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ASPECTS OF THE MACROSOMIC NEWBORN IN A ONE-YEAR COHORT

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SUMMARY

Background: *To determine the frequency, course, complications and outcome of macrosomia in newborns.*

Subjects and Methods: *A cross-sectional epidemiological study was conducted. The research was conducted at the Department of Gynecology and Obstetrics of the University Clinical Hospital Mostar (UCH Mostar), as well as at the Clinical Department for Intensive Care and Neonatology UCH Mostar in the period from January 1, 2022 to 31 December 2022. Data from the protocol, medical history and discharge letters of pregnant women who gave birth at the Clinic for Gynecology and Obstetrics, as well as data from the above for newborns transferred to the Clinical Department for Intensive Care and Neonatology was used. The parameters considered in newborns are: anthropometric measurements (birth weight, birth length, head circumference), sex, month of birth, gestational age, Apgar index, and for newborns transferred to paediatrics: pathological conditions (asphyxia, jaundice, sepsis, perinatal infection) , respiratory distress syndrome,) and the method and length of treatment.*

Results: *The occurrence of macrosomic newborns in this study is 10.4% of the total number of births in a year. A significant increase in the frequency of giving birth to macrosomic newborns from the second or more pregnancies was observed, and the number of birth complications was lower. Statistically, significantly more medication use and pregnancy pathology were found in the group of macrosomic newborns with pathology. Thus, in the group of newborns with pathology, it is more significant that they had jaundice and perinatal infection among the pathological conditions.*

Conclusion: *The frequency of macrosmia in newborns was determined, and two most common pathological conditions were jaundice and perinatal infection with a favorable perinatal background.*

Keywords: *fetal macrosomias, birth outcome, perinatal outcome*

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INTRODUCTION

A macrosomic newborn refers to a baby who is larger than average at birth. The term "macrosomia" is used to describe babies who have a birth weight that is above a certain threshold (above the 90th percentile for gestational age), typically around 4,000 grams (Sontag et al. 2018). The incidence of macrosomic newborns varies between regions and populations. In Hessian Hospitals, Germany, there was a 20% increase in newborns with a birth weight between 4000-4499 g and a 17% increase in newborns weighing more than 4499 g over a 13-year period (Berle 1997). In a study conducted in Sub Saharan Africa, the incidence of macrosomia varied between 2% to 15% (Valère et al. 2018). Macrosomia can occur due to various factors, including genetics, maternal diabetes, maternal obesity and gestational age. There is extensive evidence that maternal overweight and associated metabolic changes, including type 2 diabetes and gestational diabetes, play a central role in the development of macrosomia. The causes of high birth weight can include both genetic and environmental factors. However, the rapid increase in the prevalence of large newborns is primarily attributed to environmental causes (Henriksen 2008). The management of therapy during pregnancy in mothers of macrosomic newborns depends on the underlying condition being treated. There are several maternal underlying conditions that may contribute to macrosomia, including gestational alloimmune liver disease (Anastasio et al. 2016), endometriosis (Frincu et al. 2021) and maternal use of selective serotonin-reuptake inhibitors (Alwan et al. 2016). According to the search results, there are several studies that have examined the relationship between the mother's parity and the birth of a macrosomic child. Overall, the evidence suggests that parity may be a risk factor for macrosomia, but the relationship is not always statistically significant. Other factors, such as maternal weight gain, age, and gestational age, may also play a role (Valère et al. 2018, Amini et al. 2016). There is no clear answer to whether macrosomic newborns are more often male or female based on the search results. However, one study found that the percentage of female infants was higher than male among macrosomic infants (Al-Qashar et al. 2016) while another study shown that male newborns are more likely to be macrosomic compared to female new-

borns (Valère et al. 2018). The most common way of giving birth to macrosomic children is through cesarean section (Yamasmit 2011). It is important to note that macrosomia can increase the risk of complications during childbirth, such as shoulder dystocia (difficulty delivering the baby's shoulders) (Sontag et al. 2018). Macrosomic newborns are associated with higher rates of birth injuries, perinatal asphyxia, admissions into the special care newborn unit, hypoglycemia and hyperbilirubinemia (Bandika et al. 2014, Ogunfowora et al. 2019). The decision to transfer a macrosomic newborn to a larger clinical center or other department will depend on a variety of factors, including the newborn's medical condition, the availability of specialized care, and the admission criteria for local nurseries. Some factors that may be considered are medical conditions such as hypoglycemia or hypocalcemia (Bandika et al. 2014), delivery method (if a macrosomic newborn was delivered using vacuum-assisted delivery (VAD) or increased risk of birth injuries, such as fractures, especially to the clavicle or humerus, as well as soft tissue injuries. These injuries can occur during a difficult delivery or as a result of shoulder dystocia (Levin et al. 2021). The most common discharge diagnoses of macrosomic are not explicitly mentioned and the search results provide information on common diagnoses and conditions in newborns in general. Common diagnoses and conditions that may be relevant to macrosomic newborns are jaundice, newborn infection, early neonatal sepsis, feeding problems and complications related to prematurity (premature newborns, including those with macrosomia, may be at risk for various complications such as respiratory problems, neurological issues, and metabolic disorders) (Anagnostou et al. 2021, Camargo et al. 2021). The aim of our research was to determine the frequency, course, complications and outcome of macrosomia in newborns and to improve the way of monitoring and health interventions that can help reduce the risks associated with macrosomia as well as promote the long-term health of these newborns.

SUBJECTS AND METHODS

A cross-sectional epidemiological study was conducted. The research was conducted at the Clinic for Gynecology and Obstetrics of the University Clinical Hospital Mostar (UCH Mostar) as well as at the Clinical Department for Intensive Care and Neonatology of the UCH Mostar in the period from January 1, 2022 to December 31, 2022. Data from protocols, medical histories and discharge letters of pregnant women who gave birth at the Clinic for Gynecology and Obstetrics and data from protocols, medical histories and discharge letters for newborns transferred to the Clinical Department for Intensive Care and Neonatology were used. The study included 193 pregnant women who gave birth at the Clinic for Gynecology and Obstetrics and their newborns, as well as those newborns who were transferred to the Clinical Department for Intensive Care and Neonatology of the UCH Mostar. The parameters considered in the mother are: age, parity, type of delivery, method of fertilization, previous abortions, pathological conditions during pregnancy, medications during pregnancy, weight, height, body mass index (BMI) and body weight gain. The parameters considered in newborns are: anthropometric measurements (birth weight, birth length, head circumference), gender, month of birth, gestational age, Apgar index, and for newborns transferred to pediatrics: pathological conditions (asphyxia, jaundice, sepsis, perinatal infection, respiratory distress syndrome) and the method and length of treatment. In newborns transferred to pediatrics, pathological conditions in the form of referral and discharge diagnoses, method and outcome of treatment, and length of stay in the department were also considered. The birth weight of newborns was determined with a digital scale manufactured by Momert, model MM6475, immediately after birth, and the progression of the weight of newborns was monitored by daily weighing with the same scale. Birth length was measured with a centimeter tape manufactured by Wintape, model BWT-016. The gestational age was calculated based on the date of delivery and the date of delivery of the pregnant woman, which are recorded on the transfer list for the child from the Gynecology Clinic, which is in the medical documentation of each child. The Apgar index is the sum of the values of five criteria that are scored from 0 to 2, and the total value of the index can be from 0 to 10. It was determined in the 1st and 5th minutes. The results of the statistical analysis are expressed in absolute and relative frequencies. The significance of the differences was tested with the $\chi 2$ test (in the absence of expected frequencies with Fisher's exact test). The results of statistical tests were interpreted at the significance level of 0.05. P values that could not be expressed to three decimal places are shown as $P<0.001$. Statistical analysis of the collected data was done in IBM SPSS Statistics (version 25.0, SPSS Inc, Chicago, Illinois, USA) and Microsoft Excel 2019 (Microsoft Corporation, Redmond, WA, USA).

RESULTS

The data was taken from the period from January 1, 2022 to December 31, 2022. The total number of births in 2022 in UCH Mostar is 1,855 newborns, while the total number of macrosomic newborns is 193, which corresponds to an incidence of 10.4%. The most births in the investigated period were in the month of September, and the least in August, however, the difference was not statistically significant. In the studied sample, in the group of mothers there were statistically significantly more mothers without newborn pathology with natural birth, natural type of fertilization, significantly more mothers who did not take medication during pregnancy, and significantly more mothers who were without pathological conditions during pregnancy. According to the body mass index, the largest number of mothers was in the group of normally nourished (51%),

while 43.5% were overweight, and 4.7% were obese (table 1). Fisher's exact test statistically found significantly more use of drugs (the most frequently used drugs were antibiotics, levothyroxine, antiepileptics, methyldopa) and pregnancy pathology (the most frequently recorded conditions were infections, hypertension, epilepsy, thyroid diseases and GDM) in mothers whose children were at birth had a pathological condition that required therapy or additional diagnostic processing, and there were no significant differences between the groups in the other variables (method of fertilization and delivery, number of previous abortions, and mother's BMI). In the studied sample, the number of mothers who had two or more births is almost 50% higher than the number of first-time mothers. No significant difference was observed in maternal age, parity, height, body mass at the beginning and end of pregnancy, nor in weight gain and maternal BMI in macrosomic newborns who had a pathological condition after birth compared to macrosomic newborns without a pathological condition.

In the studied sample, there were statistically significant macrosomic newborns who were without accompanying pathology after their birth. Furthermore, the male gender is statistically more significant in the total number of macrosomic newborns. Other data refer to macrosomic newborns with some pathology who were transferred to the neonatology department. Thus, in that sample, it is more significant that the children had jaundice and perinatal infection from pathological conditions. The most common therapy they received was in accordance with the diagnosis, so phototherapy, antibiotics and supportive therapy were the most common. Most of the newborns were discharged from the hospital in less than 7 days. Only one newborn was transferred to another Clinical Center (table 2). We also observed the difference in anthropometric measurements (birth weight, birth length, head circumference), gestational age, and Apgar's vitality index in the 1st and 5th minutes of life in newborns with some pathological condition compared to newborns without pathology, where it was proven

Table 1. Presentation of data of all mothers of macrosomic newborns

	n	%	χ^2	p
Mother's group				
Pathology of the newborn	45	23,3	54,969	**<0,001**
Without newborn pathology	148	76,7		
Type of birth			44,813	**<0,001**
Natural	143	74,1		
Caesarean section	50	25,9		
Type of fertilization			189,021	**<0,001**
Naturally	192	99,5		
IVF	1	0,5		
Medicines			622,000	**<0,001**
No therapy	177	91,7		
Antibiotic	2	1,0		
Levothyroxine	11	5,7		
Antiepileptics	2	1,0		
Methyldopa	1	0,5		
Pathology of pregnancy			576,648	**<0,001**
Pregnancy without pathology	156	80,8		
Infection	3	1,6		
Hypertension	4	2,1		
Epilepsy	2	1,0		
Thyroid diseases	14	7,3		
GDM	14	7,3		
Abortions	13	6,7	144,503	**<0,001**
BMI by groups			73,378	**<0,001**
18,5- 24,9	100	51,8		
25-29,9	84	43,5		
>30	9	4,7		

significantly lower vitality index according to Apgar in the 1st minute of life. For other observed variables, there were no significant differences between these two groups.

There were significantly more birth injuries in the group of newborns with pathology, in other variables there were no significant differences between the groups (table 3).

Table 2. Presentation of parameters of macrosomic newborns

	n	%	χ^2	p
A group of newborns			54,969	**<0,001**
With pathology	45	23,3		
Healthy newborns	148	76,7		
Sex			29,145	**<0,001**
Male	134	69,4		
Woman	59	30,6		
Age when admitted to the department			42,133	**<0,001**
1-2 days	35	18,1		
3-4 days	9	4,7		
>7 days	1	0,5		
Referral diagnosis			35,667	**<0,001**
Jaundice	11	5,7		
Perinatal infection	12	6,2		
Perinatal infection + jaundice	2	1,0		
Muscular hypotonia	4	2,1		
Covid-19 positive mother	2	1,0		
Malformation syndrome	2	1,0		
Monitoring and processing	8	4,1		
Condition after resuscitation	2	1,0		
Thrombocytopenia	1	0,5		
Birth injury	1	0,5		
Discharge diagnosis			22,000	**0,005**
Jaundice	11	5,7		
Perinatal infection	10	5,2		
Perinatal infection+jaundice	6	3,1		
Neurological disorder	7	3,6		
Covid-19 positive mother	2	1,0		
Malformation syndrome	2	1,0		
Neonatal thrombocytopenia	2	1,0		
No pathology	4	2,1		
Birth injuries			871,487	**<0,001**
No birth injury	185	95,9		
Gluteus hematoma	2	1,0		
Brachial plexus injury	1	0,5		
Cephalhematoma and hematoma on the back	1	0,5		
Hematomas on the body	3	1,6		
Clavicle fracture	1	0,5		
Mechanical ventilation	1	0,5	41,089	**<0,001**
Therapy			23,289	**0,001**
Without therapy	12	6,2		

Table 2. Continuous

Antibiotics	12	6,2		
Phototherapy	9	4,7		
Antibiotics+phototherapy+supportive therapy	8	4,1		
Multiple therapy	2	1,0		
Oxygen therapy	1	0,5		
Supportive therapy	1	0,5		
Department			41,089	**<0,001**
Neonatology	44	22,8		
Intensive care	1	0,5		
Duration of hospitalization			37,356	**<0,001**
<=7 days	43	22,3		
>7 days	2	1,0		
Outcome			41,089	**<0,001**
Transferred to another institution	1	0,5		
Discharged home	44	22,8		

DISCUSSION

In our research, the frequency of macrosomia in newborns was determined, and the most common pathological conditions are jaundice and perinatal infection. It was also determined that more than three quarters of macrosomic newborns are healthy, and almost all newborns who were transferred to the pediatric department had a favorable treatment outcome. Based on numerous reports in the literature, it has been determined that macrosomic newborns are associated with an increased risk of intrapartum and neonatal complications and adverse perinatal outcome. The appearance of macrosomia in this research is similar to that in other works. In UCH Mostar in 2007, an incidence of 13.1% of macrosomic newborns was recorded (Tomic et al. 2007). In developing countries, the incidence is from 0.5 to 14.9%, which means that our research matches the frequency of macrosomia (Koyanagi et al. 2013). In our research, no significant statistical difference was proven between the ages of the mothers of healthy newborns and those who were transferred to the pediatrics department due to a pathological condition. Furthermore, considering the parity of the mothers, our research confirmed that macrosomia is associated with more births. A similar result was obtained in the research conducted by Agudelo-Espitia et al., who recorded that 40.2% of primiparous mothers and 59.8% of mothers who had two or more births gave birth to a macrosomic newborn (Agudelo-Espitia et al. 2019).When studying the mother's pathological conditions during pregnancy, two pathological conditions stand out. One of them is gestational diabetes mellitus (GDM), and this result is expected since the glucose supply to the fetus is greater. This promotes hyperinsulinemia in the fetus and consequently leads to accelerated growth. GDM occurs in 3-8% of pregnancies, and the most significant risk factors for its occurrence are the age and obesity of the pregnant woman. The frequency of GDM in the study by Donma et al. was 4.8% in mothers of macrosomic newborns, and in our study it is almost twice as high (Donma 2011). Another pathological condition that appears with the same proportion as GDM is thyroid disease. In our research, significantly more medication use and pregnancy pathology were shown in the group of mothers whose newborns were transferred to the pediatrics department after delivery. Furthermore, this research showed that almost half of the mothers at the beginning of pregnancy had a BMI greater than or equal to 25, which places them in the overweight or obese group. According to research in Mostar in 2007, only 17% of mothers had a BMI $\geq$ 25, which is statistically significantly less than in our research. The causes of high birth weight are genetic and environmental. Due to the possible impact on the environmental component, it is recommended to provide the woman with advice on nutrition and physical activity before pregnancy, which significantly reduces the risk of macrosomia and accelerated growth (Henriksen 2008). In our study, the difference in the frequency of caesarean section in mothers of healthy newborns compared to mothers of newborns with pathology was not statistically significant. In total, 25% of macrosomic newborns were born, which is higher compared to the study by Mazouni et al., where the frequency is approximately 18% (Mazouni et al. 2006). While, on the other hand, in a recent study by Jiun How Lim and associates, the frequency of caesarean section as a method of delivery is slightly less than half of the total number of deliveries (Lim et al. 2002). The general increase in the trend of cesarean delivery can be explained by the effort to avoid birth injuries to the mother and child caused by the passage of the newborn through the birth canal. The difference by gender is significant, male newborns are more than 2/3, which coincides with the research from 2017, where the results are almost equal to

our research. Regarding the gestational age, all newborns were born at term, while the average gestational weeks is 39.18. This is slightly below the expected results compared to other researches, where the number is somewhat higher (Lim et al. 2002). The reason could be more induction of vaginal delivery or elective caesarean sections to prevent fetal macrosomia and deliver the child before it reaches a mass that would contribute to complications during delivery. The vitality of the newborn was observed in the 1st and 5th minute, and we monitored the group of newborns with pathology and healthy newborns. The obtained results showed a statistically significant difference, and it was

Table 3. Difference of birth injuries in the group of macrosomic newborns with pathology and macrosomic newborns without pathology

	A group of newborns					
	With pathology		Healthy		χ^2	p
	n	%	n	%		
Sex					0,415	0,519
Male	29	64,4	105	70,9		
Female	16	35,6	43	29,1		
Birth injuries					10,445	**0,024***
No injury	40	88,9	145	98,0		
Gluteus hematoma	1	2,2	1	0,7		
Brachial plexus injury	1	2,2	0	0,0		
Cephalhematoma and hematoma on the back	1	2,2	0	0,0		
Hematomas on the body	1	2,2	2	1,4		
Clavicle fracture	1	2,2	0	0,0		

*Fisher's exact test

determined that healthy newborns have a better average vitality score. Regarding the consequences of macrosomic newborns, birth injuries were observed, which in our study were almost three times less than in the study by Akindele et al., and twice less than in the study by Venditelli et al. (Akindele et al. 2017, Vendittelli et al. 2012). The clinical picture of hypertrophic newborns was observed, as well as the symptoms and consequences they developed after birth. It can be seen from the research that the most frequent pathologies were jaundice, perinatal infection and neurological disorders. Our research coincides with the results of Akindele et al. (Akindele et al. 2017). Modern obstetric and neonatal care today is at a much higher level in terms of expertise and diagnostics and is in constant progress, so nowadays many problems that were previously seen in these newborns have been significantly reduced. Regardless of everything, macrosomia still deserves attention because of the associated morbidity risks. Any woman prenatally diagnosed with a fetus weighing more than 4000 grams, even if the prediction of macrosomia is incorrect, should be fully informed about the risks associated with macrosomia for herself and the baby. Moreover, these newborns should participate in very careful medical monitoring for timely recognition of possible pathological conditions (Zhang et al. 2008)

CONCLUSION

From our research, it can be seen that the majority of macrosomic newborns are healthy, and those that had some pathology were very successfully treated in the neonatology department and were discharged home. We believe that it would be useful to upgrade this research so that it is compared with a control group and that the research is carried out over several years, in order to obtain a more credible picture.

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Conflict of interest:
The authors declare no conflict of interest.

Contribution of individual authors:
M.J.R. conceived and designed the study; L.A. collected the data; A.K. and L.A. analyzed data; M.J.R., A.K. and L.A. interpreted the results; A.K. and L.A. prepared the tables; A.K. and L.A. drafted the manuscript; M.J.R, A.K. and L.A. edited and revised the manuscript; M.J.R. approved the final version of the manuscript.

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Ethical background:

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University Hospital in Mostar (Reg. No. 1358/23, Mostar, May 29, 2023).
Informed consent statement: Informed consent was obtained from all subjects involved in the study.
Data availability statement: We deny any restrictions on the availability of data, materials and associated protocols. Derived data supporting the findings of this study are available from the corresponding author on request.

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