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Complications and Risk Factors of Neonatal Macrosomia: A Case-Control Study

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ABSTRACT

Background: Macrosomia is defined as the birth weight of greater than or equal to 4,000 grams, which is considered to be a public health issue threatening mothers and neonates. Studies indicate that the prevalence rate of macrosomia is on the rise in developing countries. The present study aimed to evaluate the influential factors in the occurrence of neonatal macrosomia.

Methods: This case-control study was conducted at Al-Zahra Hospital in Tabriz, located in the north-west of Iran, during March 2013-February 2014. Sample population included all the live-born neonates and their mothers. The case group consisted of the neonates with the birth weight of ≥4,000 grams (n=404), and the control group included 404 newborns weighing 2,500-3,999 grams. Data were collected using a maternal and neonatal information form (maternal age, neonatal gender, mode of delivery, maternal height, and maternal history of diabetes). Data were extracted from the medical files of the samples and recorded in the form. Data analysis was performed in SPSS version 20 using descriptive and inferential statistics (independent t-test and 2χ) at the significance level of α=0.05.

Results: In total, 8,012 neonates were born during the study, 404 of whom has macrosomia (5.04%). Mean maternal age in the case and control groups was 29.6±6.1 and 27.9±8.3 years, respectively (P<0.001). Significant differences were observed in the gender (male) (odds ration [OR]=2.2 [95% CI: 1.33-3.04]; P<0.001), mode of delivery (OR=0.51 [95% CI: 0.37-0.69]; P<0.001), maternal history of diabetes (OR=4.5 [95% CI: 2.3-8.73]; P<0.001), and number of deliveries (birth rank) (OR=1.6 [95% CI: 1.19-2.39]; P<0.001) between the case and control groups.

Conclusion: According to the results, there were significant associations between macrosomia at birth and maternal age, maternal history of diabetes, and birth rank. Therefore, proper planning and educational interventions are recommended for the control of the influential factors in the occurrence of macrosomia.

Keywords: Birth rank, Diabetes, Macrosomia, Pregnancy

Introduction

Macrosomia is defined as the birth weight of greater than or equal to 4,000 grams (1). Birth weight is one of the most important criteria in the assessment of neonatal health, which significant affects perinatal mortality (2). According to statistics, the risk of macrosomia has increased in the presence of obesity and diabetes in developing countries.

According to a survey conducted by the World Health Organization (WHO) (2013) in 23 developing countries in Asia, Africa, and Latin America, the lowest prevalence rate of macrosomia was reported to be 0.5% in India, while the highest rate was estimated at 14.9% in Algeria (3). In China, the prevalence of macrosomia has been reported to be 7.5% (range: 4.1-13.4%) (4). Various studies In Iran have estimated the prevalence of macrosomia to be within the range of 3.4-11.8% (1, 5). For instance, the rate has been reported to be 3.4% by Bahrami et al. (6), 11.8% by Mardani et al. (1), and 5.8% in Tehran city (7).

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Macrosomia is associated with several maternal and fetal consequences (8, 9). Complications of cesarean section in mothers, as well as perinatal complications in infants, such as shoulder dystocia, brachial plexus palsy, asphyxia, and stillbirth, which could give rise to the need for special care in the neonatal intensive care unit (NICU) (1). According to the literature, maternal diabetes, obesity, increased maternal age, number of deliveries (birth rank), and male gender in neonates are associated with the risk of macrosomia at birth (1, 7, 8, 10). In a study in this regard, Fakhri et al. (2010) stated that the prevalence of shoulder dystocia and meconium defecation was higher in macrosomic neonates compared to the neonates with normal birth weight (11).

Considering the numerous complications of macrosomia in mothers and infants, as well as the increased risk of macrosomic birth in developing countries, the timely diagnosis, treatment, and prevention of macrosomia are of paramount importance.

The present study aimed to evaluate the influential factors macrosomia at birth in the form of a case-control research on the live-born neonates at Al-Zahra Hospital in Tabriz, Iran during one year.

Methods

Study setting

This analytical, case-control study was conducted at Al-Zahra Hospital in Tabriz, located in the north-west of Iran, during March 2013-February 2014. Sample population included all the live-born neonates and their mothers.

Study samples

The case group consisted of the neonates with the birth weight of ≥4,000 grams, and the control group included the newborns weighing 2,500-3,999 grams (n=404). In the selection of the control subjects, for each neonate weighing ≥4,000 grams (case group), the next neonate with normal birth weight (2,500-3,999 grams) born after a neonate with the birth of >4,000 grams in the same hospital was placed in the control group.

Inclusion criteria for the case group were singleton pregnancy, birth weight of ≥4,000 grams, and gestational age of 37-42 weeks. For the control group, the inclusion criteria were singleton pregnancy, birth weight of 2,500-3,999 grams, and gestational age of 37-42 weeks. The selected infants in both groups met all the inclusion criteria, with the exception of equal birth weight.

Data collection

Data were collected using a maternal and neonatal information form, including the maternal age, neonatal gender, mode of delivery, maternal height, and maternal history of diabetes, which were extracted from the medical files of the samples and recorded in the forms. In addition, the birth weight of the infants was measured using a digital pediatric scale with the precision of 10 grams (Seca, Germany).

Data analysis was performed in SPSS version 20 using descriptive and inferential statistics (independent t-test and 2 χ). Moreover, multivariate regression analysis was used to investigate the associations between neonatal macrosomia (dependent variable) and independent variables. In all the statistical analyses, the significance level was considered to be α=0.05.

Results

Among 8,014 live births during the study period, the prevalence of macrosomia was estimated at

Table 1. Demographic Characteristics of Study Samples and Their Correlations with Some Factors in Case (n=404) and Control Groups (n=404)

Variable		Case Mean ±SD	Control Mean ±SD	P-value
Maternal Age (year)		29.6±6.1	27.9±8.3	<0.001*
Birth Weight (g)		4244±284	3267±340	<0.001*
Variable	Group	N (%)	N (%)	
Neonatal Gender	Male	275 (68.1)	202(50)	<0.001**
	Female	129 (31.9)	202 (50)	
Maternal History of Diabetes	Yes	61 (15.1)	12 (3)	<0.001**
	No	343 (84.9)	392 (97)	
Birth Rank	First	126 (31.2)	186 (46)	<0.001**
	Second	189 (46.8)	152 (37.6)	
	Third	66 (16.3)	53 (13.1)	
	Fourth	23 (5.7)	13 (3. 2)	
Mode of Delivery	Natural Vaginal	141 (34.9)	215 (53.2)	<0.001**
	Caesarean Section	263 (65.1)	189 (46.8)	

*Test applied: independent samples t-test; ** Chi-square test; SD: Standard deviation

Table 2. Results of Multivariate Logistic Regression Analysis for Influential Factors in Macrosomia

Variable	OR* (95% Confidence Interval)	P-value
Maternal Age	0.98 (1.01-0.95)	0.37
Mode of Delivery	0.51 (0.37-0.69)	<0.001
Maternal History of Diabetes	4.5 (2.3-8.73)	<0.001
Neonatal Gender	2.2 (1.33-3.04)	<0.001
Birth Rank	1.6 (1.19-2.39)	0.003

*OR: odds ratio

5.04% (404 out of 8,014 infants). Mean maternal age was 28.8±6, with the minimum and maximum age of 15 and 44 years, respectively.

The results of independent t-test were indicative of a significant difference in the mean maternal age between the case group (29.6±6.1 years) and control group (27.9±8.3 years) (P <0.001). In addition, the results of Chi-square test showed a significant difference between the case and control groups in terms of multiparity, mode of delivery, maternal history of diabetes, and neonatal gender (P<0.001).

Significant differences were observed in the neonatal gender (male) (odds ratio [OR]=2.2 [95% CI: 1.33-3.04]; P<0.001), mode of delivery (OR=0.51 [95% CI: 0.37-0.69]; P<0.001), maternal diabetes (OR=4.5 [95% CI: 2.3-8.73]; P<0.001), and birth rank (OR=1.6 [95% CI: 1.19-2.39]; P<0.001) between the case and control groups.

Discussion

The present case-control study aimed to determine the influential factors in the occurrence of macrosomia at birth. According to the results, factors such as gestational diabetes, gender of the infant (male), birth rank, and maternal age were the most important risk factors for macrosomia. Moreover, mean maternal age was observed to be higher in the case group compared to the control group, and a significant association was noted between increased maternal age and risk of macrosomia at birth.

Our findings are in line with the results of the previous studies in this regard (1, 2, 4, 7, 12, 13). In the study by Mardani et al. (2012), the highest incidence of macrosomia (18%) was reported within the maternal age range of ≥35 years, while the minimum incidence rate was observed in the mothers aged less than 20 years (8.5%) (1). In another study conducted in 23 developing countries (authors, 2013), the rate of macrosomia at birth was reported to be 1.9% in Asia within the maternal age range of 20-34 years, while it was estimated at 12.1 % in the mothers aged ≥35 years (4). Accordingly, the population policy of the Islamic Republic of Iran encourages women to consider the appropriate childbearing age.

Findings of the current research were indicative of a significant difference between the mothers in the case and control groups in terms of the incidence of diabetes. According to the multivariate logistic regression analysis, neonatal macrosomia was associated with maternal diabetes (OR=4.5 [95% CI: 2.3-8.73]). Approximately 15% of the mothers in the case group had a history of diabetes, while the rate was estimated at 3% in the control group. Consistently, previous studies have confirmed the impact of maternal or gestational diabetes on birth weight and macrosomic birth (2, 4, 8), which is in congruence with the results of the present study.

In the research conducted by Mohammad Beigi et al. (2013) in Shiraz (Iran), gestational diabetes was determined as a significant influential factor in the occurrence of macrosomia at birth (12). Similarly, Bahrami et al. reported that 13% of the mothers with macrosomic neonates had diabetes, while the rate was estimated at 9.3% in the neonates with normal birth weight (6). In a five-year prospective study performed by Najafi et al. (2012) in Ahvaz (Iran), the prevalence rate of macrosomia was reported to be 9%, and a significant association was observed between maternal diabetes and macrosomia (14).

In another research conducted in 23 developing countries (cite), a statistically significant association was observed between maternal diabetes and macrosomia (4). Furthermore, a study in 2015 showed that gestational diabetes was an important prognostic factor for macrosomic birth (15). Therefore, public health planners should pay special attention to diabetes control, particularly in women, and self-care and preventive measures should also be taken in this regard.

Findings of the current research indicated a statistically significant difference in the birth rank between the case and control groups (OR=1.6 [95% CI: 1.19-2.39]). Among the mothers in the case group (macrosomia), 22% had their third delivery, while only 16.3% of the mothers in the control group were on their third delivery, which is consistent with the results of the previous studies (1, 2, 4, 6, 8, 16).

According to the results of the present study, there was a significant difference between the case and control groups in terms of neonatal gender (OR=2.2 [95% CI: 1.33-3.04]), and the risk of macrosomic birth was observed to be higher among the male infants compared to the female infants. This finding is in line with the results obtained by Linder et al. (17), Bahrami et al. (6), Ghanbari et al. (16), and Mardani et al. (1). In a study performed in Khorram Abad (Iran), Mardani et al. stated that 16.3% of the neonates with macrosomia were male, and 7.3% were female, which denotes a statistically significant difference in this regard (1). Additionally, Linder et al. (17) reported that 67.9% of the neonates with macrosomia were male, while the prevalence rate was estimated to be 53.2% in the control group.

In the current research, the rate of caesarean section was 65.1% and 48.8% in the case and control groups, respectively. In the study by Linder et al. (17), the rate of caesarean section was reported to be higher in the macrosomic birth group compared to the neonates with normal birth weight, which is consistent with the present study, as well as the findings of Tehrani et al. (7) and Mardani et al. (1, 15).

The prevalence of macrosomia was calculated to be 5.04% in the current research, which is in line with the studies by Bahrami et al. (6) and Tehrani et al. (7). Of note, the prevalence of macrosomia was reported to be 5.8% in the study by Tehrani et al. in Tehran (Iran), which is inconsistent with the findings of Mardani et al. in Khorram Abad (Iran), showing the prevalence rate of macrosomia to be 11.8% (1). The discrepancy could be due to the differences in the time, location, and sample sizes of the mentioned studies. In addition, the type of the hospital has not been mentioned in the research by Mardani et al., and it was only stated that the study was performed during the summer on the total sample size of 500 newborns. However, the current study was carried out on 8,014 neonates in a hospital affiliated to the Tabriz University of Medical Sciences during one year.

Another study in this regard reported the prevalence of macrosomic birth to be 3.4% in Tehran province, which is lower than the estimated rate in the present study. This inconsistency could be due to variations in the methodology, data collection or sample sizes since in the mentioned research, the data were not collected within one year (5).

One of the strengths of the present study based on the literature review was that it is the first research conducted in Tabriz in this regard. Furthermore, in terms of the type of the study, it is one of the few case-controls in this field.

The current research had some limitations, including the lack of access to the data on maternal height and weight before pregnancy or in the first trimester of pregnancy, as well as maternal weight gain during pregnancy and the subsequent inability to calculate the maternal body mass index. Another limitation was the lack of data on maternal employment status and education level, which should be considered the further investigations in this regard.

Conclusion

According to the results, factors such as maternal age, neonatal gender, multiparity (birth rank), and maternal history of diabetes are significant predictors of macrosomia. Therefore, considering the adjustability of some of these influential factors, proper planning and effective interventions should be implemented in order to reduce the rate of macrosomic births.

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References

1. Mardani M, Kazemi KH, Mohsenzadeh A, Ebrahimzade F. Investigation of frequency and risk factors of macrosomia in infants of Asali hospital of Khoramabad city. Iran J Epidemiol. 2013; 8(4):47-53.
2. Mathew M, Machado L, Al-Ghabshi R, Al-Haddabi R. Fetal macrosomia. Risk factor and outcome. Saudi Med J. 2005; 26(1):96-100.
3. Dennedy MC, Dunne F. Macrosomia: defining the problem worldwide. Lancet. 2013; 381(9865):435-6.
4. Koyanagi A, Zhang J, Dagvadorj A, Hirayama F, Shibuya K, Souza JP, et al. Macrosomia in 23 developing countries: an analysis of a multicountry, facility-based, cross-sectional survey. Lancet. 2013; 381(9865):476-83.
5. Maroufizadeh S, Omani SR, Amini P, Sepidarkish M. Prevalence of macrosomia and its related factors among singleton live-birth in Tehran province, Iran. J Isfahan Med Sch. 2016; 34(394): 940-5 (Persian).
6. Bahrami N, Soleimani MA. Study of some related factors with fetal macrosomia and low birth weight. J Urmia Nurs Midwifery Facul. 2014; 12(2):136-43.
7. Haji ET, Kazemi H, Kordi M. Prevalence and outcome of the macrosomic infants. Acta Med Iran. 2007; 45(6):505-9.
8. Li G, Kong L, Li Z, Zhang L, Fan L, Zou L, et al. Prevalence of macrosomia and its risk factors in china: a multicentre survey based on birth data involving 101,723 singleton term infants.

Paediatr Perinat Epidemiol. 2014; 28(4):345-50.
9. Tian C, Hu C, He X, Zhu M, Qin F, Liu Y, et al. Excessive weight gain during pregnancy and risk of macrosomia: a meta-analysis. Arch Gynecol Obstet. 2016; 293(1):29-35.
10. Yadav H, Lee N. Factors influencing macrosomia in pregnant women in a tertiary care hospital in Malaysia. J Obstet Gynaecol Res. 2014; 40(2):439-44.
11. Fakhri M. Evaluation of maternal and neonatal complications in macrosomia. J Mazandaran Univ Med Sci. 1999; 9(24):32-8.
12. Mohammadbeigi A, Farhadifar F, Soufi Zadeh N, Mohammadsalehi N, Rezaiee M, Aghaei M. Fetal macrosomia: risk factors, maternal, and perinatal outcome. Ann Med Health Sci Res. 2013; 3(4):546-50.
13. Mardani M, Rossta S, Rezapour P. Evaluation of the prevalence of macrosomia and the maternal risk factors. Iran J Neonatol. 2014; 5(3):5-9.
14. Najafian M, Cheraghi M. Occurrence of fetal macrosomia rate and its maternal and neonatal complications: a 5-year cohort study. ISRN Obstet Gynecol. 2012; 353791(10):14.
15. He XJ, Qin FY, Hu CL, Zhu M, Tian CQ, Li L. Is gestational diabetes mellitus an independent risk factor for macrosomia: a meta-analysis? Arch Gynecol Obstet. 2015; 291(4):729-35.
16. Ghanbari Z, Emamzadeh A, Bagheri M. The prevalence and risk factors of fetal macrosomia: a cross sectional study of 2000 neonates. Tehran Univ Med Sci J. 2008; 66:1-2.
17. Linder N, Lahat Y, Kogan A, Fridman E, Kouadio F, Melamed N, et al. Macrosomic newborns of non-diabetic mothers: anthropometric measurements and neonatal complications. Arch Dis Child Fetal Neonatal Ed. 2014; 99(5): F353-8.