre-pregnancy BMI categories remained stable at around 60% and 20%, respectively [15]. Observational study from the same area reported that one third (34%) of women were overweight, based on self-reported pre-pregnancy weight [5]. The representative Polish study, which included 18891 women, showed that most women (79%) was characterized by normal pre-pregnancy BMI [2]. Contrary to previously reported findings, we have observed that almost half of women (48%) were overweight before pregnancy (pre-pregnancy BMI  $\geq 25$  kg/m<sup>2</sup>).

In 2012 Lee et al. published meta-analysis including synthesized information on dietary intakes of pregnant women from Africa, Asia, Latin America and Caribbean area. Results were compared with FAO/WHO recommendations. Mean energy intake was 2055 kcal and the macronutrients intake were 63 g/d for protein, 54 g/d for fat and 323 g/d for carbohydrates. Energy and macronutrients intakes of women from Latin America were generally higher than those from Asia and Africa. Compared with FAO/WHO recommendations, only 14 out of 25 studies reached the recommended ranges. Estimated mean minerals and vitamins intakes were diversified depending on region. Most frequently deficiencies affected folate, iron and calcium [13].

It may seem paradoxical, but pre-pregnancy overweight may be simultaneously connected with nutrient deficiencies caused by excessive intake of low quality food, poor in micronutrients [1, 18]. Our findings of energy and nutrients intakes are partially consistent with other studies. We observed that women from both groups did not reach energy and fat EAR standards. In 100% of woman energy intake was lower than recommendations. It may be caused by very low median fat intake: in the normal weight women 44.3 g (38.9-51.5 g), in the overweight woman 57.3 g (46.6-78.5 g). Daily food rations of overweight women were characterized by higher content of energy and macronutrients, the differences were statistically significant (p<0.05). Polish nutritional standards do not contain requirements for cholesterol and respective fatty acids, however it is suggested that consumption of

cholesterol and saturated fatty acids should be limited due to its potentially atherogenic properties. Contrary to nutritional standards we observed that in women's diets from both groups, the intake of saturated fatty acids prevailed over intake of others fatty acids (mono- and polyunsaturated). When it comes to minerals we reported insufficient calcium intake, 64.4% of normal weight and 35.6% of overweight women do not reach EAR standard. Regarding that the foetus requires about 30 g of calcium to maintain its physiological processes, it seems to be very important. Furthermore, most of this mineral is transferred to the foetus during the third trimester and is derived from increased dietary absorption by the mother [11]. In normal weight and overweight women, we observed also iodine deficiency, it was 95.6% and 82.2% of EAR, respectively. Adequate iodine intake is absolutely crucial for the thyroid gland and brain development [4]. Recent British findings showed that mothers who were iodine-deficient during pregnancy, increased their child's risk of having a low IQ by the time they were 8 years old. [8]. In normal and overweight women we also investigated excessive sodium consumption, 2323.1 mg and 2606.5 mg, respectively. Coimbra et al. reported that high sodium diet during pregnancy produced disturbances in offspring leading to structural and functional (higher blood pressure) alterations, that persisted in adult life rats [3]. In both groups, we observed insufficient vitamin D intake, it was 79.5% of the normal weight women and 41.3% the of overweight women. It must be stressed that overweight women are at increased risk of vitamin D deficiency compared with women with healthy weight. It is caused by the sequestration of this vitamin by excess adipose tissue. As a result, the bioavailability of vitamin is reduced.

## CONCLUSIONS

Pregnant women are very vulnerable to energy and nutrients deficiencies, mainly because they have relatively greater need for them. Despite the fact that intakes of energy and all nutrients were higher in overweight women than in normal weight ones, we observed that women in both groups had risk of insufficient supply of energy, iodine, potassium and vitamin D. For this reason, accurate nutritional assessment should be an integral part of obstetric care. From a medical point of view, particular attention should be paid to overweight women, due to the increased risk of birth defects, which might be also cause by nutritional abnormalities.

### Conflict of interest

*The authors declare no conflict of interest.*



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