

SOCIAL AND CULTURAL FACTORS IN PREGNANCY COMPLICATIONS AMONG NAVAJO WOMEN

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A population of 968 pregnant Navajo women was followed in a prospective study conducted from 1980 to 1983 at the Indian Health Service Hospitals in Gallup and Crownpoint, New Mexico. The purpose of the study was to examine social and cultural influences on obstetric and neonatal complications. The extent of traditional cultural practices and the availability of social support were ascertained in structured interviews completed during each woman's first prenatal visit. In a subsample of women, the occurrence of stressful life events was also measured during a final prenatal visit in the third trimester of pregnancy. Controlling for a variety of conventional risk factors and other potential confounders, traditional women sustained complications at a rate greater than twice that of the least traditional, most acculturated women (approximate relative risk = 2.1; $p = 0.001$). Social support and life events were modestly associated with maternal complications (approximate relative risk = 0.7, 0.8, respectively; $p = 0.07$), with poorer outcomes found among those with low social support and low numbers of life events. It is proposed that the relationship of maternal complications to all three sociocultural variables—traditionality, social support, and life events—may reflect the influences of social isolation on the course and outcomes of pregnancy.

acculturation; pregnancy complications; stress, psychological

Evidence from a variety of past work suggests that sociocultural factors may be important determinants of disease distributions in populations undergoing rapid cultural change. As reviewed by Marmot (1) and Dubos (2), the culture in which people live may have significant effects on patterns of disease through intervening influences on a range of factors—including

exposure to pathogenic agents, health beliefs and behaviors, and the experience of acculturative stress. A number of studies have documented an increased risk of changes in both psychiatric and biologic health status under conditions of cultural transition and social change. The work of Cassel and Tyroler (3), for example, demonstrated significant elevations in reported

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symptoms among first generation factory employees who had recently undergone a change from a rural, folk culture to an industrial social setting. Other work, such as that by Leighton et al. (4) in rural Nova Scotia, found an increased risk of psychiatric impairment under conditions of social disorganization, and Scotch (5) and others (6, 7) reported higher rates of hypertension in populations of traditional people exposed to modern, urban societies. Not only is acculturative change often accompanied by alterations in health, but continued affiliation with the more traditional culture of origin appears to be in some cases protective. The studies of Marmot and Syme (8) and Yano et al. (9) suggest that among Japanese-American men exposure to Japanese culture during childhood and retention of traditional cultural elements into adult life have sparing effects in the development of coronary heart disease, independently of conventional risk factors.

As in the work cited above, most studies of acculturation and health have found elevated rates of disease among traditional people experiencing the most intensive exposure to and involvement in modern, western society. Nevertheless, research on cultural change has not been unequivocal in this regard, and other work has found absent, curvilinear, or positive associations between acculturative status and health, depending in part upon the category of outcome studied. Beiser and colleagues (10, 11), for example, found no greater prevalence of psychologic distress or hypertension among Senegalese migrants to urban environments, and Rosen and Voorhees-Rosen (12) reported no differences in the rates of psychiatric disturbance among Shetland Islanders who were differentially exposed to industrialization, following the discovery of the North Sea oil fields. On the other hand, work such as that by McGarvey and Baker (13) and Maoz et al. (14) suggests a curvilinear relationship between modernity and health, with subjects having ambiguous cultural identities bearing the highest rates of disorder. Finally,

some investigators (15, 16) have reported beneficial effects that may accompany modernization, including enhanced psychologic well-being and adjustment.

A population having both historical and current experience with major sociocultural change is the Navajo Indian people of the American Southwest. The Navajo are Athabaskan people whose traditional way of life is based economically on sheepherding and subsistence agriculture, with a social structure dominated by a wide network of extended family relationships. As documented by Kunitz (17) and others (18), increasing economic interdependence between Navajo and Anglo-American societies has resulted in a growing heterogeneity in the cultural practices adopted by Navajo people. Such practices range from a highly traditional lifestyle—characterized by residence in an isolated area, unemployment, little formal education, and primary use of the Navajo language—to a more acculturated lifestyle—characterized by residence in a small town, work for wages, availability of modern conveniences, and the relative neglect of traditional religious activities. Major changes in the health status of the Navajo people have occurred over the past several decades (17), yet only limited attention has been focused on the role of acculturation and traditionality in the mediation of such changes.

We examined the effects of traditionality and related social experiences on the pregnancy outcomes of a cohort of Navajo women, in a prospective study begun in 1980. Outcomes of pregnancy were chosen as a variable of interest because of past work suggesting that both psychologic (19–25) and cultural (26, 27) factors may have relevant effects on the course of pregnancy and the risk of obstetric or neonatal complications.

METHODS

Population and design

A sample of convenience, consisting of 968 pregnant Navajo women, was enrolled during the first prenatal visit to the obstet-

rics clinics at two Indian Health Service Hospitals, in Gallup and Crownpoint, New Mexico. Enrollments were completed during the two-year period between October 1980 and October 1982, and the study sample represented approximately 40 per cent of the 2,421 women presenting for prenatal care during that period. Recruitment was sequentially conducted during each prenatal clinic, without prior knowledge of variables intrinsic to the study design. At the time of enrollment, basic demographic information was collected, and a structured interview was completed to assess the availability of social support and the woman's degree of cultural traditionality. Interviews were conducted by a Navajo research assistant in either the Navajo or the English language, according to the subject's preference. In a subsample of 566 enrollees (59 per cent), a second structured interview was conducted during a final visit in the third trimester of pregnancy, in order to ascertain major life events occurring during the preceding six months. Within two months following delivery, a review of the medical record was completed, and data on obstetric and neonatal complications of pregnancy were gathered, along with information on past medical and obstetric histories. Medical record reviews were conducted without knowledge of prenatal interview results.

Measurement of variables

Subjects reported their age, education, and the income of the household in which they lived. The presence of medical conditions with possible effects on the course of pregnancy was ascertained, including anemia (hematocrit <28 per cent), diabetes, and pre-existing hypertension. Social support was measured using a weighted index of interview items modeled after the instrument of Berkman and Syme (28). The five-item index assessed marital status and the availability of both emotional support and instrumental support (or aid). For purposes of analysis, scores were collapsed into a dichotomous variable representing high or low availability of social support. Life

events were measured using a 40-item checklist derived from the instruments of Holmes and Rahe (29) and Paykel et al. (30). Several items were added to address major events specific to the Navajo culture, and a general question eliciting other stressful occurrences was presented at the end of the interview.

Subjects' degree of traditionality was evaluated using an abbreviated instrument derived in part from the work of Milligan et al. (31). Classical factor analysis of interview responses revealed two factors, corresponding to the traditionality of cultural practices and the modernity of the home environment. Five items in the first factor attained loadings of 0.45 or greater and were retained as the measure of traditionality. These were 1) religious affiliation (Navajo Way or Native American Church versus Christian or none), 2) use of corn pollen in ritual observances, 3) use of a traditional healer, 4) experiencing a Kinaalda (Navajo puberty ceremony), and 5) planning a Blessingway ceremony for the baby. In the subsequent analysis, traditionality scores were converted to a three-level variable, representing the most traditional (highest quartile), the transitional (middle two quartiles), and the least traditional (lowest quartile). Three items from the second factor had loadings of 0.45 or greater and were used as a measure of the modernity of the home. These items were the presence of electricity, running water, and a telephone.

Outcome variables evaluated were the maternal and neonatal complications listed in table 1. Maternal complications included prenatal events (such as vaginal bleeding and pre-eclampsia), intrapartum events (such as prolonged labor and Cesarean section), and post-partum problems (such as endometritis and post-partum fever). Neonatal complications included prematurity and its associated problems (such as low birth weight and respiratory distress syndrome), as well as conditions also affecting full-term infants (such as birth asphyxia and meconium aspiration). All maternal

TABLE 1

Outcome variables among 968 Navajo women at Gallup and Crownpoint, New Mexico, Service Units of the Navajo Indian Reservation, 1980-1982

Maternal complications	Neonatal complications
Vaginal bleeding	Prematurity (≤ 36 weeks)
Pre-eclampsia	Low birth weight (< 2500 g)
Gestational diabetes	Apgar score < 7
Spontaneous abortion	Sepsis
Premature rupture of membranes (≥ 1 hour prior to onset of labor)	Respiratory distress syndrome
Prolonged labor (≥ 24 hours)	Pneumonia
Cesarean section, nonrepeat	Seizure
Amnionitis	Meconium aspiration
Endometritis	Stillbirth or neonatal death
Post-partum urinary tract infection	
Post-partum fever (> 100 F (37.8 C))	

and neonatal complications assessed were events requiring active medical intervention.

Statistical analysis

Maternal and neonatal complications were treated as dichotomous variables (present/absent) in the analysis of data. Bivariate relationships among pairs of independent variables and between independent and outcome variables were examined using Pearson correlations and chi-square analyses, respectively. At the multivariate level, multiple logistic regression was used to estimate the approximate relative risk associated with an individual predictor variable, while controlling for the potentially confounding effects of other independent variables. Finally, a confounder summarization procedure (32) was used to examine the association between traditionality and complications of pregnancy at various strata of confounder scores.

RESULTS

At least one complication occurred in 46 per cent of women and 14 per cent of infants. These rates are comparable to those reported by Nuckolls et al. (21), who found

maternal or neonatal complications in 47 per cent of pregnancies, and by Norbeck and Tilden (25), who reported intrapartum complications in 39 per cent of cases and neonatal complications in 11 per cent. The rates for specific maternal complications ranged from 1.5 per cent for spontaneous abortion to 11 per cent for pre-eclampsia and post-partum fever. In the case of neonatal outcomes, rates of specific complications ranged from 0 per cent for seizures to 10 per cent for an Apgar score less than 7.

Among independent variables, measures of psychosocial experience and traditionality were normally distributed, with means at or near the midpoint of each scale. Maternal age ranged from 13 to 45 years, with a mean of 24 years, and parity ranged from zero to 19, with a mean of 1.5. Income levels were uniformly low, with only 18 per cent of households reporting yearly incomes above \$10,000. Twenty-six per cent of subjects had experienced complications during past pregnancies, and 5 per cent had a chronic medical condition. In keeping with previous work on the health behaviors of pregnant Navajo women (31), only 50 per cent of the sample presented for prenatal obstetric care in the first trimester of pregnancy, and 6 per cent were not seen until the third trimester.

Table 2 shows the interrelationships among pairs of independent variables. Due to the number of correlations examined, only those significant at the $p < 0.01$ level or less are noted. Significant associations, in the expected directions, were found among the basic demographic variables of age, education, and income. Medical and obstetric data also demonstrated the expected relationships of age, education, and income to parity and gestational age at the first prenatal visit. Among social and cultural variables, several potentially important interrelationships were found as well. Social support was significantly and positively correlated with age, income, and parity. As expected, traditional women were significantly older, less well-educated, and more likely to live in a less modern home

TABLE 2
 Bivariate relationships among independent variables (Pearson correlation coefficients) for 968 Navajo women at Gallup and Crownpoint, New Mexico, Service Units of the Navajo Indian Reservation, 1980-1982

	Independent variables										
	1	2	3	4	5	6	7	8	9	10	11
1. Age	1										
2. Education	-0.07	1									
3. Income	0.20**	0.30**	1								
4. Parity	0.62**	-0.21**	0.10*	1							
5. Past pregnancy complications	0.28**	-0.05	0.05	0.22*	1						
6. Present medical problems	0.05	0.02	0.00	0.03	-0.01	1					
7. Gestational age at first prenatal visit	-0.07	-0.09*	-0.08*	0.03	-0.06	0.03	1				
8. Social support	0.15*	0.03	0.11*	0.16**	0.06	-0.05	0.04	1			
9. Life events†	-0.09	0.06	-0.07	-0.06	0.04	-0.06	-0.07	-0.03	1		
10. Modernity of home	-0.01	0.29*	0.31*	-0.04	0.01	0.01	0.04	0.00	0.07	1	
11. Traditionality	0.16**	-0.12**	0.02	0.07	-0.01	0.01	0.00	0.06	-0.03	-0.19**	1

* $p < 0.01$; ** $p < 0.001$.
 † n for this variable = 566 rather than 968.

environment. Of importance to subsequent analyses of independent effects on pregnancy outcomes was the general finding of significant and widespread intercorrelations among predictor variables.

Table 3 presents bivariate associations between independent variables and the two dichotomous outcomes, maternal and neonatal complications. Again, only differences significant at $p < 0.01$ are noted due to the number of comparisons made. For neonatal complications, no significant associations were found. For maternal complications, on the other hand, several significant predictors were found, including both medical and sociocultural variables. Parity was related in a curvilinear manner to complication rates, with the highest rates found among the nulliparous and those with parity greater than three. Present medical problems were also strongly related to maternal outcomes, with more complications among women with such problems. Finally, both social support and traditionality were significantly related to complication rates as well, with higher rates found among the most traditional and the least supported. Within categories of traditionality, there was a stepwise increase in maternal complication rates. Lowest rates were found among the least traditional women, with intermediate and highest rates found in the transitional and most traditional groups, respectively.

Because of the high level of intercorrelation noted earlier among independent variables, multiple logistic regression analyses were conducted to better understand the joint and independent relationships of these variables to maternal outcomes. Following the methods of Kleinbaum et al. (33), independent variables of interest were selected on the basis of concerns for both precision (i.e., statistically significant relationships with maternal complications) and validity (i.e., relationships with maternal complications in past studies or theoretically important relationships with other independent variables). Under this procedure, income was eliminated because of low

TABLE 3

Bivariate relationships between independent variables and pregnancy complications in 968 Navajo women at Gallup and Crownpoint, New Mexico, Service Units of the Navajo Indian Reservation, 1980-1982

Independent variables	Distribution by variable category (%)	Outcome variables			
		Rate of maternal complications (%)	χ^2	Rate of neonatal complications (%)	χ^2
Age (years)			4.2		0.3
13-18	17	49		15	
19-35	79	45		15	
36-45	4	61		11	
Education (years)			8.4		2.9
0-8	14	53		19	
9-11	36	42		12	
12	40	50		15	
13-18	11	40		15	
Income			2.5		3.9
\$0-2,999	38	44		13	
\$3,000-4,999	21	51		17	
\$5,000-6,999	11	46		11	
\$7,000-9,999	12	47		12	
\$10,000+	18	48		17	
Parity			26.3**		4.7
0	34	57		18	
1-3	55	39		13	
4-19	11	52		10	
Past pregnancy complications			0		3.9
Present	26	47		10	
Absent	74	46		16	
Present medical problems			16.0**		0
Present	5	78		14	
Absent	95	45		15	
Gestational age at first prenatal visit (weeks)			1.7		0.2
3-13	50	49		14	
14-26	44	44		15	
27-41	6	43		15	
Social support			8.9*		0
Low	24	55		14	
High	76	43		14	
Life events†			5.1		1.2
0-1	22	55		14	
2-5	56	46		10	
6-36	22	40		13	
Modernity of home (no. of conveniences)			1.4		1.9
0	24	44		14	
1	20	48		12	
2	29	45		14	
3	27	49		17	
Traditionality			10.4*		1.9
1 (least traditional)	23	38		15	
2 (transitional)	52	46		16	
3 (most traditional)	26	54		12	

* $p < 0.01$; ** $p < 0.001$.

† n for this variable = 566 rather than 968.

variability and the absence of an association with maternal problems. The number of life events was omitted because of its limited measurement in a smaller subsample of the total population; a second logistic analysis, described below, tested for the independent effects of life events within the subpopulation of 566 women for whom information on life events was available.

Logistic analyses began with a forward selection procedure evaluating all possible two-factor interactions involving either traditionality or social support (i.e., traditionality \times age, social support \times education, etc.). None of the interaction terms attained significance levels of $p \leq 0.05$, the criterion for entry into the model. The final logistic model including only main effects

is summarized in table 4; coefficients were estimated using the unconditional maximum likelihood method. The fit of the model with all variables entered was acceptable ($p = 0.26$). Parity, present medical problems, and traditionality contributed significantly and independently to the risk of maternal complications. Controlling for the effects of other independent variables, nulliparous women had a risk of complications 2.4 times that of women with parities of one to three, and those with pre-existing medical problems had a risk 4.7 times as great as those without such problems. Within the spectrum of cultural identity, the most traditional women bore a risk of complications 2.1 times greater than their least traditional counterparts, independently of other variables' confounding influences. Finally, women with high levels of social support and more modern homes were slightly less likely to sustain compli-

cations, relationships that reached only marginal levels of significance.

One of the potential mediators of the relationship between traditionality and maternal complications is the experience of major life events. For this reason, a second logistic regression analysis was completed for the subpopulation of women ($n = 566$) in which stressful life change was also measured. As before, initial testing for two-factor interactions revealed no interaction terms that attained a 0.05 level of significance. Table 5 displays the approximate relative risks of maternal complications for all independent variables, including stressful life events. The direction and magnitude of logistic coefficients for independent variables are congruent with those found for the entire sample, indicating general representativeness of the life events subpopulation. Again, significant independent effects were found for parity, present medical

TABLE 4

*Associations between maternal complications and independent variables, by multiple logistic regression analysis, in 968 Navajo women at Gallup and Crownpoint, New Mexico, Service Units of the Navajo Indian Reservation, 1980-1982**

Variable	Logistic coefficient	Approximate relative risk	95% confidence interval	χ^2	Approximate χ^2 to remove degrees of freedom	p
Age (19-35 years vs.)				0.7	2	0.48
13-18	-0.239	0.8	0.5-1.2			
36-45	0.242	1.3	0.6-2.6			
Education (0-8 years vs.)				1.7	3	0.17
9-11	-0.434	0.6	0.3-1.2			
12	-0.240	0.8	0.5-1.3			
13-18	-0.606	0.5	0.3-0.9			
Parity (1-3 vs.)				11.0	2	0.001
0	0.893	2.4	1.7-3.5			
4-19	0.298	1.3	0.8-2.2			
Past pregnancy complications (yes, no)	0.236	1.3	0.9-1.8	1.8	1	0.19
Present medical problems (yes, no)	1.556	4.7	2.2-10.4	14.7	1	0.001
Gestational age at first prenatal visit (trimester)	-0.177	0.8	0.7-1.1	2.0	1	0.16
Social support (high, low)	-0.326	0.7	0.5-1.0	3.4	1	0.07
Modernity of home (no. of conveniences)	-0.224	0.8	0.6-1.0	3.7	1	0.05
Traditionality	0.359	1.4 (2.1)†	1.2-1.8 (1.7-2.5)†	10.5	1	0.001
Constant	-0.078					

* Hosmer goodness of fit test: $\chi^2 = 10.1$, degrees of freedom = 8, $p = 0.26$.

† Most vs. least traditional.

TABLE 5

Associations between maternal complications and independent variables in subpopulations with stressful life events known, by multiple logistic regression analysis, in 968 Navajo women at Gallup and Crownpoint, New Mexico, Service Units of the Navajo Indian Reservation, 1980-1982*

Variable	Logistic coefficient	Approximate relative risk	95% confidence interval	χ^2	Approximate χ^2 to remove degrees of freedom	<i>p</i>
Age (19-35 years vs.)				0.1	2	0.96
13-18	-0.032	1.0	0.5-1.8			
36-45	0.116	1.1	0.4-2.8			
Education (0-8 years vs.)				3.7	3	0.29
9-11	-0.009	1.0	0.4-2.3			
12	-0.070	0.9	0.5-1.7			
13-18	-0.469	0.6	0.3-1.2			
Parity (1-3 vs.)				19.4	2	0.001
0	1.040	2.8	1.7-4.6			
4-19	0.629	1.9	0.9-3.7			
Past pregnancy complications (yes, no)	0.462	1.6	1.0-2.5	3.8	1	0.06
Present medical problems (yes, no)	1.270	3.6	1.4-9.0	8.2	1	0.01
Gestational age at first prenatal visit (trimester)	-0.197	0.8	0.6-1.1	1.4	1	0.23
Social support (high, low)	-0.320	0.7	0.5-1.1	1.9	1	0.17
Modernity of home (no. of conveniences)	-0.132	0.9	0.7-1.2	1.0	1	0.32
Life events (low, medium, high)	-0.269	0.8	0.6-1.0	3.4	1	0.07
Traditionality	0.366	1.4 (2.1)†	1.1-1.9 (1.6-2.8)†	7.0	1	0.01
Constant	-0.194					

* Hosmer goodness of fit test: $\chi^2 = 11.1$, degrees of freedom = 8, *p* = 0.19.

† Most vs. least traditional.

problems, and traditionality. Life events had a marginally significant but inverse relationship with the risk of maternal complications. Women with low numbers of life events had a complication risk 1.7 times the risk for women with high numbers of events (95 per cent confidence interval = 1.3-2.3). Traditionality retained its significant association with maternal outcomes, with the most traditional women having a 2.1 times greater risk of complications.

The association of traditionality with maternal complications was further examined through the use of Miettinen's (32) confounder summarization procedure. Using the coefficients from the multiple logistic analysis reported in table 4 to weight the confounding variables, cases were ranked by their predicted probability of complications. The ranked cases were di-

vided into quintiles, and noncases were assigned to the defined strata. Stratum-specific estimates of the relative risk associated with traditionality were homogeneous and consistent with the approximate relative risks derived from the multiple logistic model. A test of the homogeneity of the association (34) across the five strata was nonsignificant ($\chi^2_{\text{Het}} = 2.6$, with 4 degrees of freedom, *p* = 0.62), indicating that the measures of association did not differ significantly at the various levels of risk. A test for linear trend (35) in the association of levels of traditionality with complications was significant ($\chi^2_{\text{M-ext}} = 13.5$, with 1 degree of freedom, *p* < 0.001), confirming the results of the multiple logistic regression.

A more detailed review of the association between traditionality and maternal com-

plications revealed that the relative risk for each individual category of complication (i.e., vaginal bleeding, pre-eclampsia, gestational diabetes, etc.) was increased in the more traditional women. The relationships of traditionality to complications cannot therefore be explained by a limited subset of obstetric problems. Further, comparison of prenatal versus post-partum complications showed no differences in the magnitude of the associated relative risks.

A final consideration was the possibility that the relationship of traditionality to maternal complications was due to systematic differences in either nutritional status or illness reporting among the most traditional women. Since the infant's weight for gestational age is known to covary with maternal nutritional status, the proportion of small, average, and large for gestational age infants was examined within the three categories of traditionality. Similarly, illness reporting across levels of traditionality was assessed by comparing the proportions of women reporting either no intercurrent illnesses, an illness without fever, or an illness with fever in the course of prenatal care. If traditional women had systematically underreported symptoms, a significantly larger proportion would be expected to have no illnesses recorded, and a smaller proportion would have had known illnesses, with or without fever. No significant differences were found among women at the three levels of traditionality for either the proportion of infants small for gestational age ($\chi^2 = 1.1$ with 4 degrees of freedom, $p = 0.90$) or the pattern of reported intercurrent illness experience ($\chi^2 = 5.5$ with 4 degrees of freedom, $p = 0.24$).

DISCUSSION

This study found a significant association between obstetric outcomes and degree of traditionality among pregnant Navajo women. Controlling for a variety of conventional obstetric risk factors, traditional women were found to experience complications of pregnancy at a rate greater than twice that of their least traditional coun-

terparts. This association is unlikely to be accounted for by the effects of either classification or selection bias. Misclassification is rendered less likely by the fact that the study was prospective in design and that all sociocultural and medical assessments were made independently, without knowledge of complementary study data. Interviews were conducted by a single Navajo research assistant, and all medical record reviews were completed by the same team of three investigators, who were blinded to the previously collected data.

A selection bias, in which the most traditional Navajo women might have avoided hospital deliveries or prenatal care except when complications arose, is also unlikely. The current rate of home delivery on the Navajo reservation is estimated between 0 per cent (17) and less than 1 per cent (B. C. Milligan, Navajo Area Indian Health Service, personal communication, 1985). It is therefore improbable that uncomplicated births to traditional women took place at home. Further, if traditional women had tended to present for prenatal care (and be enrolled in the study) only when complications developed, traditionality would have appeared disproportionately associated with prenatal problems. As noted above, however, the rates of prenatal and post-partum complications were equally increased among the most traditional subjects. Finally, it is possible that our 40 per cent nonrandom sample of women presenting for prenatal care was not representative of the entire population from which it was drawn. However, no aspect of the study's design or enrollment methods would have clearly predisposed toward oversampling women within specific categories of exposure or outcome variables.

What then accounts for the relationship of traditionality to obstetrical outcomes? Since it is unlikely that traditionality per se influences complications of pregnancy, we have regarded traditionality as a marker or proxy indicator for some other variable or condition with more direct and biologically plausible influences on the course of

pregnancy. A number of possible explanations can be raised. First, the association may reflect systematic differences in compliance with medical recommendations or other health behaviors among the most traditional women. A relative lack of familiarity or comfort with western medical practices, along with greater distances between home and hospital, may have altered the traditional women's use of available health services. Such alterations in the use of medical care could have influenced both the course of a given complication or the likelihood that a problem would reach medical attention.

Several aspects of the data are inconsistent with this account, however. The association of traditionality with maternal complications was independent of the timing of the first prenatal visit, a variable that is at least partially reflective of health behavior and the women's comfort with the hospital setting. Moreover, no differences in the reporting of intercurrent illnesses were found among women in the three categories of traditionality, suggesting that the most traditional were no less likely to convey complaints or symptoms to their physicians. Finally, it is unlikely, for most of the complications assessed, that a delay in the reporting of early symptoms would have increased the likelihood of the complication's occurrence. Premature rupture of membranes or Cesarean section for fetal distress, for example, are generally not preceded by a "subclinical" phase in which some form of intervention could have been preventive.

Second, the association of traditionality with maternal outcomes could represent differences in nutritional or general health status between women with different cultural identities. If the most traditional women were in generally poorer medical condition, this might account for a higher rate of obstetric problems. However, our results are again not supportive of this explanation. Traditionality was significantly related to complications even when controlling for the presence of the three most

prevalent, coexisting medical problems in this population: anemia, diabetes, and hypertension. While no direct assessment of nutritional status was made (except by the ascertainment of anemia), examination of infants' weights for gestational age—a known correlate of nutritional status—showed no differences along the continuum of traditionality.

Neither of the two previous explanations for the relationship of traditionality to maternal outcomes can be excluded by the data available from this study, yet both are called into question by the analyses reviewed above. A final and, we believe, equally credible account is the possibility that traditionality is reflective of some other social condition or set of social conditions that characterizes the lives of highly traditional Navajo women. This account is supported, in part, by the other social variables identified in this study as important to the maternal outcomes of pregnancy. Both social support and life events bore independent and marginally significant relationships to maternal complications. Women with low levels of social support were somewhat more likely to experience complications, and, paradoxically, women reporting fewer life events sustained higher rates of complications as well. In assessing the possible coherence of these two findings, it is important to note that nearly all of the life events evaluated in this study involve perturbations of social relationships and thus reflect some form of positive or negative interaction with other people. In the context of this population, extremely low levels of reported life events may therefore reflect a paucity of available social exchanges and a life setting characterized by marginality and isolation. With the progressive acculturation of Navajo society, it is plausible to regard the very traditional Navajo woman as a person at risk for increasing social isolation, as her peers and children move, both culturally and geographically, toward a different life-style and system of belief. It is thus reasonable to propose that the relationship of maternal

complications to all three sociocultural variables—traditionality, social support, and life events—may reflect the influences of social isolation on the course and outcomes of pregnancy. This formulation is compatible both with prior work demonstrating significant relationships between social support and pregnancy outcomes in human populations (21, 25) and with past evidence in animal models indicating adverse effects of social isolation on a range of reproductive outcomes (36–40).

Whatever the actual link between traditionality and obstetric outcomes, this study provides additional evidence that social and cultural processes are salient factors in the development of disease, particularly in populations experiencing major cultural change. Increasing attention to such processes in both the provision of medical care and the development of public health programs may bear previously unanticipated rewards.

REFERENCES

- Marmot M. Culture and illness: epidemiologic evidence. In: Christie MJ, Mellett PG, eds. *Foundations of psychosomatics*. John Wiley and Sons, 1981:323–40.
- Dubos R. Determinants of health and disease. In: Landy D, ed. *Culture, disease, and healing: studies in medical anthropology*. New York: MacMillan, 1977:31–41.
- Cassel J, Tyroler HA. Epidemiological studies of culture change: health status and recency of industrialization. *Arch Environ Health* 1961;3:31–9.
- Leighton DC, Harding JS, Macklin DB, et al. *The character of danger: the Stirling County study of psychiatric disorder and sociocultural environment*. New York: Basic Books, 1963.
- Scotch NA. Sociocultural factors in the epidemiology of Zulu hypertension. *Am J Public Health* 1963;53:1205–13.
- Beaglehole R, Salmond CE, Hooper A, et al. Blood pressure and social interaction in Tokelauan migrants in New Zealand. *J Chronic Dis* 1977; 30:803–12.
- Patrick RC, Prior IAM, Smith JC, et al. Relationship between blood pressure and modernity among Ponapeans. *Int J Epidemiol* 1983;12:36–44.
- Marmot MG, Syme SL. Acculturation and coronary heart disease in Japanese-Americans. *Am J Epidemiol* 1976;104:225–47.
- Yano K, Blackwelder WC, Kagan A, et al. Childhood cultural experience and the incidence of coronary heart disease in Hawaii Japanese men. *Am J Epidemiol* 1979;109:440–50.
- Beiser M, Collomb H, Ravel JL, et al. Systemic blood pressure studies among the Serer of Senegal. *J Chronic Dis* 1976;29:371–80.
- Beiser M, Collomb H. Mastering change: epidemiological and case studies in Senegal, West Africa. *Am J Psychiatry* 1981;138:455–9.
- Rosen DH, Voorhees-Rosen D. The Shetland Islands: the effects of social and ecological change on mental health. *Cult Med Psychiatry* 1978;2:41–67.
- McGarvey ST, Baker PT. The effects of modernization and migration on Samoan blood pressures. *Hum Biol* 1979;4:461–79.
- Maoz B, Antonovsky A, Apter A, et al. The effect of outside work on the menopausal woman. *Matritas* 1978;1:43–53.
- Meleis AI. Effect of modernization on Kuwaiti women. *Soc Sci Med* 1982;16:965–70.
- Inkeles A, Smith DH. *Becoming modern: individual change in six developing countries*. Cambridge, MA: Harvard University Press, 1974.
- Kunitz SJ. *Disease change and the role of medicine: the Navajo experience*. Berkeley: University of California Press, 1983.
- Shepardson M, Hammond B. Change and persistence in an isolated Navajo community. *Am Anthropol* 1964;66:1029–50.
- Grimm ER. Psychological and social factors in pregnancy, delivery, and outcome. In: Richardson SA, Guttmacher AF. *Childbearing: its social and psychological aspects*. Williams and Wilkins, 1967.
- McDonald RL. The role of emotional factors in obstetrical complications: a review. *Psychosom Med* 1968;30:222–37.
- Nuckolls KB, Cassel J, Kaplan BH. Psychosocial assets, life crisis and the prognosis of pregnancy. *Am J Epidemiol* 1972;95:431–41.
- Williams CC, Williams RA, Griswold MJ, et al. Pregnancy and life change. *J Psychosom Res* 1975;19:123–9.
- Newton RW, Hunt LP. Psychosocial stress in pregnancy and its relation to low birth weight. *Br Med J* 1984;288:1191–4.
- Chalmers B. Psychological aspects of pregnancy: some thoughts for the eighties. *Soc Sci Med* 1982;16:323–31.
- Norbeck JS, Tilden VP. Life stress, social support, and emotional disequilibrium in complications of pregnancy: a prospective, multivariate study. *J Health Soc Behav* 1983;24:30–46.
- Mead M. *Male and female*. London: Victor Gollanz, 1950.
- Newton N, Newton M. Childbirth in crosscultural perspective. In: Howells JG, ed. *Modern perspectives in psycho-obstetrics*. New York: Brunner-Mazel, 1972.
- Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol* 1979;109:186–204.
- Holmes TH, Rahe RH. The social readjustment rating scale. *J Psychosom Res* 1967;11:213–18.
- Paykel ES, Prusoff BA, Uhlenhuth EH. Scaling of life events. *Arch Gen Psychiatry* 1971;25:340–7.
- Milligan BC, Dalton M, Swoboda VC, et al. Nurs-

- ing care and beliefs of expectant Navajo women. *Am Indian Q* 1984;8:83-101.
32. Miettinen OS. Stratification by a multivariate confounder score. *Am J Epidemiol* 1976;104:609-20.
 33. Kleinbaum DG, Kupper LL, Morgenstern H. *Epidemiologic research: principles and quantitative methods*. Belmont, California: Lifetime Learning Publications, 1982.
 34. Breslow NE, Day NE. *Statistical methods in cancer research. Vol. I: The analysis of case-control studies*. Lyon: International Agency for Research on Cancer, 1980.
 35. Mantel N. Chi-square tests with one degree of freedom: extensions of Mantel-Haenszel procedure. *J Am Stat Assoc* 1963;58:690-700.
 36. Terman CR. Pregnancy failure in female prairie deer mice related to parity and social environment. *Anim Behav* 1969;17:104-8.
 37. Anderson CO, Denenberg VH, Zarrow MX. Effects of handling and social isolation upon the rabbit's behavior. *Behavior* 1972;43:165-75.
 38. Sackler AM, Weltman AS, Schwartz R, et al. Pre-maternal isolation effects on behavior and endocrine function of offspring. *Acta Endocrinol* 1969;62:367-84.
 39. Barlow S, McElhatton P, Morrison P, et al. Effects of stress during pregnancy on plasma corticosterone levels and foetal development in the mouse. *J Physiol* 1974;239:55P-56P.
 40. Ely DL, Henry JP. Effects of prolonged social deprivation on murine behavior patterns, blood pressure, and adrenal weight. *J Comp Physiol Psychol* 1974;87:733-40.