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Postpartum Glucose Intolerance Prevalence in Patients with Gestational Diabetes Mellitus

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ABSTRACT
Patients with gestational diabetes mellitus are at increased risk for type 2 diabetes mellitus or glucose intolerance postpartum compared with those without diabetes mellitus. The present study is Prospective observational cross sectional study done at antenatal outdoor from April 2016 to March 2018 and admitted for delivery at obstetrics and gynaecology, Department B.R. SINGH Hospital Kolkata. Total 100 pregnant women had selected as study population on the basis of inclusion and exclusion criteria. Women with GDM ranged from the ages 18.00-34.00 years with mean age (Mean±SD) of patients being 25.4400±3.6991 years. Proportion of patients was significantly higher in age group 26-30 years. The prevalence of GDM was found to be higher in women belonging to upper middle class (49.0%). GDM was more prevalent among patients with positive family history of DM. About 34% Patients treated with insulin therapy, 30% were on oral hypoglycemic drug and 36% were controlled with diet modifications. In postpartum period, 6 weeks following delivery 14% cases persistently developed impaired fasting glucose and 15% cases developed impaired glucose tolerance. Following 12 weeks of post-partum period 9% cases had impaired fasting glucose and 6% cases had impaired glucose tolerance. Rates of type 2 diabetes continue to increase, women with GDM should be educated that glucose intolerance may not be temporary, that it can be modified by behaviour changes and that is why postpartum testing is important.

INTRODUCTION

The screening of gestational diabetes mellitus (GDM) is advised for all expectant patients, however, the most effective approach and schedule for screening remains a topic of debate. According to the current guidelines of the United States Preventive Services Task Force, it is recommended to conduct screening for gestational diabetes mellitus (GDM) in pregnant patients who do not exhibit any symptoms after the 24th week of gestation. However, screening asymptomatic patients before this gestational age is not recommended. According to the guidelines set forth by the American College of Obstetricians and Gynecologists (ACOG), patients who are overweight and possess additional risk factors for the development of gestational diabetes mellitus (GDM) or undiagnosed type 2 diabetes mellitus should undergo early screening at their first prenatal visit. In the event that the initial screening yields negative results, routine screening for GDM should be conducted[1,2]. Gestational diabetes mellitus (GDM) is associated with an elevated likelihood of experiencing complications both during pregnancy and in the postpartum period. According to recent data, it is estimated that a range of 15-60% of patients diagnosed with GDM will develop overt type 2 diabetes mellitus within a period of 5-15 years postpartum. Additionally, it has been observed that 70% of individuals who were previously diagnosed with GDM will develop type 2 diabetes mellitus within 28 years following pregnancy. ACOG and the American Diabetes Association[3] advise that all patients diagnosed with GDM should undergo screening for type 2 diabetes mellitus during a postpartum visit that occurs between 4-12 weeks after delivery[2,3]. The potential association between early gestational diabetes mellitus (GDM) diagnosis, specifically before 20 weeks of gestation and the likelihood of postpartum dysglycemia remains uncertain. This is in comparison to patients who receive a GDM diagnosis during routine screening. The diagnosis of GDM during the early stages of pregnancy, prior to the peak impact of pregnancy hormones that induce insulin resistance, may indicate a reduced level of initial insulin sensitivity. In the event that early gestational diabetes mellitus (GDM) serves as an indicator for subjugated metabolic dysfunction, it may be linked to an increased likelihood of postpartum dysglycemia in comparison to GDM diagnosed at a later stage of pregnancy. The objective of this study was to conduct a comparative analysis of the incidence of postpartum dysglycemia in two distinct cohorts of patients with obesity, one diagnosed with gestational diabetes mellitus (GDM) early in pregnancy and the other diagnosed between 24-28 weeks of gestation.

MATERIALS AND METHODS

The present study is Prospective observational cross sectional study done at antenatal outdoor from April 2016 to March 2018 and admitted for delivery at obstetrics and gynaecology, Department B.R. SINGH Hospital Kolkata. Total 100 pregnant women had selected as study population on the basis of inclusion andexclusioncriteria.Informedconsenthadtakenfrom everypatientfortheirvoluntaryparticipation. Necessary information had collected as perproform a which had include Basic information, chief complain, obstetric history, menstrual history, past medical and surgical history, dietary habit, family history, gestational age at which GDM detected, treatment received during antenatal period for GDM. General physical examination for enrolled subject had done including anthropometric measurement.

RESULTS

Table 1 depicts Fifteen patients, accounting for 15.0% of the sample, were aged 20 years or younger. Twenty patients, representing 20.0% of the sample, were aged between 21 and 25 years. The majority of patients, 55 in total, were aged between 26 and 30 years, accounting for 55.0% of the sample. Lastly, 10 patients, representing 10.0% of the sample, were aged between 31 and 35 years. The calculated Z-score is 5.1121. The statistical significance level of the observed effect is less than 0.001. The outcome holds statistical significance. Our study revealed that the

Table 1: Demograhic and clinical profile of patients

Particular/sub-particular	Frequency	Percentage
Age (years)		
≤20	15	15.00
21-25	20	20.00
26-30	55	55.00
31-35	10	10.00
Socioeconomic status		
L	14	14.00
LM	11	11.00
M	15	15.00
UM	49	49.00
U	11	11.00
Family history of DM		
No	38	38.00
Yes	62	62.00
BMI (kg m^{-2})		
<25	30	30.00
25-30	51	51.00
30-35	19	19.00
>35	-	0.00
GDM diagnosed		
<24 weeks	13	13.00
24-28 weeks	57	57.00
>28 weeks	30	30.00
Treatment received by GDM Patient		
Insulin	34	34.00
Oral hypoglycemic drug	30	30.00
Controlled with diet	36	36.00
Gestational age at delivery		
<37 weeks	15	15.00
37-39 weeks	73	73.00
>39 weeks	12	12.00

incidence of gestational diabetes mellitus (GDM) was notably elevated among women who were categorized as belonging to the upper middle socioeconomic class, with a prevalence rate of 49.0%. The calculated Z-Score is 5.1539. The statistical analysis yielded a p<0.001. The outcome holds statistical significance. The classification of social strata is commonly denoted by the following abbreviations: L for Lower class, LM for Lower Middle class, M for Middle class, UM for Upper Middle class and U for Upper class.

A total of 62 patients, representing 62.0% of the sample, reported a positive family history of Diabetes mellitus. The calculated Z-Score is 3.3941. The statistical significance level, as indicated by the p = 0.0007. The outcome holds statistical significance. Out of the total number of patients, 30 individuals (30.0%) had a body mass index (BMI) below 25 kg m^{-2}, while 51 patients (51.0%) had a BMI ranging from 25-30 kg m^{-2}. Additionally, 19 patients (19.0%) had a BMI between 30.0 and 35.0 kg m^{-2} and none of the patients had a BMI exceeding 35.0 kg m^{-2}. The calculated Z-Score is 3.025. The statistical significance level, as indicated by the p-value, is 0.00252. The outcome holds statistical significance. The study revealed that 13 patients were diagnosed with gestational diabetes mellitus (GDM) before 24 weeks of gestation, 57 patients were diagnosed between 24 and 28 weeks and 30 patients were diagnosed after 28 weeks. The calculated Z-Score is 3.8511. The statistical significance level, as indicated by the p = 0.00012. The outcome holds statistical significance. A total of 34 individuals underwent insulin therapy and the resulting Z-Score was calculated to be 4.5255. The statistical significance level of the observed results is less than 0.0001. The outcome holds statistical significance. A cohort of 30 individuals were administered oral hypoglycemic medication and the resulting Z-Score was calculated to be 3.9598. The statistical significance level, as indicated by the p<0.0001. The outcome holds statistical significance. A total of 36 patients achieved control through dietary measures alone, with a corresponding Z-Score of 5.6569. The statistical analysis yielded a p<0.0001. The outcome holds statistical significance. Fifteen patients, accounting for 15.0% of the sample, gave birth prior to reaching a gestational age of 37 weeks. The majority of patients, 73 in total or 73.0%, delivered between 37 and 39 weeks of gestation. The remaining 12 patients, comprising 12.0% of the sample, delivered after reaching a gestational age of 39 weeks. The calculated Z-Score is 8.2621. The statistical significance level, as indicated by the p<0.0001. The outcome holds statistical significance.

Table 2 depicts The study revealed that a total of 80 patients, accounting for 80.0% of the sample, exhibited fasting blood sugar (FBS) levels of 95 mg dL^{-1} or lower after 6 weeks. Furthermore, at the 12 week follow-up, this percentage increased to 90%, with 90 patients displaying FBS levels of 95 mg dL^{-1} or lower. At the 6 weeks follow-up, 14 patients, constituting 14.0% of the sample, exhibited fasting blood sugar levels greater than 95-125 mg dL^{-1}. At the 12 weeks follow-up, 9 patients, comprising 9.0% of the sample, demonstrated similar results. At the 6 weeks follow-up, 6 patients, accounting for 6.0% of the sample, exhibited fasting blood sugar levels exceeding 125 mg dL^{-1}. At the 12-week follow-up, only 1 patient, representing 1.0% of the sample, displayed similar results. At the 6 weeks mark, the Fasting Blood Sugar (FBS) exhibits a Z-Score of 9.3507. The statistical significance level of the observed data, as indicated by the p<0.0001. The outcome holds statistical significance. At the 12th week, the Fasting Blood Sugar (FBS) has a Z-Score of 11.4557. The statistical significance level, as indicated by the p<0.0001. The outcome holds statistical significance. The study revealed that a total of 80 patients, accounting for 80.0% of the sample, exhibited PPBS levels below 140 mg dL^{-1} after 6 weeks. Furthermore, 93 patients, equivalent to 93.0% of the sample, demonstrated the same outcome at the 12 weeks follow-up. At the 6 weeks follow-up, 15 patients, comprising 15.0% of the sample, exhibited postprandial blood sugar levels ranging from 140-199 mg dL^{-1}. At the 12 weeks follow-up, this number decreased to 6 patients, representing 6.0% of the sample. At the 6 weeks follow-up, 5 patients (5.0%) exhibited postprandial blood sugar levels exceeding 200 mg dL^{-1}, while at the 12 weeks follow-up, only 1 patient (1.0%) demonstrated such levels. At the 6-week mark, the PPBS yields a Z-Score of 9.2039. The statistical significance level of the observed data, as indicated by the p<0.0001. The outcome holds statistical significance. At the 12 weeks mark, the Z-Score for PPBS is 12.3043. The statistical significance level, as indicated by the p<0.0001. The outcome holds statistical significance.

Table 2: Patient profile

Sample type/blood sugar level	6 weeks	12 weeks
FBS		
≤≤95 mg dL^{-1}	80 (80%)	90 (90%)
>95-125 mg dL^{-1}	14 (14%)	9 (9%)
>125 mg dL^{-1}	6 (6%)	1 (1%)
p-value	<0.0001	<0.0001
Z score	9.3507	11.4557
PPBS		
<140 mg dL^{-1}	80 (80%)	93 (93%)
140-199 mg dL^{-1}	15 (15%)	6 (6%)
>200 mg dL^{-1}	5 (5%)	1 (1%)
p-value	<0.0001	<0.0001
Z score	9.2039	12.3043

DISCUSSIONS

The current investigation was carried out within the obstetrics and gynaecology department at B.R. Singh Railway Hospital, located in Sealdah, Kolkata, West Bengal. A total of 100 pregnant patients

diagnosed with gestational diabetes mellitus were included in this study, spanning from April 2016 to March 2018. In a study conducted by Emma Morton Eggleston *et al*.[4] it was observed that a proportion of 26.0% of patients fell within the age range of 15-29 years, while 65.0% of patients were aged between 30-39 years. Additionally, 9.0% of patients were found to be within the age range of 40-44 years. Cabizuca *et al*.[5] reported that the average age of all patients was 32±5 years. The study revealed that a total of 15 patients, accounting for 15.0% of the sample, had an age of 20 years or younger. Additionally, 20 patients, representing 20.0% of the sample, had an age range of 21-25 years. The majority of the patients, 55 in total, which accounted for 55.0% of the sample, had an age range of 26-30 years. Lastly, 10 patients, representing 10.0% of the sample, had an age range of 31-35 years. The present study's results were comparable to those of a hospital-based investigation conducted in Pakistan, which demonstrated that roughly 50% of women with gestational diabetes mellitus fell within the 25-30 age bracket[6,7]. A study conducted in Bangladesh revealed that a majority of cases (57.5%) of gestational diabetes mellitus (GDM) were observed in individuals aged between 21 and 29 years[8]. According to Seshiah *et al*.[9], the average age of the pregnant women under study was 23±4 years. In a study conducted by Rajesh *et al*.[10], it was observed that the incidence of gestational diabetes mellitus (GDM) was notably higher among women from upper and upper-middle socioeconomic classes, with rates of 25% (5 out of 20) and 16.8% (20 out of 119), respectively. This difference was found to be statistically significant ($p<0.001$) when compared to women from lower-middle (4.6%, 10 out of 219) and upper-lower (3.4%, 8 out of 230) socioeconomic classes. The research findings indicate that the incidence of gestational diabetes mellitus (GDM) was comparatively greater among women from the upper middle socioeconomic strata, with a prevalence rate of 49.0%. In a study conducted by Rajesh *et al*.[10], it was observed that the incidence of gestational diabetes mellitus (GDM) was comparatively higher among women belonging to the upper and upper-middle socioeconomic classes (5/20, 25% and 20/119, 16.8%, respectively) as opposed to those from the lower-middle (10/219, 4.6%) and upper-lower (8/230, 3.4%) classes. In contrast to my research, Cheung *et al*.[11] found a correlation between gestational diabetes mellitus (GDM) and lower socioeconomic status. Keshavarz *et al*.[12] discovered a correlation between gestational diabetes mellitus (GDM) and low socioeconomic status among expectant Iranian women. The study revealed that a total of 30 patients, accounting for 30.0% of the sample, had a BMI below 25 kg m^{-2}. Meanwhile, 51 patients, comprising 51.0% of the participants, had a BMI ranging from 25-30 kg m^{-2}. Additionally, 19 patients, equivalent to 19.0% of the sample, had a BMI between 30.0 and 35.0 kg m^{-2}. Notably, none of the patients had a BMI exceeding 35.0 kg m^{-2}. There exists a positive correlation between high BMI during the time of diagnosis and the risk of postpartum type 2 diabetes[13,14]. A study conducted in Denmark has indicated that a body mass index (BMI) of 25 kg m^{-2} is a significant predictor of postpartum glucose abnormalities, which is consistent with the findings of my own study[15]. The incidence of glucose abnormalities during the postpartum period was found to be comparable across all pre-pregnancy BMI categories, with rates of 33.4, 36.2 and 35.2% observed in individuals with BMI <25 kg m^{-2}, BMI 25-30 kg m^{-2} and BMI >30 kg m^{-2}, respectively 66 In a study conducted by Nadine Farah *et al*.[16], it was observed that out of the total patients, 2.4% had a BMI below 18.5 kg m^{-2}, 52.2% had a BMI between 18.5 and 25.0 kg m^{-2}, 26.9% had a BMI between 25.0 and 30.0 kg m^{-2}, 10.0% had a BMI between 30.0 and 35.0 kg m^{-2} and 7.4% had a BMI above 35.0 kg m^{-2}. The study revealed that a total of 62 patients, accounting for 62.0% of the sample, exhibited a positive family history of diabetes mellitus. Cabizuca *et al*.[5] reported that 48.7% of individuals had a positive family history of type 2 diabetes. Letícia Schwerz Weinert and colleagues demonstrated that a family history of diabetes mellitus was present in 62 individuals (59%), which is consistent with the findings of my study.

The current investigation examined the timing of gestational diabetes mellitus (GDM) diagnosis among a sample of participants. Specifically, 13 individuals were diagnosed with GDM prior to 24 weeks of gestation, 57 were diagnosed between 24 and 28 weeks and 30 were diagnosed after 28 weeks. Berkowitz identified that 29% of the total 99 women diagnosed with gestational diabetes mellitus (GDM) were detected prior to 24 weeks, while 71% were detected after 24 weeks. Likewise to my research. In the study conducted by Soheilykhah *et al*.[17], it was observed that 33.6% of the sample (n = 37) were in the gestational age range of less than 24 weeks, 38.1% (n = 42) were between 24-28 weeks and 28.2% (n = 31) were beyond 28 weeks of gestation. In a study conducted by Banerjee *et al*.[18] and colleagues, it was observed that out of a total of 176 individuals, a group with gestational diabetes mellitus (GDM) was identified. Among this group, 25% (44 individuals) were detected before 24 weeks, 18.2% (32 individuals) were detected between 24-28 weeks, 40.9% (72 individuals) were detected between 29-34 weeks and 15.9% (28 individuals) were detected beyond 34 weeks. Cabizuca *et al*.[5] reported that among the patients studied, 42.1% had undergone insulin therapy, 6.6%

had received oral hypoglycemic drugs and 51.3% had achieved glycemic control through dietary modifications alone. The study revealed that insulin therapy was administered to 34 patients, oral hypoglycemic drugs were given to 30 patients and 36 patients were managed solely through dietary control. The study revealed that a total of 15 patients, equivalent to 15.0% of the sample, had a delivery period of gestation less than 37 weeks. Meanwhile, the majority of patients, specifically 73 individuals or 73.0% of the sample, had a delivery period of gestation ranging from 37-39 weeks. A smaller proportion of patients, specifically 12 individuals or 12.0% of the sample, had a delivery period of gestation greater than 39 weeks. A study conducted by Turki Gasim revealed that the prevalence of preterm delivery was 11.4% among individuals diagnosed with gestational diabetes mellitus. The average age of delivery was 38 weeks[19].

According to a study conducted by Rajab and Mehdi[20], it was found that the incidence of pre-term delivery, defined as delivery before 37 weeks of gestation, was significantly higher in the group of women with gestational diabetes mellitus (GDM) compared to the control group[21].

The study conducted by Kanani and Leuva[22] demonstrated that the group diagnosed with gestational diabetes mellitus (GDM) exhibited notably elevated levels of pre-term delivery in comparison to the non-GDM group (19.6% vs. 7.6%). In a study conducted by Medha Kanani *et al*.[23], it was observed that a majority of the patients, specifically 57.14%, exhibited Fasting Blood Sugar (FBS) levels of less than or equal to 95 mg dL^{-1} at the 6 weeks follow-up. Similarly, 42.86% of the patients demonstrated FBS levels of less than or equal to 95 mg dL^{-1} at the 12 weeks follow-up after undergoing dietary therapy. The study revealed that 6 out of the total 12 patients (50.0%) exhibited Fasting Blood Sugar (FBS) levels of less than or equal to 95 mg dL^{-1} during the 6-week follow-up period. Similarly, during the 12 weeks follow-up period after insulin therapy, 6 out of the total 11 patients (54.55%) demonstrated FBS levels of less than or equal to 95 mg dl^{-1}.

Kanani and Leuva[22] discovered that a total of three patients, representing 21.43% of the sample, exhibited a postprandial blood sugar (PPBS) level of 120 mg dL^{-1} or lower at the six-week follow-up, while only one patient, or 7.14% of the sample, demonstrated a PPBS level of 120 mg dL^{-1} or lower at the 12 weeks follow-up after receiving dietary therapy. The researchers observed that a total of 4 patients, accounting for 33.33% of the sample, exhibited a postprandial blood sugar (PPBS) level of $\leq$120 mg dL^{-1} at the 6 weeks follow-up, while only 1 patient, representing 9.09% of the sample, displayed a PPBS level of $\leq$120 mg dL^{-1} at the 12 weeks follow-up following insulin therapy. In a study conducted by Kaufmann *et al*.[23], it was observed that out of the 108 women who underwent reevaluation, 76% (82) exhibited normal postpartum glucose tolerance, while 24% (26) continued to exhibit dysglycemia. Among the latter group, 20% (22) had impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) and 4% (4) had diabetes. Bhavadharini *et al*.[24] reported that 95.8% (203/212) of women successfully underwent postpartum oral glucose tolerance testing. Out of the total of 203 women, a majority of 161 individuals (79.3%) returned for postpartum follow-up testing within a period of 6-12 weeks. The remaining 42 women (20.7%) returned for the same testing between 12 weeks and one year after delivery. Out of the total of 161 female participants, constituting 79.3% of the sample, who underwent the test within the 6-12 week period, 2 individuals (1.2%) were diagnosed with DM, 5 individuals (3.1%) exhibited isolated IFG, 13 individuals (8.1%) exhibited isolated IGT and 5 individuals (3.1%) exhibited combined IFG/IGT. The remaining 136 individuals (84.5%) demonstrated a return to normal glucose tolerance (NGT). Out of the total of 42 women who returned within a year, 11.9% (5 individuals) developed DM, 23.8% (10 individuals) developed isolated IFG and 2.4% (1 individual) developed combined IFG/IGT. The remaining 61.9% (26 individuals) reverted to NGT. Therefore, it was observed that dysglycemia was identified in 25 (15.5%) females during the period of 6-12 weeks and in 16 females (38.1%) during the period of 12 weeks to 1 year. Within one year of delivery, dysglycemia was observed in 20.2% (41/203) of the women. In a study conducted by Bhavadharini *et al*.[24], it was observed that out of the total number of patients, 136 (84.5%) exhibited normal glucose tolerance, while 23 (14.3%) patients displayed dysglycemia. Additionally, 2 (1.2%) patients were found to have developed DM. The study revealed that a total of 80 patients, accounting for 80.0% of the sample, exhibited Fasting Blood Sugar (FBS) levels of $\leq$95 mg dL^{-1} after 6 weeks, while 90 patients, representing 90% of the sample, demonstrated the same outcome during the 12 weeks follow-up period. At the 6-week follow-up, 14 patients, accounting for 14.0% of the sample, exhibited fasting blood sugar levels above the range of 95-125 mg dL^{-1}. Similarly, at the 12-week follow-up, 9 patients, comprising 9.0% of the sample, demonstrated elevated fasting blood sugar levels. At the 6-week follow-up, 6 patients (6.0%) exhibited fasting blood sugar levels exceeding 125 mg dL^{-1}, while at the 12 weeks follow-up, only 1 patient (1.0%) demonstrated such levels.

The study revealed that a total of 80 patients, accounting for 80.0% of the sample, exhibited PPBS levels below 140 mg dL^{-1} after 6 weeks. Furthermore,

93 patients, representing 93.0% of the sample, demonstrated the same outcome at the 12 weeks follow-up. At the 6-week follow-up, 15 patients, accounting for 15.0% of the sample, exhibited postprandial blood sugar levels ranging from 140 to 199 mg dL^{-1}. At the 12 weeks follow-up, this number decreased to 6 patients, representing 6.0% of the sample. At the 6-week follow-up, 5 patients (5.0%) exhibited postprandial blood sugar levels exceeding 200 mg dL^{-1}, while at the 12 weeks follow-up, only 1 patient (1.0%) demonstrated such levels. Our study demonstrated that there was no statistically significant correlation between the diagnosis of gestational diabetes mellitus and the association of PPBS 48 hrs after gestational age. The statistical analysis did not reveal a significant association between the diagnosis of gestational diabetes mellitus (GDM) and the measurement of postprandial blood sugar (PPBS) at 6 weeks of gestational age. The statistical analysis did not reveal a significant association between the diagnosis of gestational diabetes mellitus (GDM) and the 12 weeks gestational age of performing the postprandial blood sugar (PPBS) test.

CONCLUSION

The screening of postpartum diabetes in patients with gestational diabetes mellitus (GDM) is a global concern, including in India, due to the potential for heightened maternal and fetal morbidity, mortality and long-term implications. Screening is a crucial aspect of prenatal care in India, as pregnant women in this population are at a heightened risk of developing glucose intolerance during gestation. The current investigation revealed that advanced maternal age, elevated body mass index, higher socioeconomic status and a family history of diabetes mellitus were significantly correlated with gestational diabetes mellitus. In cases where dietary and exercise interventions prove insufficient in regulating blood glucose levels, pharmacological interventions such as oral hypoglycemic agents (metformin) and insulin therapy (human insulin, insulin analogs) are commonly employed. Women diagnosed with gestational diabetes mellitus (GDM) are at an elevated risk of developing diabetes in the future. Therefore, it is imperative to provide postpartum follow-up to minimize the potential for diabetes-related complications and prevent conception of future pregnancies in the presence of uncontrolled hyperglycemia. To conclude, with the escalating prevalence of type 2 diabetes, it is imperative to educate women diagnosed with gestational diabetes mellitus (GDM) that glucose intolerance may not be a transient condition and can be ameliorated through alterations in behavior. Hence, it is crucial to emphasize the significance of postpartum testing.

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