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Prevalence of macrosomia and its related factors in neonates born in Mashhad, Iran

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ABSTRACT

Background and Objective: Fetal macrosomia increases the risk of perinatal mortality and morbidity. The aim of this study was to determine the prevalence of macrosomia and its relationship with related factors in neonates born in the hospitals affiliated to Mashhad University of Medical Sciences.

Methods: This cross-sectional study was performed on 97569 neonates using the data obtained from the neonates' screening program in Mashhad. Their information was extracted from Sina electronics system (electronic medical records software) and analyzed using SPSS 16. The prevalence of macrosomia and its related factors are revealed by tables.

Findings: In this study, the prevalence of macrosomia was estimated at 6.6 % which was higher in male neonates than females. The mean birth weight was higher in male infants than female ones. It occurred 8.25 times higher in singletons than multiplets. The prevalence of macrosomia was increased by maternal age (P=0.001). Most of the neonates were born by cesarean section, and in most of them, the parents were not relatives. The prevalence of macrosomia gradually increased in parents living in densely populated cities and its trend gently decreased from the beginning to the end of the year.

Conclusion: The prevalence of macrosomia in infants in Mashhad was 6.6% and was correlated with maternal age during pregnancy, infant's gender, number of fetuses, mode of delivery, parental consanguinity, parental residence places and birth season.

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Introduction

Macrosomia is described as an infant with excessive birth weight, and it is determined in various ways including birth weight >4000 gr or weight >90 % for gestational age after correcting for factors of gender and ethnicity. A precise diagnosis of fetal macrosomia can only be made through measuring birth weight after delivery of the neonate. Based on these definitions, macrosomia accounts for 1-10 % of all pregnancies. The factors that can contribute to the incidence of macrosomia include genetic, gestational age, gestational diabetes and diabetes mellitus. Genetic, race and ethnic factors can affect birth weight and lead to macrosomia [1].

Male infants compared to female ones are more likely to have more weight and higher weighing (>4500 grams) at any gestational age. Macrosomic infants account for up to 10 % of the newborns in the United States [1]. Macrosomia is known as a cause of mortality and morbidity both in infants and mothers. For mothers, delivery of macrosomic infants is associated with prolonged delivery, increased probability of cesarean section, postpartum infection and postpartum hemorrhage. Macrosomic infants are at increased risk for shoulder dystocia, traumatic injury, asphyxia, and prenatal mortality. The infant born with macrosomia is prone to insulin resistance, obesity, diabetes, premature cardiovascular disease, and some cancers later in life. A study in the prestigious Lancet Magazine has shown that the incidence of macrosomic newborns in developing countries enhances with the increase in diabetes and obesity in women of reproductive age [2].

The fourth goal of the WHO for 2025 is to reduce infant mortality [1, 3]. Since macrosomia is one of the most important causes of mortality and morbidity in childhood, it is necessary to accurately estimate the incidence of macrosomia and factors that affect it. The fifth objective is to improve maternal health, aiming to reduce maternal mortality. For macrosomia is one of the most important causes of maternal birth complications, it is essential to accurately estimate the incidence of macrosomia and factors that influence it [3, 4]. In addition, one of the nutritional goals of the WHO is to ensure that the number of overweight children does not increase, that macrosomia is one of the causes of weight gain and obesity in later life [5] and that it is necessary to determine the incidence and take measures to reduce the factors influencing it.

Methods

This study was performed in Mashhad city, the capital of Khorasan Razavi Province, Iran. In this cross-sectional study, the data of the screening program of the neonates born in the hospitals affiliated to Mashhad University of Medical Sciences (all public health centers in the cities and villages, but no private centers) were used from January 2017 to February 2018. Totally, 111293 infants were born during this period, and a total of 97569 infants who had complete data in Sina electronic system (Electronic health record software of Mashhad University of Medical Sciences, A comprehensive system for integrating citizens' health information) participated in the study, of which 96780 infants were singleton. Sampling was done by census method and all neonates born in this period participated in the study. In the screening of infants on their 3rd to 5th birthdays, the infants' data on the screening sheet were recorded online in the newborn's health record. The criterion for the diagnosis of macrosomia was the only weight recorded by the scales in the centers and delivery rooms of the hospitals. The infants were divided into two groups weighing >4,000 grams and < 4,000 grams, with those weighing >4,000 grams classified as macrosomic. Measured variables included birth weight, height, head circumference, infant's place of birth (hospital, other health centers), modes of delivery (spontaneous vaginal delivery, cesarean section), place of residence of the participants (village, city (5000-500000 inhabitants) , suburban, metropolis), consanguinity between parents (yes, no) and maternal age (years).

The infants' data were extracted and processed using the capabilities of the Sina system, and the data were analyzed using SPSS 16. Then, the results of the study including the prevalence of macrosomia and its relationship with related factors were determined. Data were described by statistical indices in terms of frequency, mean±standard deviation and so on in the corresponding tables. After testing the normality of the

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data, a T-test was used to examine the relationship between the quantitative variables, and the relationship between qualitative variables was determined using the Chi-square test. P<0.05 was considered a significant level.

Results

Demographic characteristics

In this study, a total of 96780 infants were singleton and the frequency of macrosomic neonates was 6349 (6.6%). Table 1 illustrates the demographic data of singleton neonates. The information of these infants included mean weight, height, head circumference, infant's place of birth, mode of delivery, place of residence, consanguinity between parents, maternal age and gender of infants.

Findings

In the current study, 275 (56.01%) and 216 (43.99%) of newborns were males and females, respectively and the majority of macrosomic infants were boys (n=3803, 7.6%). In fact, the results of the present study indicated that the macrosomic male to female (m/f) ratio was 1.4. The highest and lowest prevalence of macrosomia was in mothers, aged ≥35 years (n=1136, 7.9%) and <20 years (n=340, 4.3%) (P=0.001), respectively. The majority of the macrosomic infants were delivered by cesarean (3202, 50.4%). The frequency of macrosomic neonates with consanguineous parents was 1.5 times greater than that in infants with no consanguineous parents. The frequency of hypothyroidism gathered through the paper sampling method was not significant in macrosomic neonates. The frequency of macrosomia gradually decreased from the beginning season of the year to the end (table 2).

Table 3 exhibits although low birth weight in multiplets is higher in female neonates than male ones, this difference is not statistically significant. Prevalence of low birth weight was 6.7 times more in multiple than singleton births.

Table 1: demographic characteristics of macrosomic infants in the neonatal screening program

Variables		Male Mean±SD N (%)	Female Mean±SD N (%)
Birth Weight		3.32±0.72	3.21±0.68
Height		50.05±2.69	49.60±2.60
Head circumference		34.92±3.16	34.50±2.39
Birthplace of Infant	Hospital	46636(99.3)	49842(99.4)
	Other health centers	340(0.7)	322(0.6)
Modes of delivery	Spontaneous vaginal delivery	26895(54)	25939(55.2)
	Cesarean section	22909(46)	21037(44.8)
	Total	49804(51.5)	46976(48.5)
Residence of the participants	Village	10392(22)	11102(22.3)
	City= 5000 to 500000 Population	8207(16.5)	7595(16.2)
	Suburban	15334(30.8)	15544(31)
	Metropolis	15116(30.4)	14445(30.7)
Consanguinity between parents	No	36148(72)	34198(72.8)
	Yes	13656(27.4)	12778(27.2)
Maternal age (years)		29.10±6.25	29.10±6.26
Number and percentage of infants		49804(51.5)	46976(48.5)

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Table 2: Comparison of variables in macrosomic infants in two groups

Variables		Weight, N (%)			Chi^2	P-value
		<4000 gr	≥4000 gr	Total		
Infant's gender	male	36001(92.4)	3803(7.6)	49804(51)	250	0.001
	female	44430(94.6)	2546(5.4)	46976(49)		
Maternal age (years)	<20	7521(95.7)	340(4.3)	7861(8)	198	0.001
	20-35	69617(93.5)	4873(6.5)	74490(77)		
	>35	13293(92.1)	1136(7.9)	14429(15)		
Modes of delivery	Natural delivery	49687(55)	314(49.6)	52834(54.6)	337	0.001
	cesarean	40744(45)	3202(50.4)	43946(45.4)		
Consanguinity	yes	24873(94.1)	1561(5.9)	26434(27)	29	0.001
	No	65558(93.2)	4788(6.8)	70346(73)		
Residence of participants	village	2032(94.6)	1171(5.4)	21494(22)	245	0.001
	City with 5000 to 500000 population	14970(94.7)	832(5.2)	15802(16.3)		
	City margin	27908(93.4)	1970(6.6)	29878(31)		
	Metropolis	27230(92)	2376(8)	29606(30.5)		
TSH level of Infants	<5	86585(93.5)	6076(6.5)	92661(95.7)	27.5	0.001
	≥5	3846(93.3)	273(6.6)	4119(4.3)		
Birth season	Spring	133301(90.5)	1403(9.5)	14704(15.1)	467	0.001
	Summer	24813(93.5)	1708(6.5)	26521(27.4)		
	Autumn	26404(93.5)	1836(6.5)	28240(29.2)		
	Winter	25913(94.9)	1402(5.1)	27315(28.2)		

Table 3. Comparison of macrosomic neonates by gender and number of infants

Variables		Weight, N (%)			Chi2	P-value
		<4000 gr	≥4000 gr	Total		
Gender of multiplet	male	359(98.9)	4(1.1)	363(46)	2.7	0.26
	female	424(98.5)	2(0.5)	426(54)		
Number of fetus	singleton	90431(93.4)	6349(6.6)	96780(100)		
	multiplet	783(99.2)	6(0.8)	789(100)	2047	0.001

Discussion

The aim of this study was to assess the prevalence and related factors of macrosomia among neonates born in the clinics and hospitals affiliated to Mashhad University of Medical Sciences from January 2017 to February 2018. The prevalence of macrosomia was found in 6349 newborns (6.6%) of the present study. Moreover, there was a significant relationship between the gender of the infants and macrosomia. The male neonates compared to female ones had 1.4 times greater chance of macrosomia. According to the studies in the United States, China, South China, Turkey, Nigeria, Bosnia and Herzegovina, India and Cameroon, the male gender was a risk factor for neonates' macrosomia [1, 2, 6-11]. The other similar study conducted in Khorramabad has suggested that the male gender is one of the factors associated with macrosomia [12], which is consistent with the results of the current and above studies.

Jazayeri et al. demonstrated that macrosomic infants accounted for up to 10% of neonates born in the United States in 2015 [1]. According to similar studies, the prevalence of macrosomic infants in some countries is as follows: China 7.3%, South China 4%s, Turkey 6.8%, Nigeria 12%, Bosnia and Herzegovina 13.1%, India 5.2% and Ghana 3.03% [2, 6-10, 13]. In the studies performed in Iran, the prevalence of macrosomia in Khorramabad was

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11.8%, Shiraz 7.6%, Tehran 5.8% and Ahvaz 9%, respectively [12, 14-16]. Based on a systematic review and meta-analysis study done on the published articles up to 2017 in Iran, the overall prevalence of macrosomia in Iran was 5.2% with a prevalence of 3.9% in Tehran and 6% in other cities [17]. According to the information mentioned above, the prevalence of macrosomia in infants born in hospitals affiliated to Mashhad University of Medical Sciences was 6.6%, which is the same as the results of similar studies.

In the present study, mothers >35 years accounted for 15% of the participants, of whom 7.9% delivered overweight babies (> 4000 g). Therefore, maternal age is a risk factor for macrosomia. It was comparable to the studies carried out in China, south China and Turkey, in which the increased maternal age was associated with macrosomia [2, 6, 7].

In the study in India conducted on infants, multiparity was one of the major risk factors for macrosomia [10]. In the study performed in Ghana, the risk of macrosomia, especially at the fifth birth was higher compared to the first or second birth [13]. In the studies fulfilled in Iran in Khorramabad and Ahvaz, high maternal age during pregnancy was one of the major risk factors for macrosomia [12, 16]. In the ongoing study, high maternal age was a risk factor for macrosomia, which is similar to the findings of the above studies.

Furthermore, the results of the current study represented that the prevalence of macrosomic neonates was about 8.25 times higher in singleton than multiple births.

The present study pointed out that the frequency of cesarean section was higher in macrosomic neonates than in other neonates. According to the studies conducted in the United States and India, macrosomia was associated with cesarean delivery [1, 10]. In the study carried out in Iran in Shiraz and Tehran, macrosomia was found to increase the rate of delivery by cesarean section, and macrosomia was associated with cesarean section [14, 15]. The present study was in accordance with the above studies.

The results of the present study exhibited that the prevalence of macrosomic infants was 5.9% and 6.8% in consanguineous and no consanguineous parents, respectively, and this difference was statistically significant, indicating that the frequency of macrosomic neonates was higher. In the ongoing study, it was observed that macrosomia enhanced with the increasing size of residence and population. The present study indicated that the prevalence of hypothyroidism using the paper sampling method was the same in macrosomic neonates as in other infants and the difference was not significant. Moreover, the results of the current study illustrated that the incidence of macrosomia gradually decreased from the beginning to the end of the year.

Limitations and strengths

Limitations of this study included the likelihood of laboratory and human error in the measurement of the infant's anthropometric indices, as well as failure to properly record the mother's birth certificate and failure to properly calibrate the delivery room scales. Of course, these human errors were very small and unavoidable and had no significant effect on the results of the study. The strengths of this study consisted of the large sample size, population-based study, high rate of completeness of infant information (88%), extensive area of the study, and high number of factors.

Suggestions

Considering the important role of macrosomia in infant and maternal mortality and morbidity, the results of the ongoing study could be used to improve the quality of antenatal care and maternal health as well as reduce maternal and neonatal mortality in the future. It is recommended that further studies should be conducted to investigate the trend of this disorder and other factors affecting it.

Application

This study can lead to an accurate estimate of the prevalence of macrosomia and its relationship to related factors in newborns and its impact on children's health, result in changes in policy to control the non-

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communicable disease as well as create guidelines that are fully consistent with the upstream goals of the family health and Health Ministry population. Besides, considering the large sample size and scope of the area, this study could be a good reference for future studies and assessing the trend of neonatal macrosomia and could be used by researchers in further research.

Conclusion

As the results indicated, the prevalence of macrosomia in infants in Mashhad was 6.6% and correlated with maternal age during pregnancy, infant's gender, number of fetuses, mode of delivery, consanguinity between parents, place of residence of parents and season of birth.

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Ethical Code

This study was approved by Ethical Committee of Mashhad University of Medical Sciences (ethical code: T5189, IRCT code: IR.MUMS.fm.REC.1396.271).

Conflict of interests

The authors declare that there is no conflict of interest.

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