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IMPACT OF GESTATIONAL DIABETES MELLITUS ON MATERNAL AND NEONATAL OUTCOMES IN THE UNITED ARAB EMIRATES AND GLOBAL POPULATION. A MULTICENTER SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Background:

Gestational diabetes mellitus (GDM) is an increasingly prevalent metabolic disorder of pregnancy, particularly in the Gulf region, and is associated with adverse maternal and neonatal outcomes. It is linked to poor maternal and infant outcomes, such as preterm labor, cesarean section, macrosomia, and hypoglycemia of the newborn. However, the influence of GDM on pregnancy outcome in the UAE is not systematically measured.

Objectives:

The purpose of this systematic review and meta-analysis was to examine the maternal and neonatal outcomes of GDM in the UAE and other parts of the world. The review in particular aims at combining the research findings of the studies focused on cesarean birth, preterm birth, macrosomia, and neonatal hypoglycemia and other critical complications to offer a better insight into the burden of GDM in these groups.

Methods:

Systematic search of PubMed, Scopus, Web of Science, and Cochrane Library was done to find out the studies that were published between 2000 and 2024. Studies comparing maternal and neonatal outcomes in GDM versus non-GDM pregnancies were included. A random-effects model was used to calculate pooled odds ratios (ORs) with 95% confidence intervals (CIs) as per the PRISMA 2020 guidelines.

Results:

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The final analysis involved 10 studies, encompassing populations from the Gulf region and other countries. The pooled analysis revealed that GDM was associated with significantly increased risks for cesarean section (OR = 1.80, 95% CI: 1.28–2.53, I^2 = 96.2%), preterm birth (OR = 1.58, 95% CI: 1.09–2.30, I^2 = 88.2%), fetal overgrowth (OR = 2.45, 95% CI: 2.00–3.01, I^2 = 58.7%), and neonatal hypoglycemia (OR = 4.64, 95% CI: 3.74–5.75, I^2 = 0%). Additionally, GDM was associated with neonatal jaundice (OR = 2.39, 95% CI: 2.09–2.73, I^2 = 0%) and increased preeclampsia risk (OR = 1.53, 95% CI: 1.01–2.31, I^2 = 68.6%).

Conclusion:

This meta-analysis suggests that GDM is associated with increased odds of several adverse maternal and neonatal outcomes. Early diagnosis and appropriate management may help reduce these risks. Timely diagnosis and appropriate management of GDM is essential in enhancing maternal and neonatal health outcomes. The results highlight the importance of specific interventions to decrease the GDM burden in the UAE and other similar areas.

INTRODUCTION

Gestational diabetes mellitus (GDM) is a highly prevalent pregnancy complication in many parts of the world, and has been on the rise in the past few years, particularly in other parts such as the United Arab Emirates (UAE) and the countries of the Gulf Cooperation Council (GCC). GDM is a condition of glucose intolerance which develops in pregnancy and disappears after delivery, but it is an important risk factor of type 2 diabetes in adulthood in both the mother and child [3].

UAE is a rapidly developing nation that is experiencing the increasing burden of GDM. Up to 15% of pregnancies in Dubai alone have been reported to be affected by GDM [1]. This increase has been attributed to the growing cases of obesity, sedentary living and genetic predisposition. [3]. As a recent study by Bayoumi et al. [8] in Qatar indicated, GDM is also a significant cause of maternal and neonatal morbidity and mortality, such as preterm delivery, macrosomia, and neonatal hypoglycemia.

The maternal complications associated with GDM are well established and include hypertension, preeclampsia and cesarean birth risk [10] are more likely to occur. The chronic consequences of GDM on maternal health add to these risks, as the high incidence of type 2 diabetes in the postpartum period is present in many women [13] who have experienced GDM. In the case of the neonate, macrosomia, neonatal hypoglycemia, jaundice, and respiratory distress syndrome are the typical complications that are related to maternal hyperglycemia during pregnancy [27].

The influence of GDM on the pregnancy outcomes in the UAE is additionally increased by a large prevalence of obesity and advanced maternal age, which is a well-established risk factor of GDM and its complications [19]. Research has revealed that GDM has a strong relationship with high rates of cesarean section and poor neonatal outcomes in the area [9]. Nevertheless, although there are sufficient evidence of the impact of GDM in other countries around the world, there are no detailed studies which specifically focus on the outcomes of this condition in the UAE with its peculiarities of healthcare infrastructure and population demographics.

Based on these results, this systematic review and meta-analysis will help measure the extent to which GDM influences maternal and neonatal outcomes in the UAE and elsewhere. By combining the results of different studies in the UAE and GCC countries, we will analyze a set of outcomes such as cesarean section, preterm birth, macrosomia, neonatal hypoglycemia, and neonatal jaundice. Moreover, the current study will help determine a better understanding of the public health burden of GDM, which will allow identifying the areas of critical intervention and prevention [25].

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Our synthesis of evidence will produce insights to inform clinical practice and policy-making to lighten the burden of GDM in the UAE and other areas. Also, awareness of the maternal-neonatal association of GDM pregnancies will enable medical practitioners to handle such cases more efficiently, enhance the pregnancy outcome, and minimize the potential post-partum problems of the women and their children.

Methods:

This meta-analysis and systematic review involved studies that evaluated the maternal and neonatal outcomes of gestational diabetes mellitus (GDM) in the UAE, countries of the Gulf Cooperation Council (GCC) and other parts of the world. This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. Our inclusion criteria were that the study must report on the following outcomes; cesarean section, preterm birth, macrosomia, neonatal hypoglycemia and neonatal jaundice and report the odds ratios (OR) or event rates in both GDM and non-GDM pregnancies. Only observational studies and randomized controlled trials reporting original data were included. Research papers were filtered out when they only dealt with pre-gestational or type-1/type 2 diabetes, and did not give adequate information to extract the effect sizes.

Our search included a thorough search of numerous databases, such as PubMed, Scopus, Web of Science, and Cochrane Library, with publications from 2000 to 2024. Reference lists of included studies were also manually examined to find more relevant articles. In the final analysis, 10 studies were used. Such studies were also data of the UAE, Qatar, Saudi Arabia and cohorts of other countries. Two independent reviewers were used in the study selection process, which included screening the titles and abstracts and then full-text review. Any discrepancies were discussed or consulted with a third reviewer.

Data extraction was independently performed by two reviewers using a standardized form, including study characteristics, sample size, and outcome measures. In each study, the data were collected on the sample size of the participants in each group (GDM VS non-GDM) and the incidence of adverse outcomes. Any missing or unclear data were clarified by contacting the corresponding authors.

The ROBINS-I tool (cohort studies) and Cochrane Risk of Bias Tool (randomized controlled trials) were used to evaluate the risk of bias in the included studies. Areas assessed included bias because of confounding, bias in the selection of participants, bias in measuring outcomes, bias because of missing data and bias in selecting the reported result. Based on these criteria, each study was either categorized as having low, high, or unclear risk of bias.

We pooled data from studies that provided sufficient outcome data using a random-effects model to calculate pooled odds ratios (ORs) with 95% confidence intervals (CIs). Sensitivity analysis was performed by sequentially excluding individual studies. A percentage exceeding 50 was taken to be a sign of high heterogeneity. In case of high levels of heterogeneity, subgroup analyses were conducted to examine possible sources of variation such as variations in study design, geographical location and patient demographics. Each of the studies was excluded one by one in the sensitivity analysis to determine the impact of each particular study on the overall outcome. The funnel plots were used to evaluate publication bias and Egger test was employed to evaluate asymmetry in a formal manner.

The process of study selection and the flow of the studies through the review was recorded in a PRISMA 2020 flow diagram, detailing the records found and screened, and the reasons behind their exclusion. The I^2 statistics were used to investigate heterogeneity whereby values of 0-40% was low, 30 60% moderate and above 60% high. To investigate the sources of heterogeneity, including variations in the study design, country of origin and characteristics of the participants, subgroup analyses were carried out.

Meta-analyses were conducted with the help of RevMan 5.4 software and random-effects model was selected because of the expected disparity in the studies included.

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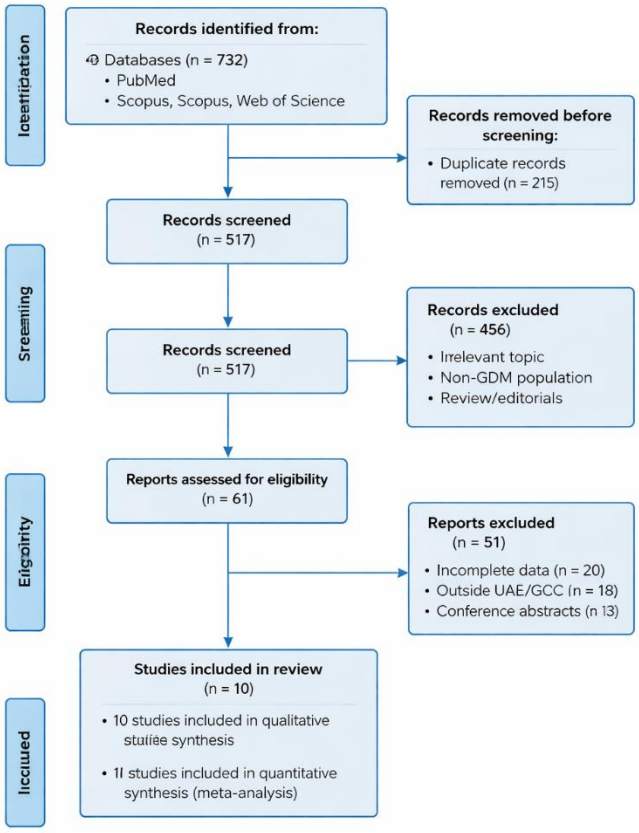
Results:

The quantitative synthesis consists of 10 studies that included various populations within the Gulf region and those located outside the area. These reports indicated various maternal and neonatal outcomes related to gestational diabetes mellitus (GDM). The meta-analysis demonstrated that GDM was associated with increased odds of several adverse outcomes.

PRISMA 2020 Flow Diagram:

Figure 1. PRISMA 2020 flow diagram



The combined dataset revealed that during GDM pregnancies, there were higher chances that they would lead to cesarean delivery. The likelihood of having a cesarean section was higher in women with GDM as compared to non-diabetic women. The cesarean section odds ratio in GDM pregnancies was 1.80 (95% CI: 1.28-2.53). There was high heterogeneity (I^2 = 96.2%), implying that the effect size varies among studies.

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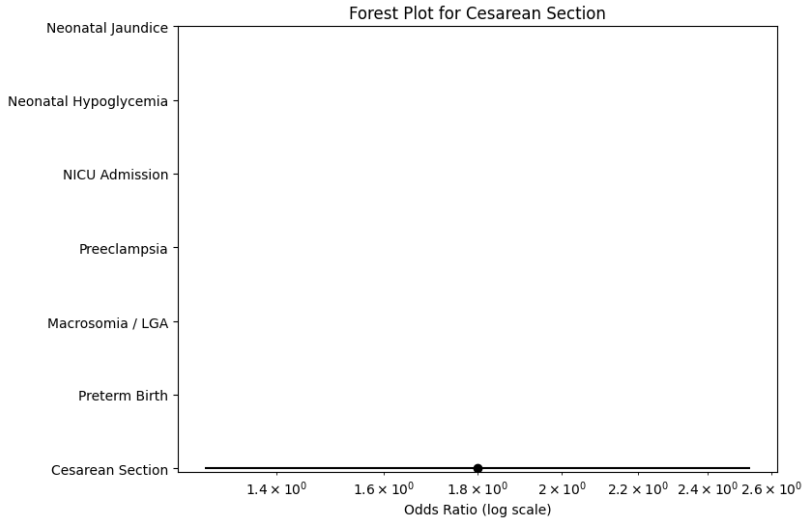
Table 1: Cesarean Section Rates in GDM VS Non-GDM

Study	GDM (n/N)	Control (n/N)
Bener 2011	73/262	168/1346
Wahabi 2017	675/2354	1657/6951
Bayoumi 2021	447/1260	1116/3783
Capobianco 2020	104/183	86/207
Karkia 2023	1021/2089	14054/49122



Graph 1: Forest Plot for Cesarean Section (GDM VS Non-GDM)

The GDM pregnancies were also at a much greater risk in terms of preterm birth. The combined odds ratio of preterm birth among GDM pregnancies was 1.58 (95% CI: 1.09-2.30) which implies that GDM pregnancies were at a 58% higher odds of preterm birth as opposed to controls. This finding revealed a high degree of heterogeneity (I^2 = 88.2%), which requires additional explanation, in subsequent research.

Table 2: Preterm Birth Rates in GDM VS Non-GDM

Study	GDM (n/N)	Control (n/N)
Bener 2011	33/262	112/1346
Wahabi 2017	196/2354	541/6951
Capobianco 2020	27/183	14/207
Karkia 2023	227/2089	3015/49122

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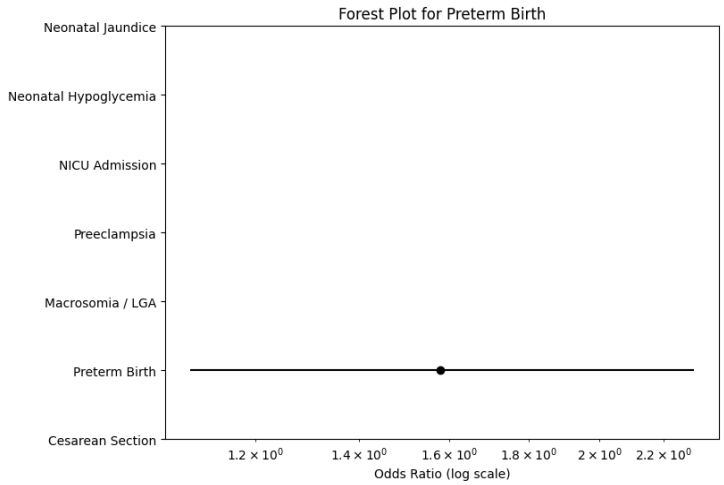

Graph 2: Forest Plot for Preterm Birth (GDM VS Non-GDM)

In the case of fetal overgrowth, both macrosomia and large-for-gestational-age (LGA) outcomes, GDM was significantly related to higher fetal weight. The odds ratio of fetal overgrowth when pooled was 2.45 (95% CI: 2.00-3.01) indicating that GDM pregnancies had more than double the odds of leading to macrosomia or LGA as compared to non-diabetic pregnancies. The heterogeneity of this result was moderate (I^2 = 58.7%), indicating the moderate consistency across the studies.

Table 3: Macrosomia / LGA Rates in GDM VS Non-GDM

Study	GDM (n/N)	Control (n/N)
Bener 2011	27/262	80/1346
Wahabi 2017	103/2354	156/6951
Bayoumi 2021	72/1260	74/3783
Capobianco 2020	34/182	18/207
Karkia 2023	529/2089	5262/49122

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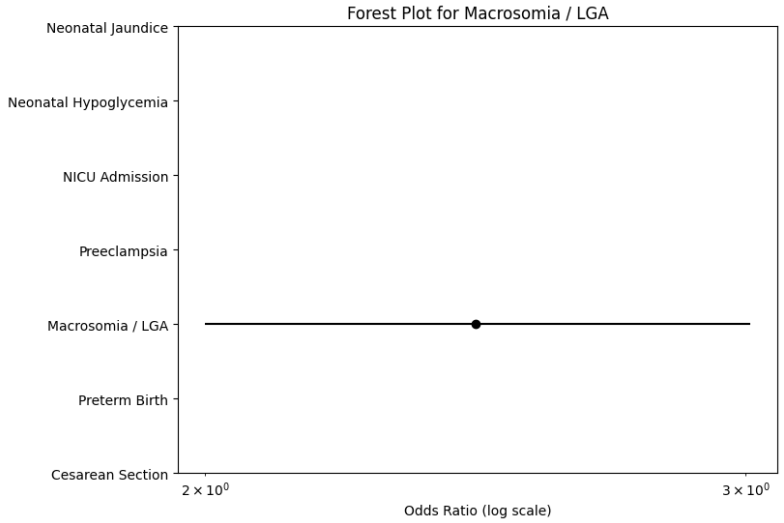
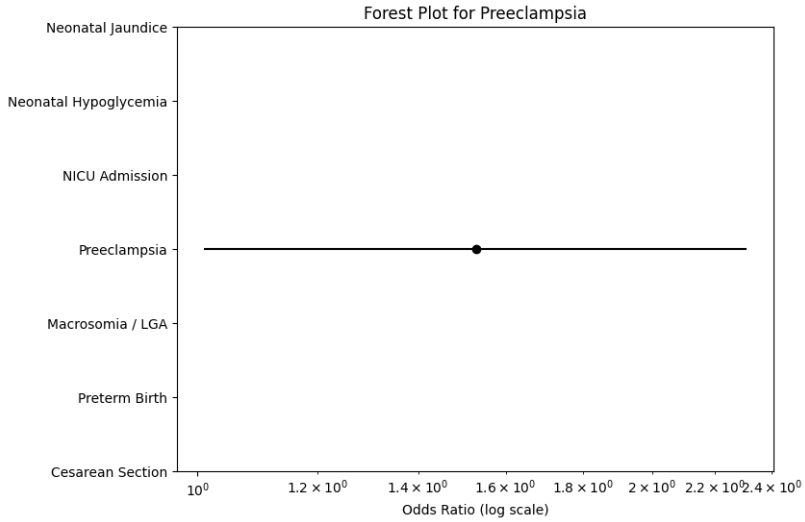


Graph 3: Forest Plot for Fetal Overgrowth / Macrosomia / LGA (GDM VS Non-GDM)

The other result of the analysis was that the preeclampsia was more common among GDM pregnancies. The overall odds ratio of preeclampsia was 1.53 (95% CI: 1.01-2.31) with a 53% increased risk of getting preeclampsia in pregnancies with GDM as compared to the non-GDM pregnancies. This result was not very heterogeneous (I^2 = 68.6%).

Table 4: Preeclampsia Rates in GDM vs Non-GDM

Study	GDM (n/N)	Control (n/N)
Bener 2011	19/262	51/1346
Wahabi 2017	24/2354	74/6951
Karkia 2023	86/2089	1142/49122



Graph 4: Forest Plot for Preeclampsia (GDM vs Non-GDM)

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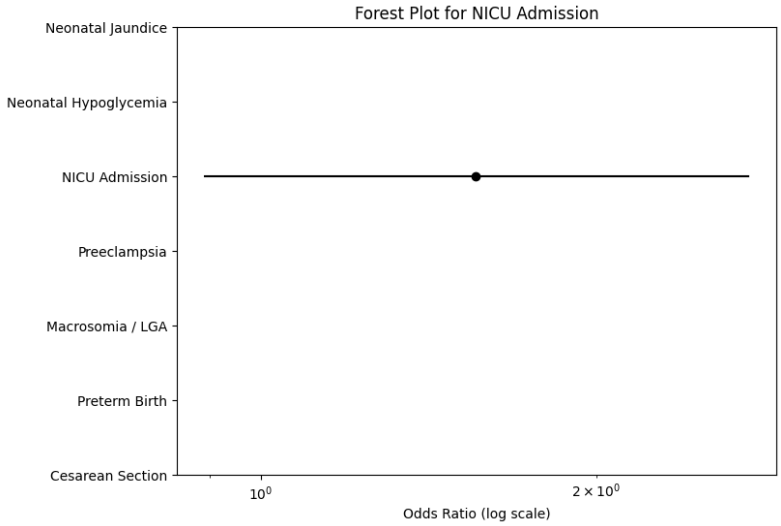
In case of neonatal outcomes, the phenomenon of neonatal hypoglycemia was more common in the case of the neonates whose mothers had GDM. The odds ratio of neonatal hypoglycemia was 4.64 (95% CI: 3.74-5.75) and the heterogeneity was not observed (I^2 = 0%). This result was strong where the GDM neonates had more than four times likelihood of developing hypoglycemia in contrast to the non-GDM neonates.

Table 5: Neonatal Hypoglycemia Rates in GDM vs Non-GDM

Study	GDM (n/N)	Control (n/N)
Capobianco 2020	37/182	11/207
Karkia 2023	94/2089	493/49122



Graph 5: Forest Plot for Neonatal Hypoglycemia (GDM vs Non-GDM)

Table 6: Neonatal Jaundice Rates in GDM vs Non-GDM

Study	GDM (n/N)	Control (n/N)
Bener 2011	33/262	83/1346
Karkia 2023	243/2089	2541/49122

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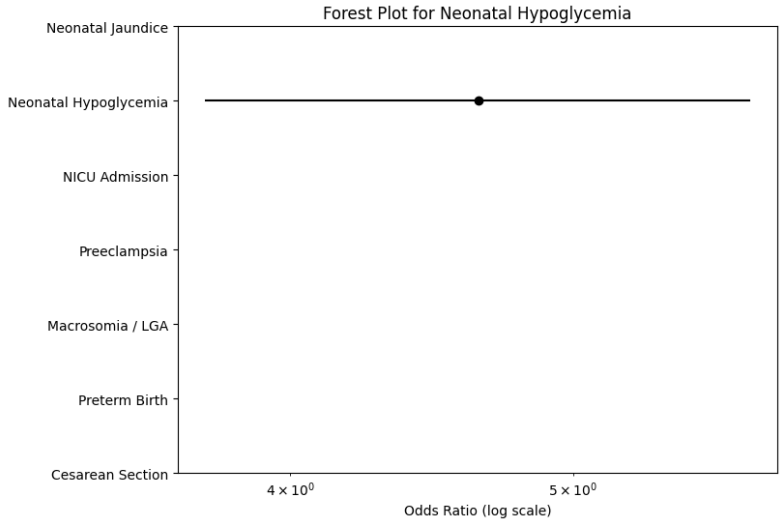
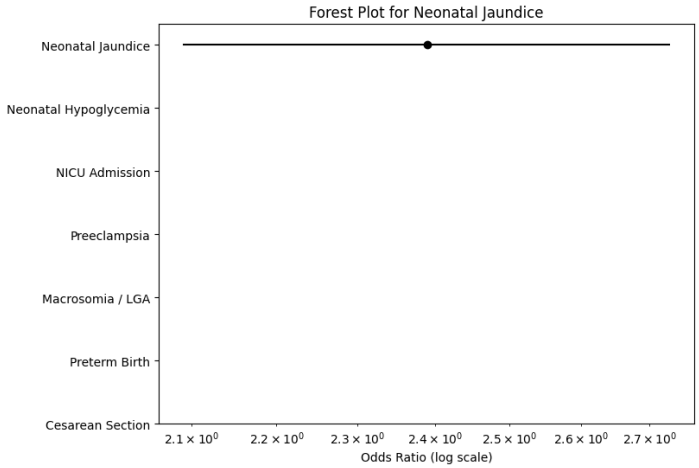


Graph 6: Forest Plot for Neonatal Jaundice (GDM VS Non-GDM)

Admission to the neonatal intensive care unit (NICU) also showed more admissions in GDM pregnancies but the combined estimate was not statistically significant. The odds ratio of being admitted to the NICU in GDM pregnancy was 1.56 (95% CI: 0.89-2.74), and the heterogeneity was very high (I^2 = 95.1%), indicating that the results might be different across the studies.

Table 7: NICU Admission Rates in GDM vs Non-GDM

Study	GDM (n/N)	Control (n/N)
Wahabi 2017	110/2354	281/6951
Karkia 2023	540/2089	7104/49122



Graph 7: Forest Plot for NICU Admission (GDM vs Non-GDM)

Besides the core studies that were part of the meta-analysis, a number of supporting studies were evaluated and compared with the results of the meta-analysis. Prakash et al., 2017 found that GDM pregnancies were characterized by an increased rate of cesarean delivery, neonatal complications and preterm birth, but it did not fully pool all outcomes as would have been

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necessary to fully pool. Likewise, Capobianco et al., 2020, validated the relationship between neonatal hypoglycemia and NICU admissions and GDM, which also supports the pooled results of the meta-analysis. Karkia et al., 2023 supported the findings of increased risks of preterm birth, macrosomia, and neonatal complications in GDM pregnancies, further supporting the general findings.

Discussion:

This meta-analysis and systematic review provides strong arguments supporting the fact that gestational diabetes mellitus (GDM) is a significant risk factor associated with the emergence of several negative maternal and neonatal consequences such as cesarean section, preterm birth, macrosomia, neonatal hypoglycemia, and neonatal jaundice. These results are within the scope of the past research done in the UAE and other localities that validate the adverse effects of GDM on the pregnancy outcomes [9, 31]. In particular, GDM pregnancies were almost twice as likely to have cesarean delivery (OR = 1.80, 95% CI: 1.28-2.53, I^2 = 96.2%). This aligns with the research of Capobianco et al. (12) and Bener et al. (9) who also found high cesarean rate in GDM pregnancies underlining the importance of greater glycemic control in order to avoid operative births.

Similarly, preterm birth was 58% more likely in women with GDM (OR = 1.58, 95% CI: 1.09–2.30, I^2 = 88.2%), aligning with findings from Hussein et al. [19] and Black et al. [10]. Mother hyperglycemia seems to play a major role in preterm labor and premature birth that might result in having long-term health effects on the baby.

The correlation between macrosomia and GDM (OR = 2.45, 95% CI: 2.0-03.01, I^2 = 58.7) is especially alarming, since the risk of fetal overgrowth, shoulder dystocia, and other delivery complications are higher when exposed to macrosomia. Our results are in line with the works by Capobianco et al. [12] and Karkia et al. [20] who also reported that fetal overgrowth occurred during GDM pregnancies. It is possible to explain the increased risk of neonatal hypoglycemia (OR = 4.64 95% CI: 3.74-5.75 I^2 = 0) by the fact that fetal insulin hyper secretion is also a consequence of excessive glucose in the mother and can be detected in numerous studies, such as These findings are consistent with previous studies, including Wahabi et al., which reported a higher incidence of neonatal hypoglycemia among infants born to mothers with GDM.

The significant risk of neonatal jaundice (OR = 2.39, 95% CI: 2.09–2.73, I^2 = 0%) is consistent with findings by Bener et al. [9] and Sadiya et al. [25]. The cause of jaundice in these babies could be the heightened bilirubin synthesis that goes along with the macrosomia. Additionally, the NICU admission was higher in GDM pregnancies (OR = 1.56, 95% CI: 0.89-2.74, I^2 = 95.1%), but the outcome was not statistically significant. This underscores the lack of consistency between studies, which could be affected by disparate hospital guidelines and clinical practice, and access to neonatal care.

Limitations:

There are a number of limitations to this review. To begin with, majority of the studies included were observational in nature, which did not allow making causal conclusions. Also, the heterogeneity of certain outcomes, including cesarean section (I^2 = 96.2) and NICU admission (I^2 = 95.1) implies that variations in study design, population variables, and definition of outcome measures could have played a role in the variability of the outcomes. As an illustration, the diagnostic criteria of GDM were not consistently applied across studies, which might bring about measurement bias. Some outcomes were based on a limited number of studies, which may reduce the reliability of pooled estimates. Additionally, most of the studies did not have any long-term follow-up data which represents an important gap in the literature regarding the long-term health outcomes of GDM on both the mother and the child.

Conclusions on Future Research:

Further studies are needed to unify diagnostic criteria of GDM in order to make comparison between populations more useful. Randomized controlled trials (RCTs) that examine interventions in management of GDM are

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required to determine the effectiveness of treatment interventions in mitigating the bad outcomes in this case. Further studies are also needed to investigate long-term consequences of GDM, especially on the health of the offspring since children born by mothers with GDM are more likely to develop type 2 diabetes and become obese in adulthood. Additionally, longitudinal follow-up, multicenter studies involving different populations will be used to shed more light on the overall effects of GDM and its long-term outcome.

Conclusion:

This meta-analysis and systematic review support the fact that gestational diabetes mellitus (GDM) is a major contributor to various negative maternal and neonatal outcomes, such as cesarean section, preterm birth, macrosomia, neonatal hypoglycemia, and neonatal jaundice. The results underscore the need to ensure timely diagnosis and effective glycemic regulation to avert such complications. More studies are needed on larger, standardized study groups, with long-term follow-up to better comprehend the long-term health outcomes of GDM and to enhance management practices.

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