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Impact of Intermittent Fasting and Incidence of Gestational DM in Overweight Pregnant Women in 3rd Trimester

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ABSTRACT

Background: The term intermittent fasting (IF), employed for health purposes or weight reduction, refers to many forms of caloric restriction. Insulin resistance has been recognized to ameliorate with fasting.

Objective: This study aimed to evaluate the influence of IF on the occurrence of gestational diabetes mellitus (GDM) in overweight pregnant women during the third trimester and its implications for maternal and neonatal outcomes.

Patients and Methods: A total of 278 obese pregnant women were divided into two groups: Group A included women who fast 16 successive hours daily including sleeping hours with all energy intake throughout the other eight hours window of the day. Group B included women who fast with the same life style. The study was conducted for 12 weeks. Maternal weight assessment was done just before delivery. Mode of delivery was reported. Screening of DM was done. Fetal assessment was done using Apgar score 1 and 5 mins and fetal weight at the time of the labor.

Results: Intermittent fasting was accompanied by increased risk of occurrence of prediabetes, which was marginally statistically significant. However, effect on occurrence of GDM or the composite incidence of prediabetes and GDM was not statistically significant. Also, after adjustment for age and baseline BMI, there was no statistically significant effect of intermittent fasting and composite occurrence of GDM or prediabetes.

Conclusion: Intermittent fasting in the 3rd trimester of pregnancy has no impact neither on the incidence of GDM in obese pregnant women nor maternal and neonatal outcomes.

Keywords: Subcuticular skin closure, Suture materials, Cesarean delivery.

INTRODUCTION

Intermittent fasting (IF) is utilized to describe a range of calorie restriction strategies used for either health or weight loss (WL). While, some authors use it three or four days a week for an entire day, others use it when a patient reduces their energy intake for multiple hours in a succession (typically 16 hours with no energy intake for the remaining 8 hours of the day) [(1)]. Programs that allow protein but not carbohydrates refer to it as intermittent fasting [(2)]. Because fasting is so popular, some people call this diet a "diet that resembles fasting," although it is simply a low-calorie diet that permits carbohydrates or macro/micronutrients to a level that will still encourage ketosis [(3)].

While, some authors use it three or four times a week for a whole day, others use it when a patient reduces their calorie intake for multiple hours in a row (frequently 16 hours with no energy intake for the remaining 8 hours of the day). You can also drink non-caloric liquids like water, coffee, and other things while fasting to help you feel less hungry. One of the main differences from religious fasting is that non-caloric fluid consumption is always allowed, which significantly reduces the danger of hypotension and dehydration, two important issues during religious fasting [(4)]. The body's metabolism may be affected by modifications to the amount and pattern of activity, meals, and fluid intake, as well as sleep patterns during and after the fast [(5)].

Numerous metabolic and inflammatory processes have been found to be improved by intermittent fasting and reduced calorie consumption. Insulin resistance, the primary symptom of type 2 diabetes mellitus (T2DM) during pregnancy, has long been known to be alleviated by intermittent fasting. Following a period of fasting, insulin levels decrease and insulin sensitivity rises. These have been demonstrated to be associated with better postprandial and fasting sugar levels. In addition, because insulin encourages the formation of adipose tissue, there is a decreased propensity to gain weight and possibly even to lose weight, which improves foetal health and reduces the negative consequences of gestational diabetes on neonates [(6)].

Contrarily, a large number of other researchers discovered no connection between fasting and intrauterine growth, birth weight (BW), birth-time indices, GDM, preterm labor (PTL), or preeclampsia (PE). Studies looking at how fasting affects moms and newborns have largely inconsistent outcomes; more study is needed to get to reliable conclusions [(7)].

PATIENTS AND METHODS

Between February 2022 and February 2023, 278 obese pregnant women contributed to this randomized controlled clinical trial at the Obstetrics and Gynecology Department, Faculty of Medicine, Ain Shams University Maternity Hospitals.

Inclusion criteria: Healthy pregnant women attended antenatal care clinic during their 2nd trimester of pregnancy for follow up aged between 18 and 35 years old with BMI ≥ 30 kg/m^2, living singleton pregnancy

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and gestational age (GA) between 24- 27 weeks at time of recruitment.

Exclusion criteria: Women with multifetal gestations, preexisting or gestational diabetes, pre-pregnancy CVD as chronic or pregnancy-induced hypertension, hepatic & renal diseases and coagulopathy or peptic ulcer.

Sampling method: Systematic random sampling was used, and women who met the inclusion requirements were randomly allocated to either group. Two hundred fifty-two opaque envelopes were serially numbered, and the appropriate letter denoting the allocated group was placed in each envelope in accordance with the randomization table. Then all of the envelopes were closed and placed in one box. MedCalc ® version 13 was used for computer-generated randomization sheets.

Confidentiality: When the patient's name appeared on any other document, the investigators stored it in a safe location and only included the patient's initials in the case report. To make it possible to identify records, the scientists kept a personal patient identification list, which comprised patient initials and the matching patient names.

Concerning safety and efficacy: No evidence of harmful effects of intermittent fasting for the fetus and no evidence of congenital fetal malformations. The fasting was performed during a safe period of the pregnancy (the third trimester).

Study procedures: During their initial prenatal treatment, the demographic and maternal information were taken via a questionnaire. Patients were exposed to the following:

Complete history taking:

- Personal history (Age, residence, occupation, marital status and special habits as smoking & alcohol).
- Menstrual history: Day of last menstrual period and regularity.
- Obstetric history (gravidity, parity, previous miscarriages and obstetric complications).
- Contraception history (type and duration of use before pregnancy).
- Medical history: Medical comorbidities with pregnancy as hepatic, renal, endocrinal, psychosocial condition, cardiovascular, diabetes and chronic hypertension.
- Surgical history: Previous Cesarean sections (CS) and its neonatal outcomes.
- Family history of maternal or fetal complications with pregnancy.
- Lifestyle.

Clinical examination:

- General examination was done with special emphasis on obstetric abdominal examination "Leopold maneuvers". Pre-pregnancy, BMI (pre-BMI) or 1st ANC visit The BMI was estimated using height and pre-pregnancy weight (BMI = weight/height^2).
- Pre-study weight.

Investigations:

- **Labs:** Routine investigations as CBC, liver and kidney function tests, coagulation profile "PT, PTT and INR", virology (Hepatitis B and C viruses), Blood group (ABO) and Rh.
- **Basic ultrasound (US) examination,** which included ultrasound measurements of classical fetal biometric parameters that comprised biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) that were taken using Mindray DP-15 Digital Ultrasonic Diagnostic Imaging System and GE Logiq E9 US machine, 2–5 MHz wide band convex, curved array transducer.

The study was conducted on (278) women who were divided into two groups:

Group A (study group): 139 women fast (drinking water, coffee with non-caloric beverages were allowed) 16 successive hours daily comprising sleeping hours with all energy intake (same calories needed during pregnancy) during the other 8 hours window of the day (that was selected by the patient). Calories needed during 3rd trimester of pregnancy were 30 Kcal/kg in the form of 50% complex carbohydrates with low glycemic index, 35% fat and 15% proteins. **Group B (control group):** 139 women with the same life style with no caloric restriction. The study was conducted for 12 weeks (24: 36 weeks).

Maternal weight assessment was done just before delivery. Gestational weight change was calculated by subtracting the body weight at delivery from the antenatal reported pregnancy weight and pre study reported weight. Mode of delivery was reported. Screening of DM was done using a 50-g oral glucose challenge test (GCT) (50 grams of glucose was given to the non-fasting patient (24-28 w) and (36-38 w). A venous blood sample was taken after one hour and when the blood glucose was above 140 mg/dL (7.8 mmol/L) and oral glucose tolerance test (OGTT) was done using 75 g oral glucose with the following cut-off points. When two readings exceeded their threshold, GDM was diagnosed: **Fasting:** 105 mg/dl, **1 hour:** 190 mg/dl, **2 hour:** 165 mg/dl and **3 hour:** 145 mg/dl.

Fetal follow up using US assessment every 3-4 weeks by basic fetal biometry was done. Fetal assessment was done using Apgar score 1 and 5 mins after delivery and fetal weight at the time of the labor.

In this protocol, patient visits were scheduled every 2 weeks and follow up of fetus growth by ultrasound was performed for basic fetal biometry and mother weight. When random blood sugar was more than 200 mg/dl, OGTT was done using 75 g oral glucose that when more than the following cut-off points, the patient was converted to high risk pregnancy follow up and when random blood sugar was less than 80 mg/dl the composition of the diet was changed.

Ethical approval: Before the study began all local regulations were followed and the OB/GYN Department Council, Ain Shams University approved the protocol and all associated documentation for ethical and research purposes. All patients gave their agreements before being included in the research after being given an intelligible explanation of the nature, scope, and potential outcomes of the clinical trial. Throughout its implementation, the study complied with the Helsinki Declaration.

Statistical analysis

IBM© SPSS© statistics version 23 was used for statistical analysis. The Fisher's exact test was used to compare intergroup differences, and categorical variables are shown as counts and percentages.

The X^2-test was used to compare ordinal data for trends. The unpaired t-test was used to examine differences between numerical variables, which were shown as mean ± SD. To investigate both within- and between-subjects effects, repeated ANOVA was used. The Kaplan-Meier (K-M) approach was used to analyze time to event. Different K-M curves were compared using the log-rank test. After controlling for confounding variables, the impact of IF on the incidence of GDM or prediabetes was investigated using multivariable binary logistic regression analysis. Statistical significance was set at $P \leq 0.05$.

RESULTS

There were no significant differences between study groups as regards maternal age, BMI at 1st ANC visit, 2nd trimester, weight at delivery and women's obstetric history and their impact on maternal and fetal outcomes (Table 1).

Table (1): Demographic characteristics of patients in both groups

Variable	Study Group (N=130)	Control Group (N=136)	p-value
Age (years), mean ± SD	27.7 ± 5.0	29.0 ± 4.5	.027†
Weight at 1st ANC visit (kg), mean ± SD	86.0 ± 14.5	84.6 ± 13.0	.416†
Height 1st ANC visit (m), mean ± SD	1.57 ± .05	1.58 ± .05	.635†
BMI at 1st ANC visit (kg/m^2), mean ± SD	34.6 ± 4.8	33.9 ± 4.2	.235†

Table (2) showed that intermittent fasting was accompanied by increased risk of the development of prediabetes, which was marginally statistically significant. However, effect on occurrence of GDM or the composite incidence of prediabetes and GDM was not statistically significant.

Table (2): Incidence of GDM and prediabetes in both groups

Variable	Study Group (N=130)	Control Group (N=136)	p-value
Prediabetes, n (%)	6 (4.6%)	0 (0.0%)	.013†
GDM, n (%)	10 (7.7%)	11 (8.1%)	>.999†

Intermittent fasting was accompanied by increased risk of occurrence of prediabetes (risk ratio = 13.6, 95% CI = 0.77 to 238.95), which was marginally significant (p =.074) with a number needed to harm (NNH) of 21.8 (95% CI = 122.439 to 11.937). Effect on occurrence of GDM or the composite incidence of prediabetes and GDM wasn't statistically significant (risk ratio = 0.951, 95% C% = 0.42 to 2.16, p-value =.905 or risk ratio = 1.52, 95% CI = 0.73 to 3.15, p-value =.259 respectively) (Table 3).

Table (3): Risk analysis for incidence of prediabetes and GDM in both groups

Adverse outcome	Relative risk	95% CI	z-statistic	p-value	NNT / NNH	95% CI
Prediabetes	13.60	0.77 to 238.95	1.784	0.074	NNH = 21.754	122.439 (Harm) to 11.937 (Harm)
GDM	0.91	0.42 to 2.16	0.12	0.905	NNT = 252.571	16.429 (Harm) to ∞ to 14.538 (Benefit)

After adjustment for age and baseline BMI, there was no statistically significant effect of intermittent fasting and occurrence of GDM (OR = 0.927, 95% CI = 0.375 to 2.293, p =.869) (Table 4).

Table (4): Multivariable binary logistic regression analysis for occurrence of GDM

Variable	Coefficient	SE	Wald	p-value	Odds ratio	95% CI
Intermittent fasting (=1)†	-0.076	0.462	0.027	0.869	0.927	0.375 to 2.293
Baseline BMI (kg/m^2)	0.014	0.050	0.076	0.783	1.014	0.920 to 1.117
Age (years)	-0.010	0.049	0.038	0.846	0.991	0.899 to 1.091
Constant	-2.619	1.993	1.727	0.189		

There were no statistically significant differences between study groups as regards incidence of preeclampsia, premature rupture of membranes (PRM), intrauterine fetal death, stillbirth, congenital anomalies, rate of CS delivery, GA at labor, BW, Apgar score at five min and mode of delivery (Table 5).

Table (5): Neonatal outcomes, change in maternal weight, change in fetal weight and mode of delivery in both groups

	Study Group (N=130)	Control Group (N=136)	p-value
Neonatal outcomes			
GA at delivery (weeks)	37.7 ± 1.8	37.7 ± 2.3	0.854†
Birth weight (kg)	2.81 ± 0.50	2.85 ± 0.52	0.511†
Apgar score at 5 min	8 ± 1	8 ± 1	0.761†
Change in maternal weight			
Weight at 1st ANC visit (kg)	86.0 ± 14.5	84.6 ± 13.0	0.416†
Weight at 2nd trimester (kg)	91.9 ± 15.7	92.0 ± 13.6	0.968†
Weight at delivery (kg)	94.5 ± 16.4	96.2 ± 14.5	0.395†
Change in fetal weight			
EFW at 1st ANC visit (kg)	0.74 ± .09	0.71 ± .10	0.010†
EFW at 36w (kg)	2.77 ± .53	2.82 ± .48	0.470†
Birth weight (kg)	2.80 ± 0.50	2.85 ± 0.52	0.511†
Mode of delivery	**Study Group**	**Control Group**	**p-value**
NVD, n/N (%)	23/41 (%56.1)	26/48 (54.2%)	0.856†
CS, n/N (%)	18/41 (%43.9)	22/48 (45.8%)	

DISCUSSION

As regards baseline characteristics, our study revealed that there were no statistically significant differences between study groups as regards maternal age, BMI at 1st ANC visit, 2nd trimester, weight at delivery and women's obstetric history and their impact on maternal and fetal outcomes.

Our study displayed that intermittent fasting was accompanied by increased risk of occurrence of prediabetes, which was marginally statistically significant. On the other hand, effect on occurrence of GDM or the composite incidence of prediabetes and GDM wasn't statistically significant. Also, after adjustment for age and baseline BMI, there was no statistically significant effect of intermittent fasting and composite occurrence of GDM or prediabetes.

As regards obstetric and fetal outcomes, we recorded that there were no significant differences between study groups as regards incidence of preeclampsia, PRMs, intrauterine fetal death, stillbirth, congenital anomalies, rate of CS delivery, GA at delivery, birth weight, Apgar score at five min and mode of delivery.

The processes behind GDM and prenatal mood dysregulations (MDs) were examined by **Ali and Kunugi** [(8)]. A case study was used to illustrate how exercise, dietary changes, and IF alter emotional and metabolic functions. Interventions like IF significantly decreased maternal body weight, plasma glucose, and psychological discomfort in this patient without causing any negative side effects. Therefore, one strategy to manage GDM and maternal MDs is IF. **Gray *et al.*** [(9)] examined the effects of daily continuous energy restriction (CER) and intermittent energy restriction (IER) on weight reduction and diabetes risk indicators in overweight women with a history of GDM over a one-year period. IER was implemented twice a week. In overweight females with a history of GDM, IER results in weight loss that is equivalent to that of CER over a 12-month period. The weight reduction varied from 4.6% to 13% of the initial body weight, with no significant differences between groups. According to **Welton *et al.*'s** [(10)], novel review comparing IER to CER in overweight and obese subjects, which comprised 12 trials with durations ranging from 8 weeks to 1 year. The study found that only two trials observed weight reduction of 5.6% and 6.8% over a period of twelve months or more [(11–12)]. The intricacies of long-term lifestyle modifications and weight control with IER have been further reinforced by other IER trials that have lasted 12 months or more and have revealed comparable WL patterns, with weight dropping for three to six months and then plateauing or increasing thereafter [(11, 13)].

According to **Ratner *et al.*** [(14)] females with a history of GDM had a 53% lower chance of developing diabetes if they lose 5 kg by lifestyle modifications. In line with previous recent studies comparing IER to CER, **Cioffi *et al.*** [(15)] reported no significant changes in diabetes risk variables across groups at 3 or 12 months.

Improvements in insulin and fasting glucose levels; participants may have been in a hypocaloric condition at the time of the last blood draw if their HOMA-IR scores and glucose tolerance, which were measured at three months, were diminished at twelve months. IER and CER subjects were consuming almost their allotted calorie allocation, according to a study of the dietary checklists. However, in order to reduce participant burden, these checklists were completed twice a week. As is often the case with dietary treatments, it is probable that some individuals were either underreporting their food consumption or overeating on their nonrecording days [16]. Decreased glucose intake during fasting in healthy pregnants inhibits skeletal muscle glucose uptake to keep normoglycaemia by suppressing insulin secretion and promoting glucagon release, which stimulates hepatic gluconeogenesis and glycogenolysis [17]. Therefore, in pregnant diabetic females, fasting during Ramadan may be a "perfect storm" of conditions that causes possibly detrimental metabolic alterations such ketogenesis [18].

Although the majority of research indicates no increased risk of diabetic ketoacidosis (DKA), there is a potential risk of fasting-triggered DKA among pregnant women with diabetes who observe the Ramadan fast. On the other hand, studies examining this topic have been poorly conducted and the findings have been inconsistent. The biggest research included 432 occurrences of DKA in 283 individuals and compared the incidence of DKA during Ramadan with other months in the United Arab Emirates [19]. According to **Abdelgadir *et al.*** [20]**,** DKA hospitalization incidence during Ramadan and the typical non-Ramadan month did not change significantly (3.6/month vs. 3.3/month, p = 0.77). In contrast, the researchers didn't specify the mother's fasting condition. Hospital length-of-stay and DKA incidence were not different in the DKAR multi-national prospective observational research of 170 diabetic patients hospitalized with DKA. On the other hand, duration was greater during Ramadan (23.8 hours) and the month after Ramadan (23 hours) than it was before Ramadan (13.2 hours). T1DM was seen in every patient with DKA during Ramadan. According to **Abdelgadir *et al.*** [21], no difference in HbA1c was detected between those with and without DKA. Hospital stays during Ramadan were longer than those in the month after, according to a previous study (DKAR1) conducted by the same group that examined 48 DKA hospitalizations. As compared to the month after Ramadan, a lower incidence of DKA was observed in both studies [20, 21]. Possible explanations include the flow-on effect of poorer glycaemic control throughout Ramadan or post-Ramadan celebrations leading to discussions about carbohydrate intake and glycaemic control. The relationship between Ramadan fasting and DKA episodes wasn't well defined, nevertheless, because the majority of patients in both groups were not fasting throughout the holy month. With no change in length of stay or death, a one-year retrospective research conducted in Libya indicated a lower incidence of DKA (15/month) than the average of 19.5/month (p<0.001). Extensive DKA rates were non-significantly greater during Ramadan (26.6% vs. 16.8%, p=0.3). Neither the local diabetes population nor the patients' fasting condition were mentioned by **Elmehdawi *et al.*** [22]**.** Just 1.8% of the 106 teenagers and young adults with T1DM (average age 19 years, average HbA1c 11.0%) in the research finished the whole fasting month, which is similar to the institutional rates seen in months other than Ramadan [23]. Prior large-scale observational investigations on the effect of Ramadan fasting on glycaemic management in diabetic cases revealed either no change or a decrease in mean BGLs and HbA1c [24–26].

Retrospective research design, dependence on patient self-recording, and comparing before and after Ramadan instead of tracking changes over the month were among the study's limitations. EPIDIAR (12,243 patients) **Salti *et al.*** [27] and CREED (3,250 patients) were two noteworthy population studies that raised concerns about hypoglycemia and were carried out in a number of Muslim-majority nations [25]. Ramadan was accompanied by a greater rate of extensive hypoglycaemia (requiring hospitalization) in EPIDIAR compared to other months (T1DM – 0.14 vs 0.03/month, p=0.0174; T2DM – 0.03 vs 0.004/month, p <0.001). In subjects with T2DM, extensive hyperglycaemia was more common during Ramadan (0.05 vs. 0.01/month, p <0.001). Up to 78.7% of T2DM cases and 42.8% of T1DM cases fasted for fifteen days or more during Ramadan. 94% of patients in CREED fasted for 15 days or more during Ramadan, with an average fasting length of 21–27 days. There was no discernible alteration in HbA1c levels before or after Ramadan. Pre-Ramadan hypoglycemia was linked to a greater chance of experiencing hypoglycemia during Ramadan, while the overall incidence of hypoglycaemia throughout Ramadan was 7.1%.

Based on a lot of previous studies, using continuous glucose monitoring (CGM) raised issues about hypoglycaemia, especially during fasting indicated that fasting individuals with diabetes may have more glycaemic variability, with BGL nadir before Iftar and peak after Iftar [28]. **Lessan *et al.*'s** [29] biggest trial included seven healthy controls and 56 mostly well-managed diabetic patients (mean HbA1c 7.2%, 50/56 had type 2 diabetes) who used insulin and sulfonylurea sparingly [29]. CGM curves during Ramadan revealed a sharp increase in interstitial sugar after Iftar, but no discernible differences in average glucose, glycaemic variability, or the frequency of hypoglycaemia between diabetic patients and controls. On the other hand, when comparing the fasting and non-fasting periods for diabetic individuals, the BGLs were considerably lower before Iftar and higher after Iftar. While, hypoglycemia incidence was low due to the exclusion of individuals with T1DM, insulin treatment, HbA1c > 8%, or a history of recent or recurrent hypoglycemia, one investigation found no change in hypoglycemia frequency [30]. When **Khalil *et al.*** [31] monitored 21 T1DM patients using insulin pumps before and during Ramadan, they observed a redistribution of insulin with a 5- to 20% drop in basal insulin during the midday fast and a rise in prandial insulin, but no significant hypoglycemia episodes.

In a randomized trial of 60 T1DM patients receiving sensor-augmented insulin pump ± low-glucose suspend, it was discovered that basal insulin needs dropped by 30% and 48.6% of low-glucose suspend warnings happened during the final three hours of the fast [(28)].

The relationship between maternal Ramadan exposure and newborn outcomes in pregnant females with GDM was only examined in research by **Almogbel *et al.*** [(32)]. 345 Muslim women from a single tertiary referral center in Australia who had singleton pregnancies between 1989 and 2010 were included in this retrospective cohort analysis. The length and trimester of Ramadan exposure had no discernible impact on the occurrence of macrosomia or mean BW. Once GA at delivery, insulin administration, and BW centile were taken into account, the prevalence of neonatal hypoglycemia decreased with longer exposure to Ramadan (OR 0.4, p = 0.02 stratified based on 21-30 days exposure versus non-exposure). Although maternal glycemia was not measured, the authors hypothesized that a lower frequency of newborn hypoglycemia without a change in birth weight would indicate improved glycemic management during Ramadan. Longer exposure to Ramadan (OR 3.9, p=0.03) and the third trimester (OR 4.3, p=0.04) was associated with a new, unexplained trend of elevated newborn hyperbilirubinemia. Lack of documentation of fasting condition was a major restriction that is pregnancies, which coincided with Ramadan without specifying whether or not the mother really fasted for the course of the month were considered Ramadan exposed pregnancies [(32)].

Ramadan fasting and foetal outcomes in healthy pregnant females have been the subject of several researches, with varying degrees of success. To confirm the risks of maternal Ramadan fasting on the foetus, further high-quality evidence is required. According to a systematic review and meta-analysis (including 31,374 pregnancies, of which 18,920 were Ramadan-exposed), there was no relationship with low BW or PTL, and there was no enough data to examine an association with other fetal parameters [(33)].

We have extrapolated possible pathways for deleterious foetal consequences based on existing relevant findings, given the paucity of data on foetal outcomes in pregnancies complicated by diabetes and Ramadan fasting. As previously stated, diabetic individuals have higher post-Iftar hyperglycaemia during Ramadan, and there is substantial evidence that maternal hyperglycemia has detrimental consequences on the fetus. These include birth traumas, PTL, neonatal hypoglycaemia in second and third trimester exposed pregnancies, fetal deformity in first trimester exposed pregnancies, and macrosomia, and possible effects on the development of obesity, T2DM, and cardiovascular disease (CVD) in later life in children [(34)].

It's unclear, though, if a month of dysglycemia—during Ramadan, for example—would be enough to put the foetus at such danger. As previously mentioned, there is evidence of elevated maternal fasting hypoglycaemia, especially before Iftar. Nevertheless, there is a lack of information about the potential adverse events of maternal hypoglycaemia on the foetus.

Reduced BW (2.9 kg vs. 3.2 kg), HC, and body length were linked to maternal single time-point hypoglycaemia. There was no difference in the manner of delivery, GA, preterm labor, Apgar scores, or NICU hospitalizations. There is currently no evidence linking maternal fasting ketosis to worse fetal outcomes, such as a lack of correlation with the incidence of fetal deformity in the diabetes in early pregnancy study [(35)].

Thus, further research is required to clarify the immediate and long-term effects of maternal fasting on the child, especially in pregnancies that are affected by diabetes.

CONCLUSION

Intermittent fasting in the 3rd trimester of pregnancy has no impact neither on the incidence of GDM in obese pregnant females nor maternal and neonatal outcomes.

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REFERENCES

1. **Harris L, Hamilton S, Azevedo L *et al.* (2018):** Intermittent fasting interventions for treatment of overweight and obesity in adults. JBI Database Syst Rev Implement Rep., 16: 507–547.
2. **Carter S, Clifton P, Keogh J (2018):** Effect of intermittent compared with continuous energy restricted diet on glycemic control in patients with type 2 diabetes. JAMA Netw Open, 1: e180756. doi: 10.1001/jamanetworkopen.2018.0756.
3. **Wei M, Brandhorst S, Shelehchi M *et al.* (2017):** Fasting-mimicking diet and markers/risk factors for aging, diabetes, cancer, and cardiovascular disease. Sci Transl Med., 9: eaai8700. doi: 10.1126/scitranslmed.aai8700.
4. **Grajower M, Horne B (2019):** Clinical Management of Intermittent Fasting in Patients with Diabetes Mellitus. Nutrients, 11: 873. doi: 10.3390/nu11040873.
5. **Alkandari J, Maughan R, Roky R *et al.* (2012):** The implications of Ramadan fasting for human health and well-being. J Sport Sci., 30 (1): 9–19.
6. **Klempel M, Kroeger C, Bhutani S *et al.* (2012):** Intermittent fasting combined with calorie restriction is e_ective for weight loss and cardio-protection in obese women. Nutr J., 11: 98.
7. **Sultan I, Taha I, Hassanein M (2015):** Ramadan fasting and maternal perspectives in healthy pregnant women: systemic review. Br J of Med Res., 6 (6): 573-86.
8. **Ali A, Kunugi H (2020):** Intermittent fasting, dietary modifications, and exercise for the control of gestational diabetes and maternal mood dysregulation: A review and a case report. International Journal of Environmental Research and Public Health, 17 (24): 9379. doi: 10.3390/ijerph17249379.
9. **Gray K, Clifton P, Keogh J (2021):** The effect of intermittent energy restriction on weight loss and

diabetes risk markers in women with a history of gestational diabetes: A 12-month randomized control trial. The American Journal of Clinical Nutrition, 114 (2): 794-803.

10. **Welton S, Minty R, O'Driscoll T *et al.* (2020).** Intermittent fasting and weight loss: Systematic review. Canadian Family Physician, 66 (2): 117-125.
11. **Headland M, Clifton P, Keogh J (2019):** Intermittent compared to continuous energy restriction on weight loss and weight maintenance: Effects after 12 months. Obesity Research & Clinical Practice, 13 (3): 268-269.
12. **Carter S, Clifton P, Keogh J (2018):** Effect of intermittent compared with continuous energy restricted diet on glycemic control in patients with type 2 diabetes: a randomized noninferiority trial. JAMA Network Open, 1 (3): e180756.
13. **Headland M, Clifton P, Carter S *et al.* (2016):** Weight-loss outcomes: a systematic review and meta-analysis of intermittent energy restriction trials lasting a minimum of 6 months. Nutrients, 8 (6): 354. doi: 10.3390/nu8060354.
14. **Ratner R, Christophi C, Metzger B *et al.* (2008):** Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. The Journal of Clinical Endocrinology & Metabolism, 93 (12): 4774-4779.
15. **Cioffi I, Evangelista A, Ponzo V *et al.* (2018):** Intermittent versus continuous energy restriction on weight loss and cardiometabolic outcomes: a systematic review and meta-analysis of randomized controlled trials. Journal of Translational Medicine, 16 (1): 1-15.
16. **Wehling H, Lusher J (2019):** People with a body mass index⩾ 30 under-report their dietary intake: A systematic review. Journal of Health Psychology, 24 (14): 2042-2059.
17. **Pe V, Davis S, Shamoon H (2003):** Hypoglycemia in diabetes. Diabetes Care, 26 (6): 1902-12.
18. **Kumar S, Diamond T (2022):** Ramadan Fasting and Maternal and Fetal Outcomes in Pregnant Women with Diabetes Mellitus: Literature Review. Frontiers in Endocrinology, 13: 900153. doi: 10.3389/fendo.2022.900153.
19. **Beshyah A, Beshyah S (2019):** The incidence of diabetic ketoacidosis during Ramadan fasting: A 10-year single-centre retrospective study. Diabetes Research and Clinical Practice, 150: 296-300.
20. **Abdelgadir E, Hassanein M, Bashier A *et al.* (2016):** A prospective multi-country observational trial to compare the incidences of diabetic ketoacidosis in the month of Ramadan, the preceding month, and the following month (DKAR international). Journal of Diabetes & Metabolic Disorders, 15: 1-6.
21. **Abdelgadir E, Hafidh K, Basheir A *et al.* (2015):** Comparison of incidences, hospital stay and precipitating factors of diabetic ketoacidosis in Ramadan and the following month in three major hospitals in United Arab Emirates. A prospective observational study. J Diabetes Metab., 6 (514): 2. DOI:10.4172/2155-6156.1000514
22. **Elmehdawi R, Ehmida M, Elmagrehi H (2009):** Incidence of diabetic ketoacidosis during Ramadan fasting in Benghazi-Libya. Oman Medical Journal, 24 (2): 99-102.
23. **Sulicman S, Haiman M, Faiza O *et al.* (2003):** Ramadan fasting and diabetic control in adolescents and young adults. Jamahiriya Medical Journal, 2(4): 49-50.
24. **Beshyah S, Hassanein M, Ahmedani M *et al.* (2019):** Diabetic hypoglycaemia during Ramadan fasting: A trans-national observational real-world study. Diabetes Research and Clinical Practice, 150: 315-321.
25. **Jabbar A, Hassanein M, Beshyah S *et al.* (2017):** CREED study: Hypoglycaemia during Ramadan in individuals with Type 2 diabetes mellitus from three continents. Diabetes Research and Clinical Practice, 132: 19-26.
26. **Vickers N (2017):** Animal communication: when i'm calling you, will you answer too?. Current Biology, 27 (14): 713-715.
27. **Salti I, Bénard E, Detournay B *et al.* (2004):** A population-based study of diabetes and its characteristics during the fasting month of Ramadan in 13 countries: results of the epidemiology of diabetes and Ramadan 1422/2001 (EPIDIAR) study. Diabetes Care, 27 (10): 2306-2311.
28. **Elbarbary N (2016):** Effectiveness of the low- glucose suspend feature of insulin pump during fasting during Ramadan in type 1 diabetes mellitus. Diabetes/Metabolism Research and Reviews, 32 (6): 623-633.
29. **Lessan N, Hannoun Z, Hasan H *et al.* (2015):** Glucose excursions and glycaemic control during Ramadan fasting in diabetic patients: insights from continuous glucose monitoring (CGM). Diabetes & Metabolism, 41 (1): 28-36.
30. **Bonakdaran S, Khajeh-Dalouie M (2011):** The effects of fasting during Ramadan on glycemic excursions detected by continuous glucose monitoring system (CGMS) in patients with type 2 diabetes. Med J Malaysia, 66 (5): 447-50.
31. **Khalil A, Beshyah S, Abu Awad S *et al.* (2012):** Ramadan fasting in diabetes patients on insulin pump therapy augmented by continuous glucose monitoring: an observational real-life study. Diabetes Technology & Therapeutics, 14 (9): 813-818.
32. **AlMogbel T, Ross G, Wu T *et al.* (2022):** Ramadan and gestational diabetes: maternal and neonatal outcomes. Acta Diabetologica, 59 (1): 21-30.
33. **Glazier J, Hayes D, Hussain S *et al.* (2018):** The effect of Ramadan fasting during pregnancy on perinatal outcomes: a systematic review and meta-analysis. BMC Pregnancy and Childbirth, 18(1): 421. doi: 10.1186/s12884-018-2048-y.
34. **Armengaud J, Ma R, Siddeek B *et al.* (2018):** Offspring of mothers with hyperglycaemia in pregnancy: The short term and long-term impact. What is new?. Diabetes Research and Clinical Practice, 145: 155-166.
35. **Moreno-Fernandez J, Ochoa J, Lopez-Frias M *et al.* (2020):** Impact of early nutrition, physical activity and sleep on the fetal programming of disease in the pregnancy: a narrative review. Nutrients, 12 (12): 3900. doi: 10.3390/nu12123900.