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MATERNAL-FETAL MEDICINE

# Could maternal pre-pregnancy body mass index affect Apgar score?

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**Abstract**
*Objective* Obesity is one of global health problems and maternal obesity may be associated with increase in risk of pregnancy complications and neonatal death. The purpose of this study was to evaluate the effect of maternal pre-pregnancy body mass index (BMI) on neonate Apgar score at minute 5.
*Methods* In a retrospective cohort study, Apgar score at minute 5 of all singleton term babies of nulliparous women whom were delivered in Shahid Sadoughi Hospital, Yazd, Iran, from 2007 to 2009 were evaluated. Body mass index (BMI: weight in kg/height in $m^2$) of the mothers were calculated and BMI less than 18.5, 18.5–24.9, 25–29.9 and more than 30 were considered underweight, normal, overweight and obesity, respectively. Neonatal Apgar score of 3–7 and less than three was considered as low and very low Apgar score, respectively.
*Results* Eighty-eight (2.8 %) women were underweight, 1,401 (44.9 %) normal weight, 1,389 (44.5 %) overweight and 242 (7.8 %) were obese. 477 (15.3 %) and 31(0.7 %) neonates had low and very low Apgar score, respectively at minute 5. Logistic regression analysis showed maternal overweight [in odd ratio of 3.7, 95 % CI 2.4–4.6] and obesity [in odd ratio of 13.4, 95 % CI 9.7–14.1] were risk factors of neonatal low Apgar score, but they had not any statistically significant effect on neonatal very low Apgar score.
*Conclusion* Maternal pre-pregnancy overweight should be more concerned to prevent complication of low Apgar score in their newborns.

**Keywords** Pre-pregnancy BMI · Nulliparous women · Apgar score · Newborn

## Introduction

Obesity is one of health problems and prevalence of woman obesity in reproductive age has increased [1].

Obesity in pregnancy might be associated with maternal complications such as increase in risk of pregnancy-induced hypertension, preeclampsia, gestational diabetes and cesarean delivery and also fetal and neonatal complications such as fetal growth abnormalities (macrosomia, intrauterine growth retardation), fetal death, cerebral palsy and other adverse neonatal and infancy outcomes [2, 3].

The Apgar score, which was introduced by Virginia Apgar in 1953, is evaluated at minutes 1 and 5, and is commonly used as a method to evaluate neonatal well-being immediately after birth and can be used as an indicator of asphyxia [4].

The Apgar score at minute 5 was shown to be more predictive of neonatal survival than at minute 1. Apgar score equal or more than seven from the total number of ten in neonate is seen as an indication of a normal condition and a three or less score is taken as a reason for specific concern [5–7].

Although, the Apgar score is not used to guide resuscitation or was not originally intended to predict long-term health outcomes, but it informs about prognosis beyond the

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neonatal period and is useful as a measure of the newborn's overall status and response to resuscitation [8].

It should be noted that it has been known for some time that a low Apgar score of 0–3 for a prolonged period of time is predictive of subsequent disability. Recent studies have shown that even transiently low Apgar score is associated with lower intelligent quotient in later life [9].

According to Moster et al. [10] study, low Apgar score was strongly associated with death and CP and the Apgar score remains important for early detection of infants at increased risk of serious and fatal conditions.

Influence of some maternal biologic factors such as age, parity and body mass index (BMI) on the neonatal Apgar score at the minute 5 has been evaluated in Straube and Kashanian studies [11, 12].

Since, the Apgar score is an important indicator of subsequent outcomes, determination of factors that might be associated with low Apgar score is of clinical interest to predict serious conditions and planning of appropriate neonatal care.

The purpose of this study was to evaluate the effect of maternal pre-pregnancy body mass index (BMI) on neonate Apgar score at minute 5.

## Methods

In a retrospective cohort study, Apgar score at minute 1 and 5 of all singleton term babies of nulliparous women whom were delivered in maternity Shahid Sadoughi Hospital, Yazd, Iran, from 2007 to 2009, were evaluated.

Annually, about 2,400 deliveries were done in this hospital. Sample size based on Z formula and confidence interval of 95 % with 80 % power to detect a significant difference between the two groups with a level of 0.05, was assessed in 3,000 mothers .

Neonatal Apgar score at minute 1 and 5 in neonates was assessed and score of 3–7 and less than three was considered as low and very low Apgar score, respectively. The Apgar score is determined by evaluating the newborn baby on five simple criteria on a scale from 0 to 2, then summing up the five values thus obtained. The resulting Apgar score ranges from zero to 10. The five criteria are summarized using words chosen to form an acronym (appearance, pulse, grimace, activity, and respiration). Apgar was scored by a first-year pediatrics resident.

Maternal data were obtained from self-reported information on pre-pregnancy weight.

(At the beginning of the pregnancy in the first visit) and height and prenatal care records database during the first visit. Body mass index (BMI: weight in kg/height in $m^2$) of the mothers were calculated and BMI of less than 18.5, 18.5–24.9, 25–29.9 and more than 30 were considered underweight, normal, overweight and obesity, respectively, based on the world health organization classification [13].

Eligible participants included mothers who remembered their pre-pregnancy weight and height and had a singleton and cephalic presentation fetus and term (38–40 weeks of gestation) pregnancy.

Under 18 years or more than 35 years old women, inappropriate pelvic in the first pelvic examination, those who used sedative or regional anesthesia during labor, those who had known maternal disease (diabetes mellitus, hypertension, cardiopulmonary disorders), who smoked during pregnancy, polyhydramnios, prolonged premature rupture of membrane, elective cesarean section, placenta previa, cord prolapsed, neonates with known neonatal disorders which can change the Apgar score (neural, pulmonary, cardiac disorders and with major congenital malformations, chromosomal abnormalities and genetic syndromes) and multiple pregnancies were excluded.

The data were analyzed using SPSS 15 statistical software. Chi-square test or Fisher exact test were used for data analysis of qualitative variables and mean values were compared using ANOVA.

Multinomial regression was used to examine low and very low neonatal Apgar score at minute 5 after adjustment for individual risk factors of maternal overweight and obesity. Differences were considered significant at $P$ values of less than 0.05.

This study has been approved by the ethics committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran, and all the participants gave a written informed consent. The survey results were kept confidential.

## Results

Finally, 3,120 mothers with singleton pregnancies and available pre-pregnancy BMI with mean age 28.1 ± 3.4 years were evaluated. Eighty-eight (2.8 %) women were underweight, 1,401 (44.9 %) normal weight, 1,389 (44.5 %) overweight and 242 (7.8 %) were obese. Comparison of some maternal and neonatal characteristics based on maternal pre- pregnancy BMI is shown in Table 1, which indicates that mean of mother age, gestational age and pregnancy weight gain, mother employment status and neonatal sex were not statistically significant different in various types of BMI.

Four hundred and seventy-seven (15.3 %) and 31 (0.7 %) neonates had low and very low Apgar scores at minute 5, respectively. Comparison of neonatal Apgar scores at minute 1 based on maternal pre- pregnancy BMI with Chi-square test are presented in Table 2, which indicates that the frequency of low neonatal Apgar score is not significantly different in various BMI.

**Table 1** Comparison of some of maternal and neonatal characteristics based on maternal pre- pregnancy BMI

| BMI | <18.5 | 18.5–24.9 | 25–29.9 | >30 | *P* value |
|---|---|---|---|---|---|
| Maternal age in year: mean ± SD | 28.2 ± 7.4 | 29.1 ± 5.5 | 28.1 ± 4.8 | 27.9 ± 4.6 | 0.3 |
| Gestational age in week: mean ± SD | 38.9 ± 1.2 | 38.7 ± 1.7 | 38.5 ± 0.9 | 38.6 ± 1.5 | 0.2 |
| Mother employment | | | | | |
| Yes [*N*(%)] | 52 (59.1) | 649 (49.50) | 625 (45) | 102 (42.1) | 0.08 |
| No [*N*(%)] | 36 (40.9) | 707 (50.5) | 764 (55) | 145 (57.9) | |
| Neonatal sex | | | | | |
| Girl [*N*(%)] | 40 (45.5) | 720 (51.4) | 673 (48.5) | 131 (54.1) | 0.09 |
| Boy [*N*(%)] | 48 (54.5) | 681 (48.6) | 716 (51.5) | 111 (45.9) | |
| Pregnancy weight gain in kg: mean ± SD | 6.8 ± 1.3 | 6.2 ± 1.4 | 7.3 ± 0.9 | 7.5 ± 1.1 | 0.1 |

**Table 2** Comparison of neonatal Apgar score at minute 1 based on maternal pre- pregnancy BMI

| BMI<br>Apgar score | <18.5<br>[*N* (%)] | 18.5–24.9<br>[*N* (%)] | 25–29.9<br>[*N* (%)] | >30<br>[*N* (%)] | Total | *P* value |
|---|---|---|---|---|---|---|
| >7 or normal Apgar score | 61 (69.3) | 1,242 (88.7) | 1,215 (87.5) | 144 (59.5 %) | 2,662 | 0.4 |
| 3–7 or low Apgar score | 20 (22.7) | 145 (10.3) | 163 (11.7) | 95 (39.3) | 423 | 0.06 |
| <3 or very low Apgar score | 7 (8) | 14 (1) | 11 (0.8) | 3 (1.2) | 35 | 0.06 |
| Total | 88 (100) | | | | 3,120 | – |

**Table 3** Comparison of neonatal Apgar score at minute 5 based on maternal pre- pregnancy BMI

| BMI<br>Apgar score | <18.5<br>[*N*(%)] | 18.5–24.9<br>[*N*(%)] | 25–29.9<br>[*N*(%)] | >30<br>[*N*(%)] | Total | *P* value |
|---|---|---|---|---|---|---|
| >7 or normal Apgar score | 68 (77.3) | 1,307 (93.2) | 1,118 (80.5) | 129 (53.3) | 2,622 | 0.09 |
| 3–7 or low Apgar score | 19 (21.6) | 84 (6) | 263 (18.9) | 111 (45.9) | 477 | 0.05 |
| <3 or very low Apgar score | 1 (1.1) | 10 (0.7) | 8 (0.6) | 2 (0.8) | 21 | 0.3 |

Table 3 shows that the 5-min Apgar score is significantly influenced by maternal BMI. Compared with newborns of normal weight mothers, low Apgar score were higher in other groups.

However, the risk of low Apgar score was increased in newborns of underweight mothers, but did not achieve significant.

## Discussion

The present study has evaluated the effect of maternal pre-pregnancy BMI on neonatal Apgar score at minutes 1 and 5.

The Apgar score is a useful and fast screening instrument for prediction of primary and secondary neonatal outcomes and neonates with Apgar score at minute 5 of less than three, had increased risk for neonatal death and CP. A low Apgar score at minute 1 might be caused by a temporary depression and Apgar score at minute 5 was shown to be more predictive of survival than the 1-min score [10].

In this study, 44.5 and 7.8 % of women were overweight and obese, respectively, before they became pregnant which is higher than that of Baron et al. [14] study with incidence of obesity of 23 %.

In this study, maternal overweight and obesity were risk factors of low Apgar score at minute 5 in their neonates, which is in compliance with other studies that found maternal obesity has significantly increased the risk of low neonatal Apgar score [11, 14, 15]. However in Baron et al. [14] study, low Apgar score and other poor outcomes were more frequent in neonates of mothers who had BMI of more than 35. However, in a population-based study of Usha Kiran et al. [16], frequency of 5 min less than 7 Apgar score was not significantly different in obese and normal weight women and also, in Danish study, no significant differences in neonatal Apgar score were seen in normal weight, overweight and obese women [17].

Possible explanations for these discrepancies are differences in race, sample size, selected number of BMI and timing of assessment of Apgar score (minute 1 or 5).

The limitation of this study was self-reporting pre-pregnancy weight and height of pregnant women, which may not always be accurate. However, another study has reported an overall correlation coefficient of 0.99 between self-reported and measured pre-pregnancy weight and has concluded that self-reported weight reflected the actual weight [18].

In conclusion, health care providers should be concerned about the potential maternal and fetal complications of pregnancy in overweight and obese woman and for better neonatal outcome in their newborns and reducing of infant morbidity and mortality, it is recommended that obese and overweight women should be treated to normalize their BMI prior to pregnancy.

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**Conflict of interest** None.

## References

1. Azarbad L, Gonder-Frederick L (2010) Obesity in women. Psychiatr Clin North Am 33(2):423–440
2. Brockelsby J, Dresner M (2006) Obesity and pregnancy. Curr Anaesth Crit Care 17(3–4):125–129
3. Kumari AS (2001) Pregnancy outcome in women with morbid obesity. Int J Gynecol Obstet 73(2):101–107
4. Sykes GS, Johnson P (1982) Indicate asphyxia? Lancet 319(8270):494–496
5. Moster D, Lie RT, Irgens LM, T. Bjerkedal, Markestad T, The association of Apgar score, Ashworth F, Molloy PM, Gu W, Stirrat GM, Turnbull AC (2001) Do Apgar Score with subsequent death and cerebral palsy: a population-based study in term infants. J Pediatr 138:798–803
6. Casey BM, McIntire DD, Leveno KJ (2001) The continuing value of the Apgar score for the assessment of newborn infants. N Engl J Med 344:467–471
7. Ramji S, Rasaily R, Mishra PK, Narang A, Jayam S, Kapoor AN (2003) Resuscitation of asphyxiated newborns with room air or 100 % oxygen at birth: a multicentric clinical trial. Indian Pediatr 40:510–517
8. Elk Grove V (2007) Guidelines for perinatal care, 6th edn. American Academy of Pediatrics and American College of Obstetricians, IL
9. Odd DE, Rasmussen F, Gunnell D (2008) A cohort study of low Apgar score and cognitive outcomes. Arch Dis Child Fetal Neonatal 93:F115–F120
10. Moster D, Lie RT, Irgens LM, Bjerkedal T, Markestad T (2001) The association of Apgar score with subsequent death and cerebral palsy: a population-based study in term infants. J Pediatr 138(6):798–803
11. Straube S, Voigt M, Jorch G, Hallier E, Briese V, Borchardt U (2009) Investigation of the association of Apgar score with maternal socio-economic and biological factors: an analysis of German perinatal statistics. Arch Gynecol Obstet 282(2):135–141
12. Kashanian M, Dadkhah F, Baradaran HR, Bakoui F (2008) Evaluation of the relationship between high maternal weight and the duration of different stages of labor, delivery rout, neonatal weight and Apgar score. Obes Res Clin Pract 13(2):225–230
13. Physical status: the use and interpretation of anthropometry: report of a WHO Expert Committee. WHO Geneva 1995
14. Baron CM, Girling LG, Mathieson AL, Menticoglou SM, Seshia MM, Cheang MS, Mutch WA (2010) Obstetrical and neonatal outcomes in obese parturients. J Matern-Fet Neonatal Med 23(8):906–913
15. Chen M, McNiff C, Madan J, Goodman E, Davis JM, Dammann O (2010) Maternal obesity and neonatal Apgar score. J Matern Fet Neonatal Med 23(1):89–95
16. Usha Kiran TS, Hemmadi S, Bethel J (2005) Outcome of pregnancy in a woman with an increased body mass index. BJOG 112:768–772
17. Rode L, Nilas L, Wøjdemann K (2005) Obesity-related complications in Danish single cephalic term pregnancies. Obstet Gynecol 105:537–542
18. Oken E, Taveras EM, Kleinman KP, Rich-Edwards JW, Gillman MW (2007) Gestational weight gain and child adiposity at age 3 years. Am J Obstet Gynecol 96(4):322e1–322e8