Examining the effect of maternal obesity on maternal and in newborn survival in pregnancies

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ABSTRACT:
Aim: The purpose of this study was to look at the effect of maternal obesity on maternal and newborn existance in pregnancies affected by GDM.
Methods: The study was conducted in Mother and Child Health Centre, Mian Wali Qureshian Rahim Yar Khan. Females having singleton pregnancies and GDM were found and recruited in an outpatient GDM education, monitoring, and care program. Maternal and neonatal pregnancy results have been contrasted for obese (30 kg/m2) and non-obese (530 kg/m2) females, as well as women in seven ascending pre-pregnancy BMI classes.
Results: There were 500 individuals in all. Maternal obesity was linked to the requirement for oral hypoglycemic medications or insulin, pregnancy-associated hypertension, interventional delivery, and caesarean delivery. Stillbirth, macrosomia, shoulder dystocia, hypoglycemia, and jaundice were all considerably elevated. When five growing categories of body mass index were examined, increasing BMI was shown to be strongly related to identical negative maternal and newborn results.
Conclusion: Increased maternal BMI is related having poorer maternal and newborn results in women suffering GDM.
Keywords: Maternal Obesity, Newborn, Pregnancies, Gestational Diabetes Mellitus.
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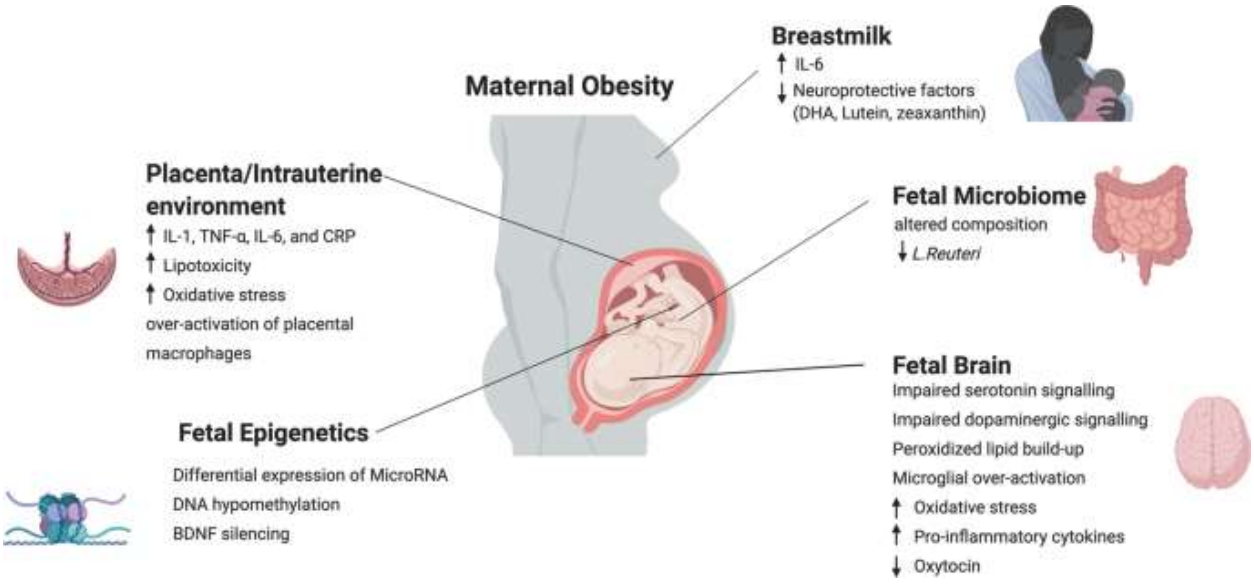
INTRODUCTION:

In recent years, the number of women of reproductive age who are obese has increased a lot. Between May 2021 and April 2022, 69% of adults in Pakistan and 58.7% of women in their reproductive age were classified as overweight or obese. This rise in obesity has brought attention to the higher risks associated with being obese during pregnancy [1]. These risks include a greater chance of needing a cesarean delivery, experiencing stillbirth, developing high blood pressure disorders during pregnancy, having structural problems with the baby, and getting gestational diabetes [2]. However, there is still some disagreement about the best way to manage the weight of obese women before they become pregnant and what recommendations to give them for weight gain during pregnancy [3]. In Pakistan, about 140,500 women, which is 5% of all pregnancies, experience gestational diabetes each year [4]. Whenever a pregnancy is affected by gestational diabetes, both the woman including the baby are at a greater chance of problems, that include caesarean delivery, delivering a big baby, low blood sugar

in the newborn, stillbirth, and admittance to the neonatal intensive care unit [5]. When a woman is both obese before pregnancy and has gestational diabetes, the risk of problems during pregnancy becomes even greater. Our current research aimed to explore effects of a higher BMI before pregnancy, which includes being overweight, obese, or severely obese, on the outcomes for both mother and baby in pregnancies complicated by gestational diabetes [6]. The study focused on women who remained admitted in an outpatient program for education and management of gestational diabetes [7].

Image 1:

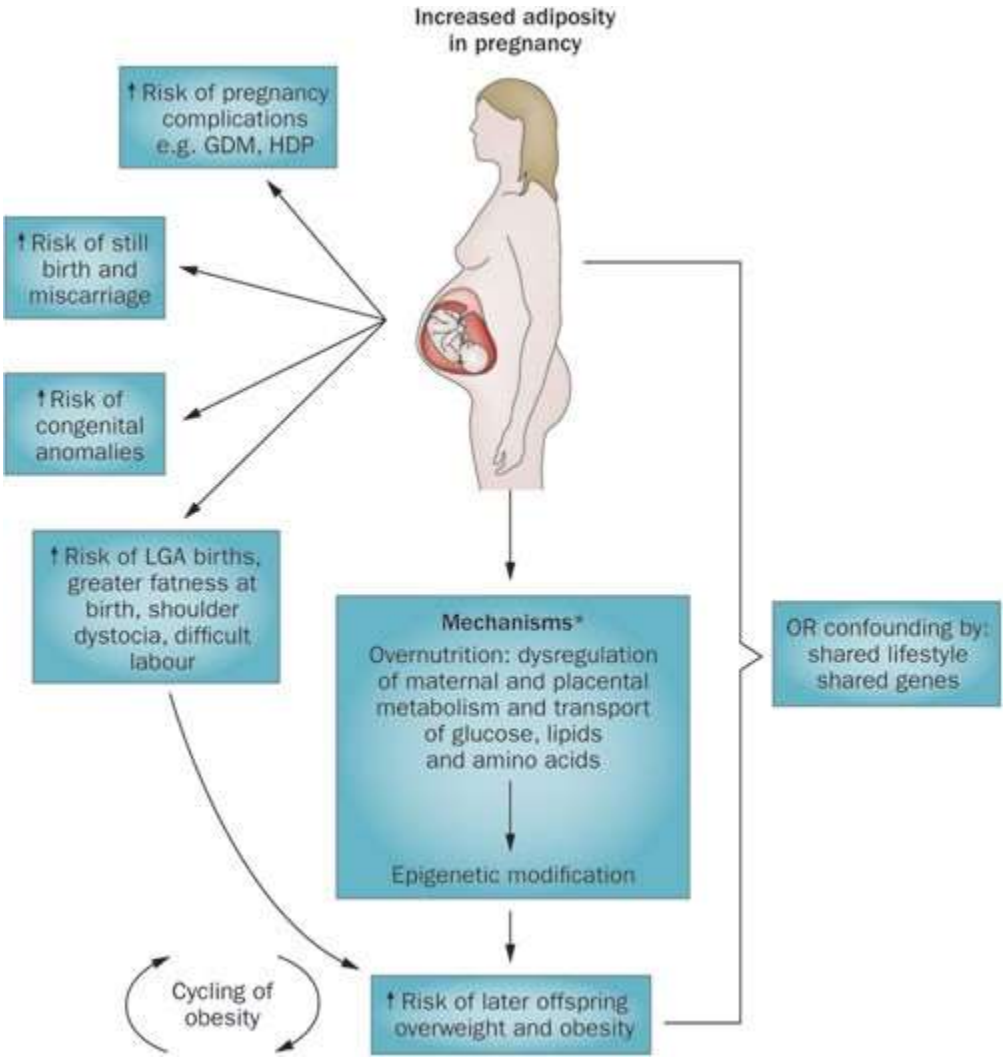


Pregnancy is a remarkable journey filled with numerous physical and emotional changes, as a woman's body adapts to support the growth and development of a new life. However, the presence of certain health conditions can significantly influence the course and outcomes of pregnancy [8]. One such condition that has garnered significant attention in recent years is maternal obesity. Maternal obesity, defined as having a body mass index (BMI) of 30 or higher before pregnancy, has become a global health concern [9]. The prevalence of obesity among females of childbearing age has been steadily rising in many countries, reflecting a concerning trend. The impact of maternal obesity extends beyond the individual, affecting both the mother and her developing fetus [10].

Our current introduction purpose was to get a summary of outcome of maternal obesity on pregnancy outcomes, shedding light on the potential risks and complications associated with this condition [11]. It explores the various factors that contribute to adverse outcomes and highlights the importance of addressing maternal obesity as a public health priority. Firstly, maternal obesity is associated with an increased risk of developing various medical conditions during pregnancy [12]. These may include gestational diabetes, preeclampsia, and hypertension, all of which can have serious implications for both maternal and fetal health. Obese women also face higher rates of cesarean section delivery due to complications such as fetal macrosomia (excessive birth weight) and difficulties in labor progression [13]. Furthermore, maternal obesity has been related to hostile fetal results. Infants born to obese mothers are more likely to experience congenital anomalies, including neural tube defects and cardiac abnormalities [14]. They are also at a greater risk of preterm birth, stillbirth, and neonatal mortality. The long-term consequences for the child's health, such as an increased susceptibility to obesity and metabolic disorders, are also areas of ongoing research and concern.

The mechanisms underlying the association between maternal obesity and hostile pregnancy outcomes are multifactorial [15]. Chronic inflammation, insulin resistance, hormonal imbalances, and altered placental function have been proposed as potential contributors. Additionally, lifestyle factors, such as poor nutrition and sedentary behavior, often associated with obesity, can further exacerbate these risks. Addressing maternal obesity requires a comprehensive approach involving healthcare providers, policymakers, and society as a whole. Preconception counseling, promoting healthy lifestyle choices, and early intervention are crucial for minimizing the risks associated with obesity in pregnancy. By providing support, education, and access to appropriate healthcare services, we can strive to expand pregnancy outcomes and ensure well-being of both mothers and their infants [16].

Image 2:



METHODOLOGY:

The study was conducted in Mother and Child Health Centre, Mian Wali Qureshian Rahim Yar Khan. We looked at a group of women who were diagnosed with a condition called gestational diabetes mellitus (GDM) during their pregnancy. We found these women by looking at a large database that had information from May

2021 to April 2022. The database had information about the women's medical condition, but it did not include their names or personal details. These women were part of a program run by Alere that provided education, monitoring, and management for GDM outside of the hospital. The women agreed in writing to participate in the program and for their health information to be used for research and reporting. Every female's healthcare practitioner diagnosed GDM, and the outpatient treatments were provided as an addition to the women's routine prenatal care. We collected information about the women's characteristics, such as their height, weight before pregnancy, and their medical and obstetric history, when they were first referred to the program.

Researchers looked at females who were currently pregnant having one child and had been identified having gestational diabetes mellitus (GDM) by their doctor. These women were part of a program that provided education, monitoring, and management for GDM outside of the hospital. We included in our analysis only those women who had information about their body mass index (BMI) before pregnancy and details about their delivery. The program involved individualized education and counseling for GDM, including a personalized plan for diet, exercise, self-care, and testing of blood glucose levels. Females were taught to test their blood glucose levels every day, including before fasting and after 1 or 2 hours of eating. A certified diabetes educator monitored the daily blood glucose and ketone values. Reports about the women's progress were shared with their healthcare providers on the weekly foundation or more often if desired. To calculate the women's pre-pregnancy BMI, we divided their weight in kilograms by the square of their height in meters. We compared the pregnancy outcomes of obese women (BMI 31 kg/m² or higher) and non-obese women (BMI less than 40 kg/m²), as well as women across five BMI categories: underweight (BMI less than 19.6 kg/m²), normal weight (BMI 19.6-25.7 kg/m²), weighty (BMI 26-27.8 kg/m²), obese (BMI 32-38.7 kg/m²), and morbidly obese (BMI 40 kg/m² or higher). We looked at various outcomes for the mothers, including the need for medication to treat GDM, cesarean delivery, in addition pregnancy-associated hypertension, which includes gestational hypertension and preeclampsia.

The study looked at different things that happen to newborn babies. They checked how early the babies were born, how much they weighed, if they were stillborn, how many days they stayed in the nursery, if they needed to go to the NICU (neonatal intensive care unit), if they had any injuries from birth like bruises or fractures, if they had trouble with their shoulders during birth, if they had low blood sugar, and if they had jaundice. The main thing they wanted to find out was if the babies had any health problems, like being too heavy, having injuries, shoulder problems, low blood sugar, or jaundice. They compared the information using different statistical tests. They used a special math model to consider the effects of different factors that were important in the study.

RESULTS:

In this analysis, four thousand six hundred ninety patients with gestational diabetes mellitus (GDM) were eligible for inclusion. All these patients had either private or Medicaid health insurance treatment in addition remained receiving prenatal care upon enrollment. Out of those individuals, 2027 were non-obese while 1780 were obese. Maternal obesity was found to be meaningly linked to higher levels of blood glucose and an increased requirement for interventions, as shown in Table I. When comparing obese women with those of normal weight or underweight, there was a significant increase in adverse outcomes for both the mothers and newborns, as indicated in Table II. The average gestational age at delivery for stillborn babies remained 36.8+6.1 weeks. A notable linear trend was observed, indicating that the rates of adverse maternal and neonatal outcomes increased with higher BMI.

Table 1: GDM therapies and maternal features.

	Obese BMI_30	**BMI**	**OR (95% CI)**	**p-value**

Pre-pregnancy BMI	37.3+6.2, 35.6 (30.0, 68.8)	24.6+3.3, 24.9 (11.5, 29.9)	–	52.001
Maternal age (years)	31.0+5.5, 32 (17, 47)	30.9+5.8, 31 (16, 51)		0.748
Married	52.4%	57.4%	0.82 (0.72, 0.93)	0.003
Nulliparous	29.2%	36.5%	-	50.002
Age_35 years	27.6%	27.0%	0.72 (0.62, 0.82)	0.652
Mean fasting BG	91.0 (59.2, 229.0) 85.3+11.9	84.3 (50.8, 176.2) 92.1+13.9,	–	51.002
GA at discharge (weeks)	32.3+5.5, 32.7 (8.7, 40.4)	33.1+4.1, 33.6 (11.0, 41.7)		51.002
GA at enrollment (weeks)	29.0+5.9, 30.3 (6.7, 38.7)	30.3+4.5, 30.6 (6.6, 39.1)		51.002
Days in program	23.6+20.9, 19 (1, 182)	21.8+17.4, 19 (1, 210)		0.005

The connotation among increasing BMI and danger of composite neonatal morbidity was found to be significant (Figure 1). To evaluate effect of patient variables on complex newborn disease, logistic regression analysis was conducted. Among the variables examined, four were identified as independent and significant factors associated with the development of at least one of compound newborn results. These factors include delivery before 38 weeks, obesity, a fasting blood glucose level above 108, and experience to oral glycemic agents. Out of those five, delivery before 36 weeks and fasting blood glucose greater than 112 exhibited the strongest overtone through composite outcome, with an odds ratio of 1.7. Additionally, influence of growing pre-pregnancy BMI on the composite outcome was significant and independent of the detrimental impacts of having the fasting blood glucose level of 113, which is an gauge of glycemic control. nevertheless the low R2 value of 0.047 indicates that the factors analysed in the current research described just 4% of the discrepancy in the dependent variable, which is the overall newborn survival. Hence, it is possible that there are other factors not considered in our current research that have an influence on newborn morbidity.

Table 2: Women having GDM had poor neonatal results:

	Obese BMI_30	**BMI**	**OR (95% CI)**	**p-value**
Delivery 546 weeks	18.3%	14.6%	1.3 (1.1, 1.6)	0.001
GA at delivery	38.1+1.9, 38.4 (21.1, 44.9)	38.3+1.7, 38.7 (25.9, 43.3)	–	51.002
Pregnancy-related HTN	24.4%	9.6%	3.0 (2.5, 3.7)	51.002
Late PTB	15.3%	12.5%	1.3 (1.0, 1.5)	0.014
Birth weight (g)	3360+623, 3374 (514, 5642)	3214+525, 3232 (964, 5091)	–	51.002
Cesarean delivery	52.9%	39.3%	1.7 (1.5, 2.0)	51.002
Stillbirth	9 (0.5%)	2 (0.1%)	5.2 (1.1, 24.0)	0.018
Birth weight44000 g	12.8%	5.7%	2.4 (1.9, 3.0)	51.002
Birth trauma	0.3%	0.1%	1.1 (0.3, 4.6)	0.846
Nursery days	4.0+7.1, 3 (1, 160)	3.3+4.1, 2 (1, 58)	–	51.002
NICU admission	14.2%	11.0%	1.3 (1.1, 1.6)	0.004

DISCUSSION:

As overweightness epidemic in Pakistan remains to go unrestricted, the recognition of maternal obesity as an independent danger aspect for adverse maternal and fetal results is increasing [16]. Numerous researches have exposed that the prevalence of gestational diabetes mellitus increases with higher pre-pregnancy body mass index (BMI) [17]. The prevalence ranges from 5-7% for women with a BMI of 31-35.8, 7-9% for a BMI of 36-38.7, and 11-13% for a BMI greater than 42 [18]. However, there have been limited studies that have evaluated the risks associated with both obesity and GDM during pregnancy. In the current research, researchers discovered a significant association between maternal obesity and poorer outcomes for both the mother and the newborn [19]. Obese women were more inclined than non-obese women to take medication to attain optimum blood sugar control. Furthermore, greater pre-pregnancy BMI enhanced the possibility of maternal and newborn mortality, specifically pregnancy-induced hypertension, caesarean delivery, and overall neonatal morbidity [20]. Women having morbid obesity had the greatest dangers, but even women with a BMI in the overweight range (BMI 26-28.6) had increased odds of caesarean delivery and pregnancy-induced hypertension than those having a normal BMI [21].

These results are consistent given prior research that has linked obesity and gestational diabetes mellitus (GDM) to an increased risk of unfavorable pregnancy results and pregnancy-related hypertension [22]. Unlike prior research, we found that obese women had considerably higher fasting blood sugar levels, a higher risk of requiring blood sugar control drugs, and a greater probability of needing cesarean birth. Surprisingly, the increased likelihood of cesarean delivery has been documented not only in obese women but also in overweight women [23]. Obesity-related insulin resistance is frequently associated to hypertensive problems; therefore these results correspond given previous studies on the influence of obesity on pregnancy.

The research we conducted is unusual in that it is the initial study to categorize results for women with gestational diabetes mellitus (GDM) not only by the existence or absence of obesity, but additionally using the extent of obesity as measured by BMI. It is also the first research to look at the influence of severe obesity on pregnancy results [24]. According to our results, this strategy has the benefit of being more specific patient counselling. The research's features comprise an extensive sample size, a thorough investigation of short-term neonatal health effects, and the incorporation of underweight mothers as a control group. Nevertheless, there are certain drawbacks to take into account [25]. To begin, the study is designed retrospectively. Second, the information were gathered over the phone from feedback from patients and were not confirmed by reading every single individual's medical record. Additionally, our investigation was limited to the short-term newborn results [26]. Nevertheless, some evidence suggests that maternal obesity and diabetes might have long-term consequences for kids, such as a higher probability of obesity and type 2 diabetes during youth and adulthood [27]. Both human and animal studies indicate that the risk of childhood diabetes in children is unable to be addressed exclusively by the child's fat. Beta-cell malfunction may also have an impact [28]. Nevertheless, the long-term implications of obesity and gestational diabetes mellitus were not assessed in this investigation [29]. In addition, while the logistic regression model employed in this investigation matches the information effectively (goodness-of-fit test $p=0.308$), the factors studied in the present investigation fail to clarify 96% of the variation in the dependent factor for the combined neonatal mortality [30]. As a result, more research must be conducted to look at other characteristics that were not included in the current investigation but may have an influence on neonatal results [31].

CONCLUSION:

In the final analysis, our findings show that women having GDM who had a pre-pregnancy BMI of 30 or above are more likely to have unfavorable maternal and newborn results. Women having GDM who are overweight (BMI 26-28.6) are at a greater risk of maternal problems such as caesarean delivery and hypertension during pregnancy. The probability of adverse consequences amongst obese women rises particularly BMI, especially severely obese women (BMI 41 or above) having the greatest chance of maternal and newborn illnesses. This knowledge is especially useful when counselling obese women on the cumulative dangers of pre-pregnancy

obesity and gestational diabetes. It additionally backs the goal of reaching a normal or lower BMI inside the obese range before to conception in order to lessen the risk of unfavorable results from pregnancy.

REFERENCES:

1. Dinsmoor, M. J., Ugwu, L. G., Bailit, J. L., Reddy, U. M., Wapner, R. J., Varner, M. W., ... & Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. (2023). Short-term neonatal outcomes of pregnancies complicated by maternal obesity. *American Journal of Obstetrics & Gynecology MFM*, *5*(4), 100874.
2. Giouleka, S., Tsakiridis, I., Koutsouki, G., Kostakis, N., Mamopoulos, A., Kalogiannidis, I., ... & Dagklis, T. (2023). Obesity in Pregnancy: A Comprehensive Review of Influential Guidelines. *Obstetrical & Gynecological Survey*, *78*(1), 50-68.
3. Rodrigues, F. D. S., Jantsch, J., Fraga, G. D. F., Dias, V. S., Eller, S., De Oliveira, T. F., ... & Guedes, R. P. (2023). Cannabidiol treatment improves metabolic profile and decreases hypothalamic inflammation caused by maternal obesity. *Frontiers in Nutrition*, *10*, 1150189.
4. Alba-Linares, J. J., Pérez, R. F., Tejedor, J. R., Bastante-Rodríguez, D., Ponce, F., Carbonell, N. G., ... & Lurbe, E. (2023). Maternal obesity and gestational diabetes reprogram the methylome of offspring beyond birth by inducing epigenetic signatures in metabolic and developmental pathways. *Cardiovascular Diabetology*, *22*(1), 44.
5. Scheidl, T. B., Brightwell, A. L., Easson, S. H., & Thompson, J. A. (2023). Maternal obesity and programming of metabolic syndrome in the offspring: searching for mechanisms in the adipocyte progenitor pool. *BMC medicine*, *21*(1), 1-13.
6. Sakali, A. K., Papagianni, M., Bargiota, A., Rasic-Markovic, A., Macut, D., & Mastorakos, G. (2023). Environmental factors affecting pregnancy outcomes. *Endocrine*, 1-11.
7. Agwara, E. O., Tendongfor, N., Jaja, P. T., Choy, A. M., & Egbe, T. O. (2023). Prevalence and pregnant women´ s knowledge of maternal obesity and excessive gestational weight gain among women attending antenatal care in Fako division, Cameroon. *The Pan African Medical Journal*, *44*(2).
8. Yonatan, E., Abu-Atta, S., Palzur, E., Ginsberg, Y., Khatib, N., Shamir, A., & Beloosesky, R. (2023). The neuroprotective effect of maternal N-acetylcysteine supplementation during lactation period, on maternal-obese offsprings' cognitive function. *American Journal of Obstetrics & Gynecology*, *228*(1), S459.
9. Lee, C. S., Zhu, S., Wu, Q., Hu, Y., Chen, Y., Chen, D., & Liang, Z. (2023). Independent and joint associations of age, pre-pregnancy BMI, and gestational weight gain with adverse pregnancy outcomes in gestational diabetes mellitus. *Diabetes Therapy*, *14*(2), 363-375.
10. Saros, L., Lind, A., Setänen, S., Tertti, K., Koivuniemi, E., Ahtola, A., ... & Laitinen, K. (2023). Maternal obesity, gestational diabetes mellitus, and diet in association with neurodevelopment of 2-year-old children. *Pediatric Research*, 1-10.
11. Naomi, R., Rusli, R. N. M., Othman, F., Balan, S. S., Abidin, A. Z., Embong, H., ... & Yazid, M. D. (2023). Elateriospermum tapos Yogurt Supplement in Maternal Obese Dams during Pregnancy Modulates the Body Composition of F1 Generation. *Nutrients*, *15*(5), 1258.
12. Dearden, L. (2023). Mechanisms mediating the impact of maternal obesity on offspring hypothalamic development and function.
13. Cinzori, M. E., & Strakovsky, R. S. (2023). Effects of Elevated Maternal Adiposity on Offspring Reproductive Health: A Perspective From Epidemiologic Studies. *Journal of the Endocrine Society*, *7*(1), bvac163.
14. Ortiz, M., Sánchez, F., Álvarez, D., Flores, C., Salas-Pérez, F., Valenzuela, R., ... & Maliqueo, M. (2023). Association between maternal obesity, essential fatty acids and BIOMARKERS OF fetal liver function. *Prostaglandins, Leukotrienes and Essential Fatty Acids*, 102541.

15. Gao, J., Li, T., Liang, D., Gong, H., Zhao, L., & Mao, X. (2023). Maternal obesity exacerbates the responsiveness of offspring BALB/c mice to cow's milk protein-induced food allergy. *Food Science and Human Wellness*, *12*(3), 920-928.
16. Villar, J., Conti, C. P. S., Gunier, R. B., Ariff, S., Craik, R., Cavoretto, P. I., ... & Papageorghiou, A. T. (2023). Pregnancy outcomes and vaccine effectiveness during the period of omicron as the variant of concern, INTERCOVID-2022: a multinational, observational study. *The Lancet*, *401*(10375), 447-457.
17. Haddad-Tóvolli, R., Morari, J., Barbizan, R., Bóbbo, V. C., Carraro, R. S., Solon, C., ... & Velloso, L. A. (2023). Maternal obesity damages the median eminence blood-brain barrier structure and function in the progeny: The beneficial impact of cross-fostering by lean mothers. *American Journal of Physiology-Endocrinology and Metabolism*.
18. Yesmin, K., Begum, F., & Islam, M. R. (2023). Nutritional Status in a Patient with Gestational Diabetes Mellitus and Pregnancy Outcome. *Journal of Bangladesh College of Physicians and Surgeons*, *41*(1), 63-74.
19. Singleton, G., Parikh, B., Heiselman, C., & Garry, D. (2023). Maternal depression and its effect on spontaneous and indicated preterm births within the nuMoM2b cohort. *American Journal of Obstetrics & Gynecology*, *228*(1), S481.
20. den Harink, T., Schuppen, J., Marciniak, M., Voet, K. A., Planken, R. N., Hoek, A., ... & van Deutekom, A. W. (2023). A preconception lifestyle intervention in women with obesity and cardiovascular health in their children. *Pediatric Research*, 1-8.
21. Luo, P., Fan, Y., Xiong, Y., Zhang, C., Yang, Z., Sun, F., & Mei, B. (2023). Metabolic Characteristics of Gestational Diabetes Mellitus and the Effects on Pregnancy Outcomes. *Diabetes, Metabolic Syndrome and Obesity*, 15-29.
22. Gascoigne, E. L., Webster, C. M., Honart, A. W., Wang, P., Smith-Ryan, A., & Manuck, T. A. (2023). Physical activity and pregnancy outcomes: an expert review. *American journal of obstetrics & gynecology MFM*, *5*(1), 100758.
23. Qian, Y., Zhang, Y., Fan, X., Yan, H., Li, X., Fan, Y., ... & Yang, J. (2023). Nonalcoholic fatty liver disease and adverse pregnancy outcomes in women with normal prepregnant weight. *The Journal of Clinical Endocrinology & Metabolism*, *108*(2), 463-471.
24. Vestergaard, A. L., Christensen, M., Andreasen, M. F., Larsen, A., & Bor, P. (2023). Vitamin D in pregnancy (GRAVITD)–a randomised controlled trial identifying associations and mechanisms linking maternal Vitamin D deficiency to placental dysfunction and adverse pregnancy outcomes–study protocol. *BMC Pregnancy and Childbirth*, *23*(1), 1-10.
25. Yang, Y., Lin, Q., Ma, L., Lai, Z., Xie, J., Zhang, Z., ... & Lin, H. (2023). Maternal fasting glucose levels throughout the pregnancy and risk of adverse birth outcomes in newborns: a birth cohort study in Foshan city, Southern China. *European Journal of Endocrinology*, *188*(1), lvac019.
26. Kissler, K. J., Hernandez, T. L., & Carlson, N. (2023). The Relationship Between Uterine Activity, Oxytocin Dosing, Labor Progress, and Mode of Birth in Nulliparas with Obesity: Minimal Usefulness of Montevideo Unit Measurement. *Biological Research For Nursing*, 10998004221150798.
27. Kyei, N. N., Waid, J. L., Ali, N., Cramer, B., Humpf, H. U., & Gabrysch, S. (2023). Maternal exposure to multiple mycotoxins and adverse pregnancy outcomes: A prospective cohort study in rural Bangladesh. *Archives of Toxicology*, 1-18.
28. Dietz de Loos, A., Jiskoot, G., Louwers, Y., Beerthuizen, A., Busschbach, J., & Laven, J. (2023). Pregnancy Outcomes in Women with PCOS: Follow-Up Study of a Randomized Controlled Three-Component Lifestyle Intervention. *Journal of Clinical Medicine*, *12*(2), 426.

29. Lailler, G., Grave, C., Gabet, A., Regnault, N., Deneux-Tharaux, C., Kretz, S., ... & Olié, V. (2023). Recurrence of hypertensive disorders of pregnancy: results from a nationwide prospective cohort study (CONCEPTION). *BJOG: An International Journal of Obstetrics & Gynaecology*.
30. Hasan, H. A., Barber, T. M., Cheaib, S., & Coussa, A. (2023). Preconception vitamin D level and In Vitro Fertilization-pregnancy outcome. *Endocrine Practice*.
31. James, T., Samakar, K., & Martin, M. J. (2023). Special delivery—metabolic bariatric surgery as a key component of maternal-fetal health care. *JAMA surgery*, *158*(1), 44-45.