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Professional paper

STATISTICAL ANALYSIS OF MATERNAL AND FETAL RISK FACTORS ASSOCIATED WITH INTRAUTERINE FETAL DEMISE

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Abstract

Fetus mortus or fetal intrauterine death is one of the potential tragic consequence in obstetrics, which can result from fetal, maternal and placental disorders. The main focus of this study is based on the correlation between maternal and fetal biological characteristics and pathological conditions with intrauterine fetal death. Maternal factors in this study included body mass index, gestation weight gain, comorbidities, whereas fetal factors consisted of gestational age at the time of fetal death and fetal body parameters including birth weight and body length. This retrospective cohort study was conducted at a tertiary care center (University clinic for gynecology and obstetrics, Skopje), which included 59 patients with fetal intrauterine death. All the clinical data for this study were obtained from patient's medical documentation, implemented in a period of time from January to December 2024. Evaluation of the data was made applying descriptive analysis and for the relation between variables were used statistical tests as the Chi square test and Student's t-test. Important significant relation was found between maternal obesity, excessive gestational weight gain and maternal comorbidities (including diabetes and hypertensive disorders) with intrauterine fetal demise. This study emphasizes the crucial role of maternal risk factors for severe fetal complications that may result in intrauterine fetal death and the importance of identification of high risk pregnancies without delay for improving prenatal and perinatal outcomes.

Keywords: Fetal intrauterine death, comorbidities, hypertensive disorders, diabetes, body parameters

1. Introduction

Intrauterine fetal death (IUFD) refers to fetal death following the twentieth week of gestation, but before or during labor, which can severely impact maternal morbidity and mortality. IUFD remains a distressing event for both future parents and the medical staff. According to Karcz and Krolak-Olejnik (2024), IUFD is still presented among pregnant women with underlying condition such as obesity, hypertensive related disorders and diabetes, despite the improvement in the prenatal and perinatal medical care.

Obesity is defined as body mass index of 30 or more, and this condition among pregnant patients is one of the most potential risk factors for adverse outcomes during pregnancy. It can result in multiple complications that negatively affect the maternal health, the function of the placenta, normal development of the fetus, leading to complications such as intrauterine fetal growth restriction, maternal hypertensive disorders and stillbirth (Grieger et al., 2021). Additionally, maternal hypertension, including preeclampsia can reduce uteroplacental perfusion and consequently increase the risk of IUFD (Fox et al., 2019).

As reported by Ye et al.(2022), fetal and maternal morbidity and mortality are increased among patient with preeclampsia, which is characterized by hypertension and proteinuria and affects

2-8 % of overall pregnancies. Moreover, gestational diabetes mellitus is known to endanger stillbirth with complications such as macrosomia, intrauterine infection and placental dysfunction (Langley-Evans, Pearce & Ellis, 2022).
The common complications from obesity and diabetes such as fetal macrosomia and intrauterine fetal distress and complications from hypertension that compromise placental function can result in fetal death. Except these factors, fetal loss is also related to several biological and extrinsic factors. Some studies were carried out with the objective of identification of maternal risk factors for IUFD with a focus on preventive measures and proper management of these cases (American College of Obstetrician and Gynecologists [ACOG], 2013; Maslovich & Burke, 2025).
With this research we explore further these maternal conditions and their correlation with fetal demise, making progress into appropriate clinical evaluation and management, with the aim to minimize the incidence of IUFD.

2. Material and methods

This retrospective observational study was conducted at a tertiary care center, University clinic for gynecology and obstetrics, Skopje, which included the medical records of 59 patients with fetal intrauterine death. All the clinical data for this study were obtained from patient's medical documentation, implemented in a period of time from January to December 2024.
The inclusion criterion was women who had experienced IUFD and had a history of chronic conditions such as hypertensive disorders, diabetes, obesity etc. Also, from the medical data were observed maternal characteristics, among them body mass index, gestation weight gain, comorbidities and overall health status. Body mass index was calculated through values of weight and height before pregnancy or during the period of the first trimester. Additionally, hypertension and diabetes status were added as yes or no depending on the clinical diagnosis.
Fetal factors consisted of gestational age at the time of fetal death and body parameters including birth weight and body length.
Descriptive statistical analysis was calculated from maternal weight gain during pregnancy, fetal birth weight and length, gestational age and body mass index of the patient. Statistical inference testing was applied using SPPS 26.0. Furthermore, we implemented tests such as a Kolmogorov – Smirnov and t-test, to examine the normality of data on BMI (Kolmogorov – Smirnov test) and against which t-test was applied to determine if there was a significant difference between participants with average BMI and the healthy limit of 25.
In our study we applied the Pearson correlation coefficients to calculate the relation between gestational age and outcomes in the fetus, such as body birth weight and length and also to investigate association between gestational age at birth and maternal weight gain, we implemented linear regression. In addition, Chi square tests were utilized if there was any association between diabetes, hypertensive disorders and Hadlock fetal weight parameters.

3. Results

For the purposes of this paper, a retrospective observational study was conducted on 59 patients from January 2024 to December 2024, in whom intrauterine fetal death was diagnosed during the defined study period. Clinical data on the body mass index (BMI) and health status of the mothers were extracted from their medical records.
Statistical analysis of the data was performed using SPSS version 26.0. Descriptive statistics were calculated to summarize the results, and the t-test for arithmetic means as well as the Chi-square test were employed.

The neonates studied were 29 females and 31 males. GWG ranged from 3 to 23 and gestational week ranged from 20 to 39. These results are presented below through diagrams.

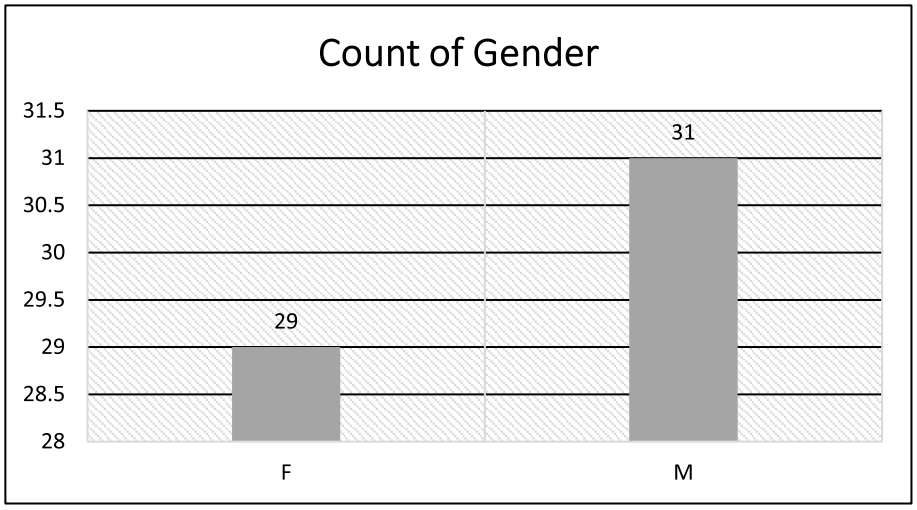

Figure 1

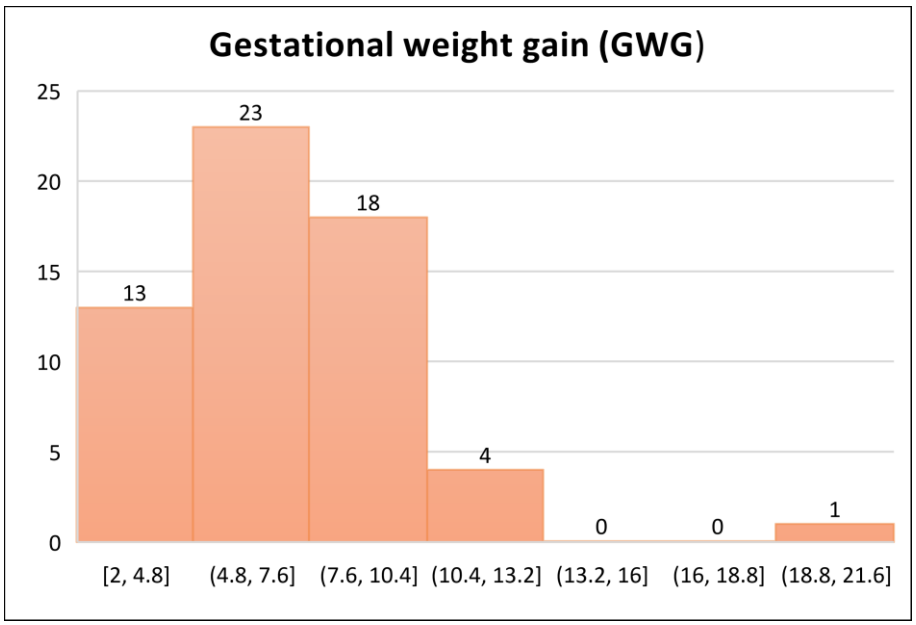

Figure 2

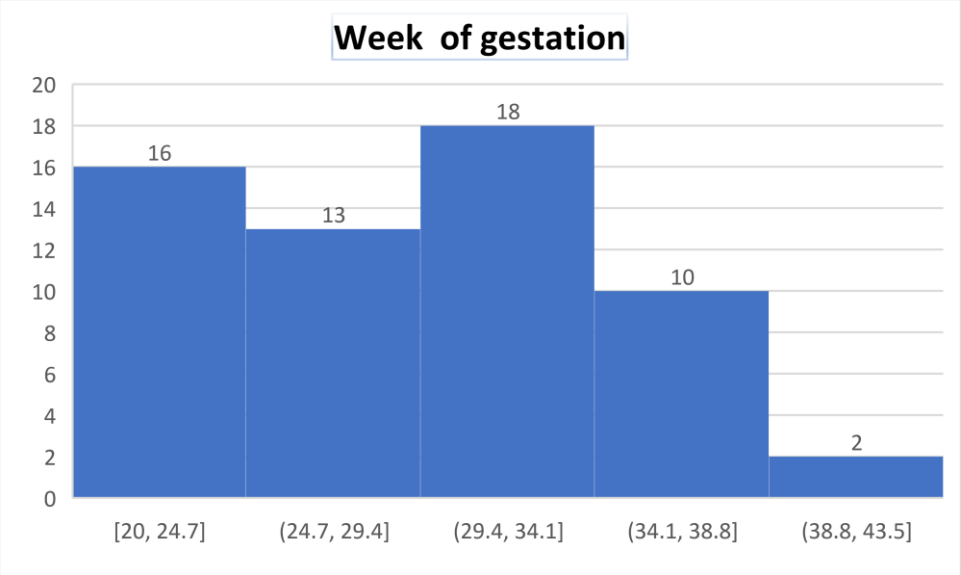

Figure 3

Descriptive statistics for the BMI variable are provided in the table:

Table 1. Descriptive statistics for BMI (N=59)

Variables	M	SD	Min	Max
BMI	**26,37**	**3.81**	**15,3**	**37,2**

By applying the Kolmogorov-Smirnov test, we determined that the BMI data are normally distributed. Next, we examined the relationship between the arithmetic mean of the BMI value of the respondents, in relation to the healthy weigh range which is smaller than 25, i.e., we test the null hypothesis $H_0: m \leq 25$, against the alternative hypothesis $H_1: m > 25$ and a significance level of 0.05. The results of this test are given in the following table:

Table 2. Result of the t-test for mathematical expectation for BMI

Variable	N	M	SD	t	p
BMI	**58**	**26,37**	**3.81**	**2,738**	**0.0041**

The value of the t-test is t = 2.738 at p < 0.05. Since p = 0.0041 is less than 0.05, we determine that there is a statistically significant difference between the standard limit for BMI and the average BMI value of the respondents. This means that the null hypothesis is rejected, and the alternative hypothesis is accepted, suggesting that the average BMI value of mothers diagnosed with intrauterine fetal demise is greater than 25.

In order to determine the relationship between the week of pregnancy (independent variable x) and the mother's weight (dependent variable y), we determined the linear regression line. Namely, from the data we obtained that the regression line is:

$$y = 4.0158 + 0.1017x,$$

where the mother's weight increases by 0.1017 kg per week. This value is lower than the lowest expected value (mothers should gain 1–1.5 kg per month, i.e., at least 1 kg per month ≈ 0.25 kg/week and at most 1.5 kg per month ≈ 0.375 kg/week).

We examined the relationship between the week of gestation and the weight of the newborn. For this purpose, we used the Pearson correlation coefficient. The results are given in the following table:

Table 3. Pearson correlation coefficient week of gestation – birth weigh

Variables	N	M	SD	r	p
Gestational week	**59**	**29.5**	**26.6**	**0.853**	**0.000**
Birth weigh	**59**	**1482.59**	**937.72**		

From the table it can be seen that the value of the Pearson coefficient is r=0.839 with p=0.000<0.05, from which it can be concluded that there is a statistically significant strong positive relationship between the two quantities, i.e., the length of the stillborn increases with increasing week.
We also examined the relationship between the week of pregnancy and the length of the stillborn. For this purpose, we used the Pearson correlation coefficient for analysis. The results are presented in the following table:

Table 4. Pearson correlation coefficient week - body length of the newborn

Variables	N	M	SD	r	p
Gestational week	**59**	**29.5**	**26.6**	**0.839**	**0.000**
Body length of the newborn	**59**	**37.27**	**9.09**		

From the table it can be seen that the value of the Pearson coefficient is r=0.839 with p=0.000<0.05, from which it can be concluded that there is a statistically significant strong positive relationship between the two quantities, i.e., the length of the stillborn increases with increasing week.
Using the Chi-square test for independence, we had checked whether there is a statistically significant relationship between hypertension and Hadlock. We divided the Hadlock values into two groups <10 and >10. From this, the following table is obtained:

Table 5.

	Hadlock >10	Hadlock <10	Total
Hypertension - yes	11	5	16
Hypertension - no	19	24	43
Total	39	29	59

At α = 0.10 the value of the Chi-square test is 3.068, with df=1 and p = 0.080< α. Hence there is a statistically significant association between Hadlock and hypertension at this level of significance. In other words, women with a Hadlock >10 are more likely to have hypertension compared to those with a Hadlock <10, and this difference is statistically significant at the 10% confidence level.
Using the Chi-square test for independence we will check whether there is a statistically significant association between diabetes and Hadlock. We divided the Hadlock values into two groups <90 and >90. Hence the following table is obtained:

Table 6.

	Hadlock >90	Hadlock <90	Total
Diabetes - yes	12	18	30
Diabetes - no	5	24	29
Total	17	42	59

At α = 0.10 the value of the Chi-square test is 4.766, with df=1 and p = 0.029< α. Hence there is a statistically significant association between Hadlock and hypertension at this level of significance. In other words, parturient women with Hadlock > 90 are more likely to have diabetes.

4. Discussion

The results of our study indicate that maternal comorbidities including diabetes, obesity, hypertensive disorders present high risk factors for intrauterine fetal death (IUFD). There was a close relation between increased maternal body mass index (>25) among participants and stillbirth, which is in agreement with other similar studies, as demonstrated on their research from Grieger et al. 2021, where they found strong correlation between obesity of the patients with the risk for stillbirth. This maternal and fetal risk factor highlights the importance of the maternal wellbeing in the prenatal and perinatal stages, also the need of early and proper detection and management of these factors to avoid complications. Starting from obesity, diabetes and hypertensive disorders, they were significantly related with prenatal and perinatal complications, thus resulting in stillbirth.
From their research, Jovanovich et al. (2023) demonstrated in their study that vascular and metabolic complications from chronic disorders can affect perinatal outcomes. The proper management of these chronic diseases is essential to avoid fetal complications and intrauterine fetal death.

5. Conclusion

From this study, we concluded that maternal health has fundamental role in proper development of the fetus and in defining pregnancy outcomes, including intrauterine fetal death (IUFD). Disorders including hypertension, diabetes, obesity are strongly connected with increased risk to IUFD, which emphasizes the importance of detailed evaluation, close follow up and management of these maternal diseases throughout the prenatal and the perinatal periods.
Furthermore, studies are needed to evaluate the risk factors that are related to intrauterine fetal death, particularly external factors and genetic factors, which can help to analyze deeper the multifactorial causes of IUFD.

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