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Diabetes in Pregnancy

Alaska, 1990-1999

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Diabetes in Pregnancy

Summary

Between 1990-1999, in Alaska, 249 (0.2%) live births occurred to women with pre-existing diabetes (type 1 or type 2), and 2,445 (2.3%) to women who developed diabetes during pregnancy (gestational diabetes). Pregnancies among Alaskan women with diabetes are being treated as high-risk in that they receive earlier and more frequent prenatal care, and they receive more frequent diagnostic procedures. Women with either pre-existing or gestational diabetes are generally older than women with no diabetes and more likely to have additional risk factors such as hypertension. Adverse maternal and neonatal outcomes occur more frequently among women with either type of diabetes.

Introduction

Uncontrolled diabetes during pregnancy can significantly increase the risk of maternal and fetal/infant morbidity and mortality (1,2). Complications that arise from the effects of maternal diabetes in early development (1st trimester) include spontaneous abortion and major congenital malformation (3). The most prominent fetal complications that can arise during the second and third trimester include still births (relatively uncommon) and macrosomia (3). Maternal risks in diabetic pregnancies are greater if the woman has pre-existing vascular disease, such as retinopathy and nephropathy (3).

Methodology

Data on maternal and neonatal outcomes of mothers with diabetes was collected from birth certificates for the years 1990 to 1999. The birth certificate in Alaska is a nationally standardized form and two types of maternal diabetes can be recorded, pre-existing (PDM) and gestational diabetes mellitus (GDM).

On 120 birth certificate records, maternal diabetes status was unclear because both gestational and pre-existing diabetes were indicated. In these cases, maternal diabetes status was considered unknown, and the record was excluded from the analysis.

Statistical analyses were performed on the data set. Chi-squared analyses were done on all of the specific data sets comparing pre-existing diabetes to no diabetes, and gestational diabetes to no diabetes within specific categories, such as race and no maternal complications. All reported results were significant at $p<0.05$, unless specified. In the case of the number of prenatal visits, analysis of variance was used to compare the means from the three different populations. In this case the F-test was done, and the results were significant at $p<0.001$.

Prevalence of Diabetes Among Women Giving Birth in Alaska

Of the live births in Alaska between 1990 and 1999, 0.2% were to women with pre-existing diabetes, 2.3% were to women with gestational diabetes, and 97.5% were to women without diabetes. (Table 1)

Table 1. Percentage of Live Births by Diabetes Status: Alaska, 1990-1999

Diabetes Status	Number of Live Births	Percentage of Total Live Births
Pre-existing Diabetes (PDM)	249	0.2%
Gestational Diabetes (GDM)	2,445	2.3%
No Diabetes	104,491	97.5%
Total	107,185	100.0%

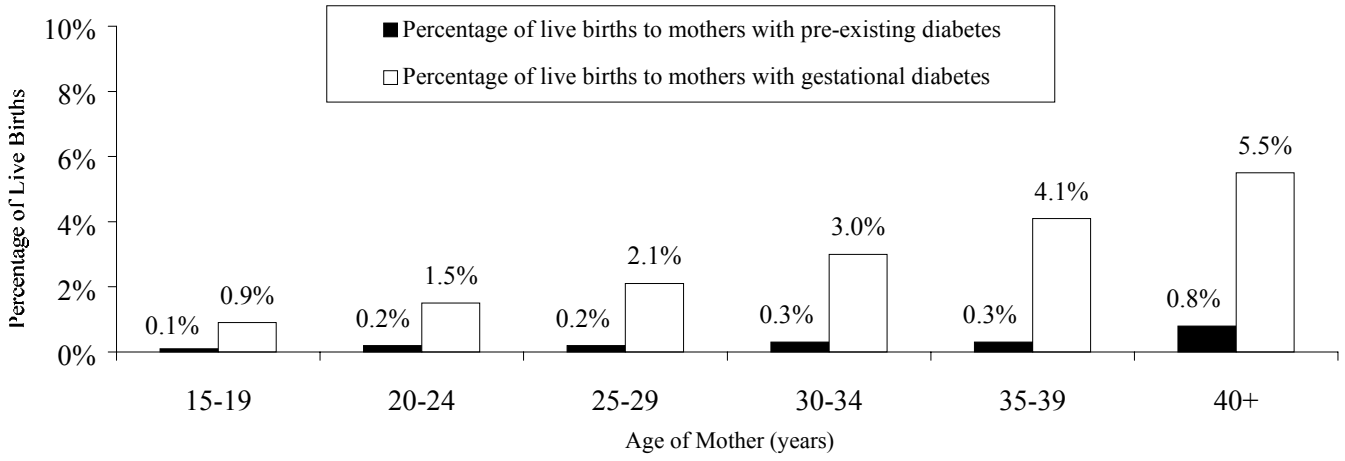
AK Vital Statistics, 1990-1999

The prevalence of both types of diabetes increased with the age of the mother; among mothers with gestational diabetes this trend was notable.

More than 6% of women over the age of 40 who gave birth had pre-existing or gestational diabetes. (Figure 1)

Prevalence of diabetes during pregnancy also varied by race. There was a significant difference between mothers with pre-existing diabetes and mothers with no diabetes by race. Among births to African-American women, and births to Asian and Pacific Islander women, there was a higher percentage of pre-existing diabetes in the mothers compared to mothers in other race and ethnic groups. There was also a significant difference by race between mothers with gestational diabetes and mothers with no diabetes. Asian and Pacific Islander women were reported to have gestational diabetes in approximately 3% of all of their live births. This is the highest prevalence of gestational diabetes in any race or ethnic group. The lowest percentage of gestational diabetes among births in a specific race or ethnic group, was among African-American women, with approximately 1.7% of live births to mothers with gestational diabetes. (Table 2)

Figure 1: Percentage of Live Births by Maternal Diabetes Status and Age: Alaska, 1990-1999



AK Vital Statistics, 1990-1999
Note: Data was missing from 221 records.

Table 2: Live Births by Maternal Diabetes Status and Race/Ethnicity: Alaska, 1990-1999

Race/Ethnicity of Mother	Live Births to Mothers with Pre-Existing Diabetes		Live Births to Mothers with Gestational Diabetes		Live Births to Mothers with No Diabetes	
White (n=71,582)	165	(0.2%)	1,566	(2.2%)	69,851	(97.6%)
Alaska Native (n=25,091)	46	(0.2%)	63	(2.5%)	24,406	(97.3%)
Black/African-American (n=4,832)	20	(0.4%)	80	(1.7%)	4,732	(97.9%)
Asian/Pacific Islander (n=4,904)	18	(0.4%)	149	(3.0%)	4,737	(96.6%)
Hispanic* (n=5,123)	10	(0.2%)	121	(2.4%)	4,992	(97.4%)

AK Vital Statistics 1990-1999,
Note: Differences between PDM and No Diabetes and between GDM and No Diabetes, by race, were statistically significant at $p<0.05$.
*Hispanic is an ethnic category and can be of any race; differences in diabetes status by Hispanic were not significant, $p=0.726$
Data was missing from 776 records.

Prenatal Care

Pre-conceptual counseling, consisting of education and information on pregnancy, should be provided to women with diabetes. Ideally it should begin at the onset of puberty and continue through menopause, thus encompassing all potential childbearing years of a woman. Planned pregnancies are the major objective of pre-conceptual counseling (3). Unfortunately, this is not always possible. Once a woman with diabetes becomes pregnant, the pregnancy should be treated as a high-risk pregnancy. With proper counseling and management the outcomes of most pregnancies complicated by diabetes can approach that of the general population (3).

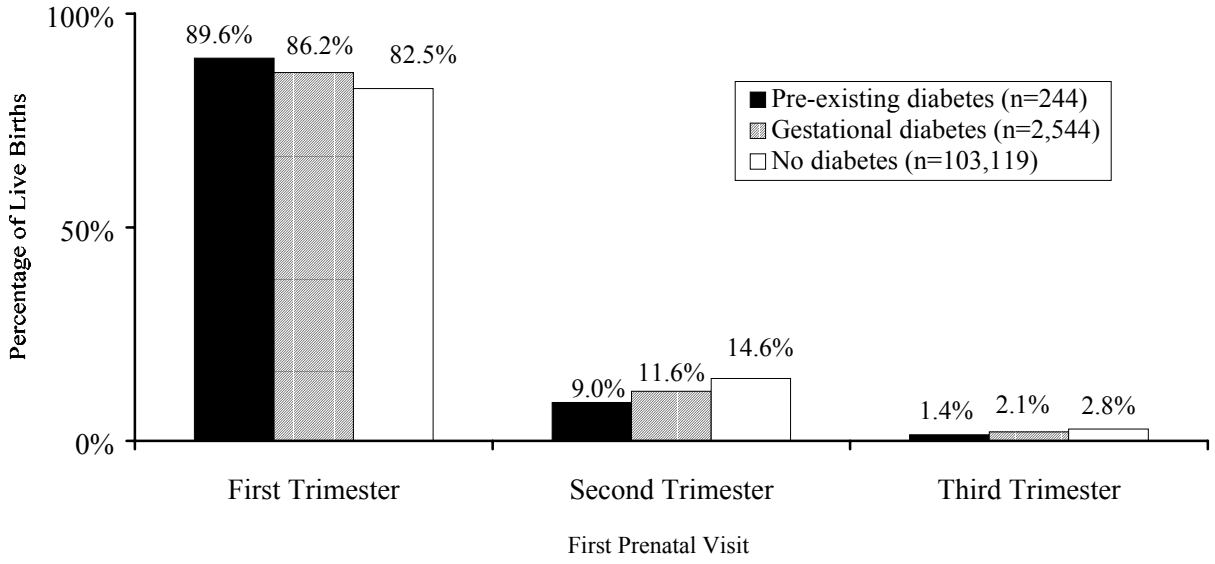
Women with pre-existing diabetes who gave birth in Alaska were more likely to obtain prenatal care in the first trimester. (Figure 2) In addition, among women who gave birth, those with pre-existing diabetes had more prenatal visits than women with gestational diabetes or with no diabetes. The mean number of prenatal visits for mothers with pre-existing diabetes (M=14.6) was greater than the mean number of prenatal visits for live births to women with gestational diabetes (M=12.6) or women with no diabetes (M=11.4). The difference between these averages was statistically significant ($p<0.001$), however, information on prenatal visits was missing from some of the birth certificates.

Medical Conditions Affecting Pregnancy

The Alaska birth certificate includes information on eighteen maternal complications. The selected complications shown in Table 3 varied markedly among births to women with diabetes (pre-existing or gestational) and births to women with no diabetes. The differences between mothers with pre-existing diabetes and no diabetes, and mothers with gestational diabetes and no diabetes, were statistically significant in regard to all of the listed complications except renal disease. The percentage of births to women with gestational diabetes who had renal disease was not significantly different from births to women with no diabetes who had renal disease.

Among women that gave birth, those with pre-existing diabetes were less likely to use tobacco or alcohol during their pregnancies than women with no diabetes. The differences, however, were not statistically significant.

Figure 2: Percentage of Live Birth by Maternal Diabetes Status and Trimester of the Mother's First Prenatal Visit: Alaska, 1990-1999



AK Vital Statistics, 1990-1999
Note: Data was missing from 11,612 records.

Table 3: Percentage of Selected Complications Among Women Who Gave Birth by Diabetes Status: Alaska, 1990-1999

Maternal Complication	Pre-Existing Diabetes (n=249)	Gestational Diabetes (n=2,445)	No Diabetes (n=104,491)
Pregnancy-Associated Hypertension	10.0%	8.1%	4.0%
Chronic Hypertension	5.6%	2.5%	0.7%
Previous Infant Weighing over 4000 grams	9.6%	9.4%	2.9%
Previous Pre-Term or Small Infant	4.0%	3.3%	1.8%
Hydramnios/Oligohydramnios	7.2%	3.6%	1.3%
Eclampsia	2.8%	1.0%	0.5%
Cardiac Disease	3.2%	0.9%	0.5%
Renal Disease	2.4%	0.2%*	0.1%

AK Vital Statistics, 1990-1999
Note: Differences between PDM and No Diabetes and between GDM and No Diabetes, were statistically significant at $p<0.05$, except for renal disease.
*Not significant, $p>0.05$

Procedures and Delivery

Among births in Alaska, mothers with pre-existing diabetes were more likely to have had amniocentesis than mothers with no diabetes. Mothers with gestational diabetes were also more likely to have undergone amniocentesis than women with no diabetes. (Table 4)

There are clinical procedures that are used before and during labor to identify or mitigate possible complications in high-risk pregnancies. Two of the most common are amniocentesis and induction of labor.

Amniocentesis is used to test for genetically inherited disorders, to do AFP (alpha-fetoprotein) testing which can detect fetal defects, and to determine fetal lung maturity (3). Maternal diabetes does not increase the risk for genetically inherited disorders, however increased age of the mother does increase risk for these disorders and malformations (4). In this study of births to women with diabetes in Alaska, the mean age of mothers with diabetes was higher than the mean age of mothers with no diabetes, and may contribute to the higher rate of amniocentesis in that group.

Type 1 diabetes is associated with an increased risk for neonatal defects such as spinal defects and ventral wall defects. These can be detected by testing for AFP, a fetal product that appears in amniotic fluid and maternal circulation (3). Testing for AFP is more accurate when amniotic fluid is used because maternal circulation may be low. Amniocentesis is also used to evaluate fetal lung maturity. Respiratory distress syndrome (RDS), or hyaline membrane disease, is characterized by reduced amounts of lung surfactants. This syndrome of newborns primarily affects premature infants (5). RDS occurs with greater frequency and at later gestational ages in infants of mothers with diabetes than in infants of mothers with no diabetes (3). AFP testing and evaluation of fetal lung maturity are two reasons for higher rates of amniocentesis among mothers with diabetes.

Information on the birth certificate does not indicate when amniocentesis was done during the pregnancy. This information would help to determine the reason the procedure was performed. For example, amniocentesis is generally done at 12 to 18 weeks to test for congenital anomalies caused by chromosomal abnormalities (6). Testing of AFP by amniocentesis is recommended between 16 and 20 weeks into the pregnancy to screen for neural tube defects. Amniocentesis to determine fetal lung maturity is done from 36 weeks to just prior to delivery. Elective delivery (induction or cesarean section) prior to 39 weeks gestation requires evaluation of fetal lung maturity (6).

Induction of labor was more common in births to women with either type of diabetes then in births to women with no diabetes. (Table 4) In the past, it was routine for women with diabetes to have their labor induced because the infant was large (macrosomia), or just for better glycemic control during the delivery to protect the infant and the mother (3). More recently, testing technology, such as amniocentesis and ultrasound, have allowed earlier detection of possible problems and abnormalities. This has made it possible for a greater number of women with diabetes to deliver vaginally (3).

Births to women with diabetes were more likely to require a cesarean section than births to mothers with no diabetes. (Table 4) Diabetes complications often require labor to be induced, but it was not possible from the information recorded on the birth certificate to ascertain whether the induction was a result of complications from the diabetes of the mother, or if there was some other cause.

Neonatal Outcomes

The birth certificate lists 17 possible neonatal complications of labor and delivery, 8 abnormal conditions of the infant at birth and 22 possible congenital anomalies. Complications, abnormal conditions and congenital anomalies were noted more frequently among infants born to mothers with pre-existing diabetes than among infants born to mothers with no diabetes. (Table 5) In the three categories of "complications of labor and delivery," "abnormal conditions of the newborn," and "congenital anomalies," births to women with no diabetes had a greater percentage of "no complications" than births to women with pre-existing or gestational diabetes.

Table 4: Percentage of Selected Obstetric Procedures and Methods of Delivery By Maternal Diabetes Status: Alaska, 1990-1999

	Pre-Existing Diabetes (n=249)	Gestational Diabetes (n=2,445)	No Diabetes (n=104,491)
Amniocentesis	26.1%	10.6%	4.1%
Induction of Labor	35.7%	32.5%	17.5%
Cesarean Section	39.9%	26.1%	15.6%

AK Vital Statistics, 1990-1999
Note. Differences between PDM and No Diabetes and between GDM and No Diabetes, were statistically significant at $p<0.05$.
Data was missing from 752 records.

Table 5: Percentage of Selected Complications, Abnormal Conditions and Congenital Anomalies Among Live Births by Maternal Diabetes Status: Alaska, 1990-1999

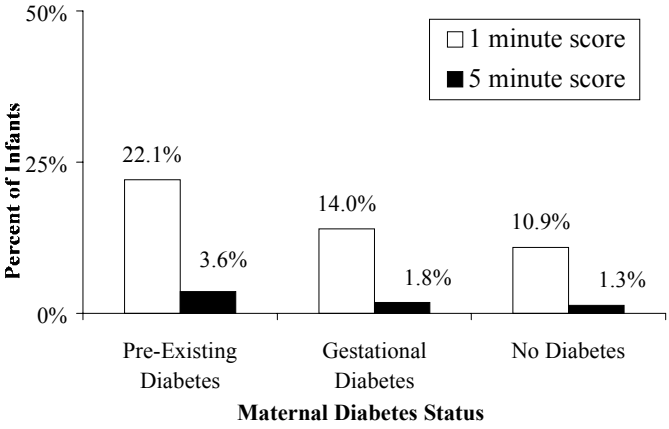
		Pre-Existing Diabetes (n=249)	Gestational Diabetes (n=2,565)	No Diabetes (n=104,491)
Complications of labor and delivery	No Complications	51.8%	50.7%	65.7%
	Abruptio placenta	2.8%	1.1%	0.8%
	Fetal distress	6.0%	7.3%	4.8%
	Cephalopelvic disproportion	6.0%	4.9%	2.4%
Abnormal conditions of the newborn	No abnormal conditions	71.1%	79.8%	88.9%
	Assisted ventilation <30 min.	11.2%	11.0%	5.1%
	Assisted ventilation >30 min.	4.4%	1.3%	1.0%
Congenital Anomalies	No congenital anomalies	90.4%	96.4%	97.8%
	Heart malformations	1.6%	0.4%	0.1%
	Other circulatory/ respiratory	2.4%	0.2%	0.1%

AK Vital Statistics, 1990-1999
Note. Differences between PDM and No Diabetes and between GDM and No Diabetes, were statistically significant at $p<0.05$.
Data was missing from 1 record for "No abnormal conditions," and "No congenital anomalies."

Apgar Scores

Apgar scores are a system for evaluating an infant's physical condition at birth (5). The infant's heart rate, respiration, muscle tone, response to stimuli and color are noted at 1 minute and again at 5 minutes. Infants with an Apgar score of less than seven at 1 minute, or 5 minutes, may indicate the need for resuscitation (5). Infants born to women with either type of diabetes were more likely to have lower Apgar scores than were infants born to women with no diabetes. Although the five-minute scores for over 95% of the infants born to women with pre-existing or gestational diabetes were greater than seven, infants born to women with diabetes were significantly more like to have an Apgar score of less than 7 at five minutes. (Figure 3)

Figure 3: Percentage of Infants with Apgar Scores less than 7 by Maternal Diabetes Status: Alaska, 1990-1999

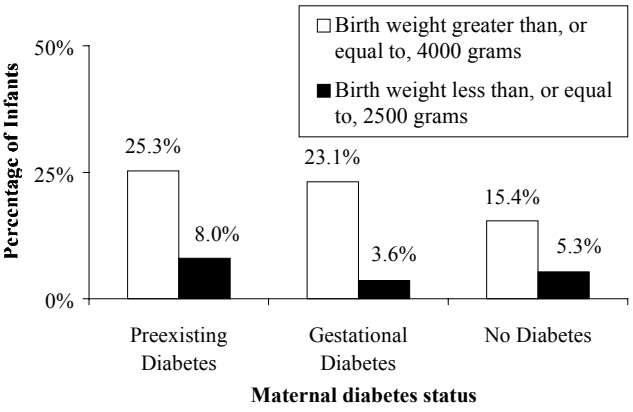


AK Vital Statistics, 1990-1999
Note: Differences between PDM and No Diabetes and between GDM and No Diabetes, for Apgar scores at 1 minute and at 5 minutes, were statistically significant at $p<0.05$.

Birthweight

Macrosomia is defined as a birth weight of 4,000 grams or higher (1). It is one of the most common neonatal complications found among women with either pre-existing or gestational diabetes in Alaska. Women with pre-existing diabetes were also slightly more likely than those with no diabetes, to give birth to low birth weight (≤2,500 grams) infants. Women with gestational diabetes were less likely to have low birth weight infants. (Figure 4)

Figure 4: Percentage of Infants with Macrosomia or Microsomia by Maternal Diabetes Status: Alaska, 1990-1999



AK Vital Statistics, 1990-1999
Note: Differences between PDM and No Diabetes for birth weight ≥4,000 grams was significant at $p<0.05$, differences for ≤2500 grams were not significant.
Differences between GDM and No Diabetes for birth weight ≥4,000 grams and birth weight ≤2,500 grams were significant at $p<0.05$.

Gestational Age

A pre-term delivery is defined as a delivery occurring prior to the 37th week of gestation, and a post-term delivery occurs after the 42nd week of gestation. Births to women with pre-existing diabetes were more likely to be pre-term deliveries and less likely to be post-term deliveries than births to women with no diabetes. (Table 6) Among births to mothers with gestational diabetes, the gestational age of infants was more likely to be between the 37 and 41 weeks than births to mothers with no diabetes, and less likely to be post-term deliveries.

Table 6: Percentage of Infants to Diabetic Mothers by Gestational Age Groups: Alaska, 1990-1999

Gestational Age	Pre-Existing Diabetes (n=243)	Gestational Diabetes (n=2,427)	No Diabetes (n=103,497)
<37 weeks	21.4%	7.1%	7.2%
37-41 weeks	77.0%	90.4%	89.2%
42+ weeks	1.6%	2.5%	3.6%

AK Vital Statistics, 1990-1999
Note: Differences between PDM and No Diabetes and between GDM and No Diabetes, were statistically significant at $p<0.05$.
Data was missing from 1,018 records.

Summary

Between 1990-1999, in Alaska, 249 (0.2%) live births occurred to women with pre-existing diabetes (type 1 or type 2), and 2,445 (2.3%) to women who developed diabetes during pregnancy (gestational diabetes). Pregnancies among Alaskan women with diabetes are being treated as high-risk in that they receive earlier and more frequent prenatal care, and they receive more frequent diagnostic procedures. Women with either pre-existing or gestational diabetes are generally older than women with no diabetes and more likely to have additional risk factors such as hypertension. Adverse maternal and neonatal outcomes occur more frequently among women with either type of diabetes.

Discussion

Some potential limitations of the birth certificate data are the accuracy and completeness of the reporting on birth certificates. There is also some controversy as to whether gestational diabetes is solely glucose intolerance due to the pregnant state of the woman, or if pregnancy unmasks the underlying propensity of the woman for glucose intolerance, which would be evident in the non-pregnant state at some future time (6). This distinction makes discerning whether a woman has gestational or pre-existing diabetes

somewhat more difficult. Another problem with the data source is that the birth certificate does not differentiate between type 1 and type 2 diabetes, which may lead to potentially different concerns and outcomes during a pregnancy.

In a 1991 study of pregnancy outcomes to mothers with pre-existing diabetes in Alaska, 17% were complicated by acute maternal complications, such as hypo- or hyperglycemia, pregnancy-induced hypertension and diabetic ketoacidoasis. Of the study population, approximately 24% of the infants had some congenital malformation, 25% had macrosomia and 10% were infants of low birth weight (8). In the 1991 study, pregnant women with diabetes in Alaska during 1980-1988 were identified from hospital records (8). It is difficult to make direct comparisons between this previous study and the current one because of the differences in the data sources. However, the rate of maternal complications and congenital malformations in infants was much lower in the 1990 to 1999 period than between 1980 and 1988. This is probably due to improved care and glycemic control throughout pregnancy and improved technology and treatment over time.

Recommendations

With proper management by a healthcare provider, the outcome of most pregnancies complicated by diabetes can be similar to that of the general population (3). Pregnant women with diabetes planning to become pregnant should maintain careful blood glucose control in order to reduce the risk of fetal malformation and maternal and neonatal complications (7). Women with pre-existing diabetes should have pre-conceptual counseling during childbearing age (3). At the earliest possible time post-conception, pregnancy should be confirmed by laboratory assessment. The woman and fetus should then be continually evaluated by a healthcare team to re-enforce goals and methods of management, which should remain essentially stable throughout the pregnancy (3). For women who are diagnosed with gestational diabetes during pregnancy, a similar evaluation process should take place after diagnosis, and careful glycemic control and weight monitoring should be undertaken to reduce the risk of maternal and neonatal complications (3). In general, it appears that women with diabetes in Alaska are being treated as high-risk pregnancies, as recommended (6).

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