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Reference #:

Journal Title: Social biology.

Article Author:

Article Title: May PA, Hymbaugh KJ, Aase JM, Samet JM; Epidemiology of fetal alcohol syndrome among American Indians of the Southwest.

Volume: 30

Issue: 4

Month/Year: 1983

Pages: 374-87 (scan notes and title/copyright pages for chapter requests)

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Epidemiology of Fetal Alcohol Syndrome Among American Indians of the Southwest

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ABSTRACT: The epidemiological features of Fetal Alcohol Syndrome (FAS) were examined among American Indians in the southwestern United States. All FAS suspects were screened in specific populations of Navajo, Pueblo, and Plains culture tribes. A total of 115 alcohol-affected children were identified. The incidence of FAS was found to be highly variable from one cultural group to the next, ranging from 1.3 per 1,000 births (1/749) for the Navajo to 10.3 (1/97) for the Plains. The pattern of age-specific prevalence indicates an increase over the past fifteen years. The overall rate of mothers who have produced fetal alcohol children was 6.1 per 1,000 women of childbearing age with a range of 4 to 33 per 1,000. These maternal prevalence rates were important for the accurate prediction of public health risk because 25 per cent of all mothers who had produced one affected child had also produced others. The average per mother was 1.3 alcohol-affected children. Other findings indicate that the mothers of these children led highly disruptive and chaotic lives and were frequently isolated from mainstream social activities. In general, the gross social and cultural patterns of the tribes studied can readily explain the variation in incidence of FAS.

In 1979, the International Year of the Child, the Indian Children's Program of the Indian Health Service (IHS) convened an expert committee to select a public health project of major importance to Indian children. This group decided to establish a Fetal Alcohol Syndrome (FAS) Project for two reasons. First, those with extensive clinical experience among Indians perceived FAS as a new and increasing problem among Southwestern tribes. Second, the early FAS literature had already identified some American Indian children with FAS (Smith et al., 1976).

The resulting FAS Demonstration Project had three goals. First, the program was to provide education and training in the recognition and prevention of FAS for health care providers, human services workers, and local community groups. Second, the program

was to offer evaluation by a pediatric dysmorphologist to all FAS suspects and initiate a treatment plan for children with FAS and other developmental problems. Third, research was to be undertaken to assess the incidence of FAS among American Indians. The complete project is described in detail elsewhere (May and Hymbaugh, 1983). This paper will focus on the third goal.

Fetal Alcohol Syndrome refers to a pattern of malformations found in children whose mothers drank alcohol excessively during pregnancy. The most common features are: varying degrees of mental retardation and CNS dysfunction, reduced birth length and weight, microcephaly, hypoplastic midface, growth deficiency throughout life, certain joint abnormalities, frequent cardiac defects, and hyperactivity (Jones et al., 1973; Jones and Smith, 1976; Rosett

et al., 1976; Streissguth et al., 1980) Recently, it has been recognized that moderate and or binge drinking may cause less severe forms of developmental damage. Thus, the teratogenic effect of alcohol can be conceptualized as a spectrum. Heavy drinking may result in the complete FAS, whereas lower levels of consumption may cause lesser mental and growth defects (Rosett, 1974, 1976; Streissguth et al., 1978; Eckardt et al., 1981).

In the U. S. and Europe, FAS is a frequently documented birth defect. Although several hundred clinical and experimental studies of FAS among humans and animals have been published, the epidemiology of FAS has not been well characterized. Data are currently available only for Seattle, Washington (Streissguth et al., 1980), Goteberg, Sweden (Olegard et al., 1979), and Roubaix, France (Dehaene et al., 1977, 1981). Estimates of the incidence of FAS vary from 1 in every 600 babies in Sweden and 1 in 700 in France, to 1 in 750 in Seattle. Fetal Alcohol Effect (FAE), a milder form of in-utero damage, has been reported in France and Sweden with an incidence approximately equal to that of FAS. Each of the above rates is based on cumulative clinical experience and not on a survey of a specific population. FAS documentation is currently not available in large national data bases (Eckhardt et al., 1981) and probably will not be in the near future. The present study is therefore unique in determining the magnitude of FAS in a defined population.

MATERIALS AND METHODS

INDIAN GROUPS STUDIED

The Indians of this study are from three very different cultural and social

traditions. The Pueblo Indians have inhabited the southwestern United States for 10,000 years or more. Their traditions emphasize sedentary, pastoral, and agricultural pursuits, and their social integration is matrilineal, complex, and strongly "emphasizes conformity with the larger (community based) group" (Dozier, 1970).

The Apache and the Ute tribes are the Plains culture groups in this study. These tribes migrated to the Southwest approximately 1,000 years ago. The nomadic, hunting, gathering, and raiding tradition of their culture is in many ways a polar opposite to the Pueblo. In Plains culture tribes, individuality is encouraged and some flamboyant behaviors such as risk-taking, drinking, and defiance are tolerated and may be encouraged. The largest permanent level of Plains social organization was traditionally a band of several allied extended families (Schroeder, 1974).

The Navajo cultural traditions are a mixture of the Pueblo and Plains traditions. The Navajo came from the same Plains traditions as the Apache, but in the past three hundred years they have adopted many traits of the Pueblo. Therefore, the Navajo patterns of social integration and behavior regulation are intermediate between the Plains and Pueblo. The Navajo emphasize conformity to group norms, but allow more individualized behavior than the Pueblo (Kluckhohn and Leighton, 1962).

The contemporary socioeconomic status of southwestern Indians shows some variation within each culture, for the individual tribal cultures are in various stages of modernization and transition (Kunitz and Levy, 1981). Many young Indians are upwardly mobile due to recent educational and economic opportunities, but the majority of the indi-

viduals and tribes are characterized by low education and limited economic development. Nevertheless, the overall differences in social integration still exist and influence behavior as evidenced by alcohol-related mortality statistics. The Plains tribes have consistently higher death rates from flamboyant behaviors such as accidents, suicide, and homicide (U.S. Public Health Service, 1978, 1979; VanWinkle, 1981; Reidy, 1982).

In sum, the three cultural traditions of these tribes generally produce different types of behavior (May, 1982). Particularly, their differing alcohol-related behaviors must be considered in evaluating the epidemiology of FAS.

METHODOLOGY

The study was undertaken in 1980-82 among American Indians of New Mexico, Southern Colorado, Southern Utah, and Northern Arizona. Indian groups served by the project resided on 26 reservations with a total population in 1980 of approximately 240,000 (U.S. Dept. of Health, Education, and Welfare, 1979). Because the land area served was vast, transportation and logistics were major obstacles and determinants of the study design.

An elaborate referral system served as the basis for this study. All research activities were coordinated on each of the outlying reservations from the central office in Albuquerque. The major focal point on each reservation was one of the eleven hospitals or ten full-time clinics operated by the IHS. At each of these installations, explicit and detailed training on the recognition and diagnosis of FAS was provided to all IHS clinical staff by the project staff and two consultant dysmorphologists. These diag-

nostic training sessions were two-hour slide and data presentations detailing the clinical characteristics of 15 FAS and FAE children from birth to 17 years of age. Further literature on FAS was subsequently provided to trainees. In each session the FAS Demonstration Project was explained, with specific instructions concerning referral of suspected FAS children. To complement the training and facilitate referral, all physicians and nurses trained were provided with a three-page referral form for FAS suspects. Items included on this form were key aspects of the parents' medical and alcohol use histories; birth length, weight, and head circumference of the suspect, and a simple checklist of 29 characteristics generally found in FAS. In addition, the referring clinicians were asked to attach growth charts, developmental test results, and other relevant information.

At each clinic or hospital one or two "designated persons" were the major liaisons with the project. The project staff at the central office worked closely with local staff to review and verify the records of the referred child and of his/her parents. Referrals were encouraged for any child considered suspicious because of clinical features of FAS and a maternal history of drinking. The primary emphasis in ascertainment was on children under 15 years of age. FAS suspects were then scheduled for clinics at the health installation from which they were referred. The project staff and one or more of the project dysmorphologists traveled to the outlying clinic where data collection and diagnostic evaluations were completed.

To standardize the final diagnosis, a weighted diagnostic form was developed for the project by a committee of

ten experienced dysmorphologists. The form consisted of 36 separate diagnostic items divided into four sections: drinking history, radiologic findings, growth and development, and clinical observations. The section on clinical observations contained eleven subsections: general observations, lateral facial profile, ear, eye, nose, neck, chest, arms, and hands, heart, back, and skin. Screened children were categorized for project purposes as FAS, FAE, suspicious, or without signs of fetal alcohol damage. Two diagnostic categories, FAS and FAE, were used for definite alcohol damage. For the diagnosis of FAS, all of the following were required: (1) prenatal and postnatal growth deficiency; (2) mental deficit and developmental delay; (3) facial dysmorphia; (4) physical abnormalities; and (5) documentation of alcohol abuse during pregnancy. FAE designated a milder form of prenatal alcohol damage with the child showing all of the features of FAS, but to a lesser degree. A diagnosis of "suspicious" indicated that the child met many of the criteria of FAE, except for adequate evidence of abusive maternal drinking. Without exception, all diagnoses were made by two dysmorphologists, who both have considerable experience with FAS and American Indians. The major orientation for the diagnosis was toward future therapy and habilitation of the child (May and Hymbaugh, 1983).

Alcohol histories of the mothers and some fathers were obtained from multiple sources. In most cases, adequate documentation was available in medical charts through notes and visits for alcohol-related illness and trauma. Records of local and tribal police, and social welfare agencies were also consulted.

Additional informants, such as clinic and field health personnel, relatives, friends, and social service workers were used to further substantiate the history. A strict quantitative definition of alcohol abuse was not possible. Verification was assumed when all sources were in complete agreement that alcohol abuse was common during pregnancy. Since most of these reservations were quite small and of restrictive residence, these informants were quite aware of the drinking patterns of the mothers.

Population data used in the analysis were derived from Indian Health Service estimates. These estimates were based on 1970 U.S. census data, actual Indian births and deaths, and net county migration (U.S. Dept. of Health, Education, and Welfare, 1979). They were the latest available figures which were age- and community-specific.

Two different rates were calculated to describe the occurrence of FAS and FAE. Prevalence rates for children ages 0-14 were calculated with 1979 population estimates as the denominators. To approximate the incidence of FAS and FAE at birth, the actual natality was reconstructed by combining the 1979 population estimates and mortality experience from life tables.¹ The Navajo data were corrected with a tribe-specific life table (Carr and Lee, 1978), whereas the Pueblo and Plains figures were adjusted with a life table for all U.S. Indians (Indian Health Service, 1975). The incidence was then calculated as the ratio of

¹It would have been preferable to use actual births for the denominator, but this was not possible because tribal affiliation is not recorded on birth certificates and because of the IHS system of aggregating birth date.

the total number of cases to the total number of births.

The prevalence of mothers who had produced an FAS or FAE child was also calculated. The denominators for these rates were the 1974 estimates of women aged 15-44 years. Since the children ages 0-14 in 1980 were born between 1967 and 1981, 1974 is the midpoint year.

Overall rates in each table were calculated for the entire population covered by the FAS project in the Southwest. These rates were adjusted by the direct method with weights proportional to the representation of each culture in the entire study area.

In the results section data are presented for individual reservations and service units. The specific reservations and tribes are not named to avoid stigmatization. Therefore, the results are reported in a way that cites important identifying cultural information, but pseudonyms are used for the particular subtribes, reservations, or areas studied.

RESULTS

The FAS project held 23 clinics in sixteen different locations. Of the 243 children evaluated, 31.3 per cent had FAS, 16.0 per cent had FAE, and 5.3 per cent

were considered suspicious (Table 1). Among the 47.4 per cent diagnosed as not having FAS, most were diagnosed as normal. Other specific anomalies were found in 12 per cent of the children examined, including hypoparathyroidism, blepharophimosis and Down, Melnick-Needles, Fetal Hydatoin, Noonan, and Cornelia deLange syndromes.

The average birth measurements of the diagnosed children were consonant with FAS in other populations when compared with standard growth charts. Indian FAS children were small at birth in length (mean = 17.3 inches, predicted = 20), weight (mean = 4.6 lbs., predicted = 7.5), and head circumference (mean = 12.2 inches, predicted = 13.6) (National Center for Health Statistics, 1976). Other studies have shown that normal Southwest Indian babies are heavier and longer at birth (Adams and Niswander, 1968), than those of other U.S. populations. Growth patterns for the first two or three years of a child's life were particularly important in diagnosing this condition. Some of the children diagnosed as having fetal alcohol effect were "low normal" (e.g., 10th percentile) at birth on standard growth charts, but their growth curves showed inadequate

growth, resulting in a marked "flattening" of the curve and a decline in percentile rank in their first few years.

The detailed epidemiological analyses which follow were limited to the seven service units and reservations where ascertainment was judged to be complete by project staff and local health personnel (Table 2). The fertility rates of these tribes during the past seven years were comparable and the age structures of these different reservation populations were similar. In these areas there were 55 FAS children and 30 FAE children (aged 0-14) among a total 1979 population of 51,137 of which 2963 were aged 0-14. Four alcohol-affected children 15 years or older were also found. The Plains groups have the highest rates, with the Navajos and Pueblos lower. Although the rates vary slightly within each group, those for the Navajo and Pueblo are quite compara-

ble to data from Seattle, Sweden, and France (Streissguth et al., 1980; Olegard et al., 1979; Dehaene et al., 1981). The incidence among the Plains tribes exceeds the upper range of any previously reported rates, but the overall culture-adjusted rates are quite similar to previous studies. Age-specific prevalence rates were lower in the older ages (Table 3), with the exception of Plains reservation N.

One unanticipated finding in this research was the frequent occurrence of two or more alcohol-damaged children born to one mother (Table 4). On the completely screened reservations, 85 FAS or FAE children were born to 65 mothers, an average of 1.3 affected children per mother. Fifteen mothers produced more than one damaged child, among them one set of twins (dizygotic). Variation in the pattern of recurrent affected births were found between tribal

TABLE 1

DISTRIBUTION OF DIAGNOSES OF PATIENTS EVALUATED IN FAS PROJECT CLINICS

Diagnoses	Total	Per Cent	Male	Female	Sex Ratio*
Fetal Alcohol Syndrome (FAS)	76	31.3%	41	35	117
Fetal Alcohol Effect (FAE)	39	16.0	26	13	200
Suspicious	13	5.3	4	9	44
Other/Not FAS	115	47.4	64	51	125
Total	243	100%	135	108	125

*Sex ratio (males per 100 females).

TABLE 2
BIRTH INCIDENCE AND PREVALENCE (AGES 0-14) OF FETAL ALCOHOL CHILDREN BY CULTURAL GROUP AND SERVICE UNIT* OR RESERVATION†

CULTURAL GROUP AND SERVICE UNIT OR RESERVATION	FAS			FAS & FAE		
	Birth Incidence	FAS (All Births)	Preval. in Ages 0-14	Birth Incidence	FAS & FAE (All Births)	Preval. in Ages 0-14
Navajo Culture	1.4	(1/690)	1.6	2.2	(1/448)	2.5
Service Unit-F	1.5	(1/655)	1.7	2.2	(1/447)	2.5
Service Unit-W	1.3	(1/749)	1.5	2.2	(1/449)	2.5
Pueblo Culture	2.0	(1/495)	2.2	2.4	(1/408)	2.7
Reservation-W	1.5	(1/660)	1.7	2.1	(1/471)	2.3
Reservation-N	5.9	(1/170)	6.4	7.8	(1/128)	8.6
Service Unit-C	1.9	(1/522)	2.1	1.9	(1/522)	2.1
Southwest Plains Culture	9.8	(1/102)	10.7	17.9	(1/56)	19.5
Reservation-S	10.3	(1/97)	11.3	17.6	(1/57)	19.2
Reservation-N	9.2	(1/109)	10.0	18.3	(1/55)	20.0
Total Culture Adjusted Rate†	1.8	(1/633)	2.0	2.8	(1/427)	3.1

*A service unit is a geographical area served by a single U.S. administrative unit, usually characterized by one major language and tribal affiliation.

†Rates per 1,000.

‡Adjusted by the direct method to the proportion of each culture in the entire Southwest study area.

TABLE 3
AGE-SPECIFIC PREVALENCE RATES FOR FAS AND FAS/FAE COMBINED, BY CULTURAL GROUP AND SPECIFIC LOCATION*

CULTURAL GROUP	FAS		FAS & FAE	
	Ages		Ages	
	0-4	5-14	0-4	5-14
Navajo Culture	3.7	0.5	5.2	1.0
Service Unit-F	4.4	0.3	6.2	0.7
Service Unit-W	2.7	0.7	3.7	1.5
Pueblo Culture	4.7	1.1	5.7	1.3
Reservation-W	4.1	0.5	5.2	1.0
Reservation-N	16.3	2.9	24.4	2.9
Service Unit-C	3.7	1.5	3.7	1.5
Plains Culture	11.7	10.2	17.5	20.5
Reservation-S	19.9	6.8	26.6	15.3
Reservation-N	0.0	14.4	4.7	26.7
Total Culture				
Adjusted Rate	4.2	1.0	5.7	1.8

*Rates per 1,000.

cultures, but the differences are not readily interpreted because of small numbers.

The prevalence of mothers with damaged offspring was lowest among the

Pueblo and Navajo, and much higher among the Plains tribes (Table 4). These rates are useful in measuring the extent and origin of risk in each population.

Social maladjustment, high-risk lifestyles, and high mean maternal age at birth of the damaged children were characteristic of the mothers in this study (Table 5). Of the fetal alcohol children, 73 per cent were adopted or in foster placement. In most cases, the child had been left with relatives or friends, abandoned, or other neglect was documented. In 23 per cent of the cases, the mother was dead, almost always from accidents, cirrhosis of the liver, or other alcohol-related trauma and illness. There was variation by culture, with the lowest mortality in the Navajo and the highest in the Plains. The screening process used could have increased the proportions of deceased mothers and children in foster placement, if foster parents were more likely to have their

TABLE 4
VARIABLES CONCERNING MOTHERS BEARING MULTIPLE AFFECTED CHILDREN AND MATERNAL PREVALENCE BY CULTURAL TYPE AND LOCATION

CULTURAL GROUP AND SERVICE UNIT OR RESERVATION	MOTHERS PRACTICING MULTIPLES*	FETAL ALCOHOL CHILDREN PER MOTHER†	MOTHERS BEARING FAS & FAE CHILDREN PER 1,000 WOMEN 15-44 YEARS OF AGE
Navajo Culture	21.4%	1.3	5.3
Service Unit-F	26.7%	1.5	4.9
Service Unit-W	15.4%	1.2	5.9
Pueblo Culture	25.0%	1.4	4.6
Service Unit-W	20.0%	1.4	3.9
Reservation-N	50.0%	2.0	8.0
Service Unit-C	20.0%	1.2	4.5
Plains Culture	28.0%	1.2	30.5
Reservation-S	30.8%	1.3	33.3
Reservation-N	25.0%	1.2	27.9
Total	24.6%	1.3	7.5
Total Culture Adjusted Rate	22.3%	1.3	6.1

*Per cent of mothers who have produced two or more FAS or FAE children.

†The total number of FAS and FAE children divided by the number of mothers producing them.

TABLE 5
SELECTED SOCIAL VARIABLES OF MOTHERS, FETAL ALCOHOL CHILDREN, AND OTHER CHILDREN

VARIABLES	FAS & FAE	Not FAS & Other Diagnosis	Signif. Level*
born in foster placement	73.3%	42.5%	p=0.02
deceased mothers	23.1%	15.7%	p=0.10
adopted	10.7%	5.8%	...
relatives	25.0%	5.0%	...
friends	36.0%	29.5%	...
mean age of mother			
of FAS child†	29.7	26.9	p=0.02
of other child	28.1	27.8	...
of FAS child	32.6	26.6	...
of other child	30.7	26.3	...

*Significance level determined by Z test. Ellipsis dots indicate significance level not reported because of small numbers.
†Age at delivery for mother was not available for 16 of the 65 mothers of fetal alcohol children.

children evaluated. Mothers bearing FAS and FAE children had a mean age at delivery of 29.7, higher than that of mothers of the non-FAS children and higher than the mean age at delivery for all Navajo mothers (24.8) (Kroudy and May, 1983). Of all the mothers who produced FAS and FAE children, only 18 per cent were under

age of 25. rates (Table 2) were comparable to or higher than those from other populations (Streissguth et al., 1980; Olegard et al., 1979; Dehaene et al., 1981); thus, bias from incomplete ascertainment appears unlikely. Second, alcohol histories were not obtained directly from the mothers. However, the combination of medical records and community informants was generally sufficiently sensitive to identify abusive drinking during pregnancy. Third, calculation of incidence rates for FAS and FAE required a pragmatic reconstruction of birth numbers. This approach also assumes no deaths among children with FAS and FAE and, as a result, probably underestimates the actual incidence. Fourth, a similarly pragmatic technique was used to calculate the prevalence of mothers who had given birth to an FAS or FAE child (Table 4). Mid-point population figures were used to estimate the numbers of women at risk for giving birth to an alcohol damaged child. Although this approach is relatively crude, the prevalence estimates should provide a

DISCUSSION

A referral network and clinical screening system were used to identify prevalent cases of FAS and FAE in southwestern American Indian groups. This approach was determined largely by feasibility issues and may have limitations for the epidemiological analyses of this paper. First, the adequacy of case-finding cannot be independently verified. Accordingly, we limited the calculation of prevalence and incidence to the populations where screening was known to be satisfactory. The resulting

satisfactory measure of inter-tribal variation.

With these limitations in mind, the incidence of FAS among Southwestern Indians can be compared to previously reported rates. The Navajo rate (1 per 690 births) and overall rate for Southwest Indians (1 per 633) are lower than that reported for Seattle (1 per 750) and fall between the rates for Roubaix, France (1 per 700) and Goteberg, Sweden (1 per 600). The Pueblo rate of 1 per 495 is higher than those for all the comparison populations. The Plains incidence of 1 per 102 births is much higher than any previous figures reported. The overall incidence of FAS and FAE found among Southwest Indians, 1 per 427, is quite comparable to the estimates from France and Sweden, although the criteria used in this study may be more strict than those used in Europe.²

The age-specific rates (Table 3) raise three interesting thoughts. First, the literal interpretation is that the occurrence of FAS and FAE is increasing among the groups, especially among the Navajo and Pueblo. Second, the screening process might have been effective in identifying younger children. Third, fetal alcohol children may have unusually high mortality experience in their early years.

Attention can now be turned to possible explanations for the variability in occurrence of FAS in the three American Indian populations studied. Among the possible explanations for this disparity are innate biological differences among the groups, either in the liability for prenatal alcohol damage or in the

metabolism of ethanol itself, differences in the teratogenic agent, or sociocultural differences among the tribes studied.

BIOLOGICAL CONSIDERATIONS

While a number of studies in the past have attempted to show differences between Indians and Caucasians in the rate or extent of alcohol breakdown, no convincing differences have been substantiated. The common stereotype of the "drunken Indian" has not been borne out either in terms of aberrant metabolism of alcohol (Reed et al., 1976; Schaeffer, 1981), liver biopsies (Bennion and Li, 1976), or in the proportion of the Indian population abusive of alcohol (May, 1982). Furthermore, there is no evidence for a genetic component in production of the Fetal Alcohol Syndrome, for the type and severity of its manifestations are identical in Indian and non-Indian children (Aase, 1981). While it would be premature to rule out innate metabolic differences of a subtle kind, or the presence of some environmental or genetic cofactors which influence the occurrence of FAS, there is presently no valid information which points in this direction (Schaefer, 1981).

SUBSTRATE DIFFERENCES

Conceivably, there might be some ingredient in the different alcoholic beverages consumed by different groups which might account for different risks for FAS in offspring of alcoholic women. In previous surveys, the type of beverage consumed had no discernible influence either on the incidence or the severity of FAS in children of drinking mothers. Total alcohol intake seems to correlate best with these outcomes (Iber, 1980), but even this seems to be

possible, since more than half of the offspring of severely alcoholic women seem to be protected from the effects of maternal alcohol abuse (Jones and Streissguth et al., 1976; Rosett et al., 1976; Streissguth et al., 1980). In our study, a usual variety of alcoholic beverages is consumed both by mothers of affected and unaffected children. Also, alcohol is definitely the drug of choice among the adults of the study population (May, 1982; Levy and Kunitz, 1974).

SOCIOCULTURAL FACTORS

For the purposes of this discussion, sociocultural factors can be viewed as rating expectations which either foster or inhibit individual drinking behavior and also influence the style of consumption. In considering maternal drinking patterns, four considerations need attention: rate, severity, and duration of alcohol abuse in women of childbearing age, and the timing of alcohol intake in relation to the gestation in question.

National surveys indicate that 60 per cent of all U.S. women consume some alcohol (National Institute on Alcohol Abuse and Alcoholism, 1981), while surveys among the Navajo and Plains tribes show that only 13 to 55 per cent of women drink (Levy and Kunitz, 1974; Longclaws et al., 1980; Whittaker, 1962, 1982). Certain subsegments within each tribe, however, have significant alcohol abuse problems as evidenced by high rates of death from accidents, liver cirrhosis, and other alcohol related causes (U.S. Public Health Service, 1978, 1979) among Indian men and women (Streissguth, 1980).

In these groups, certain distinct social factors may have a profound influence

on the severity of alcohol abuse in women and the resulting incidence of FAS and FAE. While the per cent of population drinking within each tribe influences the findings, drinking style is more relevant to severity of abuse. For example, the highest percentage of drinking women is found among the Plains tribes (50-55%; Whittaker, 1962, 1982), with considerably lower percentages among the Pueblo and Navajo (13-23%; Levy and Kunitz, 1974). As expected, the Plains tribes had the highest incidence of fetal alcohol damage. However, the Plains rate of FAS and FAE (in Table 2) is five (4.9) to seven (7.0) times higher than the other tribes, much higher than would be dictated solely by the proportion of drinkers. This is due to the normative pattern of social regulation. The Plains tribes allow for considerably more individuation of behavior, especially alcohol-abusive behavior (Jessor et al., 1968; Curley, 1967). More Plains women are permitted to follow abusive behaviors, while the low incidence rates of the Pueblo and Navajo exemplify tighter control exercised on individuation and alcohol abuse. Bearing an alcohol-damaged baby is not condoned in the mainstream of any of these tribal groups, but it is more common with the loose social integration of the Plains groups.

Social variables can also influence drinking severity and FAS in some special circumstances. An example from our study clearly demonstrated that alcohol abuse rates can be atypically high at certain times which clearly puts more pregnancies at risk. One small Plains reservation (reservation N) with a high incidence of fetal alcohol problems had received royalties for a number of years from the sale of resources extracted

²Personal communication with Ann P. Streissguth, Ph.D., University of Washington, and Kenneth Warren, Ph.D., NIAAA.

from their lands. Payments of approximately \$100 per month were distributed to adult tribal members on a per capita basis. For various reasons, the tribe suspended the payments in the late 1970's, and the prevalence of fetal alcohol syndrome appears to have decreased dramatically (Table 3). Of the fourteen Fetal Alcohol children found on this reservation under the age of 15, only one FAE child had been born after the cessation of per capita payments.

Ostracism from a tribal culture may also affect the severity of alcohol abuse. As in most areas of the United States, female Indian adolescents usually experiment with alcohol, but as they grow into their twenties, societal rules become more strictly enforced. Among the Plains tribes more variation in drinking behavior is afforded women, but among the Navajo and Pueblo a woman who continues drinking is much less likely to be tolerated or accepted, especially among the Pueblo. More clearly than in many societies, traditional Pueblo or Navajo people enforce a definite choice on most of their women—to abstain or to be partially or totally ostracized. Those who continue regular or heavy drinking are removed from participation in most family and tribal activities. Once this occurs, stigmatization fixes their alcoholic life style and promotes increased severity of abuse.

Informants consistently reported the ostracism pattern for mothers who produced two or more children with fetal alcohol damage. They were often characterized as unreachable and far removed from mainstream tribal society. We postulate that ostracism maintains the severity and duration of abusive drinking and thus may explain the birth of multi-

ple affected children to a single mother and also the higher rate of FAS among the Pueblo than among the Navajo. Support for this hypothesis is the ratio of FAS to FAE. The ratio is very different between tribes (Table 4). In the Plains groups there are as many FAE children produced as FAS (approximately 1 to 1), while among the Navajo and Pueblo the ratio is approximately 2 to 1 and 4 to 1 respectively. This variation is consistent with the anticipated effects of ostracism and drinking behavior, since the Pueblo exercise the strongest ostracism and the Plains the weakest.

Ostracism may also prolong the duration of alcohol abuse. Among American Indian groups, the period of childbearing is longer than that of the general population (Broudy and May, 1983). The combination of sustained alcohol abuse and this prolongation of childbearing years increases the risk for FAS. In this study a pattern of successively more severely affected offspring was repeatedly observed. Among the women who produced more than one fetal alcohol child, the later children always were diagnosed as having equal (47 per cent) or more severe damage (53 per cent). Therefore, as long as a mother continued to drink, the degree of severity of symptoms increased with each succeeding child. However, several cases indicated that if a mother quit drinking in subsequent pregnancies, normal children were born.

CONCLUSIONS

The ascertainment method used in this study employed several successive levels of screening for children suspected of having Fetal Alcohol Syndrome. This technique, with a weighted

checklist of FAS characteristics used in the final screening, was quite cost-effective and yielded reliable prevalence figures for the three American Indian groups surveyed. While not a guarantee of 100 per cent ascertainment, this approach may prove useful in further epidemiologic studies of FAS and other teratogenic conditions in limited populations to permit assessment of risk and planning for intervention.

Analysis of the data gathered in this study showed consistent differences in incidence and patterns of recurrence of FAS among the three subject groups. These differences were of greater magnitude than expected and can best be explained by the unique social and cultural dynamics of the three populations surveyed. The risk for Fetal Alcohol problems correlates better with the drinking style of each group than with overall figures for alcohol consumption. This is by no means a new concept in alcohol studies (Bales, 1946), but bears particularly important implications for the epidemiology of the Fetal Alcohol Syndrome.

Since FAS cannot be treated after the fact, but can be prevented completely by education and other measures directed at women in the childbearing years (Russell and Bigler, 1979; Rosett et al., 1981; Sokol and Miller, 1980; Streissguth et al., 1983), the ability to define a subpopulation at high risk has great importance as a public health issue (Little, 1979; Little and Streissguth, 1981). Edu-

cation and intervention efforts can be targeted with greater effectiveness once these factors have been determined, and existing social constraints might be turned to positive uses in supporting efforts at alcohol abstinence in pregnant women. During the course of the study, it became evident that the issue of fetal alcohol damage gained widespread and enthusiastic interest among health workers and the general population (May and Hymbaugh, 1983), in contrast to the indifferent response often generated by approaches to other alcohol-related problems. Since the Fetal Alcohol Syndrome is the most common severe birth defect in the groups surveyed, any potential preventive measures hold promise for a significant reduction in the tremendous social, financial, and personal burdens caused by this disorder.

ACKNOWLEDGMENTS

This project has been supported by contracts 242-79-0072, 242-79-0081, and 240-81-0002 of the Indian Health Service and the Health Services Administration, and Research Career Award 5 K04 HL00951 of NHLBI.

The authors gratefully acknowledge the assistance of many individuals within the All Indian Pueblo Council and the Indian Health Service, particularly Roland Johnson, Emmanuel Moran, Marlene Hafner, Al Hiatt, David Broudy, David Heppel, Ed Little, Joe Sonderleiter, and others. Also special thanks to Kirk Aleck, Ann Streissguth, Lorraine Ration, Nadine Wacondo, and Cindy Self.