Gestational Diabetes Screening

The International Association of the Diabetes and Pregnancy Study Groups Compared With Carpenter-Coustan Screening

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OBJECTIVE: To evaluate whether one-step gestational diabetes screening recommended by The International Association of the Diabetes and Pregnancy Study Groups (IADPSG) is associated with better maternal, perinatal, or neonatal outcomes than the two-step Carpenter-Coustan screening.

METHODS: In this before–after retrospective cohort study conducted between July 1, 2010, and December 31, 2013, we compared Carpenter-Coustan and IADPSG screening in patients with singleton pregnancies. All patients diagnosed with gestational diabetes received intensive teaching, home glucose monitoring, and medications as indicated. The primary outcome was the rate of large-for-gestational-age neonates. Secondary outcome measures were macrosomia (greater than 4,000 g), primary cesarean delivery, neonatal intensive care unit admission, preterm delivery, preeclampsia, and hyperbilirubinemia. We determined that a sample size of 2,782 per group was sufficient to detect a 2% difference in the primary outcome between groups with 80% power assuming a 10% incidence in the before group. The groups were compared using Fisher exact test for proportions and a χ² test for odds ratios.

RESULTS: In the before (Carpenter-Coustan) group, 513 (17%) of the 2,972 patients were diagnosed with gestational diabetes, and in the after (IADPSG) group, 847 (27%) of the 3,094 patients were so diagnosed (P<.001). There was no significant difference in rates of large for gestational age, 10% and 9%, respectively (P=.25). The IADPSG group had a significantly higher primary cesarean delivery rate—16% compared with 20% (P<.001), but there were no significant differences in any other pregnancy outcomes.

CONCLUSION: Although one-step screening was associated with more patients being treated for gestational diabetes, it was not associated with a decrease in large-for-gestational-age or macrosomic neonates but was associated with an increased rate of primary cesarean delivery. Our results did not support the IADPSG-recommended screening protocol.

(Obstet Gynecol 2016;127:10–7)
DOI: 10.1097/AOG.0000000000001132

Gestational diabetes has been associated with preterm delivery, preeclampsia, macrosomia (birth weight greater than 4,000 g), increased risk of cesarean delivery for arrest disorders, shoulder dystocia, neonatal hyperbilirubinemia, and respiratory distress syndrome as well as the later development of noninsulin-dependent diabetes mellitus. Some studies show an association between fetal exposure to uncontrolled maternal blood glucose and subsequent neonatal and childhood obesity.

Much controversy exists about how to identify gestational diabetes and whether the benefits of intervention justify the expense, the anxiety, and the possible risks associated with this diagnosis. For many years, health care providers in the United States have screened for gestational diabetes using a two-step test early in gestation in those patients deemed to be at high risk and a second test at 24–28 weeks of gestation to average-risk patients. Values were considered abnormal if they exceeded those recommended by either the Carpenter and Coustan and Fourth International Workshop-Conference Criteria or the values designated by the National Diabetes Data...
The American College of Obstetricians and Gynecologists continues to recommend this two-step approach.

Based on observational studies that specifically evaluated maternal, perinatal, and neonatal outcomes, The International Association of the Diabetes and Pregnancy Study Groups (IADPSG) and the World Health Organization recommended new criteria for the diagnosis of gestational diabetes. They recommend that a hemoglobin A1C (Hb A1c), a random plasma glucose, or a fasting plasma glucose test be performed at the first prenatal visit to identify undiagnosed pregestational diabetics and that a one-step 2-hour glucose tolerant test with a 75-g glucose load be performed at 24–28 weeks of gestation for those not identified as having pregestational diabetes.

In this study we sought to address whether changing from the traditional two-step Carpenter-Coustan screening recommended by the American College of Obstetricians and Gynecologists to the one-step test recommended by The International Association of Diabetes and Pregnancy Study Groups would be associated with meaningful improvements in maternal, perinatal, or neonatal outcomes.

MATERIALS AND METHODS
In November 2011, our hospital and affiliated clinics switched from the two-step Carpenter-Coustan screening approach to the one-step approach recommended by the IADPSG. We performed a before–after retrospective cohort study that compared patients before and after the change. We extracted demographic and obstetric data from the electronic medical record and verified it by selective chart review.

The sample consists of singleton pregnancies managed from the first trimester within the Kaiser Permanente Baldwin Park Medical Center and its affiliated clinics between July 1, 2010, and December 31, 2013. Mothers who were classified as diabetic before pregnancy were excluded. To keep the before and after groups statistically independent, patients were excluded if they had more than one pregnancy in the study period.

For the primary outcome of large birth weight for gestational age and sex (LGA), we determined that a sample size of 5,564 (2,782 per group) would allow the detection of an absolute rate difference of 2% between groups assuming a rate of 10% in the before group with 80% power at the 0.05 (two-tailed) significance level.

![Fig. 1. Cohort selection criteria for before and after groups.](Feldman. Carpenter-Coustan Criteria vs IADPSG Criteria. Obstet Gynecol 2016)
Figures 1 and 2, respectively, illustrate the screening protocols used in the before and after groups. Patients with Hb A$_1c$ levels of 6.5% or higher were considered to have overt diabetes. Because they had not been diagnosed with diabetes before the pregnancy, they were included in our treatment group and for statistical purposes were also categorized as having gestational diabetes. These patients were not excluded because our before group likely also had some patients with undiagnosed overt prepregnancy diabetes. Patients with Hb A$_1c$ levels between 5.7 and 6.4 were diagnosed with prediabetes and were treated in a similar manner as those having gestational diabetes. For statistical purposes, they were also included with those having gestational diabetes.

The care of patients with gestational diabetes did not change over the time course of the study. Patients attended a nutrition class and began home glucose monitoring with a fasting and three postprandial tests. The patients were seen in the office every 1–4 weeks at the discretion of their health care provider.

Fig. 2. The protocol for glucose screening in pregnancy before the change.
Typically, if more than one third of the fasting results was greater than 95 mg/dL or one third of the postprandial tests greater than 130 mg/dL at 1 hour or 120 mg/dL at 2 hours, the patients were started on either insulin or glyburide at the discretion of their health care provider. During this study metformin was used only in isolated cases. Patients who were prescribed any medication were monitored with twice-weekly fetal nonstress tests and amniotic fluid index measurement from 34 to 36 weeks of gestation to delivery. Patients who required medication were induced at 39 weeks of gestation if they had not gone into labor spontaneously. Patients who did not require medication were induced by 42 weeks of gestation.

We described the characteristics of the before and after groups using means with standard deviations or medians with interquartile regions for continuous variables. For discrete variables, we used percentages and counts. P values were obtained using Fisher test for proportions and Wilcoxon for continuous variables.

The primary study outcome was LGA, defined as a birth weight greater than the 90th percentile for gestational age and sex. The odds ratio between the two groups was computed, and an unadjusted comparison of the before and after groups was done using a χ² test. We used a logistic regression model to compare the two groups adjusting for certain covariates.

Secondary outcomes included neonatal intensive care unit admission, preterm delivery (before 37 weeks of gestation), preeclampsia, and hyperbilirubinemia (which was inferred if phototherapy was used). A secondary analysis was performed to evaluate the association of body mass index (BMI, calculated as weight [kg]/[height (m)]²) with the primary and secondary outcome measures. Body mass index was treated as a continuous variable. We used a logistic regression model to adjust for certain covariates.

This study was approved by the Kaiser Permanente Southern California institutional review board.

RESULTS

After exclusions, the final sample included 6,066 pregnancies (2,972 before protocol change and 3,094 after protocol change; Fig. 3; Table 1). The average maternal age of the two groups was 30 years. The median BMI at the first prenatal care visit for both groups was not significantly different. There was a greater proportion of patients with gestational diabetes mellitus in the after group (27% compared with 17%, P < .001) and more patients diagnosed with prediabetes (15% compared with 4%, P < .001). There was no significant difference in rates of LGA, 10% in the before group and 9% in the after, respectively (P = .25). No significant difference was noted in the median number of perinatal encounters or in the proportion of patients who underwent labor induction. Although no significant difference existed in the number of patients being treated with metformin, a greater number was treated with insulin and glyburide in the after group. There was no significant difference in prenatal weight at the first prenatal care visit between the two groups (P = .67).

![Fig. 3. The protocol for glucose screening in pregnancy after the change.](image)


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Mothers in the before group had a higher median weight than those in the after group both at the last visit before delivery and at the postpartum checkup 4 weeks after the delivery. There was a significant difference between the before and after groups in weight change from the first prenatal care visit to the postpartum checkup. However, this change was too small to be clinically significant.

A significant difference in frequency of cesarean deliveries was noted between the before and after groups, even among patients not diagnosed with gestational diabetes (Table 2). However, there was no significant difference in the adjusted odds of cesarean deliveries resulting from arrest disorders between the two groups. Table 3 shows that the odds of having a primary cesarean delivery were significantly greater in the after group. However, no significant difference was noted in the odds of having LGA (greater than the 90th percentile for age and sex) between the before and after groups. In contrast, a statistically significant difference in LGA neonates, macrosomia, and primary cesarean delivery was noted between patients with different BMIs at the first prenatal visit (Table 4).

**DISCUSSION**

In our study cohort, the use of the one-step IADPSG protocol for gestational diabetes screening instead of the two-step approach using the Carpenter-Coustan criteria cutoffs was associated with an increase in the rate of gestational diabetes from 17% to 27%. However, the IADPSG approach was not associated with a lower rate of LGA neonates, macrosomia, neonatal
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Table 4. Unadjusted and Adjusted Odds Ratios for Events by Body Mass Index at First Prenatal Care Visit

<table>
<thead>
<tr>
<th>Pregnancy Outcomes, Before vs After</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGA</td>
<td>1.08 (1.06–1.09)*</td>
<td>1.07 (1.06–1.09)*</td>
</tr>
<tr>
<td>Macrosomia</td>
<td>1.07 (1.05–1.09)*</td>
<td>1.06 (1.04–1.08)*</td>
</tr>
<tr>
<td>NICU admissions</td>
<td>1.01 (0.99–1.03)</td>
<td>0.99 (0.97–1.02)</td>
</tr>
<tr>
<td>Preterm births</td>
<td>1.04 (1.02–1.05)*</td>
<td>1.02 (1.01–1.03)</td>
</tr>
<tr>
<td>Total cesarean deliveries</td>
<td>1.05 (1.03–1.06)*</td>
<td>1.04 (1.03–1.05)*</td>
</tr>
<tr>
<td>Primary cesarean deliveries*</td>
<td>1.03 (1.02–1.05)*</td>
<td>1.03 (1.02–1.05)*</td>
</tr>
<tr>
<td>Cesarean deliveries as a result of arrest disorders</td>
<td>1.02 (1.01–1.04)*</td>
<td>1.03 (1.01–1.05)*</td>
</tr>
<tr>
<td>Preeclampsia</td>
<td>1.07 (1.04–1.09)*</td>
<td>0.97 (0.93–1.01)</td>
</tr>
<tr>
<td>Hyperbilirubinemia</td>
<td>1.01 (0.99–1.03)</td>
<td>1.01 (0.99–1.03)</td>
</tr>
<tr>
<td>Shoulder dystocia</td>
<td>1.08 (1.02–1.15)*</td>
<td>1.06 (0.99–1.13)*</td>
</tr>
</tbody>
</table>

OR, odds ratio; CI, confidence interval; LGA, large for gestational age; NICU, neonatal intensive care unit.

Significance codes:
* .0001.
.001.
.01.

* Patients with prior cesarean deliveries not included. There were 2,540 patients before and 2,565 patients after the protocol change that did not have prior cesarean delivery.

using the same treatment for gestational diabetes for both the before and after time periods. However, this strength may limit the generalizability of the results. The population studied had a majority Hispanic and Pacific Islander and Asian ethnicity. For this population, the rate of gestational diabetes by either testing criteria is higher than what has been reported in other studies with more diverse populations. Furthermore, as a retrospective analysis, this study has inherent limitations. Changes in practice patterns do occur over time as noted by the increase in cesarean deliveries even in patients who did not have gestational diabetes. However, the increase in total cesarean deliveries between the before and after groups was even greater. The difference between the increase that can be accounted for by changes in practice pattern and the total increase suggests that changing the testing criteria contributed to the increase in cesarean deliveries. This study grouped patients with prediabetes with those who developed gestational diabetes in the late second trimester. These two groups may be intrinsically different and may require a different treatment approach. A study evaluating the differences between these two groups and how they respond to treatment may result in a smaller proportion of LGA neonates and possibly even cesarean deliveries.

In summary, in this study, the IADPSG screening method for gestational diabetes was not associated with a reduction in LGA newborns or cesarean deliveries but was associated with a higher rate of gestational diabetes.

REFERENCES


