

REVIEW ARTICLE

Obstetrics

Impacts of Ramadan fasting during pregnancy on pregnancy and birth outcomes: An umbrella review

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Abstract

Background: Despite a large number of primary research studies, and systematic and narrative reviews, there is no consensus on the impact of fasting during Ramadan while pregnant on pregnancy and birth outcomes. Currently, there is no evidence-based guideline for Muslim women regarding Ramadan fasting during pregnancy and clinicians cannot provide firm recommendations.

Objectives: To review the current evidence regarding the impact of Ramadan fasting during pregnancy on pregnancy and birth outcomes.

Search Strategy: We conducted an umbrella review of all systematic and narrative reviews examining the impacts of fasting during Ramadan while pregnant on pregnancy and birth outcomes by searching PubMed, CINAHL, and Cochrane Registry of Systematic Reviews databases between November 2023 and February 2024.

Selection Criteria: We included all systematic and narrative reviews examining the impacts of Ramadan fasting on pregnancy and birth outcomes. The primary outcome was the change in birth weight, gestational age at birth, fetal growth indices, and Apgar score as well as the risk of delivery by cesarean section and the risks of gestational diabetes and pre-eclampsia.

Data Collection and Analysis: We summarized the data using narrative synthesis and descriptive statistics as appropriate. This study was registered with PROSPERO, ID: CRD42023478819.

Main Results: Out of 943 published reports identified across all database searches, 13 systematic and narrative reviews were included, of which three were systematic reviews with meta-analysis, six were systematic reviews without meta-analysis, and the remaining four were narrative reviews. There is no sufficient evidence that Ramadan fasting during pregnancy may reduce gestational age at birth or increase the risk of preterm birth (PTB). There is little evidence to support the hypothesis that maternal Ramadan fasting may reduce birth weight or increase the risk of low birth weight (LBW). Systematic reviews showed pooled estimates of odds ratios ranging between 0.93 (95% confidence interval [CI] 0.60–1.44) and 0.99 (95% CI 0.72–1.37) for PTB,

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and between 1.05 (95% CI 0.87–1.26) and 1.37 (95% CI 0.74–2.53) for LBW. There is no sufficient evidence that Ramadan fasting during pregnancy may increase the risk of delivery by cesarean section, gestational diabetes, or the risk of pre-eclampsia. None of the reviews reported evidence regarding the impacts of fasting during pregnancy on rare but clinically significant pregnancy and birth outcomes such as stillbirth, miscarriage, congenital anomalies, or neonatal deaths.

Conclusion: There is little evidence that Ramadan fasting during pregnancy can negatively impact pregnancy and birth outcomes. Primary research studies on this issue suffered from significant methodologic limitations and systematic reviews showed significant heterogeneity for several pregnancy and birth outcomes. High-quality primary research studies that collect data on multiple confounders and effect modifiers are needed to investigate this issue and help reaching evidence-based recommendations.

KEYWORDS

birth outcome, birth weight, fasting, pregnancy, preterm birth, Ramadan

1 | INTRODUCTION

Fasting during the holy month of Ramadan in Islam entails abstaining from consuming foods and drinks, and engaging in specific behaviors such as sexual activity and smoking, from dawn to sunset by healthy adults. During this period, Muslims typically eat two meals a day: *Suhoor*, before dawn, and *Iftar*, at sunset. Fasting alters the quantity, quality, and frequency of food intake, shifting food consumption to exclusively nocturnal eating, thereby disrupting the normal circadian rhythm. Ramadan, the ninth month in the Islamic calendar, can rotate through different seasons because the Islamic lunar calendar is approximately 11 days shorter than the Gregorian calendar. Consequently, daily fasting durations vary from 11 h to 18 h per day, depending on the season and geographical location (latitude).¹ Although pregnant women are exempted from fasting if they are concerned about their health or the health of their fetus, many choose to fast if Ramadan coincides with pregnancy. Approximately 80%–90% of pregnant Muslim women fast during Ramadan, at least partially, because of religious and cultural beliefs.^{2–4} The impact of fasting during pregnancy on pregnancy and birth outcomes remains under debate. This issue is further complicated by the fact that the nutritional requirements of pregnant women are significantly different from those of non-pregnant women and the growing concern about both undernutrition and overnutrition during pregnancy.

The alteration of food quality and quantity during pregnancy has been linked to short-term and long-term consequences in offspring since early observations by Barker,^{5–7} which were later framed as the Developmental Origin of Health and Disease. This framework explains how maternal nutrition or other exposures can impact pregnancy and birth outcomes through epigenetic mechanisms,^{8,9} potentially elucidating one of the possible ways through which Ramadan fasting might affect birth outcomes. Additionally, animal models have demonstrated that prolonged food withdrawal increases the production of uterine prostaglandins¹⁰ and uterine contractions,¹¹

suggesting a plausible mechanism through which Ramadan fasting could predispose to preterm birth (PTB). In humans, prolonged periods without food intake during pregnancy have been associated with elevated maternal corticotropin-releasing hormone concentrations and an increased risk of preterm delivery.¹² In fact, placental corticotropin-releasing hormone has been reported to play a direct role in the physiology of parturition and in the processes related to fetal growth and maturation.^{13,14} Conversely, Ramadan fasting during pregnancy might reduce the risk of PTB by lowering blood sugar and insulin resistance. Elevated blood glucose levels, even below the diagnosis criteria of diabetes,¹⁵ increase the risk of PTB, and non-diabetic maternal hyperglycemia can lead to adverse pregnancy outcomes.¹⁶ A systematic review based on five primary studies involving 462 participants suggested that Ramadan fasting may reduce blood glucose levels,¹⁷ potentially lowering insulin resistance and oxidative stress, mechanisms that could mitigate the risk of PTB. However, studies on volunteers, which compared fasting and non-fasting individuals, either showed some positive effects on inflammatory status¹⁸ or no effect.¹⁹ Among pregnant women, no difference in oxidative stress was found between the fasting and non-fasting groups.²⁰ In conclusion, there are several plausible theoretical pathways through which Ramadan fasting during pregnancy may negatively or positively affect pregnancy and birth outcomes.

Several epidemiologic studies have attempted to investigate the impact of Ramadan fasting during pregnancy on various pregnancy and birth outcomes, yielding conflicting results (reviewed recently by Chen et al.¹⁷ and Ong et al.²¹). Furthermore, several systematic reviews with meta-analyses,^{17,21,22} as well as without meta-analysis,^{23–28} and narrative reviews^{29–32} were conducted, also producing controversial findings. Consequently, there is no consensus on whether fasting during pregnancy increases the risk of PTB, low birth weight (LBW), delivery by cesarean section, or any other pregnancy and birth outcomes. As a result, no evidence-based guidelines or recommendations could have been formulated regarding fasting

during Ramadan for pregnant Muslim women. Most online resources encourage Muslim women to consult with their clinicians if they intend to fast during Ramadan. However, until a more comprehensive review of the available evidence is conducted, clinicians and other pregnancy healthcare providers cannot make evidence-based recommendations. Since the initiation of this umbrella review, one effort to provide an evidence-based guide was published.³³ Additionally, the European Foundation for the Care of Newborn Infants has recently called for allowing mothers to decide whether to fast,³⁴ based on one of the reviews included in our study.²¹ Therefore, we conducted this umbrella review of systematic and narrative reviews to summarize the current evidence on the impacts of fasting during the holy month of Ramadan during pregnancy on pregnancy and birth outcomes, with the aim of aiding ongoing and future efforts to develop evidence-based guidelines.

2 | MATERIALS AND METHODS

We conducted an umbrella review with the aim to collect and assess previous systematic reviews to evaluate the cumulative evidence on the impact of fasting during the holy month of Ramadan during pregnancy on various pregnancy and birth outcomes. The question addressed by this review, as per the PECO (Population, Exposure, Comparison, and Outcome) framework, is: “among apparently healthy pregnant women, does fasting holy month of Ramadan adversely impact pregnancy/birth outcome compared to not fasting?”. In this review, we followed the nine-step pathway of umbrella reviews³⁵ and adhered to the guidelines of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 statement.³⁶ The review was registered with the international prospective register of systematic reviews (PROSPERO) ID: CRD42023478819.

2.1 | Search strategy and eligibility

We systematically searched PubMed, CINAHL and the Cochrane Registry of Systematic Reviews databases between November 2023 and February 2024 to identify reviews examining the impacts of Ramadan fasting on pregnancy/birth outcomes. We used several combinations of Medical Subject Headings (MeSH) or keywords, including “Fasting”, “Ramadan”, “Muslim”, or “Islam” linked by the boolean operator “AND” with “Pregnancy”, “Gestation”, “Birth”, “Birth weight”, “Preterm”, “Fetal growth”, “Gestational diabetes”, “Pre-eclampsia”, “Cesarean section”, “Miscarriage”, “Stillbirth”, “Ectopic pregnancy”, “Hypertension”, and “Fetal health”. An additional search was conducted from the reference lists of the retrieved review studies. The search terms were developed with input from all members of the study team, while database searches were conducted independently by two members of the research team (MER and MAS), supervised by the leading investigator (AAT).

We included systematic reviews and meta-analyses that reported the impact of Ramadan fasting during pregnancy on pregnancy and

birth outcomes. As we found a limited number of systematic reviews with meta-analysis on this topic, narrative reviews were also included. We excluded editorials, letters, conferences proceedings, summaries, books, opinions, and duplicate studies. We also excluded reviews that included pregnant women with pre-existing health conditions like type 2 diabetes. The primary outcomes of interest were pregnancy/birth outcomes, including birth weight, PTB (defined as birth before 37 weeks of pregnancy), mode of delivery, stillbirth, pre-eclampsia, miscarriage, ectopic pregnancy, gestational diabetes, gestational hypertension, and fetal health.

2.2 | Quality assessment

The MOOSE (Meta-analyses of observational studies in epidemiology) 2 checklist was used to assess the quality of the reviews included in this study. Two researchers independently assessed the quality of each review. Scores were compared, and discrepancies were resolved through discussion and consultation with a third researcher to reach a consensus. Based on the MOOSE 2 score, reviews were rated as low quality (1–11 score), moderate quality (12–27 score), and high quality (28–35 score).³⁷

2.3 | Data extraction and synthesis

Two reviewers extracted the following information from each included review: author and year of publication, type of review, study design, the total number of studies included, the total number of participants, outcomes measured, and authors' conclusions. The total number of studies and participants varied in the same review by outcome variable assessed. Information about the impacts of fasting during pregnancy on pregnancy/birth outcomes from the reviews were synthesized narratively and reported according to the outcomes of interest.

3 | RESULTS

We identified 943 published reports through all database searches. An additional three reviews were identified from the reference lists of the retrieved studies. First, two independent researchers screened the studies by title/abstract and removed the irrelevant studies ($n=932$). Then, full-text screening was conducted for 14 reviews. One review was excluded after full-text screening as it did not meet the inclusion criteria. Overall, 13 reviews met the inclusion criteria and were included in this umbrella review (Figure 1).

3.1 | Study characteristics and quality of reviewed studies

Of the 13 reviews included, three were systematic reviews with meta-analysis,^{17,21,22} six were systematic reviews without meta-analysis,^{23–28}

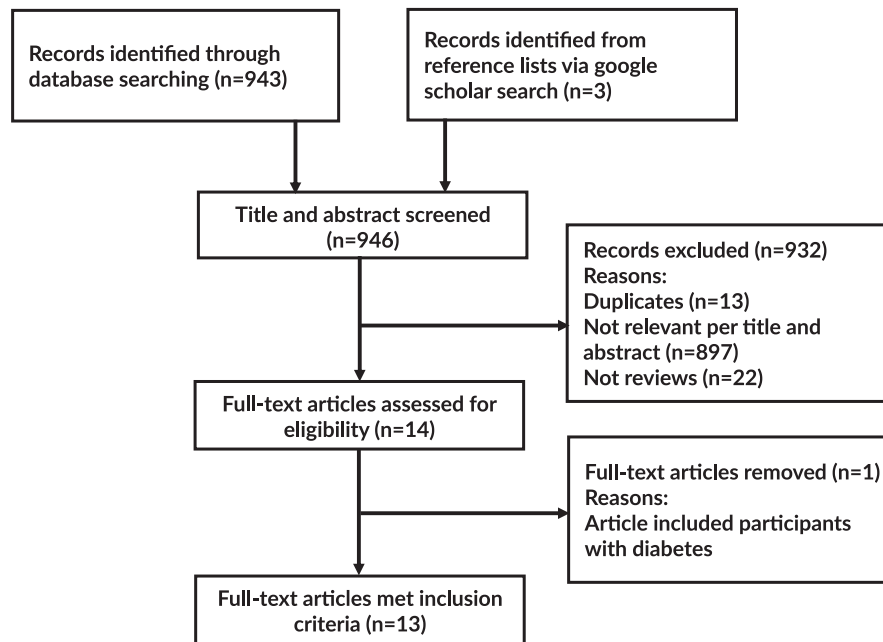


FIGURE 1 Literature search flow chart.

and the remaining four were narrative reviews.^{29–32} Among the six systematic reviews without meta-analysis, four summarized the evidence for the impact of Ramadan fasting during pregnancy on different pregnancy outcomes, fetal health parameters and long-term impacts,^{23–25,27} one review focused only on long-term impacts,²⁸ and one focused only on fetal health.²⁶ The four narrative reviews summarized the evidence regarding the impacts of Ramadan fasting during pregnancy on different pregnancy and fetal health parameters, including birth weight, preterm birth, mode of delivery, fetal health parameters, and long-term impacts based on selected primary studies^{29–32} (Table 1). Based on the MOOSE 2 score, four reviews were found to be of high quality,^{17,21,22,24} five reviews to be of moderate quality,^{23,25–28} and the rest to be of low quality.^{29–32}

3.2 | Association between Ramadan fasting during pregnancy and gestational age at birth or preterm birth

Of the 13 reviews, four examined the association between Ramadan fasting and gestational age at birth,^{17,21,23,25} and six reviews considered gestational age at birth as a categorical measure (frequency of preterm birth).^{17,21,22,24,29,30} Of these reviews, three conducted meta-analysis.^{17,21,22} Based on 11 primary studies with 2040 participants, of whom 1204 were exposed to fasting, Chen et al.¹⁷ reported no significant difference in the gestational age at birth between the Ramadan fasting group and the non-fasting group (pooled mean difference 0.05 weeks, 95% confidence interval [CI] –0.22 to 0.31 weeks). Similarly, based on seven studies, the authors reported no significant association between Ramadan fasting during pregnancy and the

risk of PTB (odds ratio [OR] 0.93, 95% CI 0.60–1.44). In another review, based on three primary studies, Ong et al.²¹ reported no overall significant difference in gestational age at birth between the Ramadan fasting group and the non-fasting group (no pooled mean difference reported), highlighting the conflicting results of the primary research studies on this issue (in two studies, mothers who fasted during pregnancy had a shorter gestational period; and in one study, mothers who fasted had a longer gestational period). Similarly, the authors reported no significant difference in the frequency of PTB in all three reviewed studies. Based on five primary studies with 5600 participants (1193 were exposed to Ramadan fasting), Glazier et al.²² reported no significant difference in the odds of PTB between the Ramadan fasting group and the non-fasting group (OR 0.99, 95% CI 0.72–1.37). Systematic reviews without meta-analysis and the narrative reviews all reported that maternal Ramadan fasting had no significant impact on gestational age at birth or PTB.^{21,23–25,29,30} Overall, there was no evidence to support the notion that Ramadan fasting during pregnancy may reduce gestational age at birth or increase the risk of PTB.

3.3 | Association between Ramadan fasting during pregnancy and birth weight or low birth weight

Of the 13 included reviews, 10 investigated the association between birth weight and maternal Ramadan fasting,^{17,21–25,29–32} of which three were meta-analyses,^{17,21,22} three were systematic reviews without meta-analysis,^{23–25} and four were narrative reviews^{29–32} (Table 1). The first meta-analysis included 31 441 pregnancies, of which 19 030 were exposed to fasting, and showed that maternal Ramadan fasting had no significant impact on birth

TABLE 1 Study characteristics and quality.

Authors and year of publication	Type of reviews	Number and type of primary studies	Number of participants	Outcomes summarized	Author's conclusion	Quality
Ong et al. 2023 ²¹	Systematic review (with meta-analysis)	14 (Case-control: 6, prospective cohort: 7 and retrospective cohort: 1)	2889	Birth weight, AFI, BPD, EFW, FFL, FHC, FAC, gestational age at birth/preterm birth, BPP, APGAR score, fundal height, NST	Ramadan fasting during pregnancy has negative impacts on fetal health, but evidence was not strong enough to draw this conclusion. Future robust primary research is needed for better understanding about the impacts of Ramadan fasting on fetal health	High quality
Chen et al. 2023 ^{17a}	Systematic review (with meta-analysis)	41 (Case-control study: 17, cross-sectional study: 12, cohort study: 12)	6680	Gestational weight gain, fasting blood glucose, gestational age at birth/preterm birth, birth weight/LBW, hematologic parameters, mode of delivery, oxidative stress markers, ketonuria, risk of GDM, risk of hypoglycemia, risk of pre-eclampsia, risk of pregnancy-induced hypertension, AFI, APGAR score, NICU, birth anthropometry, long-term outcomes: child IQ, height and weight for age, BMI	Ramadan fasting did not have an impact on BW and gestational age at birth, but data regarding the impacts on other outcomes was not consistent and recommend future prospective cohort study	High quality
Noshili et al. 2022 ²³	Systematic review (without meta-analysis)	43 (Cross sectional: 5, case-control: 6, prospective cohort: 11, and retrospective cohort: 21)	N/A	NST, biophysical characteristics, MCA, AFI, BPD, birth weight/LBW, gestational age at birth, mode of delivery, FHC, long-term impacts: child IQ, blood pressure, hemoglobin levels, lung capacity, BMI of adults who exposed to Ramadan fasting before birth	Ramadan fasting had no adverse effects on maternal and fetal health	Moderate quality
Oosterwijk et al. 2021 ²⁴	Systematic review (without meta-analysis)	43 (Cross sectional: 5, case-control: 6, prospective cohort: 11, and retrospective cohort: 21)	N/A	NST, MCA, AFI, BPD, FFL, birth weight/LBW, preterm birth, mode of delivery, birth length and head circumference, long-term impacts: child IQ, blood pressure, hemoglobin levels, lung capacity, BMI of adults who exposed to Ramadan fasting before birth.	The association between Ramadan fasting and offspring health outcomes was not supported by evidence. Recommend larger prospective and retrospective study	High quality

TABLE 1 (Continued)

Authors and year of publication	Type of reviews	Number and type of primary studies	Number of participants	Outcomes summarized	Author's conclusion	Quality
Mahanani et al. 2021 ²⁸	Systematic review (without meta-analysis)	16 (Cohort study: 16)	N/A	Long-term impacts: child IQ and disability, blood pressure, hemoglobin levels, lung capacity, BMI of adults who exposed to Ramadan fasting before birth, under-five mortality, mortality under 1 year, mortality under 3 months, mortality under 1 day, and earnings	In utero Ramadan exposure adversely impacts long-term health outcomes and economic well-being, but there could be confounding factors. Recommend future longitudinal study for strong evidence	Moderate quality
Giazier et al. 2018 ²²	Systematic review (with meta-analysis)	22 (Cross sectional: 6, case-control: 3, prospective cohort: 5, and retrospective cohort: 8)	31 374	Perinatal mortality, preterm birth, birth weight/LBW, and stillbirth, neonatal death, maternal death, hypertensive disorders of pregnancy, GDM, congenital abnormalities, neonatal morbidity, and placental weight as secondary outcomes	Ramadan fasting during pregnancy did not impact birth weight and had a negative impact on placental weight. There was insufficient evidence regarding the impacts on other outcomes	High quality
Adawi et al. 2017 ^{27b}	Systematic review (without meta-analysis)	45 (Cross sectional: 1, case-control: 10, and prospective cohort: 34)	2567	Maternal antioxidant status, total oxidant status, oxidative stress index, maternal complications, birth weight, fetal development	Ramadan fasting had some mild effects on immune system and did not have any effects on other outcomes	Moderate quality
Mirsane et al. 2016 ³²	Narrative review	N/A	N/A	Birth weight/LBW, AFI, fetal Doppler, delivery parameters, and lipid profiles of mothers	Ramadan fasting had no significant effect on health of pregnant women	Low quality
Rouhani and Azadbakht, 2014 ^{25c}	Systematic review (without meta-analysis)	N/A	N/A	Body weight/LBW, intrauterine growth, pregnancy duration and anthropometric measures of offspring, FFL, FAC, BPD, AFI, fetal heart rate, BMI during adulthood	Ramadan fasting had no serious adverse effect on offspring but recommended to avoid fasting during pregnancy due to lack of evidence	Moderate quality
Faris et al. 2014 ³⁰	Narrative review	N/A	N/A	Milk composition, birth weight/LBW, preterm birth, biochemical and biophysical parameters of babies, fetal body weight, AFI	Maternal fasting during Ramadan has no deleterious impacts on the birth weight or biochemical and biophysical parameters of babies	Low quality
Ahmed and Lykke, 2014 ²⁹	Narrative review	N/A	N/A	Fetal movement, birth weight/LBW, preterm birth, mode of delivery, long-term impacts: BMI, cardiovascular disease risk during adulthood, child IQ	Ramadan fasting did not have an impact on preterm delivery, but there were some impacts on fetal movements and long-term health outcomes	Low quality

(Continues)

TABLE 1 (Continued)

Authors and year of publication	Type of reviews	Number and type of primary studies	Number of participants	Outcomes summarized	Author's conclusion	Quality
Zoukal and Hassoune, 2019 ²⁶	Systematic review (without meta-analysis)	10 (Case control: 10)	1390	AFI, fetal weight, fetal doppler, BPD, FFL, FHC	Ramadan fasting during pregnancy has no harmful impacts on fetal development	Moderate quality
Mazidi et al., 2014 ³¹	Narrative review	N/A	N/A	Birth weight/LBW, neonatal height, head circumference, thyroid hormones, AFI	Ramadan fasting has no effects on neonates' birth weight, head circumference, height, and thyroid hormones during growth years	Low quality

Abbreviations: AFI, amniotic fluid index; BMI, body mass index (calculated as weight in kilograms divided by the square of height in meters); BPD, biparietal diameter; BPP, biophysical profile; EFBW, estimated fetal body weight; FAC, fetal abdominal circumference; FFL, fetal femur length; FHC, fetal head circumference; GDM, gestational diabetes mellitus; IQ, intelligent quotient; LBW, low birth weight; MCA, middle cerebral artery; NICU, neonatal intensive care unit; NST, nonstress test.

^aThis review summarized the impacts of chronic malnutrition, which includes meal skipping, meal frequency, night eating, and Ramadan fasting, on maternal and offspring outcomes and included a total of 66 primary studies. Among these primary studies, 41 studies with 6680 pregnant women investigated the impacts of Ramadan fasting on maternal and offspring outcomes.

^bThis review summarized the impacts of Ramadan fasting on the immune system among different populations including pregnant women and included a total of 45 studies. Among these, one study with 72 pregnant women investigated the impacts of Ramadan fasting on the immune system among different populations including pregnant women and included a total of 45 studies. Among these, four studies investigated the impacts of Ramadan fasting on health outcomes among different populations including pregnant women and included a total of 45 studies. Among these, four studies investigated the impacts of Ramadan fasting on maternal and fetal health outcomes.

weight (standardized mean difference 0.03, 95% CI 0.00–0.05) or frequency of LBW (OR 1.05, 95% CI 0.87–1.26).²² These findings did not change after stratifying the analysis of Ramadan fasting by trimester. Two more recent reviews with meta-analysis were conducted.^{17,21} The first, included 19 primary studies and reported that maternal Ramadan fasting had no significant effect on birth weight (pooled mean difference 0.01 kg, 95% CI –0.06 to 0.08 kg), with studies showing significant heterogeneity.¹⁷ Similarly, based on four primary studies, authors reported no significant association between maternal Ramadan fasting and frequency of LBW (OR 1.37, 95% CI 0.74–2.53). These findings remained unchanged in subgroup analyses. The other meta-analysis reported that maternal Ramadan fasting during the third trimester or both the second and the third trimester of pregnancy was associated with reduced birth weight by 60 g ($P < 0.007$) and 80 g ($P = 0.03$), respectively, with no analysis regarding the frequency of LBW.²¹

The three reviews that did not perform meta-analysis^{23–25} reported mixed results about the association between maternal Ramadan fasting and birth weight or the frequency of LBW. One of these reviews summarized the findings of 15 primary studies, of which one study with 402 participants reported that the mean birth weight was significantly lower in the Ramadan-fasting group ($P = 0.024$), while 14 primary studies did not find a significant difference in the birth weight between Ramadan-fasting and non-fasting group.²⁴ The other two systematic reviews reported that maternal Ramadan fasting was not significantly associated with birth weight.^{23,25} None of these reviews reported that Ramadan fasting during pregnancy significantly affected the frequency of LBW.^{23–25} The four narrative reviews, which did not mention how many primary studies were included, also reported mixed results regarding the association between maternal Ramadan fasting and birth weight or LBW.^{29–32} Two narrative reviews reported that some primary studies reported that Ramadan fasting during pregnancy was associated with LBW,^{29,30} whereas the other two reported no association.^{31,32} From the above, one can conclude that despite birth weight being the most commonly studied outcome, there was little evidence to support the hypothesis that maternal Ramadan fasting may reduce birth weight or increase the risk of LBW.

3.4 | Association between Ramadan fasting during pregnancy and fetal growth indices (biparietal diameter, abdominal circumference, femur length)

Several reviews reported findings regarding the impact of Ramadan fasting during pregnancy on fetal growth indices such as biparietal diameter (BPD),^{21,23–26,32} femur length,^{21,23,24,26,32} or abdominal circumference.^{21,23,24,26,31,32} Apart from one review,²¹ none included a meta-analysis of their outcomes. Based on five primary studies, Ong et al.²¹ reported that the BPD growth was reduced by –0.20 mm (95% CI –0.37 to –0.03 mm, $P = 0.02$) when Ramadan fasting occurred in the first trimester (one study with 80 pregnancies), by –0.20 mm (95% CI –0.38 to –0.02, $P = 0.03$) in the second trimester (one study with 80 pregnancies), and by –0.21 mm (95%

CI -0.39 to -0.02 mm, $P=0.03$) in the third trimester (two studies with 249 pregnancies). However, fasting in both the second and third trimesters (three studies with 223 pregnancies) was associated with an increase in BPD by 0.39 mm (95% CI 0.15 – 0.64 mm, $P=0.002$), findings driven by one study. The same primary studies that investigated the association of Ramadan fasting with BPD (reviewed by Ong et al.²¹) investigated the link between Ramadan fasting and fetal femur length. Findings related to femur length were similar to those related to BPD, showing a small decrease in the growth of fetal femur length when Ramadan fasting occurred during the second trimester (-0.20 mm, 95% CI -0.34 to -0.06 , $P=0.006$), a non-significant increase in femur length in the third trimester, but a slight increase in the growth of fetal femur length when Ramadan fasting occurred during both second and third trimesters of pregnancy (0.17 mm, 95% CI 0.06 – 0.29 , $P=0.003$). The systematic reviews without meta-analysis reported similar mixed results regarding the association of Ramadan fasting with BPD or femur length. For instance, based on nine primary studies, Oosterwijk et al.²⁴ reported that one study found a positive association between Ramadan fasting and fetal BPD, whereas another study found a negative association. The narrative review reported no significant difference in BPD or femur length between the Ramadan fasting and non-fasting groups.³² No meta-analysis included abdominal circumference, but overall, none of the reviews reported that Ramadan fasting during pregnancy had an impact on abdominal circumference. Overall, there was insufficient evidence to support the notion that Ramadan fasting during pregnancy may negatively affect fetal growth indices.

3.5 | Association between Ramadan fasting during pregnancy and mode of delivery

Four reviews reported the impacts of Ramadan fasting during pregnancy on the mode of delivery,^{17,23,24,29} none of them performed meta-analysis. One review²³ did not report findings on the impacts of Ramadan fasting during pregnancy on the mode of delivery. The other three reviews^{17,24,29} reported mixed results. For instance, the systematic review by Chen et al.¹⁷ included nine primary studies, one of which reported that the proportion of cesarean sections was significantly higher in the non-fasting group compared with the Ramadan fasting group; another study showed that cesarean section was higher in the fasting group but the remaining seven studies showed no association between Ramadan fasting during pregnancy and delivery by cesarean section.¹⁷ Overall, delivery by cesarean section was not a commonly investigated outcome in the studies that investigated the impact of maternal Ramadan fasting on pregnancy outcomes, nor in the systematic reviews that investigated this issue, probably because it is related to many other outcomes, such as gestational age and pre-eclampsia. Currently, there is no evidence that maternal Ramadan fasting may increase the risk of delivery by cesarean section.

3.6 | Association between Ramadan fasting during pregnancy and gestational diabetes, hypertension, and pre-eclampsia

Of all the reviews, only one investigated the association of Ramadan fasting during pregnancy with fasting blood glucose level, gestational diabetes, gestational hypertension, or pre-eclampsia.¹⁷ This review performed a meta-analysis that included five primary studies with 462 participants, of whom 232 were exposed to fasting. It showed that fasting blood glucose was significantly lower in the Ramadan fasting group compared with the non-fasting group (mean difference -2.73 mg/dL, 95% CI -5.23 to -0.22 mg/dL, $P=0.03$). However, based on three primary studies, no significant difference was found in the proportion of gestational diabetes between the Ramadan fasting group and the non-fasting group. The same review, based on three primary studies, reported no significant impact of Ramadan fasting during pregnancy on pre-eclampsia.¹⁷ As expected, maternal Ramadan fasting may reduce fasting blood glucose, but there was no evidence that it decreases or increases the risk of gestational diabetes or the risk of pre-eclampsia.

3.7 | Association between Ramadan fasting during pregnancy and Apgar score as well as amniotic fluid index

Of the 13 reviews, nine investigated the association between amniotic fluid index (AFI) and Ramadan fasting,^{17,21,23–26,30–32} of which one conducted a meta-analysis.²¹ Ong et al.²¹ reported that Ramadan fasting during the second trimester was significantly associated with reduced AFI, based on a single case-control study with 80 participants. Based on three primary studies where Ramadan fasting occurred during the third trimester and five studies where Ramadan fasting occurred during the second and third trimester, Ong et al.²¹ reported that Ramadan fasting was associated with reduced AFI. They highlighted a study that showed that Ramadan fasting predisposed to oligohydramnios. Chen et al.¹⁷ highlighted the conflicting results of the studies regarding AFI, with one study showing that fasting in the second trimester was significantly associated with reduced AFI, two studies showing no significant difference, and three studies reporting that Ramadan fasting was associated with higher AFI. The five systematic reviews without meta-analyses reported mixed results about the association between Ramadan fasting during pregnancy and AFI. For instance, a review of nine primary studies with 1221 participants reported that eight studies did not find a significant association between Ramadan fasting and AFI, while one study reported that Ramadan fasting was significantly associated with reduced AFI.²⁶ The three narrative reviews reported no significant association between Ramadan fasting and AFI.^{30–32} Intuitive thinking, as well as the literature, tend to support the notion that Ramadan fasting may reduce AFI, as Ramadan fasting implies refraining from all fluid intake (including water), which may lead to dehydration, particularly when Ramadan coincides with the hot summer.

Two reviews examined the impacts of Ramadan fasting on the Apgar score.^{17,21} Ong et al.²¹ summarized the findings of three primary studies, of which one study ($n=215$) reported that the 5-min Apgar score was significantly higher in the fasting group compared with the non-fasting group (9.00 ± 0.01 vs. 8.92 ± 0.53 , $P=0.044$), but there was no significant difference in the 1-minute Apgar between the two groups. The other two studies included in this review reported no significant difference in the 1-min or 5-min Apgar scores between the Ramadan fasting and non-fasting groups.²¹ The other systematic review reported no significant difference in the 1-min or 5-min Apgar scores between the Ramadan fasting and non-fasting groups.¹⁷ Overall, there was no evidence that maternal Ramadan fasting can negatively impact the Apgar score.

3.8 | Association between Ramadan fasting during pregnancy and other outcomes

None of the reviews reported evidence regarding the impacts of Ramadan fasting during pregnancy on rare but clinically significant pregnancy and birth outcomes such as stillbirth, miscarriage, or neonatal deaths. Other outcomes, such as placental weight, were investigated by a few primary research studies. For example, only three studies included placental weight (reviewed by Glazier et al.²²), one of which reported a significantly lower placental weight in women who fasted for Ramadan during pregnancy, whereas the other two studies found a significant increase in placental weight.²² Similarly, three studies investigated biophysical profile as an outcome (assessed through Manning score including fetal movements, breathing movements, tone, and amniotic fluid volume), reviewed by Ong et al.,²¹ none of which showed a significant difference between fasting and non-fasting groups. Finally, four studies investigated the association of Ramadan fasting and gestational weight gain (GWG) throughout the pregnancy (reviewed by Chen et al.¹⁷), with two studies showing lower GWG in the fasting group and the other two studies showing no difference between the two groups. Overall, there was no significant difference in GWG between the fasting and non-fasting groups (pooled mean difference 0.5 kg; 95% CI -1.27 to 0.26 kg). However, monitoring GWG during the month of Ramadan only showed that GWG was significantly lower among the fasting pregnant women compared with the non-fasting women.

4 | DISCUSSION

4.1 | Summary of main findings

The aim of this study was to assess the current evidence on the impacts of fasting for the holy month of Ramadan during pregnancy on pregnancy and birth outcomes, which is a prerequisite for developing evidence-based guidelines to assist clinicians in providing informed advice. We reviewed all systematic and narrative reviews on this topic including all short-term pregnancy and birth outcomes and

outlined the way forward for research on this topic. Some pregnancy and birth outcomes have been studied more than others, hence the evidence regarding each varies. Based on the current literature, there is little evidence suggesting that maternal fasting during pregnancy reduces the gestational age at birth or increase the risk of PTB. There is also little evidence that Ramadan fasting during pregnancy reduces birth weight or increases the risk of LBW. The few primary studies that showed difference in birth weight between fasting and non-fasting groups reported clinically insignificant differences in birth weight, which could be attributed to residual or unmeasured confounding. Our review also suggests that there is no evidence that Ramadan fasting during pregnancy increases the risk of delivery by cesarean section, pre-eclampsia, or gestational diabetes. There is also little or no evidence that Ramadan fasting during pregnancy affects fetal growth indices or Apgar score. However, there is a tendency in the literature to show that fasting during pregnancy may reduce AFI, which seems to be related to the hours of fasting and the season in which fasting occurs.

4.2 | Discussion of main findings

A major weakness of the primary research on this topic is the lack of a theoretical framework that accounts for major confounding factors and effect modifiers, which may explain the contradictory results of the primary research studies. With randomized controlled trials possibly deemed unethical on this issue, research studies need to collect data on all potential confounders and effect modifiers and consider these during the analysis. For example, previous studies have shown that pregnant women who are more likely to fast during Ramadan are those with perceptions of physical ability³⁸ and higher pre-pregnancy body mass index (BMI; calculated as weight in kilograms divided by the square of height in meters),⁴ both of which are strongly related to several pregnancy and birth outcomes. In fact, pre-pregnancy BMI has been linked to preterm birth,³⁹⁻⁴² macrosomia/large-for-gestational-age infants,^{39,43-47} gestational diabetes,^{39,42,48,49} pre-eclampsia,^{42-44,49} delivery by cesarean section^{39,42,49} as well as several other adverse pregnancy and birth outcomes. It is also possible that Ramadan fasting during pregnancy may affect birth outcome differently between obese and non-obese mothers. Therefore, pre-pregnancy BMI should be considered both as a confounder and an effect modifier. However, no systematic review has stratified the analysis by pre-pregnancy obesity. Studies have also suggested that pregnancy and birth outcomes may not be affected if mothers have good nutritional status before fasting due to having sufficient nutritional reserves to support fetal growth (reviewed by Glazier et al.²²). Hence, the background nutrition of the mothers should be considered in any study investigating this issue. In fact, all theoretically plausible pathways through which Ramadan fasting during pregnancy may affect pregnancy and birth outcomes can be influenced by the background health and nutrition of pregnant women.

Furthermore, methodologic variation between primary research studies hampers making firm conclusions from systematic reviews.

For example, Ramadan follows the Islamic lunar calendar, which has approximately 354 days in a year, so it starts 10 days earlier than the previous year and can fall in any of the four seasons. This indicates that the number of hours for which mothers fast per day depends on the season in which Ramadan falls and geographical location. The daily fasting time length depends on the geographical location (latitude) and season. Furthermore, the total hours of fasting also depend on whether the pregnant woman consumes the pre-fast meal *Suhoor*, which may or may not happen. Nevertheless, none of the reviews stratified the analysis by the duration of fasting (hours/day). To investigate the impact of fasting in a dose–response fashion, we need to collect data on the daily fasting duration and the total number of days of fasting.

4.3 | Strengths and limitations

This is the first umbrella review on the impact of Ramadan fasting during pregnancy on pregnancy and birth outcomes. We included all systematic and narrative reviews and up-to-date attempts to assist clinicians in providing evidence-based advice. However, this review has limitations, including the exclusion of studies in languages other than English and the gray literature on this topic. Another limitation of this umbrella review comes from the fact that the majority of the original reviews did not include meta-analysis and when they did, they showed significant heterogeneity for some outcomes. Finally, the original primary research studies included in the reviews suffered from significant methodologic limitations.

5 | CONCLUSIONS

This work has reviewed the current evidence regarding the impact of fasting for the holy month of Ramadan during pregnancy on pregnancy and birth outcomes. We found little evidence that Ramadan fasting during pregnancy can negatively impact these outcomes. The current shared decision making approach suggested by Shahawy et al.³³ regarding fasting seems to be wise as a temporary solution. However, before suggesting that Ramadan fasting during pregnancy is safe, it is essential to conduct high-quality primary research to reach evidence-based recommendations for health professionals. Further research on this topic should take into account pre-pregnancy obesity and the nutritional status of pregnant women. Data should be collected on the duration of fasting (hours/day), length of fasting (in days), season of fasting, and trimester in which fasting occurs so that researchers can investigate the potential effect of Ramadan fasting on pregnancy and birth outcomes in a dose–response fashion. Dietary patterns (quantity and quality) during fasting in addition to sleep habits and physical activity, iron deficiency anemia, and other pre-existing conditions should also be considered. Studies hypothesized that fasting late during pregnancy may impact birth weight more compared with fasting at the beginning of the pregnancy,²² so further investigations need to include

pregnant women in all trimesters. Also, studies should be sufficiently large to investigate significant but rare outcomes such as stillbirth and congenital anomalies. Finally, studies are needed to investigate the impact of fasting before pregnancy on pregnancy and birth outcomes.

AUTHOR CONTRIBUTIONS

A.A.T. contributed to conceptualization, methodology, investigation, analysis, and drafting the original manuscript. M.D.E. and M.A.S. contributed to methodology, investigation, analysis, and editing the original manuscript. A.H.Z., and W.F.K. contributed to conceptualization, methodology, investigation, and editing the original manuscript.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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REFERENCES

1. Azizi F. Research in Islamic fasting and health. *Ann Saudi Med.* 2002;22:186-191.
2. Baynouna Al Ketbi LM, Niglekerke NJ, Zein Al Deen SM, Mirghani H. Diet restriction in Ramadan and the effect of fasting on glucose levels in pregnancy. *BMC Res Notes.* 2014;7:392.
3. Prentice AM, Prentice A, Lamb WH, Lunn PG, Austin S. Metabolic consequences of fasting during Ramadan in pregnant and lactating women. *Hum Nutr Clin Nutr.* 1983;37:283-294.
4. van Bilsen LA, Savitri AI, Amelia D, Baharuddin M, Grobbee DE, Uiterwaal CS. Predictors of Ramadan fasting during pregnancy. *J Epidemiol Glob Health.* 2016;6:267-275.
5. Barker DJ. Fetal origins of coronary heart disease. *BMJ.* 1995;311:171-174.
6. Paneth N, Susser M. Early origin of coronary heart disease (the "Barker hypothesis"). *BMJ.* 1995;310:411-412.
7. Howe D, Wheeler T. Early origin of coronary heart disease. Maternal nutrition in early pregnancy may affect placental ratio. *BMJ.* 1995;310:1468.
8. Lapehn S, Paquette AG. The placental Epigenome as a molecular link between prenatal exposures and fetal health outcomes through the DOHaD hypothesis. *Curr Environ Health Rep.* 2022;9:490-501.
9. Chang H, Wang D, Xia W, et al. Epigenetic disruption and glucose homeostasis changes following low-dose maternal bisphenol A exposure. *Toxicol Res (Camb).* 2016;5:1400-1409.
10. Silver M, Fowden AL. Uterine prostaglandin F metabolite production in relation to glucose availability in late pregnancy and a possible influence of diet on time of delivery in the mare. *J Reprod Fertil Suppl.* 1982;32:511-519.
11. Binienda Z, Massmann A, Mitchell MD, Gleed RD, Figueroa JP, Nathanielsz PW. Effect of food withdrawal on arterial blood glucose

- and plasma 13,14-dihydro-15-keto-prostaglandin F2 alpha concentrations and nocturnal myometrial electromyographic activity in the pregnant rhesus monkey in the last third of gestation: a model for preterm labor? *Am J Obstet Gynecol.* 1989;160:746-750.
12. Herrmann TS, Siega-Riz AM, Hobel CJ, Aurora C, Dunkel-Schetter C. Prolonged periods without food intake during pregnancy increase risk for elevated maternal corticotropin-releasing hormone concentrations. *Am J Obstet Gynecol.* 2001;185:403-412.
 13. Wadhwa PD, Garite TJ, Porto M, et al. Placental corticotropin-releasing hormone (CRH), spontaneous preterm birth, and fetal growth restriction: a prospective investigation. *Am J Obstet Gynecol.* 2004;191:1063-1069.
 14. Challis JR. Maternal corticotropin-releasing hormone, fetal growth, and preterm birth. *Am J Obstet Gynecol.* 2004;191:1059-1060.
 15. Metzger BE, Lowe LP, Dyer AR, et al. Hyperglycemia and adverse pregnancy outcomes. *N Engl J Med.* 2008;358:1991-2002.
 16. Kenyon AP, Shnnan AH. Non-diabetic maternal hyperglycaemia was associated with adverse pregnancy outcomes. *Evid Based Med.* 2008;13:150-151.
 17. Chen YE, Loy SL, Chen LW. Chrononutrition during pregnancy and its association with maternal and offspring outcomes: a systematic review and meta-analysis of Ramadan and non-Ramadan studies. *Nutrients.* 2023;15(3):756.
 18. Aksungar FB, Topkaya AE, Akyildiz M. Interleukin-6, C-reactive protein and biochemical parameters during prolonged intermittent fasting. *Ann Nutr Metab.* 2007;51:88-95.
 19. Ibrahim WH, Habib HM, Jarrar AH, Al Baz SA. Effect of Ramadan fasting on markers of oxidative stress and serum biochemical markers of cellular damage in healthy subjects. *Ann Nutr Metab.* 2008;53:175-181.
 20. Ozturk E, Balat O, Ugur MG, et al. Effect of Ramadan fasting on maternal oxidative stress during the second trimester: a preliminary study. *J Obstet Gynaecol Res.* 2011;37:729-733.
 21. Ong AKW, Yee AL, Fong AJH, Arasoo VJT, Ramadas A. Effects of Ramadan fasting on fetal health: a systematic review. *Aust N Z J Obstet Gynaecol.* 2023;63:625-637.
 22. Glazier JD, Hayes DJL, Hussain S, et al. The effect of Ramadan fasting during pregnancy on perinatal outcomes: a systematic review and meta-analysis. *BMC Pregnancy Childbirth.* 2018;18:421.
 23. Noshili A, Jamshed M, Hamdi A, et al. Effects of fasting in Ramadan on pregnancy outcome: systematic review. *IJOCS.* 2022;16:721-730.
 24. Oosterwijk VNL, Molenaar JM, van Bilsen LA, Kiefte-de Jong JC. Ramadan fasting during pregnancy and health outcomes in offspring: a systematic review. *Nutrients.* 2021;13(10):3450.
 25. Rouhani MH, Azadbakht L. Is Ramadan fasting related to health outcomes? A review on the related evidence. *J Res Med Sci.* 2014;19:987-992.
 26. Zoukal S, Hassoune S. The effects of Ramadan fasting during pregnancy on fetal development: a general review. *Tunis Med.* 2019;97:1132-1138.
 27. Adawi M, Watad A, Brown S, et al. Ramadan fasting exerts immunomodulatory effects: insights from a systematic review. *Front Immunol.* 2017;8:1144.
 28. Mahanani MR, Abderbuih E, Wendt AS, et al. Long-term outcomes of in utero Ramadan exposure: a systematic literature review. *Nutrients.* 2021;13(12):4511.
 29. Ahmed UZ, Lykke JA. Ramadan, fasting and pregnancy. *Ugeskr Laeger.* 2014;176:V03140144.
 30. MeA-IE F, Al-Holy MA. Implications of Ramadan intermittent fasting on maternal and fetal health and nutritional status: a review. *Mediterranean. J Nutr Metab.* 2014;7:107-118.
 31. Mazidi M, Rezaie P, Nematy M. The effects of Ramadan fasting on growth parameters: a narrative review. *JNFH.* 2014;2:41-45.
 32. Mirsane S, Shafagh S. A narrative review on fasting of pregnant women in the Holy month of Ramadan. *J Fasting Health.* 2016;4:53-56.
 33. Shahawy S, Al Kassab L, Rattani A. Ramadan fasting and pregnancy: an evidence-based guide for the obstetrician. *Am J Obstet Gynecol.* 2023;228:689-695.
 34. European Foundation for the Care of Newborn Infants. The fasting month of Ramadan: does intermittent fasting of pregnant women influence the risk for preterm birth? 2024 (Vol 2024).
 35. Cant R, Ryan C, Kelly AM. A nine-step pathway to conduct an umbrella review of literature. *Nurse Author Ed.* 2022;32:31-34.
 36. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ.* 2021;372:n71.
 37. Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis of observational studies in epidemiology (MOOSE) group. *JAMA.* 2000;283:2008-2012.
 38. Alaeddine C, Schreiber J, Amin MEK. Ramadan fasting intentions among pregnant women in Lebanon. *J Egypt Public Health Assoc.* 2024;99:1.
 39. Chen CN, Chen HS, Hsu HC. Maternal Prepregnancy body mass index, gestational weight gain, and risk of adverse perinatal outcomes in Taiwan: a population-based birth cohort study. *Int J Environ Res Public Health.* 2020;17:1221.
 40. Ke JF, Liu S, Ge RL, Ma L, Li MF. Associations of maternal prepregnancy BMI and gestational weight gain with the risks of adverse pregnancy outcomes in Chinese women with gestational diabetes mellitus. *BMC Pregnancy Childbirth.* 2023;23:414.
 41. Cnattingius S, Villamor E, Johansson S, et al. Maternal obesity and risk of preterm delivery. *JAMA.* 2013;309:2362-2370.
 42. Rahman MM, Abe SK, Kanda M, et al. Maternal body mass index and risk of birth and maternal health outcomes in low- and middle-income countries: a systematic review and meta-analysis. *Obes Rev.* 2015;16:758-770.
 43. Li M, Zhang CY, Yue CY. Effects of pre-pregnancy BMI and gestational weight gain on adverse pregnancy outcomes and complications of GDM. *J Obstet Gynaecol.* 2022;42:630-635.
 44. Hung TH, Hsieh TT. Pregestational body mass index, gestational weight gain, and risks for adverse pregnancy outcomes among Taiwanese women: a retrospective cohort study. *Taiwan J Obstet Gynecol.* 2016;55:575-581.
 45. Liu P, Xu L, Wang Y, et al. Association between perinatal outcomes and maternal pre-pregnancy body mass index. *Obes Rev.* 2016;17:1091-1102.
 46. Wahabi H, Esmaeil S, Fayed A. Maternal Prepregnancy weight and pregnancy outcomes in Saudi women: subgroup analysis from Riyadh mother and baby cohort study (RAHMA). *Biomed Res Int.* 2021;2021:6655942.
 47. Su WJ, Chen YL, Huang PY, et al. Effects of Prepregnancy body mass index, weight gain, and gestational diabetes mellitus on pregnancy outcomes: a population-based study in Xiamen, China, 2011-2018. *Ann Nutr Metab.* 2019;75:31-38.
 48. Chu SY, Callaghan WM, Kim SY, et al. Maternal obesity and risk of gestational diabetes mellitus. *Diabetes Care.* 2007;30:2070-2076.
 49. Doherty DA, Magann EF, Francis J, Morrison JC, Newnham JP. Pre-pregnancy body mass index and pregnancy outcomes. *Int J Gynaecol Obstet.* 2006;95:242-247.

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