The Relation between Early Pregnancy Anthropometric Indices among Primiparous Women and Macrosomia

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ABSTRACT

*Introduction:*The prevalence of obesity is increasing in both developed and developing nations. Body mass index (BMI) is the most common index for obesity assessment and its relation with most complications among non-pregnant and pregnant women is known. However, no study has evaluated the relation between abdominal obesity and macrosomia among pregnant women. *Methods:*In this prospective study, anthropometric indices including weight, height, and waist circumference (WC) of 1140 nulliparous pregnant women during their first trimester of pregnancy (6th-10th weeks) were measured by the researcher. According to the classification of the World Health Organization, women with BMI > 25 kg/m^2 were considered as overweight or obese. Abdominal obesity was defined as WC $\geq$ 88 cm. Finally, mothers were followed up and fetal macrosomia was recorded in a checklist. Data was analyzed in SPSS$_{15}$.*Results:* The results showed that 77.5% of women aged 20-35 years and 92.7% were housewives. The mean (SD) values of BMI and WC were 24.32 (4.08) kg/m^2 and 81.84 (9.25) cm, respectively. The prevalence of overweight (BMI = 25-29.9 kg/m^2) and obesity (BMI > 29.9 kg/m^2) was 27.6% and 8.8%, respectively. Abdominal obesity based on WC was found in 34.8% of the subjects. *Conclusion:* Findings of this study revealed obesity in over one third of nulliparous pregnant women during their first trimester. Moreover, the high prevalence of macrosomia, in these women confirmed the importance of maternal education about obesity-related complications in order to change their lifestyle and prevent obesity.

Introduction

Overweight has become one of the main health issues in the United States and other rich countries. It had also turned into an epidemic for a number of years. To be more precise, an epidemic is the widespread and transient increase in the severity and prevalence of a disease over a short period of time. However, obesity is in fact endemic and thus always exists. Being a worldwide issue, obesity is even found in third world countries. In addition to general negative consequences, the presence of this condition during pregnancy can impose danger on the fetus. Fetuses of obese women are prone to severe forms of pregnancy-related complications. Long term effects of obesity include significant increases in morbidity and mortality of mothers.[1] The most important direct causes of mortality in mothers, i.e. bleeding, infections, and preeclampsia,[2] are more prevalent in obese women.[3]

High levels of body mass index (BMI), which has been recommended by the World Health Organization to measure obesity, are related with risk factors of diseases. However, some studies have shown that the pattern of body fat distribution has a more determining role in identifying disease risk factors. Although people with excess abdominal fat

are suggested to be at a higher risk for diabetes, high blood pressure, and cardiovascular diseases, a single consensus has not be reached on abdominal obesity.[4] Furthermore, since BMI has limitations and is suitable for the measurement of total body fat,[5] waist circumference and waist to hip ratio are frequently used for identifying the distribution of body fat.[6] In comparison to other direct methods of abdominal fat measurement, such as magnetic resonance imaging (MRI), the two mentioned methods are not complicated and are easily applicable.[7] Nevertheless, the best obesity index to predict the risk of cardiovascular diseases is still controversial.[4] In women who are at a higher risk of cardiovascular diseases because of higher BMI, increased waist circumference will help the earlier diagnosis of cardiovascular diseases.[8] Higher waist circumference, i.e. abdominal obesity, has been found to be related with cardiovascular diseases and diabetes in many studies on non-pregnant women. A limited number of studies have been conducted on the correlation between waist circumference and pregnancy complications such as macrosomia.

Various findings have indicated the necessity of a screening program to identify high risk women, the potential impact of nutritional interventions, and implications of future research on pregnancy outcomes. There are a limited number of studies on the correlation of waist circumference and macrosomia, especially in pregnant women. Therefore, this research was conducted to evaluate the correlation between fetal macrosomia and obesity at the beginning of pregnancy, BMI, and waist circumference in pregnant women.

Materials and methods

This prospective study aimed to determine the status of anthropometric indices of pregnant mothers in their first trimester of pregnancy and its relation with macrosomia. The sample size was determined by statistical information from similar past studies and by using the formula of difference between two ratios.[9] Using quota sampling and considering the 60:40

ratio of health centers to health bases in Tabriz, Iran, health centers and bases were randomly selected with the same ratio. Due to the need for a large sample size in this study and the researchers' preference to include all samples, collecting subjects was considered as a long process. The first part of the study, i.e. sampling and measuring anthropometric indices, thus took 4 consecutive months. Finally, 1140 primiparous women at 6th-10th weeks of gestation who referred to health centers and bases of Tabriz were randomly selected. The inclusion criteria were the desire to participate in the study, having no underlying disease (heart, pulmonary, renal, neurological, or digestive diseases, diabetes, hypo- or hyperthyroidism, addiction, mental retardation, and physical abnormalities) according to the individuals own declaration, no past history of recurrent abortions and mole, no past history of operations on the uterus, referring to the health center in the first trimester of pregnancy (6th-10th weeks), no past history of giving birth (nulliparous), not suffering from hyperemesis gravidarum, and not having a special diet. The exclusion criteria were withdrawal from the study, disproportionate weight gain during pregnancy compared to the baseline BMI without having had gestational diabetes.

The average weight was calculated after three measurements without shoes and with light clothing using a Seca scale with an accuracy of 100 g. Height was measured without shoes by a wall-mounted measuring tape with an accuracy of 0.5 cm. BMI was then calculated by dividing weight (in kg) to height squared (in m²) and recorded in a checklist. Waist circumference values measured by a flexible anthropometric measuring with an accuracy of 0.5 cm were also recorded in the checklist. All measurements in this study were performed and recorded by the same trained researcher. The validity of the checklist was confirmed by feedbacks from professors with expertise in the subject, and by applying their corrections and comments. According to the WHO classification, low, healthy, and high weights were determined as BMI < 18.5 kg/m², 18.5-24.9 kg/m², and 25-29.9 kg/m², respective-

ly. BMI > 30 kg/m² and a waist circumference of 88 cm and higher were defined as obesity. Newborns with a weight of higher than 4 kg were considered to be macrosomic. The macrosomia of newborns was recorded in the checklist by considering their birth records which were provided by the mothers. Moreover, the weight of the mothers was monitored during pregnancy and women with disproportionate weight gain were excluded from the study.

Data was analyzed using SPSS₁₅. Mean values of anthropometric indices of women with and without a macrosomic newborn were compared by independent sample t-test. All participants provided written consents after they were explained about the whole study procedure. In addition, they were allowed to withdraw from the study at any time they wished.

Results

In the current study, 95% of women had no past history of pregnancy and abortion. The majority of pregnancies were planned with prenatal care. In addition, 3.6% of the mothers had taken folic acid before pregnancy. While 77.5% of women aged 20-35 years, 21.4% were under the age of 20. Moreover, 1057 women (92.6%) were housewives, 652 (57.2%) did not have high school diploma. The mean (SD) values of BMI and waist circumference were 24.32 (4.08) kg/m² and 81.84 (9.25) cm, respectively (Table 1). Based on BMI, the prevalence of low weight, healthy weight, overweight, and obesity were 6.2%, 57.4%, 27.6% and 8.8%, respectively (Figure 1). The prevalence of abdominal obesity, based on waist circumference, was 34.8% (Figure 2). Fetal macrosomia was significantly more prevalent among women whose BMI and waist circumference indicated obesity (Table 2).

Table 1. Anthropometric indices in pregnant women during their first trimester

Anthropometric indices	Mean (SD)	95% CI
Weight (kg)	62.27 (0.35)	61.58-62.95
Height (cm)	0.15 (159.76)	159.46-170.05
BMI (kg/m2)	0.12 (24.32)	24.19-24.43
Waist circumference (cm)	81.84 (0.35)	81.15-82.52

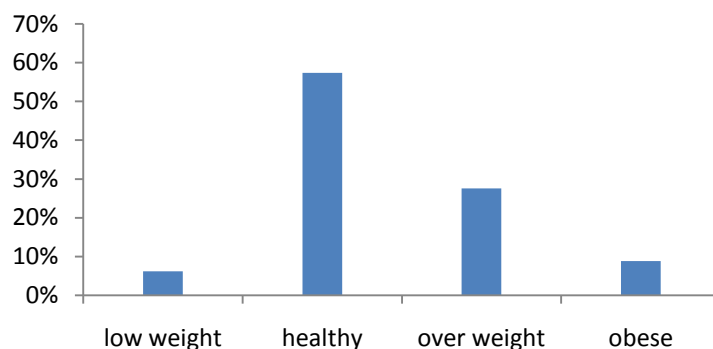**Figure 1.** Body mass index (BMI) of women during their first trimester of pregnancy
(BMI < 18.5 kg/m2, 18.5-24.9 kg/m2, 25-29.9 kg/m2, and ≥ 30 kg/m2 indicated low weight, healthy weight, overweight, and obesity, respectively.)
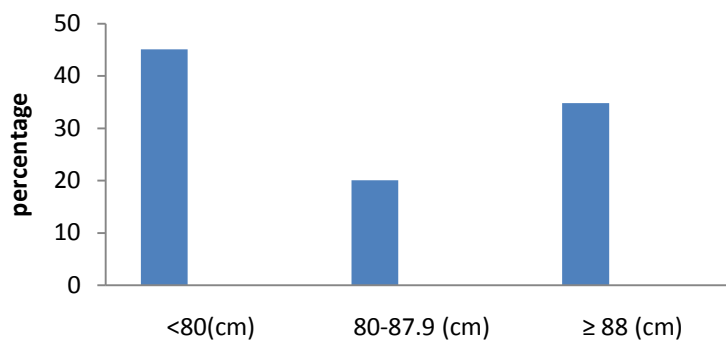
Figure 2. Waist circumference (WC) of women during their first trimester of pregnancy (WC < 80 cm, 80-88 cm, and ≥ 88 cm indicated healthy weight, at risk of obesity, and obesity, respectively.)

Table 2. Anthropometric indices of women with and without a macrosomic fetus

		Body mass index (kg/m2)	Waist circumference (cm)
Macrosomia	Yes	28.28 (1.10)	90.05 (1.50)
	No	24.34 (0.13)	82.14 (0.30)
P*		0.0001	0.0001

Values are expressed as mean (SD); * Independent sample t-test

Discussion

The findings of this study indicated obesity to be prevalent in pregnant women during their first trimester in Tabriz, Iran. Based on BMI, the prevalence of overweight and obesity were 27.6% and 8.8%, respectively. On the other hand, the calculated waist circumference values showed abdominal obesity in 34.8% of the subjects. The findings of the current study revealed a significant increase in the prevalence of fetal macrosomia among women whose BMI and waist circumference were in the obese range. Wendland et al. reported similar results.[10]

The findings of the current study suggested that waist circumference is the best and simplest anthropometric index for determining obesity. Other researchers have also introduced waist circumference as the best anthropometric index for screening the risk factors of cardiovascular diseases in the society. Zhu et al. studied 9019 American men and women and showed waist circumference to provide more information on risk factors of cardiovascular diseases in comparison to BMI.[11] Janssen et al. evaluated the associations between obesity-related factors, such as hypertension, lipid disorders, and metabolic syndrome, and obesity indices in 14924 adults. Their results showed waist circumference, but not BMI, to be illustrative of risk factors related to obesity.[12] Other studies on the obesity of mothers based on BMI suggested a significant correlation between high BMI of mothers and the risk of fetal macrosomia.[12-17]

A study in 2008 on 51506 pregnant women showed a high prevalence of fetal macrosomia in obese women (24.8%) in comparison to women with healthy BMI.[18] Moreover, in a retrospective study, Kerrigan and Kingdon found the prevalence of obesity among 8176 women who had given birth to be 17.7%. They also reported obesity to be correlated with pregnancy complications such as fetal macrosomia and thus highlighted the necessity of more attention of caretakers to the weight of mothers.[19] In a similar retrospective cohort study in Saudi Arabia, El-Gilany and Hammad showed that even with more care and attention to obese pregnant women before pregnancy, there was an increase in the unfavorable results of their pregnancy and labor.[20] Several studies have noted the increased risk of pregnancy complications in mothers and fetuses, especially fetal macrosomia, because of obesity and high BMI of the mother during pregnancy. The resulting high morbidity and mortality in mothers and fetuses underlines the importance of increasing the knowledge of mothers in this respect.[21-24] The current study also confirmed the significant

correlation between high BMI of mothers and fetal macrosomia. Moreover, a significant statistical correlation was found between abdominal obesity of the pregnant mother and fetal macrosomia, which was addressed by few studies. Therefore, it is believed that BMI and waist circumference have independent effects on obesity-related illnesses. Waist circumference is the simplest index because it only requires one measurement with a lower chance of error compared to other obesity indices. Among the other advantages of waist circumference over other anthropometric indices, the most important is its ease of use and interpretation in clinical conditions.

Conclusion

Despite the undeniable importance of measurements before pregnancy, women are not accessible before they get pregnant. However, previous studies have suggested measurements during the early stages of pregnancy to be of the same value in evaluating obesity-related complications among overweight or obese women. A limitation of this study was assessing the anthropometric indices during the first trimester of pregnancy. On the other hand, the retrospective method of the study, in which mothers were observed closely during their pregnancy, was an advantage of the study. The current study, which was undertaken with the aim of studying different anthropometric indices during the first trimester of the pregnancy, showed a prevalence of general and abdominal obesity in more than one third of pregnant women during their first trimester in Tabriz. Considering the high prevalence of obesity in pregnant women in this study, raising knowledge on the adverse consequences of general and abdominal obesity during pregnancy in women can be an effective and preventive measure. It can be concluded that waist circumference is also a better indicator for screening of obesity, which is a risk factor for other complications in pregnant women. Assessment of this index would thus be essen-tial in routine clinical examinations of pregnant women.

Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

Acknowledgments

References

1. Cunningham FG, Williams JW, Leveno KJ, Bloom S, Hauth JC. Williams Obstetrics. 22nd ed. New York: McGraw-Hill; 2006, 1082-84p.
2. UNICEF. Media Center. Maternal mortality [Online]. 2008 [Cited 2008 Mar 7]. Available from: http://www.unicef.org/iran/fa/media_4464.html
3. Wataba K, Mizutani T, Wasada K, Morine M, Sugiyama T, Suehara N. Impact of prepregnant body mass index and maternal weight gain on the risk of pregnancy complications in Japanese women. Acta Obstet Gynecol Scand 2006; 85(3): 269-76.
4. Esmailzadeh E, Azad Bakht L. Anthropometric assessment to predict hypertension among women in Tehran, Iran. TUMJ 2008; 66(6): 413-20 [Persian].
5. Lean ME, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. BMJ 1995; 311(6998): 158-61.
6. Mahan LK, Stump SE. Krause's Food & Nutrition Therapy. 12th ed. Philadelphia: Saunders/Elsevier; 2008. 398-402 p.
7. Janssen I, Katzmarzyk PT, Ross R. Waist circumference and not body mass index explains obesity-related health risk. Am J Clin Nutr 2004; 79(3): 379-84.
8. Ardern CI, Katzmarzyk PT, Janssen I, Ross R. Discrimination of health risk by combined body mass index and waist circumference. Obes Res 2003; 11(1): 135-42.
9. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering

singleton babies. BMC Public Health 2007; 7: 168.

10. Wendland EM, Duncan BB, Mengue SS, Nucci LB, Schmidt MI. Waist circumference in the prediction of obesity-related adverse pregnancy outcomes. Cad Saude Publica 2007; 23(2): 391-8.

11. Zhu S, Wang Z, Heshka S, Heo M, Faith MS, Heymsfield SB. Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. Am J Clin Nutr 2002; 76(4): 743-9.

12. Janssen I, Katzmarzyk PT, Ross R. Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. Arch Intern Med 2002; 162(18): 2074-9.

13. Mazumder U, Sarker S, Riaz BK, Chowdhury TA. Maternal over weight and obesity: its effect on pregnancy outcome. Mymensingh Med J 2011; 20(2): 213-8.

14. Norman JE, Reynolds RM. The consequences of obesity and excess weight gain in pregnancy. Proc Nutr Soc 2011; 70(4): 450-6.

15. Mandal D, Manda S, Rakshi A, Dey RP, Biswas SC, Banerjee A. Maternal obesity and pregnancy outcome: a prospective analysis. J Assoc Physicians India 2011; 59: 486-9.

16. Ovesen P, Rasmussen S, Kesmodel U. Effect of pre-pregnancy maternal overweight and obesity on pregnancy outcome. Obstet Gynecol 2011; 118(2 Pt 1): 305-12.

17. Dodd JM, Grivell RM, Nguyen AM, Chan A, Robinson JS. Maternal and perinatal health outcomes by body mass index category. Aust N Z J Obstet Gynaecol 2011; 51(2): 136-40.

18. Voigt M, Straube S, Zygmunt M, Krafczyk B, Schneider KT, Briese V. Obesity and pregnancy:a risk profile. Z Geburtshilfe Neonatol 2008; 212(6): 201-5.

19. Kerrigan AM, Kingdon C. Maternal obesity and pregnancy: a retrospective study. Midwifery 2010; 26(1): 138-46.

20. El-Gilany AH, Hammad S. Body mass index and obstetric outcomes in pregnant in Saudi Arabia: a prospective cohort study. Ann Saudi Med 2010; 30(5): 376-80.

21. Narchi H, Skinner A. Overweight and obesity in pregnancy do not adversely affect neonatal outcomes: new evidence. J Obstet Gynaecol 2010; 30(7): 679-86.

22. Tsoi E, Shaikh H, Robinson S, Teoh TG. Obesity in pregnancy: a major healthcare issue. Postgrad Med J 2010; 86(1020): 617-23.

23. Sirimi N, Goulis DG. Obesity in pregnancy. Hormones (Athens) 2010; 9(4): 299-306.

24. Salihu HM, Weldeselasse HE, Rao K, Marty PJ, Whiteman VE. The impact of obesity on maternal morbidity and feto-infant outcomes among macrosomic infants. J Matern Fetal Neonatal Med 2011; 24(9): 1088-94.