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THE IMPACT OF MATERNAL OBESITY ON MOTHER AND NEONATAL HEALTH: STUDY IN A TERTIARY HOSPITAL OF ASTANA, KAZAKHSTAN

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ABSTRACT

This study was aimed to investigate the impact of maternal obesity on mothers and their neonatal health. Our study population consisted of 157 women with completed singleton pregnancies, which included both obese (Body mass index, BMI≥30) and non-obese women (BMI<30). Data were collected from case histories, and ante- and postnatal records at the tertiary hospital in Astana, Kazakhstan between January and February of 2008. Associations between pregnancy and delivery-related complications, outcomes, and maternal obesity were estimated as odds ratios (ORs) and 95% confidence intervals (CIs) using a logistic regression model. Women aged 30 years or more were at higher risk of obesity (OR=3.1, 95% CI=0.8–11.6) than women less than 30 years old. Multiparous women were also at higher risk of obesity (OR=4.1, 95% CI=0.9–19.6) than primiparous ones. Obese women were also more likely to have longer hospital stays of more than 10 days (OR=2.2, 95% CI=0.8–6.2), and were more prone to eclampsia/pre-eclampsia (OR=24.7, 95% CI=2.2–44.8), cesarean sections (OR=2.1, 95% CI=0.7–6.2), and abnormal labor (OR=8.1, 95% CI=1.0–63.8) compared to non-obese women. Neonatal complications such as pneumonia (OR=3.4, 95% CI=0.6–20.2) and fetal macrosomia (OR=2.2, 95% CI=0.6–8.0) were also more common among babies born to obese mothers. Congenital baby birth defects were strongly associated with maternal obesity (*P*=0.016). We concluded that maternal obesity is associated with increased risks of both maternal and neonatal complications, and that such risks increase with advanced age and parity of the mother. Hence, medical practices must take these complications into account by ensuring an adaptable and early management in order to improve mothers and their neonatal health.

Key Words: BMI, Maternal obesity, Pregnancy and neonatal complications, Kazakhstan

INTRODUCTION

The World Health Organization (WHO) defines obesity as an abnormal or excessive fat accumulation that presents a risk to health, using the body mass index (BMI) ≥30 as a crude estimate.[1)] Obesity contributes to significant morbidity and mortality worldwide from several

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diseases, including heart disease, diabetes and cancer.[2] There are approximately 350 million obese people in the world. Overall, about 2.5 million deaths are attributed to it.[3] The WHO characterizes obesity as a pandemic issue, with a higher prevalence in females, especially those of child-bearing age, than in males.[4]

Obesity has emerged as a major health problem in both developed and developing countries. The Third National Health and Nutrition Examination Survey conducted in the USA showed that among American women aged 25 and above, 28% were overweight and 28% were obese.[5] A study conducted in England showed that 18% of adult women suffered from obesity.[6] A study in the United Arab Emirates determined that 40% of married women were obese.[7] Over the last several years the rising rate of obesity has become a major public health concern not only in the West but also among Asian populations.[8] In 1990, a study in Kazakhstan enrolling 25,107 subjects older than 15 years revealed an excessive BMI in 36.1%, among whom obesity was diagnosed in 23.7%.[9] The obesity incidence was increasing with age and was negatively associated with the level of physical activity.[9]

Pregnancy complications in obese women were identified as early as 1945.[10] Complications of obesity seriously affect the obstetric outcome of such women, endangering both maternal and fetal health and well-being. Chinese researchers estimate that increasing BMI is associated with increased risks of adverse obstetric outcomes, such as pre-eclampsia, gestational diabetes, and preterm delivery among Chinese.[11] Since then, a number of studies have reported a clear association between maternal obesity and adverse pregnancy and neonatal outcomes. In particular, obesity in pregnancy is associated with a high rate of preeclampsia, pregnancy-induced hypertension, gestational diabetes, abnormal labor, cesarean section, fetal macrosomia, lower respiratory tract infections, and infant birth defects.[2,12-15]

In Kazakhstan, obesity and its effects on pregnancy and the newborn have not been carefully studied, with only a few studies reporting on it. A report by Kadyrova *et al.* found that the incidence of arterial hypertension, coronary heart disease and chronic diseases of the biliary tracts were, respectively 5, 4, and 3-fold higher in obese subjects than in those with a normal BMI.[9] There has been a gross insufficiency of information concerning obesity and its effects on pregnant women and neonatal health in Kazakhstan, which has warranted special attention. To our knowledge, ours was the first study on the effects of maternal obesity on pregnancy and neonatal outcomes carried out in that country. The aims of this study were to investigate the impact of maternal obesity on mothers and their neonatal health, and to evaluate the associations among maternal obesity and pregnancy complications, delivery outcomes, and neonatal complications.

MATERIALS AND METHODS

Our study is a retrospective cohort analysis. Initially, data collection was targeted on the records of 171 women at the tertiary hospital, Astana, Kazakhstan, between January and February of 2008. Only women with a singleton pregnancy booked on or before 20 completed weeks of gestation, and who gave birth at 24 or more completed weeks of gestation, were included in the statistical analysis. A total of 14 women were excluded from further study, 7 of whom had incomplete antenatal records and another 7 who gave birth to twins. The final study population consisted of 157 women with completed singleton pregnancies. Data were derived using a checklist from case histories and, ante- and postnatal records, which contained age, weight, height, previous obstetric history, and a variety of items concerning pregnancy, delivery and neonatal periods. The anonymity of each respondent's identity was strictly observed at all phases of analysis and reporting, hence ethical clearance was exempted. However, prior permission from

the hospital authority was given to collect data from their patient registry.

BMI calculation and grouping

BMI was calculated as the ratio of weight (kg) divided by height (m^2). Women were divided into four groups according to the WHO's classification: underweight, BMI<18.50; normal range, BMI 18.50–24.99; overweight, BMI 25.00–29.99; and obese, BMI≥30.00.[11] However, a statistical comparison was carried over between two groups: "obese" and "non-obese," which later consisted of a combined three BMI groups (underweight, normal weight, and overweight).

Outcome measures

The incidence of complications during pregnancy, delivery, and neonatal periods were evaluated for non-obese and obese groups. A case history, ante- and postnatal records of the mother and her children up to 28 days after delivery were made available from the patient registry. Pregnancy complications included the following: pre-eclampsia and/or eclampsia, amniotic fluid disorders (oligohydramnios and polyhydramnios), and placental insufficiency. Delivery complications included premature rupture of a membrane, and abnormal labor which refers to a condition that deviates from what most women undergoing spontaneous vaginal delivery experience.[16] Delivery outcomes included vaginal delivery and/or a cesarean section. Newborn complications studied were: intrauterine growth retardation, cerebral ischemia, pneumonia, birth defects, and fetal macrosomia (a fetal birth weight above 4,000 grams regardless of gestational age).[17] Since this study was carried out in a tertiary hospital, a specialist obstetrician and a specialist pediatrician were responsible for diagnosing maternal and neonatal complications.

Statistical analyses

Statistical analyses were conducted using the Statistical Package for Social Science, version 16.0 (SPSS, Chicago, Ill, USA). Continuous variables were presented as the mean and standard deviation (SD) for normally distributed data, and as median and the interquartile range (IQR) for non-normal data. Categorical data were presented as the frequency and percentage. Associations between maternal and neonatal complications involving the obesity of women were measured using a logistic regression model, and were estimated as odds ratios (ORs) and 95% confidence intervals (CIs). ORs were adjusted for age at delivery, parity, and length of a hospital stay. A Chi- square test was applied to compare categorical variables, and a two-tailed *P*-value less than 0.05 was regarded as statistically significant.

RESULTS

One hundred and fifty-seven pregnant women between 19 and 45 years of age who had a singleton delivery were included in this study. Among them, 84.8% were Kazakhs and 94.2% were from urban areas. The mean (±SD) age of the respondents was 30.5 (±5.5) years. The distribution of BMI was as follows: underweight 25 (15.9%), normal weight 101 (64.3%), overweight 14 (8.9%), and obese 17 (10.8%), whereas 52 (33.1%) pregnant women had suffered from some sort of pregnancy-related complications, 46 (29.3%) had experienced complications during delivery, while 66 (42.0%) of pregnant women required a cesarean section to deliver the baby. Nevertheless, almost a quarter (26.8%) of the newborn babies had some complications during birth. Maternal characteristics and outcomes are summarized in Table 1.

Table 1 Maternal characteristics and outcomes

Characteristics	Number	Percentage
Age at delivery (years)		
19–24	25	15.9
25–29	44	28.0
30–34	47	29.9
≥35	41	26.1
Mean=30.5 SD=5.5 Minimum=19 Maximum=45		
Nationality		
Kazakh	145	84.8
Other	26	15.2
Residence		
Urban	161	94.2
Rural	10	5.8
Profession		
Housewife	76	48.4
Clerk	65	41.4
Worker	12	7.6
Student	4	2.5
Parity		
Primipara	63	40.1
Multipara	94	59.9
BMI[a]		
Underweight	25	15.9
Normal	101	64.3
Overweight	14	8.9
Obesity	17	10.8
Pregnancy complications		
Yes	52	33.1
No	105	66.9
Delivery complications		
Yes	46	29.3
No	111	70.7
Delivery outcomes		
Vaginal delivery	91	58.0
Cesarean section	66	42.0
Hospital stay (days)		
<11	77	49.0
≥11	80	51.0
Median=11.0 IQR[b]=6–14 Minimum=2 Maximum=47		
Neonatal complications		
Yes	42	26.8
No	115	73.2

[a]BMI: body mass index. BMI was classified into following groups: underweight, BMI <18.50; normal range, BMI 18.50–24.99; overweight, BMI 25.00–29.99, and obesity, BMI ≥30.00.[11] [b]Interquartile range

Table 2 shows that among newborns, the male:female ratio was 54.8:45.2. About 131 (83.4%) newborns were delivered at the normal weight of 2,500–4,000 gms. However, 8 (5.1%) were low birth-weight babies with weights of <2,500 gms, and 18 (11.5%) of newborns were macrosomic with birth weights over 4,000 gms. Whereas 13 (8.3%) of the neonates were delivered before full term (i.e. 37 weeks), the median (IQR) period of gestation was 38.0 (37.0–39.0) weeks, ranging from 27 to 42 weeks.

Table 2 Neonatal characteristics

Characteristics	Male		Female		Total	
	N	(%)	N	(%)	N	(%)
Total	86	(54.8)	71	(45.2)	157	(100.0)
Birth weight (in grams)[a]						
<2,500	6	(75.0)	2	(25.0)	8	(5.1)
2,500–4,000	65	(49.6)	66	(50.4)	131	(83.4)
>4,000	15	(83.3)	3	(16.7)	18	(11.5)
Gestational age (in weeks)						
<37	10	(76.9)	3	(23.1)	13	(8.3)
37–42	76	(52.8)	68	(47.2)	144	(91.7)
Median=38.0 IQR[b]=37–39 Minimum=27 Maximum=42						

[a]Birth weight <2500 grams was classified as low birth weight (LBW),[41] and >4000 grams as fetal macrosomia regardless of gestational age,[17] [b]Interquartile range

Table 3 demonstrates that elderly and multiparous women were more likely to be obese than young and primiparous women with ORs of 3.1 (95% CI=0.8–11.6, *P*=0.090) and 4.1 (95% CI=0.9–19.6, *P*=0.075), respectively. Obese women also tended to show an increased tendency towards a longer hospital stay of more than 10 days (OR=2.2, 95% CI=0.8–6.2, *P*=0.135).

Table 3 Association of age, parity, and hospital stay with maternal obesity

Characteristics	Obese[a]		Non-obese[b]		OR[c]	95% CI[d]	*P* value
	N	(%)	N	(%)			
Total	17	(100.0)	140	(100.0)			
Age at delivery (years)							
<30	3	(17.6)	66	(47.1)	1	Reference	
≥30	14	(82.4)	74	(52.9)	3.1	0.8–11.6	0.090
Parity							
Primipara	2	(11.8)	61	(43.6)	1	Reference	
Multipara	15	(88.2)	79	(56.4)	4.1	0.9–19.6	0.075
Hospital stay (days)							
<11	7	(41.2)	70	(50.0)	1	Reference	
≥11	10	(58.8)	70	(50.0)	2.2	0.8–6.2	0.135

[a]Obese means women with BMI≥30.0, [b]Non-obese means women with BMI<30.0; [c]OR: Odds ratio; ORs were adjusted for parity in age group, and for age in parity and hospital stay; [d]CI: Confidence interval

Associations among pregnancy, delivery, and neonatal complications with maternal obesity are illustrated in Table 4. A statistically significant difference between the compared groups was observed in the prevalence of eclampsia/pre-eclampsia (P=0.010). Obese groups of women com-

Table 4 Associations of pregnancy, delivery, and neonatal complications with maternal obesity

Characteristics	Obese[a]	Non-obese[b]	OR[c]	95% CI[d]	P value
	N (%)	N (%)			
Pregnancy complications					
No	7 (41.2)	98 (70.0)	1	Reference	
Yes	10 (58.8)	42 (30.0)	3.6	1.2–10.6	0.040
Eclampsia/pre-eclampsia					
No	14 (82.4)	136 (97.1)	1	Reference	
Yes	3 (17.6)	4 (2.9)	24.7	2.2–44.8	0.010
Amniotic fluid disorders					
No	14 (82.4)	122 (87.1)	1	Reference	
Yes	3 (17.6)	18 (12.9)	1.7	0.4–7.1	0.449
Placental insufficiency					
No	11 (64.7)	112 (80.0)	1	Reference	
Yes	6 (35.3)	28 (20.0)	2.2	0.7–6.8	0.171
Delivery complications					
No	14 (82.4)	97 (69.3)	1	Reference	
Yes	3 (17.6)	43 (30.7)	0.6	0.2–2.3	0.460
Premature rupture of membrane					
No	16 (94.1)	106 (75.7)	1	Reference	
Yes	1 (5.9)	34 (24.3)	0.2	0.02–1.6	0.129
Abnormal labor[e]					
No	15 (88.2)	134 (95.7)	1	Reference	
Yes	2 (11.8)	6 (4.3)	8.1	1.0–63.8	0.056
Delivery outcomes					
Vaginal delivery	7 (41.2)	84 (60.0)	1	Reference	
Cesarean section	10 (58.8)	56 (40.0)	2.1	0.7–6.2	0.164
Neonatal complications					
No	10 (58.8)	105 (75.0)	1	Reference	
Yes	7 (41.2)	35 (25.0)	2.3	0.8–6.9	0.131
Fetal macrosomia[f]					
No	13 (76.5)	126 (90.0)	1	Reference	
Yes	4 (23.5)	14 (10.0)	2.2	0.6–8.0	0.244
Intrauterine growth retardation					
No	16 (94.1)	134 (95.7)	1	Reference	
Yes	1 (5.9)	6 (4.3)	1.5	0.1–15.1	0.738
Cerebral ischemia					
No	14 (82.4)	128 (91.4)	1	Reference	
Yes	3 (17.6)	12 (8.6)	2.0	0.5–8.8	0.345
Pneumonia					
No	15 (88.2)	135 (96.4)	1	Reference	
Yes	2 (11.8)	5 (3.6)	3.4	0.6–20.2	0.180
Birth defect					
No	14 (82.4)	136 (97.1)	1	Reference	
Yes	3 (17.6)	4 (2.9)	8.8	1.5–50.1	0.016

[a]Obese means women with BMI≥30.0, [b]Non-obese means women with BMI<30.0; [c]OR: odds ratio; ORs were adjusted for age of mother at delivery and parity; [d]CI: confidence interval; [e]abnormal labor refers to a process that deviates from what most women undergoing spontaneous vaginal delivery experience,[16] [f]birth weight >4000 grams as fetal macrosomia regardless of gestational age[17]

pared to non-obese groups displayed a substantially increased risk for eclampsia/pre-eclampsia, but a relatively lower risk for amniotic fluid disorders and placental insufficiency. In contrast to women from the non-obese group, obese women were more likely to require a cesarean section (OR=2.1, 95% CI=0.7–6.2, *P*=0.164). In particular, obese women were more likely to undergo abnormal labor (OR=8.1, 95% CI=1.0–63.8, *P*=0.056). Baby birth defects were strongly associated with maternal obesity (*P*=0.016), with the ORs for obese women being greater than those for the non-obese group (OR=8.8, 95% CI=1.5–50.1). Obese women tended to exhibit an increased risk of fetal macrosomia (OR=2.2, 95% CI=0.6–8.0, *P*=0.244), pneumonia (OR=3.4, 95% CI=0.6–20.2, *P*=0.180), cerebral ischemia (OR=2.0, 95% CI=0.5–8.8, *P*=0.345), and intrauterine growth retardation (OR=1.5, 95% CI=0.1–15.1, *P*=0.738) than those in the non-obese group.

DISCUSSION

We identified several factors related to pregnancy, delivery, and neonatal complications which were more prevalent among obese mothers and their children than among their non-obese counterparts. This study indicated that an increasing BMI was associated with a heightened risk of maternal and neonatal complications. Compared to women from a non-obese group, obese women were found to run a higher risk of eclampsia/pre-eclampsia, placental insufficiency, and abnormal labor. As for delivery outcomes, obese women were more likely to require a cesarean section, while their newborns ran a higher risk of cerebral ischemia, pneumonia, and birth defects. Overall, our conclusions were in agreement with many previous studies.[18,19)]

Our findings that higher BMIs (obesity) are common among older mothers raises the possibility that increasing maternal and fetal complications have also been reported by several other studies.[11,12,20,21)] Leung *et al.* in their study reported a stronger impact of high BMIs on adverse obstetric outcomes, and they suggested using a lower cut-off for BMIs to preserve maternal and child health.[11)] Wolfe in his study "High prepregnancy body-mass index – a maternal-fetal risk factor," recognized higher BMIs as a risk factor for both mothers and their newborns.[19)] In our study, multiparous women had higher BMIs than primiparous woman, which may be related with their tendency to gain weight with each pregnancy.[21,22)]

The risk of pre-eclampsia has been positively associated with a raised BMI. In Kazakhstan, gestosis, which includes eclampsia/pre-eclampsia, took second place among the several causes of maternal mortality.[23)] We discovered a 25-times higher risk of pre-eclampsia in obese compared to non-obese women, and similar findings have been reported in China, Australia, and Scotland.[11,12,24,25)] In addition to increasing BMIs, the sedentary lifestyle of Kazakh women and their dietary habits may add a heightened risk to developing pre-eclampsia.

Obesity-induced complications of pregnancy, such as preeclampsia and/or eclampsia, fetal macrosomia, low birth weight, etc. further complicate delivery outcomes. Very often an elective termination of pregnancy in the form of a cesarean section is needed to save both the mother and her newborn. We found that cesarean deliveries were two-times more prevalent among obese mothers than those who were non-obese. Several other studies cited reports similar to ours.[2,11,14,15,23,26-31)]

Concerning fetal risks, our data indicate that obese women were more likely to have macrosomic babies. Although genetic, racial, and ethnic factors play a role in macrosomia,[32)] the risk is relatively low among Asian women. Parental height and weight may also influence the birth weights of children. Obesity has been associated with elevated insulin resistance and high levels of insulin in the fetus, even in the absence of maternal diabetes.[33)] Although no conclusive risk factors for macrosomia could certainly be identified so far, much about birth weight variations

has remained unexplained; however, macrosomia has reportedly been associated with neonatal morbidity, injury and cesarean sections.[34] Despite the relatively small number of observations, this study has observed elevated risks for birth defects in neonates among obese compared with non-obese women (OR=8.8, 95% CI=1.5–50.1, *P*=0.016), a finding that was again in agreement with previous reports.[35-40] Our findings that pneumonia was 3 times more common among children of obese mothers was also supported by the findings of other researchers.[13]

Our study had several limitations worthy of mention. We collected data from a relatively small sample of women which may pose a threat to the generalization of our findings. We could not address some other underlying reasons of pregnancy and neonatal health-related issues such as compromised immunity arising out of malnutrition, diabetes, HIV/AIDS etc. in mothers. Finally, we followed mothers and neonates only until they were hospitalized. We could not follow-up for an entire neonatal period, which may have resulted in underestimation of some actual neonatal ailments. Despite these limitations, we consider our findings provide an important source of information for policy makers as well as future researchers in this field.

In conclusion, the results of our study indicated higher risks of maternal (pregnancy and delivery related) and neonatal (congenital and perinatal) complications among obese mothers than those among the non-obese. The major maternal obesity-associated risks were pregnancy and delivery-related complications, including eclampsia/pre-eclampsia, abnormal labor, and birth defects of neonates. Thus, medical practice must take these complications into account by ensuring adaptable and early management to improve both maternal and neonatal health.

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