Diabetes in Pregnancy in Zuni Indian Women

Prevalence and subsequent development of clinical diabetes after gestational diabetes

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OBJECTIVE — To determine the prevalence of gestational diabetes mellitus in Zuni Indian women and the subsequent rate of diabetes among Zuni women with GDM.

RESEARCH DESIGN AND METHODS — A retrospective analysis of 809 deliveries over a 4-yr period among Zuni Indian women was conducted to determine the prevalence of GDM and diabetes antedating pregnancy. A prospective case-control study of 47 full-blooded Zuni Indian women with GDM and 47 control subjects was performed to determine the progression to clinical diabetes in women with a first-time diagnosis of GDM. Cases with GDM delivered during a defined 8-yr period. The control group of Zuni women delivered during the same time period but had plasma glucose values <7.8 mM on the 1-h glucose screening test. Cases with GDM and control subjects were matched for age, body mass index, gravidity, and length of follow-up. All women were re-evaluated for diabetes up to 9 yr after the index pregnancy.

RESULTS — Between 1987–1990, 116 cases of GDM and 8 cases of pre-existing diabetes were identified, giving a prevalence of maternal diabetes in pregnancy of 15.3%. At the time of follow-up, 14 of 47 (30%) women with GDM had developed diabetes after a mean of 4.8 yr compared with only 3 of 47 (6%) from the control group with an average of 5.5 yr follow-up.

CONCLUSIONS — GDM is prevalent among Zuni Indians and is associated with an increased risk of diabetes. Glucose tolerance after GDM may deteriorate at a greater rate in Native Americans than in other populations.

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GDM, gestational diabetes mellitus; BMI, body mass index; NIDDM, non-insulin-dependent diabetes; IDDM, insulin-dependent diabetes mellitus; IHS, Indian Health Service; GTT, glucose tolerance test.

NIDDM has reached epidemic proportions among many American Indian tribes (1). Although this form of diabetes usually affects older adults, Indian women of childbearing age frequently develop NIDDM during their childbearing years and are at risk for GDM (2,3). The effects of diabetes during pregnancy—including both GDM and overt NIDDM—have been described in the Pima Indians of southern Arizona in detail. Not only does GDM predispose the fetus and the mother to complications during the perinatal period, but diabetes in pregnancy identifies both a mother and child at risk for developing diabetes in the future (4–8). As blood glucose levels increase in response to a 75-g GTT during pregnancy, the probability that the mother will subsequently develop diabetes also increases (4). A vicious cycle has been described in which the diabetic pregnancy, independent of any genetic influence, predisposes the infant to obesity and early deterioration to diabetes during childbearing years, thus perpetuating early-onset diabetes across generations (9).

Because of the major implications of GDM for both mother and child, the IHS, an agency of the Public Health Service responsible for the health care of American Indians and Alaska Natives, has implemented routine prenatal screening for diabetes among many tribes. Prevalence rates of GDM among the Navajo, Alaska Natives, and Tohono O'odham have been published, and vary from 3.4 to 5.8%; however, no information is available in these tribes on the rates of subsequent diabetes in the mother (2,10,11).

In conjunction with diabetes prevention efforts in the New Mexico Pueblo of Zuni, IHS providers became concerned about GDM and the role of GDM as a risk factor for diabetes in the community. High rates of diabetes in the Zuni have been described since 1970 when GTTs were administered to a representative sample of the tribe. In this

sample, 31% of those ≥35 yr of age had carbohydrate intolerance, defined as a plasma glucose >10 mM 1 h after a 75-g carbohydrate load (12). A 1978 study found that 24.7% of the population >45 yr of age were receiving care for diabetes (13). In 1989, a report from the Zuni Hospital noted 28.2% of the population ≥35 yr of age had clinical diabetes (14). Community intervention programs to increase fitness and physical activity have been started in the Zuni in recent years with the goal of preventing diabetes among high-risk individuals, including women with a history of GDM (15). As part of the long-term evaluation of diabetes prevention efforts, health-care providers reviewed the experience of Zuni women followed at the Zuni Health Center to assess the prevalence of diabetes in pregnancy, the actual rates of GDM, and the subsequent deterioration of glucose tolerance among Zuni women with GDM.

RESEARCH DESIGN AND METHODS

— The Pueblo of Zuni with its 8300 residents occupies a well-defined 407,247-acre reservation in western New Mexico. Medical care, which includes obstetrical services, is provided at the Zuni Indian Hospital, a 35-bed hospital operated by the IHS on the reservation. Complicated obstetrical patients are referred to other IHS hospitals in the vicinity or to referral hospitals in nearby towns.

All women who received their prenatal care at the Zuni Indian Hospital were identified from two sources: the maternal service record and the obstetrical audits of deliveries performed in other facilities. The maternal service record is maintained in the labor and delivery suite where an entry is made for each parturient. The record includes a section in which antepartum risk factors, including diabetes, are noted. The semiannual obstetrical audit performed by the medical staff at the Zuni hospital reviews the actual records of all women who deliver at other facilities. All patients receiving prenatal care at the Zuni Hospital since 1981 were screened for GDM using a 50-g, 1-h oral glucose load between 24 and 28 wk gestation according to standard guidelines (16). Patients with a plasma glucose value >7.8 mM on the screen received a 100-g, 3-h oral GTT. Charts were reviewed to ensure that each case met the criteria for GDM as defined by O'Sullivan and Mahan (17). Information on the extent of Zuni heritage was available in recent years from the IHS registration system. Rates of GDM were calculated only for 1987–1990 because the extent of Zuni heritage was systematically available for all prenatal patients during that time period.

We used a prospective case-control design to examine the subsequent experience of women diagnosed with GDM compared with women without GDM. Cases were defined as all women of full Zuni heritage, pregnant between 1 January 1981 and 31 December 1988, who met O'Sullivan and Mahan's (17) criteria for GDM. Women with a diagnosis of GDM in a prior pregnancy or diabetes diagnosed before pregnancy were excluded. Control subjects were selected among women of full Zuni heritage who were pregnant during the same time period, but whose 50-g glucose screening test was <7.8 mM. Control subjects were matched to the cases on the basis of age, BMI, gravidity, and the length of follow-up.

The clinical records of both groups were reviewed between 1 October 1989 and 1 December 1991 for evidence of clinical diabetes using the National Diabetes Data Group criteria (18). Patients without a clinical diagnosis of diabetes were screened using a random glucose or a 75-g GTT. Diabetes was diagnosed if the 2-h plasma glucose on glucose tolerance or the random glucose was >11 mM. Plasma glucose was measured by a glucose oxidase method (Dimension analyzer, Glasgow, Delaware). Data were analyzed using the product limit method as described by Kaplan and Meier to create a model showing the development of diabetes after a first GDM pregnancy or a nondiabetic pregnancy (19).

RESULTS

— Between 1987–1990, 809 pregnancies among 591 women of at least half-Zuni descent were followed at the Zuni facility. Review of records revealed a total of 116 cases of GDM among 81 mothers, and 8 cases of NIDDM preceding pregnancy in 7 women. These 124 cases yielded an overall prevalence of 15.3% (124 of 809) for diabetes in all pregnancies during recent years and a prevalence of 15.1% (89 of 591) among mothers delivering during the same period. When cases of preexisting diabetes were excluded, the prevalence of GDM during the 4-yr period was 14.5% (116 of 801)—involving 13.9% (81 of 584) of mothers delivering during the period.

Review of the maternal and obstetrical records from 1981–1988 identified 103 possible cases of GDM in women of full-Zuni heritage. Of the 103, 15 were excluded because of incomplete records, 17 had GDM diagnosed in prior pregnancies, 8 had previously diagnosed NIDDM, and 12 did not meet the actual criteria for GDM. Thus, 51 eligible women were found. Of these, 47 had known glucose tolerance status at the time of follow-up or could be contacted for testing. The characteristics of the 47 cases with a first diagnosis of GDM and the 47 control subjects are shown in Table 1. The two groups were similar in age, BMI, and gravidity. Mean follow-up time was 4.8 yr for the patients with GDM and 5.5 yr for the control group.

Of the 47 cases of GDM, 30 had evidence on their charts of normal glucose tolerance in the postpartum period. After the postpartum period, an additional 14 of the remaining 17 women had evidence of normal glucose tolerance recorded. Between the index pregnancy and the follow-up, 6 (13%) cases developed diabetes and were receiving treatment. Of the remaining 41 women with GDM, 5 already had been screened for

Table 1—*Comparison of matched Zuni women at follow-up by history of GDM*

	GDM	No GDM
n	47	47
Age (yr)*	32 (21–48)	32 (21–44)
BMI (kg/m^2)*	30.2 (21–44)	30.1 (23–42)
Gravida (yr)*	3.4 (1–7)	3.2 (2–6)
Follow-up (yr)*	4.8 (0.5–8)	5.5 (3–9)
Diabetes at follow-up (*n*)	14	3

*Range is in parentheses.

diabetes immediately before the follow-up period and found to be normal; the remaining 36 cases were screened and an additional 8 cases of diabetes were diagnosed. Among the control women, 2 of 47 patients had developed clinical diabetes, and 1 more was identified during the screening period. Thus, almost 30% of the Zuni women with GDM developed diabetes during the follow-up period compared with 6% of comparable Zuni women who did not have GDM. Because of the varying follow-up times, a model was created to show the development of diabetes subsequent to a GDM and non-GDM pregnancy (Fig. 1). According to this model, by 6 yr of follow-up, 36% of Zuni women with prior GDM will have developed diabetes compared with 10% of control patients.

CONCLUSIONS— Marked racial and geographic variation in the prevalence of GDM have been reported, from a low of 0.15% to a high of 16% (20–23). Comparisons of these studies, however, have been hampered by lack of agreement in the criteria used in estimating the GDM rate (20,24). Whether the varied prevalence represents true differences or only reflects the changing approaches to diagnosis and screening is not clear. Our rate of 14.3% represents cases of diabetes in pregnancy in women with a negative history of prior diabetes. Although the prevalence of GDM among Zuni Indian women reported in this study is among the highest in the literature, it may, in fact, be an underestimate. Because ~10% of the women with abnormal results on the initial screen did not return for the formal GTT, cases of GDM may have been missed. It also is possible that some women would have been diagnosed with GDM had they received a full GTT, even though they passed the 50-g screen (16).

Because of the high prevalence of NIDDM among adult Zuni Indians, the high rate of GDM may reflect patients who already had NIDDM but had not been diagnosed before the pregnancy. It is interesting to note, however, that in the group of patients with GDM examined in the follow-up study, 44 of 47 women had documentation in their chart of reverting to a normal glucose at a postpartum visit, or of a normal glucose tolerance when screened during the follow-up period. This suggests that only a small percentage of the GDM patients diagnosed during pregnancy were true cases of NIDDM who had not been previously diagnosed.

When considering racial differences in the prevalence of GDM, it is important to note the effect of maternal age and obesity, which can influence the rates of GDM (25). In the U.S. population as a whole, the average age of parturition is older than in the Native American population (26). Thus, the differences between the prevalence rates

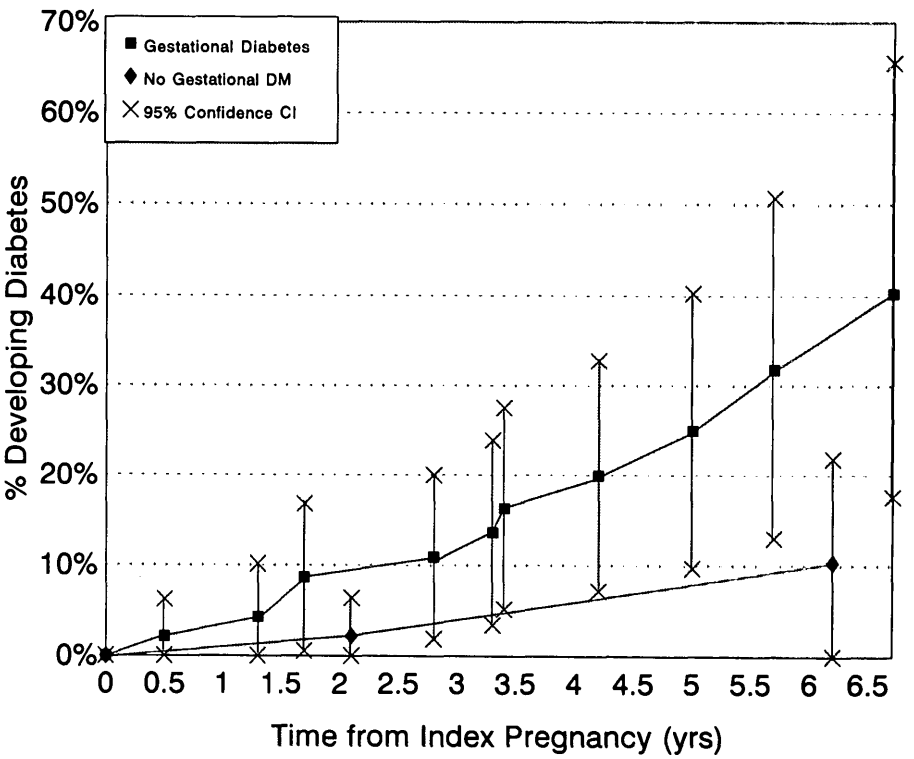

Figure 1—*Development of diabetes in Zuni Indian women by history of GDM.*

Table 2—*Development of diabetes after GDM and non-GDM pregnancies in selected studies*

	Follow-up (yr)	GDM (%)	No GDM (%)	Reference
Pima (1980)	4–8	27.5	7	4
Copenhagen (1989)	2–10	18	0	27
Boston (1989)	28	36	5.5	28
Australia (1991)	16	40	10	29
Zuni (1993)	0.5–9	30	6	

of GDM would be more striking if adjusted for age.

Although many studies have analyzed the incidence of diabetes in former GDM patients, only four other studies compared GDM patients with women without a history of GDM and maintained consistent criteria for both groups (4,27–29). Table 2 presents a comparison of the Zuni data with that of comparable studies. Although the five studies differ in the diagnostic criteria used for GDM, the progression from GDM to diabetes can be compared to the progression in women with negative screening histories. Among the Pima Indians in Arizona, 27.5% of women with World Health Organization criteria for GDM progressed to diabetes during a 4- to 8-yr follow-up, compared with 7.1% of women who did not meet the criteria (4). Nonnative populations from Boston, Copenhagen, and Melbourne also revealed high rates of progression to diabetes, but during longer follow-up times (27–29). Our data are consistent with the Pima data and suggest that glucose tolerance in American Indians deteriorates at a faster rate after an index pregnancy with GDM than in other populations.

These findings emphasize the need for comprehensive diabetes screening programs for pregnant American Indian women. The initial glucose screen to identify pregnant women at risk for diabetes may be unnecessary in these high-risk populations because all prenatal patients are at high risk and should probably receive a full GTT. Finally, meticulous follow-up for women who have had GDM, and public health programs to reach these high-risk women and their offspring, are needed.

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