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Bioelectrical impedance method for assessing later body-composition considering the influence of breastfed on gender

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Abstract

Purpose: to study the effect of breastfeeding on body composition in both male and female via bioimpedance analysis method. analysis methods.

Methods: we determined the body composition (body fat percentage, muscle mass percentage, and bone mass percentage) by bioimpedance analysis methods in 60 adults (31 male and 29 female) who were classified as underweight, normal and overweight subjects aged 20 years old. Average BMI was 21.4 Kg/ m^2 which calculated by traditional formula.

Findings: The differences in %BF assessed using bipolar analyzers were significantly higher for female than male. There was a significant difference ($P<0.05$) in %BF by foot-foot analyzer, BMI and %muscle mass between those who had breastfeeding and those who had never breastfed at all for both male and female adults. In addition, Just for male, there was a significant difference ($P<0.05$) in %bone mass according to different feeding types.

Conclusion: results suggest that exclusive breastfeeding protects from elevating body fat in both sex. For male, it appears a higher %muscle mass in breastfeeding than bottle feeding in comparison with female. Our data also shows that the association between breastfeeding and later %bone mass is not equally among different sex and it is stronger among male subjects than among female subjects. More studies are needed to demonstrate a link between breastfeeding and later body composition taking infant sex into account.

Key words: Bioimpedance; Body composition; BMI; Breastfeeding; Gender.

Introduction

The impact of early-life nutrition and breastfeeding on adult obesity and body composition is controversial [1, 2]. Although a number of primary and review articles provide strong evidence of the protective effect of breastfeeding against obesity [3, 4, 5, 6, 7], still other studies have reported an inverse relationship or no relationship at all [8].

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However, a number of factors influence body composition like food and fluid intake. Infant nutrition, specifically breast-feeding, seems to be associated with overweight and obesity in pre-school children and adolescents [4, 5]. A systematic review of many published and unpublished studies found lower mean body mass indexes (BMIs) in subjects who had been breastfed in infancy than in those who had been formula-fed [9]. These studies have suggested that breastfeeding during infancy has an effect on later body composition and hence the reduction of the likelihood of the risk of obesity in throughout life [6, 7].The mechanisms behind a potential association between breastfeeding and later obesity can be broadly categorized as Behavioral and Nutritional explanations [10]. Behavioral explanation illustrates how breastfed babies may learn to self-regulate their energy intake better than formula-fed babies. Nutritional explanations could involve the metabolic consequences of ingesting breast milk [11]. It might include lower serum concentrations of insulin, a hormone that promotes fat storage, in breastfed infants than in infants fed cow's milk-based formula, a higher protein intake and hence higher plasma insulin concentrations in infancy has been suggested to promote later obesity [12]. The growth acceleration hypothesis suggests that the benefits of breastfeeding for long-term obesity may be due to a slower pattern of growth in breastfed compared with formula-fed infants [13]. Observed advantages of breastfeeding lend support to this hypothesis [9, 14, 15].

Body composition was assessed by body mass index (BMI) equations and skinfold measurement. Although, the BMI is an appropriate screening tool for obesity, but probably it is least valid estimate of body composition. In the same manner, Skin-fold measurements also used to assess obesity come with a number of associated errors such as personal errors in measurement and instrument error.

As such, it is important to consider all these factors in making a conclusive determination regarding the protective effect of breastfeeding against body composition. Therefore, these limitations of earlier studies evaluating the association between infant feeding and obesity will continue to cast doubts on the relationship between breastfeeding and overweight/ obesity [16].

To overcome these drawbacks, this study aimed to prospectively examine the association between breastfeeding and body composition for adults through foot-foot bio impedance analysis. The main outcome measures of body composition were the percentages of the body fat, body water, and bone mass.

Method

Subject

The Study has been done between Nov. and Dec. 2012 on physics students at the University of Duhok, Faculty of science, Physics Department. The study population was 31 male and 29 female aged between 18 and 23 (mean=20.5). All Subjects have been informed that the data will be used for research. They were completely conscious of the importance of precision of information during examination and through questionnaire. Each participant was interviewed using Preceded questionnaire. According to their breastfeeding, they have been categorized to three groups; breastfeeding, breast and bottle and bottle feeding. The weaning was started at age one year in most of the breastfed group, while in mixed group, weaning was started before age 4 months.

Anthropometrics

The most recent definitions of overweight and obesity by The World Health Organization [17] are shown in table 1. All objects have been instructed to takes off their shoes and heavy clothing items and remove all items from their pockets before being weighed. In the same way, we make sure that their hair styles do not affect accuracy of height measurement; body weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively. BMI was calculated by dividing body mass (kg) by status (m^2).

Table 1: Definitions of body mass index

Determinant	Body mass index (kg/m2)
Underweight	<18.5
Normal weight	18.5–24.9
Overweight	25–29.9
Obesity class I	30.0– 34.9
Obese class II	35–39.9
Obese class III	> 40.0

Bioelectrical impedance analysis

According to anthropometric data, BIA was obtained by commercially available body composition analyzers foot to foot (Body analyzer Scale Model BA 833, ADE Fitness, Germany). SF-BIA device worked at 50 kHz and oscillating current of 800 μA to determine impedance in Ohms. First of all, personal data like gender, body height and age have to enter the BCAs and saved under selected locations. All participants were required to step on the scale in bare feet and remain stationary while the measurement is taking place within a few seconds. Accordingly, body composition with reference to body weight, %body fat, % body water, % muscle mass and % bone mass will be indicated. The analysis is based on the measure of the body's electrical resistance. A low, safe electrical signal passes freely through fluids contained in lean tissue. The body analyzer accurately

measures the resistance and with reference to anthropometric data uses it to calculate elements of body composition.

Statistical analysis

Illustrative statistics including means and standard divisions for assessing BMI, %BF %Muscle Mass, and %Bone Mass were computed for defined age and gender participants using Excel 2010. (A *p*-value less than 0.05 was regarded as statistically significant) has been compared by ANOVA single factor.

Results

Data from 60 healthy adults, (20±1.65) years old (31 male and 29 female), were included in the analyses. The characteristics of the study subjects according to gender are summarized in table 2. The mean and standard division has been determined.

Table 2: Anthropometric data, mean values and standard divisions for %BF, % muscle mass and %bone mass were measured by BIA for participants.

Characteristics	Male N=31		Female N=29	
	Mean	SD	Mean	SD
Age(yrs.)	20	1.65	19	0.82
Weight(Kg)	63.9	11.38	53.6	8.08
High (m)	172	6.22	157	5.92
BMI (Kg/m^2)	21.3	3.38	21.5	2.78
BF%	15.1	5.6	23.7	6.6
Muscle Mass%	44.8	2.79	37.6	3.27
Bone Mass%	14.3	0.86	10.5	0.79

Table 3 demonstrates the BMI categories according to its values. Female were lighter and shorter than male. Consequently, the prevalence of overweight was markedly lower for male (12.9%) than for female (13.79 %). despite the fact that female had a similar mean BMI to male, they had a significantly greater mean %BF than male ($P<0.05$).

Table 3 BMI category percentage of the study subjects.

BMI Category	BMI(Kg/m^2)	Male	Female
Underweight %	<18.5	16.12	6.9
Normal %	18.5-24.5	70.9	79.31
Overweight %	>25	12.9	13.79

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Table 4 shows the mean values of body compositions (percent body fat %BF, BMI, %Muscle Mass and %Bone Mass) for both gender according to different feeding types (breast, bottle, and mixed feeding for bottle and breast collectively).

Table 4 mean values of the measurable parameters of body composition for male and female according to feeding types.

Feeding	BF %		BMI(Kg/m^2)		Muscle Mass %		Bone Mass %	
	Male	Female	Male	Female	Male	Female	Male	Female
Breast	12.86	23.79	20.73	21.45	45.06	37.73	14.49	10.81
Breast &Bottle	12.86	25.03	19.85	21.87	45.7	37.03	14.61	10.51
Bottle	23.47	31.23	26.82	24.4	40.45	34.06	13	9.96

The body compositions were compared between male and female according to different feeding types as illustrated in table 5. The results show statistical significant differences (P <0.05) in the mean values of %BF, BMI, %Muscle Mass and %Bone Mass between breastfeeding, bottle feeding, and mixed feeding for male as measured by the respective devices. While non-significant difference (P >0.05) between breastfeeding and breast &bottle were observed. In contrast, the results show significant differences only between the breastfeeding and bottle in %BF and BMI for female.

Table 5 *P*- value of significant differences for the parameters of body composition between the three types of feeding for male and female.

Feeding		**BF%**		**BMI(Kg/m^2)**		**Muscle Mass %**		**Bone Mass %**	
		Bottle	**Breast &Bottle**	**Bottle**	**Breast &Bottle**	**Bottle**	**Breast &Bottle**	**Bottle**	**Breast &Bottle**
Male	**Breast**	0.0017	*0.5824*	0.00119	*0.4401*	0.0036	*0.5223*	0.001	*0.6823*
	Breast &Bottle	0.0012	–	0.0003	–	0.0006	–	0.0003	–
Female	**Breast**	0.0067	*0.0959*	0.0174	*0.3785*	*0.0645*	*0.0958*	*0.141*	*0.4217*
	Breast &Bottle	*0.0914*	–	*0.1000*	–	*0.6267*	–	*0.2867*	–

Column charts of body composition were plotted for different categories of feeding for both male and female. %BF and BMI were substantially higher in adult (male and female) who had never been breast-fed. These statistical differences were greater in male, *P*= 0.0017 and 0.00119 for %BF and BMI respectively) than in female, *P*= 0.0067 and 0.0174 respectively). A similar behavior was observed for mixed feeding in comparison with bottle-fed as shown in figure 1and 2. Generally speaking, the variable of %BF was higher for female than male.

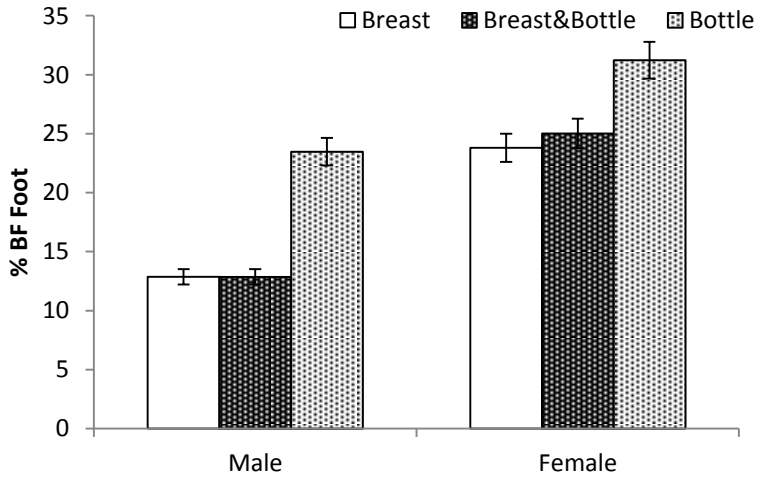

Figure 1 comparing between male and female in %BF measured by for different feeding types

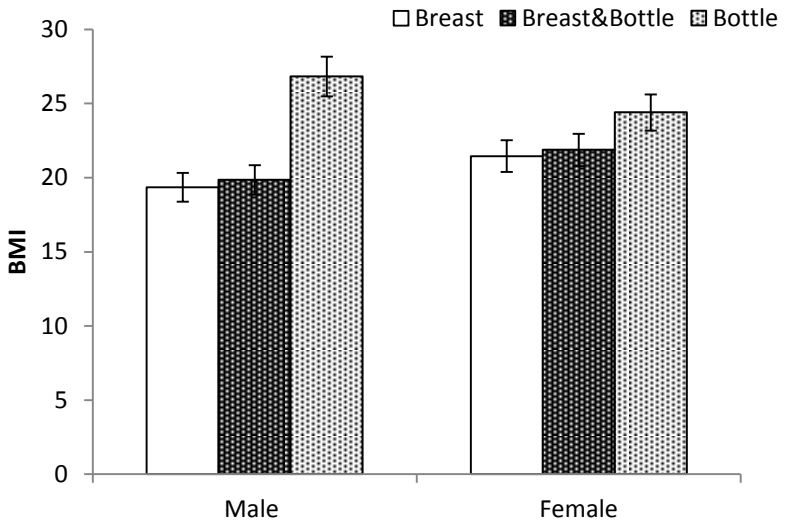

Figure 2 comparing between male and female in BMI for different feeding types

Oppositely to the other three body composition variables, the %muscle mass and %bone mass were higher for male than female as present in figures 3 and 4. No significant difference between

breastfeeding and bottle-fed was observed when the data was examined by gender to determine %muscle mass. The eccentric characteristic was revealed by %bone mass for male. It appears significant differences between breastfeeding and bottle in one side and mixed feeding and bottle in other side. While no significant difference was appeared for female at all (figure 4).

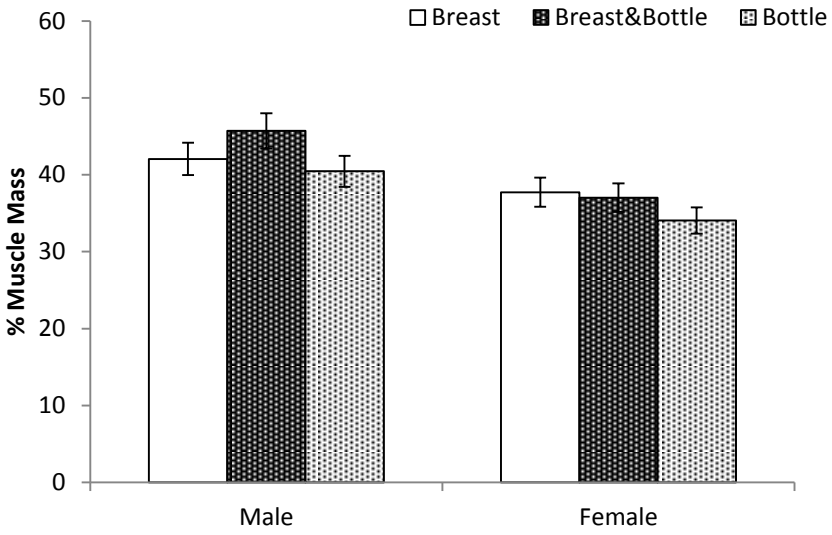

Figure 3 comparing between male and female in %muscle mass for different feeding types

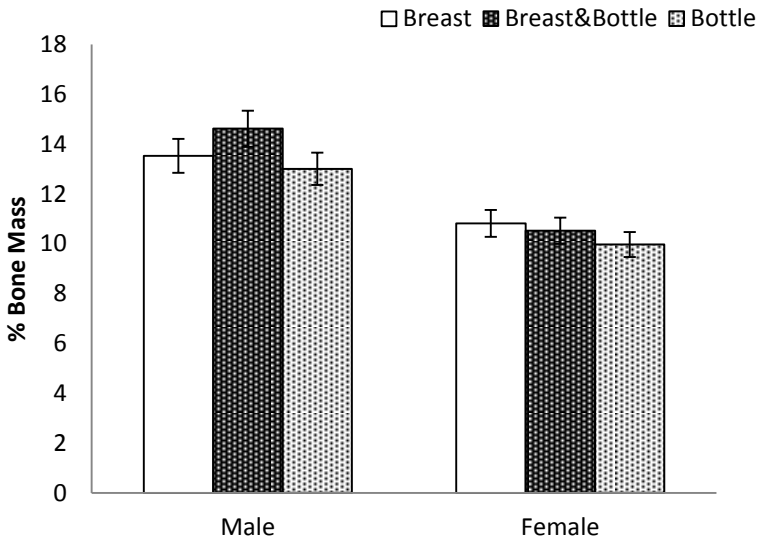

Figure 4 comparing between male and female in % bone mass for different feeding types

Discussion

This study examined the consistency measures of body composition in young adults aged ≈20 years. The accuracy of BIA devices may be impacted by a variety of factors such as waist or hip circumference. We made no effort in the present study to measure these factors since we were interested in how the device would estimate regardless of body size. Beside that the same values of BMI for male and female strongly reinforce the view of BMI does not differentiate between the shape of female (apples shapes) and the shape of male (pears shapes) [18].

The results of the present study show that for both male and female, the breastfeeding tended to be associated with lower risk of long-term overweight (high %BF). This finding reinforces the view that breastfeeding factor is involved in maintaining a healthy body weight [19, 20, 21]. No significant change of BMI for all feeding types for male and female. This is consistent with breastfeeding not independently influences BMI in young adults [19]. This result confirms the aforementioned point of view that BMI is least valid estimate of body composition.

As far as we know, the first attempt of studying the association between breastfeeding and later muscular mass in adult has been done in 2010 [22], our studying is the second attempt for examining the same goal beside other body compositions for male and female.

On the other hand, to our knowledge, this is the first report to present a relation between breastfeeding and later body composition taking sex into account. Mothers of male infants produced milk that had 25% greater energy content than mothers of female infants. Greater nutritional investment in sons may account for the greater observed growth rates in male compared to female infants [23].

The data and figures revealed a change of %muscle mass as a function of feeding types. Even it didn't reach a statistical significance; the relation appears a higher %muscle mass in breastfeeding than bottle feeding with most clearly in male comparing with female. This is a normal relationship as increased body fat in the bottle feeding at the expense of muscle mass.

The last characteristic %bone mass was defiantly differed from other body composition. Since breastfeeding was associated with %bone mass for male and was diminished for female. These results are consistent with breastfeeding in early life is associated with a beneficial increase in bone mass at adults and a reduction in fracture risk during adolescence [24]. However, the influence of breastfeeding on later bone mass in life is unclear. Others have found no such effects [25].

As much as we know, all the previous studies have been done regardless of the gender. Therefore the main finding of our study indicated that the breastfeeding for male has a long-term influence on bone mass in healthy adults, while no significant effect has been shown in female. We suggest that

the gender difference in milk composition and milk energy content may affect the later growth between male and female adults.

In summary, this study of 31 male and 29 female showed that sex and feeding type had different significant effect on later body composition for an infant sex-based difference in breast milk composition which may affect body composition in adults.

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