Original Paper

The Association Between Pre-pregnancy Body Mass Index and Gestational Weight Gain on Pregnancy Outcomes: A Retrospective Cohort Study

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ABSTRACT

Introduction: Elevated pre-gestational body mass index (obese/overweight) and improper gestational weight gain are important risk factors for predicting adverse pregnancy outcomes.

Objective: We aimed to identify the association between pre-pregnancy body mass index (BMI) and gestational weight gain on birth outcomes.

Materials and Methods: Data from this retrospective cohort study were extracted from 1457 (out of 1800) pair health records belonging to the pregnant mother and infants at Ahvaz Iran health care centers from 2010 to 2018. Ten public health care centers were randomly selected from the headquarters west and east of Ahvaz City. The samples were selected based on the inclusion criteria. They divided into different groups based on BMI (underweight, normal, overweight, and obese) and gestational weight gain (GWG) groups (inadequate and excessive versus adequate). Pregnancy outcome was analyzed according to the GWG during pregnancy for each BMI group through multivariable multinomial logistic regression. Relationships between maternal BMI, GWG, and offspring weight were examined. The analysis of covariance (ANCOVA) was used with adjusting the baseline values. The risks for adverse birth weight outcomes in women with different pre-pregnancy BMIs and GWGs were tested using the multivariable multinomial logistic regression analysis.

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Results: The Mean±SD of maternal age was 28.36±5.60 years. The Mean±SD birth weight was 3271.37±486.57 g. About 4.5%, 89.3%, and 6.2% of newborns were low birth weight, normal weight, and macrosomia, respectively. Also, 46.4% of women had weight gain above the guidelines. The increased risk for large for gestational age in overweight mothers (odds ratio [OR] =3.18, 95%CI; 0.45-7.29, P=0.007) and an increased risk for small for gestational age in those mothers with gestational weight gain below the guidelines (OR=2.9, 95%CI; 1.16-7.45, P=0.02). An increased risk of large for gestational age, low birth weight, and macrosomia were observed in overweight mothers with gestational weight gain out of the guidelines. An increased association was found between the maternal pre-pregnancy BMI and fasting blood sugar in 24 to 28 weeks of gestation. Hence, hyperglycemia is related to the incidence of macrosomia (OR=3.58, 95%CI; 1.70-7.66, P=0.0001).

Conclusion: Managing maternal weight with respect to reproductive health care is required for all women in childbearing age (before and during pregnancy) to reduce the adverse pregnancy outcome.

Highlights

- Pre-gestational body mass index and gestational weight gain outside of the normal range are associated with increased risks for adverse birth weight.

- Gestational weight gain is a physiologic condition for maternal and fetal health.

- The early increased weight gain during pregnancy is associated with the progress of gestational diabetes mellitus.

Plain Language Summary

The global burden of overweight and obese pregnant women has increased in high-income and middle-income countries. Therefore, we aimed to determine the association between pre-pregnancy BMI and gestational weight gain on birth outcomes. Then, this retrospective cohort study was extracted from 1457 pair health records belonging to pregnant mothers and infants at Ahvaz health care centers, Ahvaz City, Iran. Overweight and obese mothers gained weight in the second trimester beyond the recommended range. An increased risk of large for gestational age, low birth weight, and macrosomia were observed in overweight mothers with gestational weight gain out of the guidelines. Likewise, hyperglycemia was associated with 3.58-fold increase in the incidence of macrosomia.

Introduction

Normal pre-pregnancy body mass index (BMI) and maternal gestational weight gain (GWG) can have positive effects on birth and maternal outcomes [1]. According to The World Health Organization (WHO), the prevalence of overweight and obesity is increasing in all age groups worldwide, and it is related to non-communicable diseases [2]. The global burden of overweight and obese pregnant women has increased in high-income and middle-income countries. Additionally, Iran was considered one of the 20 high overweight burden countries [3].

The pre-pregnancy BMI and GWG below or above the Institute of Medicine (IOM) guidelines are considered two effective factors in pregnancy outcomes [1]. The prevalence of the adverse effects was reported as 37.2% in pregnant women and 34.7% and 61.1% among underweight and obese (grade 3) women, respectively. Adverse maternal and infant outcomes were affected by maternal pre-pregnancy BMI more than incremental gestational weight gain [4].

A meta-analysis reports that a low GWG is positively related to Small for gestational age (SGA) and preterm birth and lower risk for large for gestational age (LGA) and macrosomia. Also, a higher risk for LGA, macrosomia, and cesarean delivery has been found in excessive GWG [5]. Excessive GWG can result in adverse maternal outcomes such as cesarean delivery, gestational diabetes mellitus (GDM), preeclampsia, and postnatal weight retention [6]. In 2009, IOM recommended the mean and range for the incremental weight gain during the second and third trimesters in relation to the pre-pregnancy BMI class [7]. Despite the importance of adequate total GWG, excessive GWG before 20 weeks was associated with a higher risk of LGA, regardless of total GWG [8]. Also, early excessive GWG can lead to a higher prevalence of GDM, regardless of pre-pregnancy BMI [9]. Several epidemiological studies have provided evidence from different regions of Iran in terms of the role of GWG and pre-pregnancy BMI and adverse pregnancy outcomes. Hence, low birth weight (LBW) is more prevalent in women with GWG less than the recommended weight gain by IOM. Also, macrosomia is reported in women with GWG higher than the guideline [10, 11]. In addition, women with pre-pregnancy obesity are associated with macrosomic infants [12, 13]. The finding of different studies in various geographical areas highlight the importance of maternal pre-pregnancy BMI and GWG on pregnancy outcomes in Iran [10-15]. Therefore, this retrospective cohort study was conducted to determine the relationship between maternal pre-pregnancy BMI, GWG, and pregnancy outcomes.

Materials and Methods

Data from this retrospective cohort study were extracted using the pair health records of the pregnant mothers and infants from healthcare centers in Ahvaz City, Iran, from June 2010 to June 2018. Ten public healthcare centers were randomly selected through simple random sampling from the headquarters in the west and east of Ahvaz. During this period, the data were obtained from maternal-newborn health records. The subjects were selected based on the inclusion criteria.

In the current study, we did not include some gestational complications and diseases, like preeclampsia, diabetes type 2 or 1, preterm birth, asthma, and hypertension. Hence, we included gestational diabetes mellitus (GDM) without other complications and diseases.

The final sample size consisted of 1457 pair participants out of 1800 files based on GWG as the main variable with a Mean±SD value of 9.3±7.9, precision of 0.8, which is equivalent to 9% of the mean [16] and 99% test power, and confidence interval of 95%, 1794 equal to 1800 participants was considered. In the following, 78 pregnant women without measurements of their offspring were excluded. Also, 129 participants were excluded due to the presence of diabetes, severe hypertension, newborn congenital disease, anemia, preeclampsia, preterm birth, cancer history, and asthma. Moreover, 136 mothers had only health records for the third trimester.

The exclusion criteria were as follows: incomplete data for the mother during pregnancy and her offspring, multiple pregnancies, preeclampsia/ eclampsia, type 2 diabetes mellitus, severe hypertension history, offspring congenital disease, and preterm pregnancy. The extracted information included maternal characteristics, including age, pre-pregnancy weight and height, pre-pregnancy BMI, GWG, last delivery mode, pregnancy history consisting of GDM, lifestyle before and during pregnancy, alcohol consumption, and smoking, fasting blood sugar (FBS) in 24-28 week, (categorized into ≥ 92 and <92 according to International Association of Diabetes and Pregnancy Study Groups) [17], and offspring characteristics comprising of gender, birth weight, small for gestational age, large for gestational age, appropriate size for gestational age at birth, low birth weight, normal birth weight, and macrosomia.

SGA and LGA newborns were defined as those whose birth weights for gestational age were <10th and > 90th percentiles. Macrosomia and LBW were defined by a birth weight >4000 g and <2500 g, respectively [18].

Pre-pregnancy BMI and GWG categories were grouped in terms of the IOM recommendations. Some variables were calculated as per following: pre-pregnancy BMI (kg/m^2) by dividing pre-pregnancy self-reported body weight (kg) over square height (m^2) was measured at the first antenatal visit, incremental weight gain (g/wk.) through the difference between weight 2 and weight 1 (g) divided by weeks between weights [19].

The two trained research assistants comprehensively collected information from maternal antenatal documents. SPSS software, version 18.0 (SPSS, Inc, Chicago, Illinois, USA) was used for statistical analyses. P values less than 0.05 were considered statistically significant using the 2-tailed tests. The independent t test was used for univariate evaluation.

The analysis of covariance (ANCOVA) by adjusting the baseline values (maternal age, maternal pre-BMI, and infant birth weight) was performed to compare the GWG during the second and third trimesters with FBS. The risk for adverse birth weight outcomes (macrosomia, LBW, SGA, and LGA) in women with different pre-pregnancy BMIs and GWGs were tested using the multivariable multinomial logistic regression analysis to estimate adjusted odds ratios (aOR) and 95% confidence interval (95% CI). The association between maternal FBS level and macrosomia was performed through binary logistic regression.

Results

This study included 1457 pairs of the mother and offspring. The Mean±SD maternal age was 28.36±5.60 years. The increasing trend of pre-pregnancy BMI was observed along with the rising maternal age. Female gender was positively associated with LBW in pre-pregnancy normal-weight mothers (P=0.04). Also, 82.1%, 92.3%, and 94.9% of mothers regularly consumed their routine folic acid/multivitamin-mineral supplement in the first, second, and third trimesters, respectively. Underweight mothers gained inadequately in the second and third trimesters, while overweight and obese mothers gained beyond the IOM recommended range in the third trimester.

The frequency of maternal overweight and obesity was 56.8%. The proportion of underweight mothers was 3.5%. Also, 36.6% and 46.4% of mothers with GWG were below and above IOM guidelines, respectively. The normal and appropriate birth weights for gestational age were reported as 89.3% and 81%, respectively. Also, no preterm birth was registered in the present study. Moreover, the prevalence of LBW, SGA, LGA, and macrosomia were 4.5%, 10.1%, 9%, and 6.2%, respectively. Also, GWG above IOM guidelines was found at 56.3% and 51% in overweight and obese mothers, respectively. The prevalence of inadequate GWG and excessive weight gain in normal-weight mothers were 39.7% and 37.3%, respectively (Table 1).

The analysis of covariance (ANCOVA) exhibited that the FBS level ≥92 mg/dL was 9.4%. An association was found between maternal pre-pregnancy BMI and FBS level (P=0.0001). The increase in the prevalence rate of macrosomia was found at 11.9% and 5.6% in the mothers with FBS≥ and less than 92 mg/dL, respectively (P=0.004). The binary logistic regression showed that FBS ≥92 mg/dL was related to a higher incidence of macrosomia (OR=2.75, 95% CI; 1.43–5.25), especially with adjusted variables (pre-pregnancy BMI, maternal age, hemoglobin, delivery mode, and GWG in the second and third trimester) (aOR=3.58, 95% CI; 1.69–7.58). GWG during the second and third trimesters was higher in mothers with FBS ≥92 mg/dL compared to FBS less than 92 mg/dL (0.358 g/wk. vs. 0.235 g/wk., P=0.01).

The multivariable multinomial logistic regression model showed that overweight mothers were at increased risk of LGA, and mothers with GWG below the IOM guideline were at an increased risk for SGA compared to GWG within the IOM guideline (Table 2). The findings of the ANOVA test displayed that the birth weight increased (P=0.04) along with higher pre-pregnancy BMI (P=0.04) (Table 3).

The multivariable multinomial logistic regression model showed that GWG less than the IOM guidelines was associated with higher rates of SGA (OR=5.4, 95%CI; 1.02-28.4, P=0.04) for mothers with a pre-pregnancy normal BMI. For overweight mothers, GWG less than the IOM guidelines was associated with higher rates of macrosomia (OR=5.4, 95%CI; 2.73-32.7, P=0.001), LBW (OR=4.61, 95%CI; 2.91-8.53, P=0.0001), and LGA (OR=10.3, 95%CI; 7.84-54.01, P=0.001) compared with the overweight mothers with GWG within the IOM guidelines. In addition, for overweight mothers, GWG above the IOM guidelines was associated with higher risks of macrosomia (OR=13.3, 95%CI; 13.32-13.33, P=0.0001), LBW (OR=11.23, 95%CI; 11.22-11.25, P=0.0001), and LGA (OR=6.6, 95%CI; 2.6-32.1, P=0.0001) compared to the overweight mothers with GWG within the IOM guidelines (Table 4).

Discussion

The findings indicated an increased risk for LGA, LBW, and macrosomia in overweight mothers and an increased risk of SGA in mothers with GWG below IOM guidelines. The prevalence of macrosomia in the present study was higher than in the previous study reported in Iran [10-12]. Besides maternal pre-pregnancy BMI, excessive gestational weight gain is another critical point of view that needs more attention.

We found that women who were overweight or obese before pregnancy and had excessive gestational weight gain showed a three-fold increase in the risk of adverse outcomes. The mean GWG was similar to the IOM recommendations in normal BMI mothers during the second trimester of pregnancy and differed from IOM guidelines in other groups of pre-gestational BMI during mid or late pregnancy. Women with overweight/obesity in the third trimester tend to have gestational weight gain within the guideline range of IOM. This finding might be likely due to receiving more counseling from health personnel in health centers about the impact of excessive weight gain and pregnancy outcome, so they behaved wisely during the rest of the pregnancy period. Similarly, previous studies [20, 21] report that higher

Table 1. Characteristics of the studied sample of mothers (n=1457)

Variables		Mean±SD/No. (%)	
Maternal age (y)		28.36±5.60	
Pre-pregnancy BMI* (kg/m²)	<18.5	43(3.5)	
	18.5-24.9	491(39.7)	
	25-29.9	459(37.2)	
	>30	242(19.6)	
GWG based on IOM guidelines	Below	452(36.6)	
	Within	210(17)	
	Above	573(46.4)	
Last delivery mode	Cesarean	557(47.2)	
	Vaginal	622(52.8)	
Gestational diabetes mellitus		43(3.5)	
Variables		**Incremental GWG (kg/wk.)**	
		Second Trimester	**Third Trimester**
Pre-pregnancy BMI (kg/m²)	Underweight	0.46±0.243	0.43±0.643
	Normal	0.37±0.408	0.37±0.553
	Overweight	0.38±0.336	0.32±0.561
	Obesity	0.29±0.340	0.22±0.616
FBS	<92 (mg/dL)	1305(90.6)	
	≥92 (mg/dL)	135(9.4)	
First-trimester supplement intake	Yes	981(82.1)	
	No	214(17.9)	
Second-trimester supplement intake	Yes	1105(92.3)	
	No	92(7.7)	
Third-trimester supplement intake	Yes	987(94.9)	
	No	53(5.1	

Abbreviation: BMI, body mass index; GWG, gestational weight gain; IOM, Institute of Medicine; FBS, fasting blood sugar

BMI contributes to excessive GWG. Furthermore, due to the low number of underweight mothers, it was impossible to make an association between GWG, pre-pregnancy BMI, and birth weight status. In normal-weight mothers, a high risk of SGA was significantly associated with inadequate GWG. In agreement with the previous studies, an increased risk of LGA [22, 23], LBW [24], and macrosomia [24, 25] was observed in overweight mothers with GWG outside guidelines, significantly.

The exact mechanisms of the relationships between maternal obesity and low or excessive birth weight of an offspring are unknown. Besides genetic susceptibility, placental functions and maternal nutritional status are the main indicators of fetal growth [26-28]. Placen-

Table 2. Adverse birth weight outcomes associated with maternal pre-pregnancy BMI and gestational weight gain according to institute of medicine guidelines

	Variables	Macrosomia OR 95% CI (Lower-Upper)	P*	LBW OR 95% CI (Lower-Upper)	P*	LGA OR 95% CI (Lower-Upper)	P*	SGA OR 95% CI (Lower-Upper)	P*
Pre-pregnancy BMI	Normal	1		1		1		1	
	Underweight	0.42 0.05 – 3.68	0.43	1.58 0.39 – 6.33	0.51	0.21 0.02 – 1.74	0.14	1.27 0.3 – 4.95	0.78
	Overweight	0.52 0.199- 1.38	0.19	1.93 0.51 – 7.38	0.33	3.18 1.45 – 7.29	0.007	1.26 0.56-2.82	0.56
	Obese	0.77 0.31 – 1.89	0.56	1.63 0.71- 5.69	0.45	1.1 0.85 – 1.4	0.12	1.21 0.54 – 2.7	0.63
Gestational weight gain	Within IOM guideline	1		1		1		1	
	Below IOM guideline	0.47 0.125–1.79	0.88	3.17 0.77–3.14	0.11	1.11 0.4–3.07	0.83	2.9 1.16– 7.45	0.02
	Above IOM guideline	1.09 0.33 – 3.57	0.27	0.855 0.16–4.51	0.85	0.46 0.14–1.45	0.18	1.7 0.77–4.19	0.17

*Multivariable multinomial logistic regression was applied, and data were presented as OR (95% CI) adjusted for gestational weight gain during trimesters 2 and 3, maternal age, gravity, maternal fasting blood sugar, delivery mode, and infant gender.

Abbreviations: BMI, body mass index; LBW, low birth weight; SGA, small for gestational age; LGA, large for gestational age; IOM, Institute of Medicine; OR, odds ratio

tal malfunction is associated with developing LBW and fetal growth restriction [29].

The prevalence of GWG above the IOM recommendations is more common than the below one, which agrees with the results reported by Power et al. [21]. In our study, 46.4% of mothers had weight gain greater than the guideline IOM recommendation. Also, a recent systematic meta-analysis reported 47% GWG above guidelines [5]. Inadequate GWG is related to a high risk of SGA and LBW, consistent with a longitudinal cohort

Table 3. The association between birth weight with pre-pregnancy BMI and gestational weight gain according to the institute of medicine guidelines

Variables		Birth Weight (Mean±SD)
Pre-pregnancy BMI	Underweight	3194.28±398.16
	Normal	3244.54±479.2
	Overweight	3265.13±499.39
	Obese	3346.59±508.13
	P*	0.04
GWG	Below IOM guideline	3265.90±496.13
	Within IOM guideline	3246.31±445.38
	Above IOM guideline	3282.74±503.37
	P*	0.64

*ANOVA test

Abbreviations: GWG, gestational weight gain; IOM, Institute of Medicine; BMI, body mass index

Table 4. Birth weight associated with gestational weight gain according to institute of medicine (IOM) guidelines in women with pre-pregnancy BMI

Maternal BMI	Outcome	No. (%)			Below VS Within Adjusted OR (95% CI) [b] (Lower-Upper)	P*	Above VS Within Adjusted OR (95% CI) [b] (Lower-Upper)	P*
		Below IOM Guidelines [a]	Within IOM Guidelines [a]	Above IOM Guidelines [a]				
Under weight	Normal birth weight	0	0	0	-	-	-	-
	Macrosomia	1(4.8)	0	0	-	-	-	-
	LBW	20(95.2)	12(100)	9(100)		-	-	-
	AGA	17(81)	2(16.7)	0	-	-	-	-
	SGA	2(9.5)	10(83.3)	9(100)	-	-	-	-
	LGA	2(9.5)	0	0		-	-	-
Normal weight	Normal birth weight	13(6.7)	14(12.5)	6(3.3)	1		1	
	Macrosomia	8(4.1)	4(3.6)	13(7.2)	1.204 0.138–0.48	0.86	0.845 0.105–6.804	0.87
	LBW	174(89.2)	105(93.8)	162(89.5)	5.98 0.504–0.96	0.15	0.351 0.016-7.925	0.51
	AGA	27(13.8)	13(9.0)	14(12.5)	1		1	
	SGA	156(80)	117(81.3)	94(83.9)	5.4 1.02–28.4	0.04	0.418 0.096–1.818	0.24
	LGA	12(6.2)	14(9.7)	4(3.6)	0.665 0.084–5.24	0.69	2.48 0.348–17.72	0.36
Over weight	Normal birth weight	6(4.2)	2(3.6)	13(5.1)	1		1	
	Macrosomia	10(6.9)	3(5.5)	17(6.6)	10.3 7.84–54.01	0.001	13.3 13.327–13.33	0.0001
	LBW	128(88.9)	50(90.9)	227(88.3)	5.4 2.73–32.7	0.001	11.23 11.22–11.25	0.0001
	AGA	3(9)	5(9.1)	25(9.7)	1		1	
	SGA	117(85.5)	47(85.5)	205(79.8)	2.19 0.38–12.67	0.38	1.415 0.254–7.88	0.69
	LGA	14(9.7)	3(5.5)	27(10.5)	4.61 2.91–8.53	0.0001	6.6 2.6–32.1	0.0001
Obesity	Normal birth weight	2(2.3)	1(3.4)	6(4.9)	1		1	
	Macrosomia	10(11.4)	3(10.3)	6(4.9)	0.605 0.34-10.74	0.73	4.01 0.24–65.02	0.33
	LBW	76(86.4)	25(86.2)	110(90.2)	1.2 0.21-80.6	0.9	0.064 0.0001–19.02	0.34
	AGA	7(8)	5(17.2)	10(8.2)	1		1	
	SGA	70(79.5)	20(69)	98(80.3)	2.3 0.23-23.24	0.47	0.036 0.001–1.12	0.05
	LGA	11(12.5)	4(13.8)	14(11.5)	0.387 0.042–3.55	0.4	2.21 0.293–16.67	0.44

*Multivariable multinomial logistic regression analysis was applied, and [b] Data are presented as OR (95%CI). [a] Data are presented as No. (%).
Abbreviations: BMI, body mass index; LBW, low birth weight; SGA, small for gestational age; LGA, large for gestational age; IOM, Institute of Medicine; OR, odds ratio

study in China [30] and Taiwan [31], and higher pre-gestational BMI increased risk for LGA and macrosomia are in agreement with other studies reported in overweight/obese mothers [32].

In our study, higher pre-BMI was associated with a higher risk of adverse birth weight. Likewise, Lima et al. [33] reported an increasing trend for birth weight across higher pre-pregnancy BMI.

Moreover, the prevalence of macrosomia (6.2%) was higher in Ahvaz than the mean of Iran (5.2%) [34] and lower than in a previous retrospective hospital-based (2007-2011) study conducted in Ahvaz, which was reported at 9% [13].

A recent meta-analysis found that childhood overweight/obesity could be attributed to maternal pre-pregnancy overweight [35]. Maternal pre-pregnancy obesity reflects maternal genetic susceptibility, nutritional status, fat accumulation, and inflammation, while gestational weight gain reflects fluid expansion and growth of the fetus, placenta, and uterus [36, 37].

In the present study, we attempted to have a large possible sample size from different healthcare centers to cover all ethnic groups together. However, the exact number of other ethnic groups is not included in maternal records. So, we could not explore ethnic differences in pre-pregnancy BMI, the prevalence of GWG below or outside IOM guidelines, and pregnancy outcomes.

In addition, pre-pregnancy weight was recorded from antenatal records, and it may be measured by health members or self-reported, leading to the risk of recall bias. However, they were valid for epidemiologic studies [38]. Moreover, in the current study, the IOM guideline was applied for GWG based on pre-pregnancy BMI. Furthermore, the recent meta-analysis [39] explored ethnic differences based on IOM guidelines and regional guidelines in maternal pre-pregnancy BMI and GWG on pregnancy outcomes across the USA, Western Europe, and East Asia. However, there were data restrictions from the Middle East. The IOM approaches are primarily based on US citizens and showed limited data on ethnic differences in associations between GWG and pregnancy outcomes, leading to heterogeneity and diminishing the chance of comparisons across regions. Asia is the most inhabitant of the world's population. Likewise, Asians are likely to have a higher percentage of adipose tissue, especially visceral adiposity, at lower BMI cut-off points than that stated by the WHO as standard cut-off points [40]. Therefore, establishing a new guideline and GWG recommendation for Asian populations is necessary for optimal risk reduction during pregnancy.

In the present study, the information related to socio-demographic and lifestyle characteristics (alcohol consumption and smoking) was unreliable due to social beliefs.

Based on the results, screening for overweight and obesity is an important preventive approach. It seems that along with all gestational monitoring and nutrition counseling, more educational programs in healthcare centers are vital. Consequently, the important results of this study were the association between a higher prevalence of maternal overweight, obesity, and excessive GWG.

Ethical Considerations

Compliance with ethical guidelines

This study was approved (Ethical Code: IR.AJUMS.REC1396.80) by the Research Deputy of Ahvaz Jundishapur University of Medical Sciences (AJUMS). All study procedures followed the principles of the Declaration of Helsinki.

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Authors' contributions

Conceptualization and supervision: Fatemeh Borazjani, Shokrollah Salmanzadeh, and Maryam Azhdari; Methodology: Fatemeh Borazjani and Kambiz Ahmadi Angali; Investigation, writing original draft and review: All Authors; Data collection: Parvin Shahri and Maryam Azhdari; Data analysis: Kambiz Ahmadi Angali; Funding acquisition and resources: Fatemeh Borazjani.

Conflict of interest

The authors declared no conflict of interest.

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