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Influence of pre-pregnancy body mass index and gestational weight gain on the results of bioelectrical impedance analysis as well as body weight changes in the post-partum period

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Key words: pre-pregnancy body mass index, gestational weight gain, bioelectrical impedance analysis, obesity

Abstract

Introduction and the aim:

There has been an alarming rise in the incidence of overweight and obesity worldwide. The prevalence of maternal obesity has more than doubled from 7.6 to 15.6% over the last two decades.

The aim of the study is to compare findings of the bioelectrical impedance analysis (BIA) and body weight changes during 5-6 months after delivery depending on gestational weight gain (GWG) as well as pre-pregnancy body mass index (PPBMI).

Material and methods:

The study participants (76 mothers) were divided into groups according to PPBMI and GWG:

1. group (n=59) - PPBMI<24.9 kg/m^2

2. group (n=17) - PPBMI ≥25 kg/m^2

1' group (n=41) - normal GWG

2' group (n=35) - excessive GWG

The methodology includes the results of questionnaires conducted among mothers in the early post-partum period and several months after delivery. Maternal body composition and hydration status were assessed by the BIA method at 48-72 hours after delivery. Statistical analysis was performed using the Mann-Whitney, χ^2 test, and cross tabulation. A p-value ≤0.05 was considered statistically significant.

Results:

Lower fat tissue index (13,8 vs. 18,9; p<0,0001), adipose tissue mass (33,8 vs. 53,2; p<0,0001), and total body water (32,0 vs. 37,5; p< 0,001) as well as larger related free fat tissue mass (49,7% vs. 39,5%; p<0,001) were observed in the group of patients with PPBMI<24,9 kg/m^2.

Lower fat tissue index (11,9 vs. 18,2; p<0,001), adipose tissue mass (33,0 vs. 43,3; p<0,0001), total body water (31,2 vs. 35,5; p<0,01) and neonatal birth weight (3132,6 g vs. 3575g;p<0,01) were observed in the group of patients with normal GWG.

Conclusions:

The BIA method is a standardized technique, which is non-invasive, fast and well tolerated by patients. It seems to be capable to serve as a valuable tool in the assessment of maternal body composition and hydration status.

Introduction:

There has been an alarming rise in the incidence of overweight and obesity worldwide. The prevalence of maternal obesity has more than doubled from 7.6 to 15.6% over the last two decades [1]. The growing number of obese women has a huge impact on infants, their mothers and service providers. Maternal obesity is a reason of an additional 47 500 high dependency hospitalizations in England. The Centre for Maternal and Child Enquiries indicates many effects of the obesity, such as: cardiac disease, gestational diabetes, or even not fully discovered psychological impact on obese pregnant women [2].

According to the current state of scientific knowledge, pre-pregnancy obesity and excessive gestational weight gain (GWG) have been regarded as independent risk factors for post-partum complications in both mothers and their children, which will subsequently lead to an increased risk of chronic diseases later in their lives. The lifestyle of pregnant women depends on the rate and extent of their gestational weight gain, which may result in the persistence of overweight and obesity in the postnatal period and occurrence of new complications, including type 2 diabetes mellitus, cardiovascular diseases and metabolic syndrome [3]. Gestational weight guidelines of the Institute of Medicine [4] provide ranges of recommended weight gain for specific pre-pregnancy body mass index (BMI) categories in relation to the least risk of adverse perinatal outcomes. It is recommended that in order to prevent adverse maternal as well as infant outcomes, women with normal weight at the time of conception should limit their total weight gain in pregnancy to 11.5-16 kg, overweight women to 7-11.5 kg and obese women should not exceed the weight gain of 5-9 kg [4]. Unfortunately, more than two-thirds of pregnant women exceed gestational weight recommendations of the Institute of Medicine [5].

Aim of the study:

The aim of the study is to compare findings of the bioelectrical impedance analysis (BIA) and body weight changes during 5-6 months after delivery depending on GWG as well as PPBMI.

Material and methods:

The study comprised women who were in a singleton term pregnancy and were hospitalized at the Chair and Department of Obstetrics and Perinatology, at the Medical University of Lublin. The data collection was performed between June 2016 and September 2016. All of the study subjects included in this study were Caucasian.

The study participants (76 mothers) were divided into groups according to pre-pregnancy BMI (PPBMI) and GWG.

1. group (n=59) - PPBMI<24.9 kg/m^2

2. group (n=17) - PPBMI ≥25 kg/m^2

1’ group (n=41) - normal GWG

2’ group (n=35) - excessive GWG

The exclusion criteria were as follows: multiple pregnancy, chronic infectious diseases, current urinary infections, metabolic disorders (such as polycystic ovarian syndrome; except those listed in the inclusion criteria for the studied groups), mental illness, cancer, liver diseases, cardiovascular disorders, fetal malformation, premature membrane rupture, intrauterine growth retardation, the presence of metallic prostheses, and pacemakers or cardioverter-defibrillators.

The methodology includes the results of questionnaires conducted among mothers 2-3 days and few months after delivery. Anthropometric measurements were performed after a 6-h fasting in the early post-partum period (i.e. 48-72 hours after delivery) The maternal body composition and hydration status were evaluated by means of the BIA method and with the use of a body composition monitor (BCM) (Fresenius Medical Care). Statistical analysis was performed using the Mann-Whitney, χ^2 test, and cross tabulation. All of the analyses were performed using the Statistical Package for the Social Sciences software (version 19; SPSS Inc., Chicago, IL, USA). A p-value ≤0.05 was considered statistically significant.

All of the patients were informed about the study protocol, and a detailed written consent was obtained from each patient who agreed to participate in the study.

The study protocol received approval from the Bioethics Committee of the Medical University of Lublin (no. KE-0254/221/2015 [25th June 2015] and no. KE-0254/348/2016 [15th December 2016]).

Results:

Lower fat tissue index (13,8 vs. 18,9; p<0,0001), adipose tissue mass (33,8 vs. 53,2; p<0,0001), and total body water (32,0 vs. 37,5; p< 0,001) as well as larger related free fat tissue mass (49,7% vs. 39,5%; p<0,001) were observed in the group of patients with PPBMI<24,9 kg/m2 (Figure 1).

Lower fat tissue index (11,9 vs. 18,2; p<0,001), adipose tissue mass (33,0 vs. 43,3; p<0,0001) and total body water (31,2 vs. 35,5; p<0,01) were observed in the group of patients with normal GWG (Figure 2). Neonatal birth weight was not statistically significant in 1 and 2 group whereas the related free fat tissue mass did not reveal statistical significance in 1’ and 2’ group.

Additional results without statistical significances between the studied groups were presented in Tables 1 and 2.

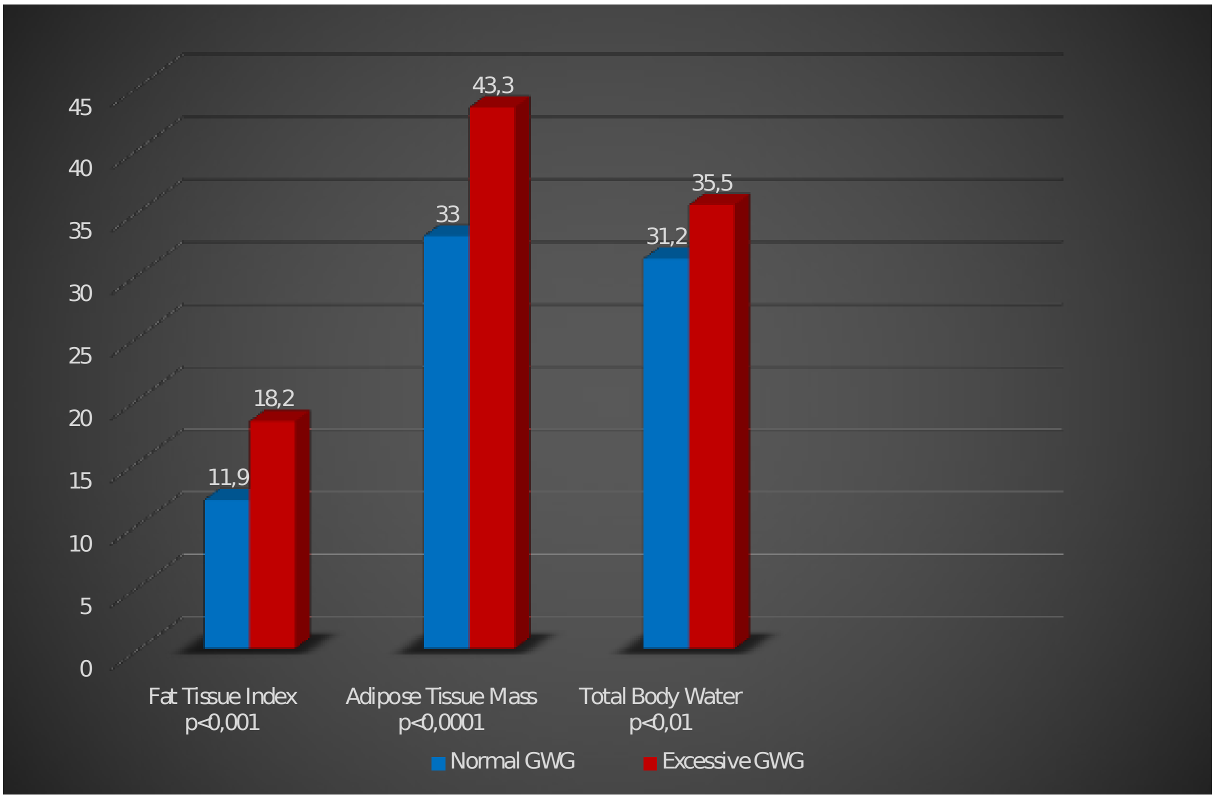

Figure 1. Results of BIA depending on PPBMI

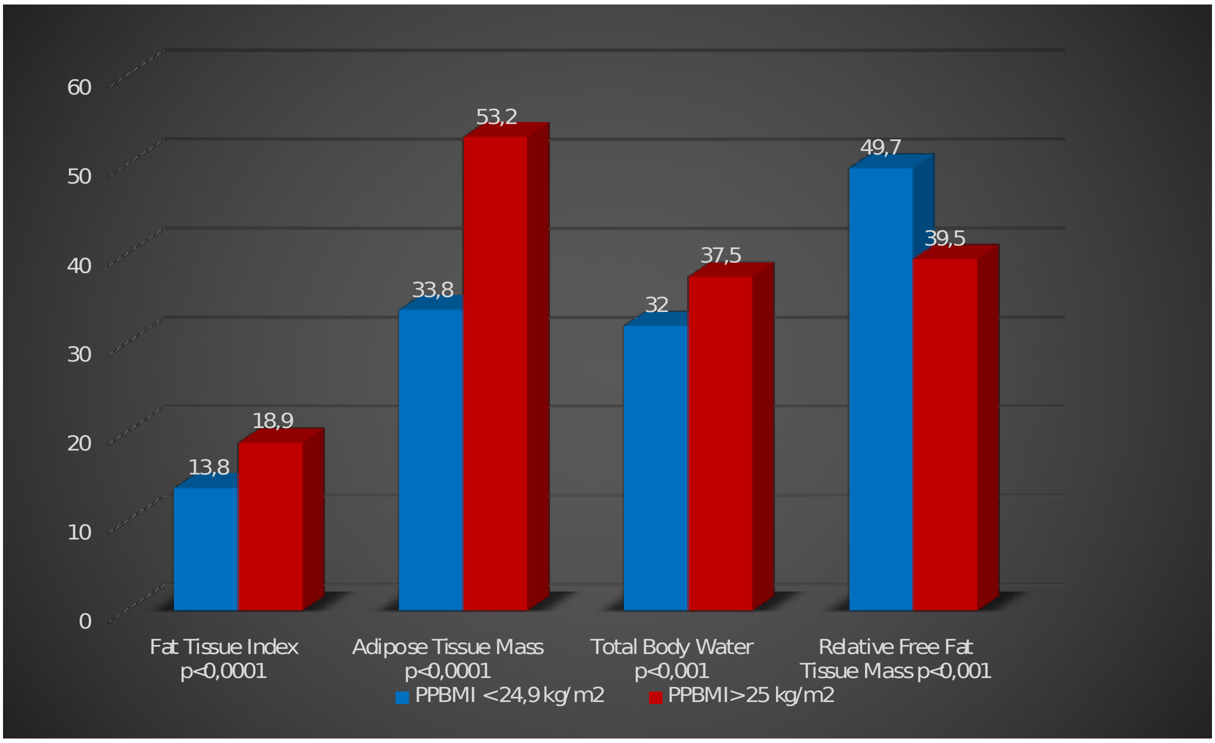

Figure 2. Results of BIA depending on GWG

Table 1. Results of BIA depending on PPBMI (without statistical significance).

	PPBMI<24.9	**PPBMI ≥25**
LTI	12,12	12,2
V urea	30,9	36,3
ECW	15,1	17,8
ICW	17,0	19,7
E/L	0,9	0,9
LTM	33,8	34,3
rel LTM	49,7	39,5
Fat	25,1	39,1
rel Fat%	36,0	43,6
BCM	18,0	18,3

PPBMI: pre-pregnancy body mass index

LTI: Lean Tissue Index

V urea: Volume of urea distribution

ECW: Extracellular water

ICW: Intracellular water

E/L: Extracellular water/ Intracellular water

LTM: Lean Tissue Mass

rel LTM: Relative Lean Tissue Mass (LTM/ body weight)

Fat: total weight of lipids

rel Fat%: Relative Fat (Fat/ body weight)

BCM: Body cell mass

Table 2. Results of BIA depending on GWG (without statistical significance).

	normal GWG	excessive GWG
LTI	11,9	12,6
V urea	30,3	34,3
ECW	14,6	16,8
ICW	16,7	18,7
E/L	0,9	0,9
LTM	33,2	35,0
rel LTM	50,5	44,7
Fat	24,2	32,1
BCM	17,6	18,8

GWG: Gestational weight gain

LTI: Lean Tissue Index

V urea: Volume of urea distribution

ECW: Extracellular water

ICW: Intracellular water

E/L: Extracellular water/ Intracellular water

LTM: Lean Tissue Mass

rel LTM: Relative Lean Tissue Mass (LTM/ body weight)

Fat: total weight of lipids

BCM: Body cell mass

The results of the questionnaires showed that women with normal GWG changed their diet in 60.5% during pregnancy, while women with excessive GWG only in 38.2%.

On the other hand, women with normal GWG were noted to have slower weight loss in the period of 5-6 months after delivery.

Discussion:

In order to assess the maternal body composition and hydration status, the BIA method was used in our study. This standardized technique is non-invasive, fast, and well tolerated by patients [3,6]. The physical properties of BIA, its measurement variables, and their clinical significance, have well been described in many previously published reports [3,6,7]. BIA appears to be a more accurate predictor of the gestational and post-partum outcomes than BMI [7]. Wang et al. [7] noted that the maternal increased BMI and gestational weight gain reflect the pregnancy nutritional status. BMI, however, is only a surrogate indicator of obesity and does not measure the distribution of fat. Fat and free-fat masses, measured by BIA, can accurately reflect the body fat compositions and have been considered as better predictors of maternal nutritional status than BMI [3,6,7].

BIA is based on the rate of electric current which flows with at different rates through different tissues. The main component of human body is water with ions which are localized in two compartments: extra-cellular and intra-cellular water. The other part of the body is composed of non-conducting materials such as fat tissue, which provide resistance to the flow of electric current [8].

The problem of pre-pregnancy obesity among pregnant women becomes lately more popular. This is because the knowledge about the potential consequences for the development of their offspring is higher. Both PPBMI and GWG affect the course of pregnancy, postpartum period as well as long-term development of the child. Maintaining an appropriate level of PPBMI and later GWG control may prevent the development of future complications.

GWG depends on the lifestyle of pregnant women, which can result in the persistence of overweight and obesity in the postnatal period and the appearance of new complications including metabolic syndrome. Evaluation of the effect of improper lifestyle of pregnant women - physical inactivity and improper diet - appears to be important in understanding the pathogenesis of diseases of “modern” civilization [9].

Measuring the weight of pregnant women and minding accurate PPBMI and GWG seems crucial when it comes to health and quality of life of both mothers and their offspring. On the other hand, body weight measurements in the early post-partum period, when the mothers are usually hospitalized, allow to determine BMI loss at 48-72 hours after delivery as well as body weight gain as a result of a difference between the gestational weight gain and rapid weight loss during delivery.

The rate of weight loss after delivery and of return to pre-pregnancy BMI values seems to be important for the maternal future health and prevention of metabolic complications. Both obstetricians and midwives should pay special attention to proper nutrition of pregnant women. Their education on the optimal gestational weight gain during the first pregnancy check-ups will pay dividends in the maternal programming for future diseases, such as dyslipidemia, insulin resistance, type 2 diabetes mellitus, overweight, obesity and metabolic syndrome.

Changing eating habits during pregnancy has an impact on GWG, which is an argument in following a diet. An interesting observation was also the fact that women with normal GWG reduced their weights slower.

Following a diet should be important for future mothers and pregnant women, because eating habits have an influence on GWG.

Conclusions:

The BIA method is a standardized technique, which is non-invasive, fast and well tolerated by patients. It seems to be capable to serve as a valuable tool in the assessment of maternal body composition and hydration status.

Due to many complications for both mothers and their offspring maintaining the right level of PPBMI as well as GWG control is going to be an important recommendation. Moreover, the control of a propriate level of PPBMI and GWG can prevent the development of obesity among young generations.

The study has shown that changing eating habits during pregnancy has an impact on GWG, which is an argument in following a diet. An interesting observation was also the fact that women with normal GWG reduced their weights slower.

Results of the study should lead to the discussion about the prevention of obesity.

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