Clinical Medicine

Prevalence of Gestational Diabetes in a Navajo Indian Community

JONATHAN R. SUGARMAN, MD, *Shiprock, New Mexico*

A retrospective analysis of 4,094 deliveries among Navajo Indian women was carried out to determine the prevalence of gestational diabetes mellitus and diabetes antedating pregnancy. Three data sources—a local prenatal registry, a delivery room log, and hospital discharge records—were evaluated for their usefulness as surveillance systems for gestational diabetes. In all, 177 cases of gestational diabetes and 13 cases of preexisting diabetes were identified, giving a prevalence of maternal diabetes in pregnancy of 4.6%. When women with preexisting diabetes or documented gestational diabetes during a previous pregnancy were excluded, the prevalence of gestational diabetes during the study period was 3.4%. Although each data source used separately failed to identify 20% to 40% of diabetic pregnancies, more than 97% of cases were identified using a combination of the prenatal registry and the delivery log.

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The prevalence of non-insulin-dependent diabetes mellitus (NIDDM) is rising among many American Indian tribes.[1] If the hypothesis is correct that gestational diabetes mellitus represents the discovery during pregnancy of preexisting glucose intolerance rather than a separate disorder with a cause related to pregnancy,[2] then American Indian populations with high rates of NIDDM would be expected to have high rates of gestational diabetes when compared with the general population. This expectation is realized among the Pima Indians, who have the highest reported prevalence of NIDDM; the reported prevalence of abnormal glucose tolerance in Pima pregnancies is approximately 10%.[3,4]

Although the outcomes of diabetic pregnancies have improved considerably in the past half century, gestational diabetes still represents a risk factor for adverse perinatal outcomes.[3,5-7] In addition to its effects on perinatal morbidity and mortality, maternal diabetes in pregnancy is a powerful risk factor for the development of NIDDM in the offspring. The prevalence of NIDDM among the offspring of pregnancies complicated by diabetes in Pima Indians is 45% at ages 20 to 24, compared with 8.6% among the offspring of women in whom diabetes developed after the pregnancy.[8]

The age- and sex-adjusted prevalence of NIDDM among adult Navajo Indians, the largest Indian tribe in the United States, is about 60% higher than that in the general US population.[9] Because of the association of high rates of NIDDM with high rates of gestational diabetes in populations, and because of the clinical significance of maternal diabetes complicating pregnancy, a retrospective analysis of a large cohort of Navajo Indians seeking prenatal care at an Indian Health Service facility on the Navajo Reservation was done to determine the prevalence of gestational diabetes and NIDDM antedating pregnancy among pregnant Navajo women. In addition, three data sources were evaluated to assess their suitability as surveillance systems for gestational diabetes.

Patients and Methods

Shiprock Hospital is a 50-bed Indian Health Service hospital in northwest New Mexico located in the northeastern corner of the 25,000-square mile Navajo Reservation. There are about 40,000 registered patients at the facility, which has a catchment area of more than 4,000 square miles. Almost all Indian Health Service beneficiaries residing within the service unit are full-heritage Navajo Indians. Obstetric care is provided by obstetrician-gynecologists, certified nurse-midwives, and family practitioners.

All cases of Navajo women with gestational diabetes or preexisting NIDDM who sought prenatal care at Shiprock Hospital or who delivered at the facility and whose delivery dates were between October 1, 1983, and September 30, 1987, were identified by reviewing three sources of data. The first source is a registry of all prenatal patients receiving care at the Maternal Child Health Clinic at the facility. The registry entry for a patient is updated at each visit, and each case of gestational diabetes or preexisting diabetes is identified by a color-coded registry card. The prenatal and hospital records of all patients on the registry who delivered during the study period and in whom diabetes was diagnosed were reviewed to confirm the diagnosis of diabetes mellitus using criteria that will be discussed. All patients who delivered within the study period were included in the analysis, regardless of whether they delivered at the facility or elsewhere.

The second source, a delivery log, is maintained in the labor and delivery suite, and an entry is made for each parturient. The log includes a section of check boxes in which antepartum risk factors, including diabetes mellitus, are

From the Navajo Area Indian Health Service, US Department of Health and Human Services, Shiprock, New Mexico.
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Reprint requests to Jonathan R. Sugarman, MD, Shiprock Public Health Service Hospital, PO Box 160, Shiprock, NM 87420.

noted. All entries during the study period were reviewed, and those in which the box for diabetes was checked were added to the analyses after the diagnosis was confirmed by the chart review.

The final source is a list of all hospital discharges with ICD-9* codes 648.0 (diabetes mellitus complicating pregnancy, childbirth, or the puerperium) and 648.8 (abnormal glucose tolerance complicating pregnancy, childbirth, or the puerperium) for patients treated at Shiprock Hospital. The list was provided by the Indian Health Service Office of Program Statistics and was used to identify cases of diabetes from the first two data sets that were not so identified in the registry or the delivery log. Hospital and prenatal records were reviewed to confirm diagnoses, and all patients for whom one of the above codes was listed and who delivered during the study period were included in the analysis.

The criteria used by Indian Health Service providers for diagnosing gestational diabetes are detailed in Table 1. A policy that all patients seen in the clinic undergo screening for diabetes mellitus was instituted nine months before the study period. The clinic policy regarding screening frequency and criteria for gestational diabetes and the oral glucose tolerance test criteria for the diagnosis of gestational diabetes changed during the study period, and no attempt was made to standardize the diagnoses using one set of criteria. Clinical diagnoses of NIDDM were accepted if they met the National Diabetes Data Group criteria.[10] The 95% confidence intervals for prevalence figures were calculated using the binomial distribution.

Deliveries at Shiprock Hospital were numbered chronologically, and a random number generator was used to choose a sample of 100 patients. The sample was reviewed to establish the frequency with which screening blood glucose tests and follow-up oral glucose tolerance tests were done in the study population and to search for patients meeting the criteria for gestational diabetes but not included in one of the three data sets described above. The distribution of glucose screening by trimester was also recorded.

International Classification of Diseases, ninth revision. Ann Arbor, Mich, Commission on Professional and Hospital Activities, 1978.

Results

A total of 177 cases of gestational diabetes and 13 cases of NIDDM antedating pregnancy were identified among 4,094 deliveries, yielding an overall prevalence of maternal diabetes in pregnancy of 4.6% (95% CI 4.0 to 5.3). When cases with preexisting diabetes or documented gestational diabetes during a previous pregnancy were excluded, the prevalence of gestational diabetes during the study period was 3.4% (95% CI 2.9 to 4.0). The rates for each fiscal year (October 1 to September 30) are detailed in Table 2. Eleven women contributed two diabetic pregnancies during the study period. All but three of the women in the study resided in the Shiprock Service Unit or in communities surrounding the service unit or sought prenatal care at Shiprock Hospital.

Patients with gestational diabetes were older (mean, 30.5 years; SD, 5.7 years) than were other obstetrical patients (mean, 24.9 years; SD, 5.8 years).

Of the randomly selected sample of prenatal patients, 90% had definite documentation of screening for gestational diabetes in the chart. Of the other ten patients, four had no prenatal care, three received prenatal care elsewhere and may have been screened, two received care elsewhere and were not screened, and one received care at Shiprock Hos-

TABLE 1.—*Screening and Oral Glucose Tolerance (OGT) Test Criteria for Gestational Diabetes, Shiprock (NM) Hospital, October 1, 1983, to September 30, 1987*

Time Period During Which Criteria Used	Screening Glucose Value 1 h After 50-gram Glucose Load, mg/dl	Oral Glucose Tolerance Criteria*				Schedule for Screening and OGT Test
		Fasting Blood Glucose Level, mg/dl	Serum Glucose Level After 100-gram Glucose Load, mg/dl			
			1h	2h	3h	
10/1/83 to 5/1/86	≥130	110	200	150	130	All screened at first visit; high-risk† women screened at 28 to 34 weeks' gestation
5/1/86 to 7/15/86	≥130	110	200	150	130	All screened at first visit and 28 to 34 weeks (if first visit at 24 to 28 weeks, screened at first visit and 32 weeks)
7/16/86 to 8/15/86	≥130	105	190	165	145	All screened at first visit and 28 to 32 weeks
8/16/86 to 9/30/87	≥140	105	190	165	145	All screened at first visit and 28 to 32 weeks

*Diagnosis of gestational diabetes mellitus made when any 2 OGT values are exceeded.
†High risk is a woman with a previous infant weighing 4 kg (9 lb) or more, a previous history of gestational diabetes, a family history of diabetes, suspected macrosomia, glucosuria, a previous unexplained stillborn, or a history of congenital anomalies.

TABLE 2.—*Prevalence of Gestational Diabetes Mellitus (GDM) and Preexisting Maternal Diabetes Among Navajo Indian Women Who Delivered From October 1, 1983, to September 30, 1987, Shiprock (NM) Hospital*

Date	Total Number of Deliveries	Cases With GDM or Preexisting Diabetes, No.	Prevalence of Deliveries With GDM or Preexisting Diabetes, %*	Documented GDM With Previous Pregnancy, No.	Preexisting Maternal Diabetes (NIDDM), No.	Prevalence of Deliveries With GDM Excluding Women With Previous GDM and Preexisting NIDDM, %*
10/1/83 to 9/30/84	992	41	4.1 (3.0-5.5)	7	5	3.0 (2.0-4.2)
10/1/84 to 9/30/85	1,041	35	3.4 (2.4-4.6)	7	1	2.6 (1.8-3.7)
10/1/85 to 9/30/86	1,005	67	6.7 (5.2-8.3)	13	4	5.1 (3.8-6.6)
10/1/86 to 9/30/87	1,056	47	4.5 (3.3-5.8)	12	3	3.1 (2.1-4.3)
Total	4,094	190	4.6 (4.0-5.3)	39	13	3.4 (2.9-4.0)

NIDDM=non-insulin-dependent diabetes mellitus

*Numbers in parentheses are 95% confidence intervals.

TABLE 3.—*Sensitivity (Percent) of a Series of Surveillance Systems for Identifying Gestational Diabetes and Preexisting Maternal Diabetes Among Navajo Indian Women Who Delivered From October 1, 1983, to September 30, 1987, Shiprock (NM) Hospital*

Delivery Date	Hospital Discharge Data,* %	Delivery Log, %	Prenatal Registry, %	Log or Registry, %
10/1/83 to 9/30/84	61	69	78	100
10/1/84 to 9/30/85	69	69	94	97
10/1/85 to 9/30/86	52	54	88	96
10/1/86 to 9/30/87	62	72	60	98
Total	61	64	80	97

*Data provided by the Indian Health Service Office of Program Statistics.

pital but failed to keep her scheduled appointment for screening. In all, 17 patients were screened only in the first trimester. Oral glucose tolerance tests were done in 75% (12/16) of those with screening results of 140 mg per dl or higher and 67% (14/21) of those with screening results 130 mg per dl or higher. All of the four patients with gestational diabetes noted in the random sample were included in one of the data sets. The diagnosis of gestational diabetes would have been made in one additional patient near the end of the study had the criteria for oral glucose test results for the early part of the study been applied.

The completeness of data sources for the surveillance of gestational diabetes varied. All three sources were highly specific, with only one patient on the maternal hospital discharge records and one patient on the prenatal registry incorrectly recorded as having gestational diabetes. (The patient on the prenatal registry had diabetes with a previous pregnancy but normal oral glucose tolerance during the index pregnancy.) The sensitivity of each data source—the number of cases identified on data source versus the total number of cases—is presented in Table 3. The combination of delivery log and prenatal registry identified the greatest number of cases.

Discussion

There has been little uniformity in the criteria used in studies attempting to estimate rates of gestational diabetes mellitus. Among several large studies in which the diagnosis was made on the basis of the results of one-hour 50-gram glucose screens and three-hour oral glucose tolerance tests, the prevalence of abnormal glucose tolerance in pregnancy ranged from 2.4% to 6.3%.[2] The prevalence of gestational diabetes in a small cohort of Navajo women at two Indian Health Service hospitals was 6.1%, although only 40% of Navajo women delivering at those hospitals during the study period were included in the analysis.[11] When 21 patients excluded from analysis in that study because a glucose screen was done before 28 weeks' gestation are included in the study denominator—thereby more closely reflecting the population in the present study—the prevalence of gestational diabetes in that study falls to 5.4%.

The prevalence of gestational diabetes is probably underestimated in the present study. About a quarter of patients with abnormal results on glucose screens did not undergo an oral glucose tolerance test in the random sample of the study population, primarily because patients failed to keep scheduled appointments. Because the positive predictive value of an abnormal screen in the random sample was 20%, the prevalence of gestational diabetes would have increased 1.4% if the rate of the disorder in the seven people without a definitive diagnosis was equal to that in the rest of the study population. In addition, 17% of the patients were tested only in the first trimester, and additional cases may have been diagnosed had all patients been screened in the second or third trimester. Furthermore, the clinical criteria for gestational diabetes used by local Indian Health Service providers changed during the study period, and it is possible that additional cases may have been diagnosed earlier in the study had the criteria of O'Sullivan and Mahan been used throughout the study period.[12] This may account for the greater number of cases diagnosed during the last two years of the study. In the random sample, however, one additional case that was not classified as gestational diabetes by the O'Sullivan and Mahan criteria would have met the criteria used earlier in the study. Finally, it is likely that a greater number of cases would have been diagnosed later in the study had the screening criteria of greater than 130 mg per dl been retained.

The study population included women who sought prenatal care at Shiprock Hospital or who delivered at the facility during the study period. While 98.4% of patients with diabetes resided either in the Shiprock Service Unit or in communities surrounding the service unit, or sought prenatal care at the facility, it is probable that some women living within the geographic boundaries of the service unit sought prenatal care and delivered elsewhere. No data system exists that would make it possible to determine whether women who resided in the service unit but who sought prenatal care elsewhere differed with respect to the prevalence of gestational diabetes of preexisting NIDDM from those included in the study population. It is unlikely that Navajo women with gestational diabetes or preexisting NIDDM were selectively referred to Shiprock Hospital for delivery from other areas, as no specialized obstetric or neonatal services distinguish it from other facilities within a 160-km (100-mile) radius. The possibility, however, that women in the study cohort were not representative of Navajo women within the geographic catchment area of the hospital cannot be definitely excluded.

All three surveillance systems would have resulted in an incomplete ascertainment of cases had each been used in isolation. Although the gold standard for the diagnosis of gestational diabetes was inclusion in at least one of the surveillance systems, the inclusion in at least one of the data sets of all cases of the disorder identified in the random sample is consistent with the hypothesis that few additional cases would have been identified by other methods such as a vital record review. Vital records have been examined as sources of data regarding the incidence of diabetes in pregnancy. In the states of Washington and South Carolina, birth and fetal death certificates identified less than 75% and 40%, respectively, of cases of maternal hyperglycemia that were noted on the mothers' hospital charts.[13,14] The prevalence of diabetes of 28/1,000 deliveries identified by hospital discharge data in this population of Navajo women is fourfold that identified in deliveries in South Carolina in 1978 and threefold to tenfold that identified by hospital discharge records in several other studies reviewed by the National Diabetes Data Group.[6]

Maternal diabetes mellitus in pregnancy appears to be more common among Navajo Indians than among the general US population. Surveillance of gestational diabetes among Navajos is best done when several data sets are com-

bined. Comprehensive prenatal registries have been advocated by others as mechanisms to monitor rates and outcomes of pregnancy in diabetic women.[15] Such registries may be particularly useful among other populations, such as other Native American communities and Hispanic populations in some parts of the United States believed to have high rates of non-insulin-dependent diabetes mellitus and gestational diabetes.[1,16] Because prenatal registries similar to that described above are not currently used at most Navajo Area Indian Health Service hospitals, the optimal surveillance of gestational diabetes among Navajos would be facilitated by establishing registries at those facilities. Efforts to develop local prenatal registries are currently underway.

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