

Maternal obesity as a perinatal risk factor

Otyłość matki jako czynnik ryzyka perinatalnego

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Summary

Objective: The aim of the study was to estimate the effect of maternal obesity on pregnancy course, delivery and newborn well-being.

Material and methods: Data about women who delivered in PMMH was analyzed and obese pregnant women (pre-pregnancy BMI ≥ 30) were included in the study group; the rest of the mothers constituted the control group. The pregnancy course, labor and delivery, and newborn well-being were taken into consideration.

Results: 4648 women were found in our delivery database, among them 208 (4.48%) were classified as obese. In this group, pregnancy-associated hypertension was common, either non-proteinuric one (8.65% vs 2.39%, $p=0.001$) or preeclampsia (4.81% vs 1.58%, $p<0.05$). There were also more cases of gestational diabetes mellitus requiring insulin therapy (9.62% vs 1.48%, $p<0.001$) and polyhydramnios (4.81% vs 2.11%, $p<0.05$) than in case of controls. The mean gestational age at delivery and newborn general health (estimated by Apgar score, mean umbilical cord pH and the incidence of cases with $pH \leq 7.10$) were similar in both groups. The mean birthweight (3266g vs 3100g, $p<0.05$) and the incidence of macrosomia (20.19% vs 5.69%, $p<0.001$) were significantly higher in the study group. The delivery mode was comparable in both groups, with the marked tendency towards higher incidence of elective cesarean sections in case of obese mothers (27.88% vs 19.90%, $p=0.01$).

Conclusion: Maternal obesity is a significant perinatal risk factor; with pregnancy-associated hypertension and gestational diabetes requiring insulin therapy in obese mothers and macrosomia in newborns as most common complications.

Key words: pregnancy / obesity / pregnancy outcome /

Streszczenie

Cel pracy: Celem pracy była ocena wpływu otyłości matki na przebieg ciąży, porodu i stan noworodka.

Materiał i metody: Retrospektywnej analizie poddano przebieg porodów pacjentek hospitalizowanych w ICZMP w latach 2004-2006. Grupę badaną stanowiły ciężarne otyłe (przedciążowe BMI ≥ 30); pozostałe pacjentki stanowiły grupę kontrolną. Analizie poddano przebieg ciąży i porodu oraz stan urodzeniowy noworodków.

Wyniki: Wśród 4648 kobiet znalezionych w naszej bazie danych odbytych porodów 208 (4,48%) zostało zakwalifikowanych jako otyłe. W tej grupie pacjentek znacznie częściej występowało nadciśnienie tętnicze związane z ciążą, nadciśnienie tętnicze bez białkomoczu (8,65% vs 2,39%, $p=0,001$) oraz preeklampsja (4,81% vs 1,58%, $p<0,05$). Znacznie częściej występowały przypadki cukrzycy ciążowej wymagającej leczenia insuliną (9,62% vs 1,48%, $p<0,001$) i wielowodzia (4,81% vs 2,11%, $p<0,05$). Średnia wieku ciążowego w momencie porodu i stan noworodków (oceniany w skali Apgar, średnie wartości pH w tętnicy pępowinowej oraz przypadki $pH \leq 7,10$) były podobne w obu badanych grupach. Średnia masy urodzeniowej (3266g vs 3100g, $p<0,05$) i wystąpienie makrosomii (20,19% vs 5,69%, $p<0,001$) były znamienne wyższe w grupie badanej.

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Sposób porodu był porównywalny w obu badanych grupach, z zaznaczoną tendencją wzrostową elektywnego cięcia cesarskiego w grupie matek otyłych (27,88% vs 19,90%, $p=0,01$).

Wnioski: Otyłość matki jest znaczącym czynnikiem ryzyka perinatalnego; u otyłych kobiet nadciśnienie tętnicze indukowane ciążą i cukrzyca ciążowa wymagająca leczenia insuliną są najczęstszymi powikłaniami, natomiast najczęstszym powikłaniem noworodkowym jest makrosomia

Słowa kluczowe: **cięża / otyłość / wyniki położnicze /**

Introduction

Obesity has a highly negative impact on the general health of contemporary societies. It strongly contributes to significant morbidity and mortality rates caused by numerous conditions, chief among them diabetes mellitus type 2, hypertension, heart disease and some neoplasms. In recent years, the prevalence of overweight and obese individuals has increased in many countries, especially in Europe and the USA. In the USA the percentage of obese people ($BMI \geq 30 \text{ kg/m}^2$) has more than doubled in the last 20-30 years, from 12.8% in 1976 to 27% in 1999 [1].

Obesity also affects women in the reproductive age and the percentage of obese mothers in Europe ranges from 8-19%. A growing number of studies has concluded that maternal obesity is a significant risk factor of pregnancy complications, both for a mother and a child [1, 2].

As far as mothers are concerned, the most threatening medical complications include gestational diabetes, hypertension, thromboembolism, complications of labor and the necessity of a cesarean section. There is a notably increased rate of cesarean deliveries in the group of obese mothers. An adverse pregnancy outcome of the offspring results from macrosomia, intrauterine growth restriction (IUGR), unexplained stillbirth and congenital anomalies. There is an increased rate of congenital anomalies in this group of newborns [1, 3].

So far, the majority of published studies has come from the United States and Polish literature on this subject is limited and outdated. In the present population-based study, we have aimed at estimating the effect of maternal obesity on pregnancy course, delivery mode and newborn well-being in an unselected Polish population.

Materials and methods

Data was obtained from the Polish Mother's Memorial Hospital, Department of Maternal-Fetal Medicine delivery database, which comprises details of pregnancy, the mode of delivery and neonatal outcome for all patients who had delivered in the Department between 01.01.2004-21.04.2006.

In an retrospective analysis all singleton pregnancies which ended after 22 completed weeks of gestation, with available information on height and pre-pregnancy weight were included; if the pre-pregnancy weight lacked the weight recorded at the first visit it was used for further calculations. BMI was calculated with the use of a standard equation: weight (kg) divided by squared height (m^2).

The BMI values were used to stratify the sample: pregnant women with $BMI \geq 30$ were considered obese and included in the study group (group II), while patients with $BMI < 30$ constituted the control group (group I).

Outcome measures included maternal morbidity with special attention paid to gestational diabetes and pregnancy-associated hypertension, gestational age at delivery (weeks), mode of delivery, newborn birthweight and well-being. The following definitions were used for further analysis of the birthweight: neonatal macrosomia defined as birthweight above 90 percentile for the gestational age and small-for-date as birthweight below 3 percentile. Definitions for the gestational (non-proteinuric) hypertension and preeclampsia were based on recommendations of the *American College of Obstetricians and Gynecologists* [4]. The assessment of newborn well-being was based on 1-min. Apgar score and umbilical blood analysis (pH). 1-min. Apgar score < 4 pts as well as $pH \leq 7.10$ were regarded as indicators of bad condition of a newborn.

The raw frequencies of various outcomes were calculated and the comparison of estimates was performed with Student's t test, χ^2 test and Fisher's exact test if appropriate; with a value of $p < 0.05$ as significant. The mean values in groups were compared with linear regression model in which the control group was used as a reference. All statistical analysis was performed with STATA 8.

Results

Information on BMI was available for 4648 pregnancies; within this sample 208 patients had $BMI \geq 30$ (4.48% of all patients who had delivered during the analyzed timeframe).

Obesity was positively associated with hypertension in pregnancy, either non-proteinuric one or preeclampsia (PE). The frequency of glucose intolerance requiring insulin therapy (gestational diabetes – GDM-G2) was also higher in the obese group. There was no difference in the incidence of intrauterine infections, intrahepatic cholestasis of pregnancy (ICP) and urinary tract infections (UTI). (Table I). Mean gestational age at delivery was not significantly different in the study and control groups, 37.3wk vs 37.8wk respectively ($p=0,5$). The newborn well-being was also comparable. However, there was a marked tendency towards higher incidence of low 1-min Apgar score in the study group (i.e. < 4 pts), $p=0.06$. (Table II).

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Table I. Maternal morbidity.

| | Group I (BMI <30) n (%) | Group II (BMI ≥30) n (%) | p |
|--------------------------------|----------------------------|-----------------------------|--------|
| Non - proteinuric hypertension | 50 (2.39) | 9 (8.65) | 0.001 |
| PE - moderate | 18 (0.86) | 2 (1.92) | Ns |
| PE - severe | 15 (0.72) | 3 (2.88) | <0.05 |
| UTI | 4 (0.19) | 1 (0.96) | Ns |
| GDM-G1 | 36 (1.72) | 3 (2.88) | Ns |
| GDM- G2 | 31 (1.48) | 10 (9.62) | <0.001 |
| Polyhydramnios | 21 (1) | 5 (4.81) | <0.05 |
| Oligohydramnios | 4 (2.11) | 5 (4.81) | Ns |
| Intrauterine infection | 23 (1.1) | 3 (2.88) | Ns |
| ICP | 46 (2.2) | 1 (0.96) | Ns |

BMI – body mass index, PE – preeclampsia, GDM – gestational diabetes, UTI – urinary tract infection.

Table II. Newborn status.

| | Group I (BMI <30) | Group II (BMI ≥30) | p |
|----------------------------|------------------------|------------------------|--------|
| 1-min Apgar score (mean) | 8.62 | 8.38 | Ns |
| 1-min Apgar score <4 | 84 (2%) | 10 (4.8%) | 0.06 |
| Cord pH (mean) | 7.27 | 7.26 | Ns |
| Cord pH ≤7.10 | 136 (3.25%) | 12 (5.77%) | Ns |
| Birthweight (gram, mean) | 3100.29 (SD 751.19) | 3266.25 (SD 928.97) | <0.05 |
| Macrosomia (>90 centil) | 238 (5.69%) | 42 (20.19%) | <0.001 |
| Small-for-date (<3 centil) | 438 (10.48%) | 10 (4.8%) | 0.06 |

Table III. Mode of delivery.

| | Group I (BMI <30) n (%) | Group II (BMI ≥30) n (%) | p |
|------------------------------|----------------------------|-----------------------------|-------|
| Spontaneous vaginal delivery | 2376 (56.84) | 86 (41.35) | Ns |
| Elective cesarean section | 832 (19.90) | 58 (27.88) | 0.01 |
| Emergency cesarean section | 722 (17.27) | 48 (23.08) | 0.027 |
| Forceps | 218 (5.22) | 4 (1.92) | 0.5 |
| Breech delivery | 8 (0.19) | 1 (0.96) | Ns |

Mean birthweight was significantly greater in the obese group, 3266g vs 3100g, $p < 0.05$. The detailed analysis of the birthweight revealed an increased rate of neonatal macrosomia in the study group (20.19%), approximately 4 times higher than in the control group (5.69%). The incidence of birthweight above 4000g was also greater in the study group compared with controls, 17.31% vs 5.89% respectively, $p < 0.001$. On the other hand, the frequency of small-for-date babies was lower in the obese group but the difference was not significant. (Table II).

We have also analyzed the incidence of congenital anomalies and found no statistically significant difference. The most frequent anomalies in the obese mothers were those of the central nervous system (2.9%). There was a higher incidence of stillbirth in the obese group but the difference was not significant (1.92% vs 0.53%, $p = 0.12$).

Mode of the delivery is summarized in table III. The frequency of cesarean sections, either elective or emergency, was increased in obese women. The incidence of forceps delivery and breech delivery was similar in both groups.

Discussion

An increasing prevalence of overweight and obese pregnant women highlights the need for more extensive and in-depth knowledge on possible maternal and fetal complications due to maternal obesity.

The most frequently detected maternal adverse effect of obesity is glucose intolerance. Salomon et al reported the relative risk (RR) of gestational diabetes of 2.1 for pregnant women with BMI 25-29.9kg/m², and RR of 2.9 for mothers with BMI ≥30kg/m² [5]. Similar results were reported in a British study [2] where Sebire et al analyzed the pregnancy and delivery outcome in a population of 287 213 women. These authors compared outcomes in women stratified according to pre-pregnancy BMI. In this population, 27.5% of women were overweight and 10.9% obese. In the obese women, the incidence of gestational diabetes was high (3.5%) and the relative risk was 3.6 [2]. Baeten et al also reported similar results, with a 6.0% gestational diabetes rate (OR=5.3 compared with patients with BMI <20) [10]. In the present study we confirmed the increased incidence of glucose intolerance requiring management, either a diet or insulin therapy. The finding that in the majority of obese women (70%) insulin therapy had to be implemented is of clinical significance.

Most studies have noted that obesity is linked to pregnancy-associated hypertension with but only a few distinguished between gestational (non-proteinuric) hypertension and preeclampsia [1, 2]. Edwards et al reported a general increase of hypertension in pregnancies, without distinguishing between those two entities [6]. On the other hand, Thadhani et al found an increased incidence of either gestational hypertension or preeclampsia in women with BMI ≥30kg/m², with relative risk of 2,6 and 2,1 respectively [7]. Our study confirms that obese women are at a higher risk of gestational hypertension and preeclampsia, especially severe one.

Macrosomia is one of the most important complications as far as offspring of obese women is concerned. The suggested underlying pathophysiological mechanism is fetal hyperinsulinemia in response to elevated serum glucose level in obese mothers [2]. Several authors found that maternal obesity is an independent risk factor for neonatal macrosomia [1, 8, 9, 10]. Baeten et al noted an increased risk of fetal/neonatal macrosomia in patients with BMI ≥30kg/m² (OR=2.1) [1]. Our findings of a high incidence of macrosomia (20.19%) and birthweight exceeding 4000g (17.31%) in offspring of obese mothers are consistent with the previous reports.

Obese women are consistently found to be at an increased risk of cesarean section compared with non-obese women [8]. In the present study, we also observed a higher rate of cesarean sections, either elective or emergency. This can be attributed to an increased incidence of macrosomia and almost threefold rise in the newborns with birthweight >4000g.

Our study confirms that obesity in pregnancy is a significant risk factor for adverse perinatal outcome. In the face of a rapidly increasing prevalence of obesity in women at the reproductive age, the understanding of risks related to obesity in pregnancy is essential for providing an adequate perinatal care. It should be stressed that obesity is one of the few alterable risk factors of an adverse pregnancy outcome.

Thus, a proper education of patients in the preconception period and reduction of body mass may significantly improve pregnancy outcomes.

Conclusions

1. Maternal obesity is a significant risk factor for pregnancy-associated hypertension, especially severe preeclampsia, gestational diabetes requiring insulin therapy and polyhydramnios.
2. The most common neonatal complication is macrosomia; there is also significant difference in birthweight .

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