Epidemiology of Fetal Alcohol Syndrome in a South African Community in the Western Cape Province

ABSTRACT

Objectives. This study determined the characteristics of fetal alcohol syndrome in a South African community, and methodology was designed for the multidisciplinary study of fetal alcohol syndrome in developing societies.

Methods. An active case ascertainment, 2-tier methodology was used among 992 first-grade pupils. A case–control design, using measures of growth, development, dysmorphology, and maternal risk, delineated characteristics of children with fetal alcohol syndrome.

Results. A high rate of fetal alcohol syndrome was found in the schools—40.5 to 46.4 per 1000 children aged 5 to 9 years—and age-specific community rates (ages 6–7) were 39.2 to 42.9. These rates are 18 to 141 times greater than in the United States. Rural residents had significantly more fetal alcohol syndrome. After control for ethnic variation, children with fetal alcohol syndrome had traits similar to those elsewhere: poor growth and development, congruent dysmorphology, and lower intellectual functioning.

Conclusions. This study documented the highest fetal alcohol syndrome rate to date in an overall community population. Fetal alcohol syndrome initiatives that incorporate innovative sampling and active case ascertainment methods can be used to obtain timely and accurate data among developing populations. (*Am J Public Health.* 2000;90:1905-1912)

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In the United States, the rate of fetal alcohol syndrome has been estimated to range from 0.33 per 1000[1] to 2.2 per 1000.[2] A more recent average has placed the rate for the developed world at 0.97 per 1000.[3] In certain American Indian reservation communities in the United States that are considered by some to be at very high risk, the rate of fetal alcohol syndrome seldom exceeds 10 per 1000.[4,5] The average rate of fetal alcohol syndrome found among American Indians, based on active case ascertainment methods, was 8 per 1000 in the birth cohorts 1970 through 1980.[6] Studies of African Americans of low socioeconomic status (SES) in selected inner-city areas have yielded a rate of 2.29.[3]

Various methods, including both active and passive case ascertainment, have been used to determine the prevalence of fetal alcohol syndrome. Information for estimating fetal alcohol syndrome prevalence comes from birth records, registries, clinic-based studies, and population-based initiatives.[7] Because of wide variation in methodologies, comparison of fetal alcohol syndrome prevalence and the epidemiologic characteristics of fetal alcohol syndrome between populations is often difficult to impossible. For example, virtually all active case ascertainment studies, in which outreach in major geographic areas focuses on aggressive case finding, have been carried out among American Indians. Passive, record-based systems and clinic-based methods have been used to study fetal alcohol syndrome among patients presenting for routine medical services (e.g., prenatal and birthing services). Passive case ascertainment has been used predominantly in mainstream populations in North America and Europe.[6,8] Data from these different methods vary greatly in their completeness and in the types obtained in each setting.[7,9,10]

Recently, a study committee of the Institute of Medicine endorsed active case ascertainment as the most accurate method for epidemiologic studies, but active methods are logistically challenging, expensive, and time-consuming.[7]

In this article, we summarize an active case ascertainment initiative funded by US and South African sources to establish the prevalence of fetal alcohol syndrome in a community in the Western Cape Province of the Republic of South Africa. As part of a binational commission initiated by the vice presidents of the 2 countries, scientists from the United States visited parts of South Africa to lecture, share information, and survey potential research opportunities.[11] These visits, sponsored by the National Institute on Alcohol Abuse and Alcoholism,[12] raised concern about the frequent occurrence of fetal alcohol syndrome in various South African subpopulations. Epidemiologic studies of fetal alcohol syndrome seemed necessary in the Western Cape Province in the southwest of the country. The total population of the province is 3 721 200, of which 57% is Cape Coloured (mixed race), 18% is Black, 24% is White, and 1% is other. Cape Town is

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the most densely populated area of the region, but 40% of the population live outside the Cape Town metropolitan area in small towns and rural settlements like the one studied here.[11]

Many people of the Western Cape are involved in growing grapes and producing wine, and this has influenced the modal regional drinking patterns. For several centuries, wine was distributed among and consumed daily by workers as partial payment for labor. This custom is referred to as the "Dop" system. Dop has been outlawed by at least 2 legislative acts, but residual patterns of regular and heavy alcohol consumption by workers remain today as its legacy in Western Cape society. Furthermore, increased availability of inexpensive commercial wine, beer, and liquor today in shebeens (illegal bars) and carry-out sources has exacerbated problems of heavy drinking.[13,14] Weekend binge drinking is a major form of recreation among subsegments of the population.

The anonymous study community has been a willing research host. Similar in social and economic character to many others in the Western Cape, the community had a population of 45 225 (35 364 urban and 9861 rural) in 1996,[15] the vast majority of whom were classified as Coloured.

Methods

The diagnosis of fetal alcohol syndrome, first formulated in 1973 by Kenneth L. Jones and David Smith,[16] describes a pattern, which few had recognized earlier,[17,18] of anomalies and deficits in children prenatally exposed to large amounts of alcohol. Children with fetal alcohol syndrome have characteristic facial and body dysmorphology, a pattern of delayed physical growth and development, and mental and behavioral deficits.[18,19] Many investigators, including study groups of The Research Society on Alcoholism and the Institute of Medicine,[7,19–21] have refined, catalogued, and quantified these 3 hallmarks of fetal alcohol syndrome over the years. Even though fetal alcohol syndrome can be diagnosed without confirmation of heavy maternal drinking,[7] a detailed maternal history is very desirable to confirm the nature of gestational drinking and to document social circumstances, particularly in cases in which dysmorphology is less consistent.[19]

In this study, we did not attempt to aggregate the individual traits of prenatal alcohol exposure into lesser, nonsyndrome diagnoses commonly referred to as fetal alcohol effects, alcohol-related birth defects, or alcohol-related neurodevelopmental deficits.[7,22,23] Only fetal alcohol syndrome (or not fetal alcohol syndrome), the most accurate and rigorous diagnosis, was used. Fetal alcohol syndrome had been diagnosed previously in South Africa[24] but not in an explicit epidemiologic study.

Specific fetal alcohol syndrome diagnostic components of the US Institute of Medicine[7] were used: (1) facial and other dysmorphology, (2) diminished structural growth for age, (3) developmental (intelligence and social skills) delay, and, when possible, (4) confirmation of maternal alcohol consumption. Once data for each of these components were independently collected, quantified, and analyzed, a structured case conference of examining specialists in each domain was held (Figure 1).

Establishing 2-Tier Screening Through Preliminary Physical/Dysmorphology Assessment

Dysmorphology, growth, and developmental data for the children were collected with a 2-tier screening method *after* normative data were assessed for this particular population. Four 2-person teams (1 expert dysmorphologist and 1 South African physician training in fetal alcohol syndrome diagnosis) worked independently but simultaneously and used standardized assessment criteria to examine all children in sub-A (first-grade) classrooms. Twelve of the 13 elementary schools in the community (N = 992 sub-A children) were accessed. The one school that refused to participate was an all-White school with 80 children. Ethnographic knowledge of the community indicates that this school sample was representative of the community. The low mobility of the local population ensures that the vast majority of the study children underwent gestation and were born locally.

Furthermore, the research team searched for out-of-school children and found only 2 children without a major developmental delay in the targeted age range (5–7 years). Children from the community who were in special schools for the developmentally delayed also were examined. Two cases of fetal alcohol syndrome from the community were confirmed via diagnostic methods similar to those described below.

The screening of schoolchildren proceeded as follows. First, a complete dysmorphology examination was given to each of the initial 406 schoolchildren from classrooms in 6 of the rural and urban schools to gauge both local normative growth parameters and possible fetal alcohol syndrome dysmorphology relative to US National Center for Health Statistics charts. Second, data for these 406 children were analyzed. All the children with suspected classic fetal alcohol syndrome had height, weight, and occipitofrontal circumference measurements below the 10th centile on 1 of the 3 measures. Third, with local parameters assessed, cutoff points were set for implementing the 2-tier screening system. Fourth, all of the 586 children in sub-A classrooms in the remaining 6 schools received tier I screening (height, weight, and occipitofrontal circumference). Children whose measurements were below the 10th centile on occipitofrontal circumference or on both height and weight were referred for the complete examination (tier II) by the dysmorphology teams. Finally, 220 of the remaining children met these criteria and were referred for complete examinations. Therefore, 626 children (63%) received full dysmorphology examinations (see Figure 1).

Full examinations for so many children also provided intensive training for South African physician trainees. Every child receiving the complete screen (tier II) was examined by 2 of the physician teams. Each 2-member team examined and measured the child's occipitofrontal circumference, palpebral fissure length, philtrum length, inner and outer canthal distance, and other indicators such as abnormalities in joints, heart function, and palmar creases. Findings were recorded on child data forms, and physicians in each team verified each other's findings. All physicians were "blinded" from any prior knowledge of the child or mother. Once seen by 1 team, the child was directed to another "blinded" team who repeated the examination and measurements as a reliability check.

Mean differences between dysmorphologists' measurements for the first 25 children were checked and were insignificant for key measures: inner canthal distance (0.22 cm), interpupillary distance (0.29 cm), and palpebral fissure length (0.04 cm). Interrater reliability was later checked for 194 matched pairs with the square root of the Pearson product moment correlation (r). Results were 0.91 for inner canthal distance, 0.85 for interpupillary distance, and 0.84 for philtrum measurements.

Complete Diagnostic Sequence

After the dysmorphology examination had been completed by 2 teams, a child was assigned a preliminary diagnosis of not fetal alcohol syndrome, deferred, or fetal alcohol syndrome based on the quantified fetal alcohol syndrome checklist and all clinical findings. Children with a deferred diagnosis had the appearance and some anomalies of fetal alcohol syndrome with growth delay, but developmental test and maternal interview data were definitely required for a final diagnosis. Only those with the classic fetal alcohol syndrome phenotype and measurements well below the fifth centile on all measures received a *preliminary* fetal alcohol syndrome diagnosis. All children with a preliminary or deferred diagnosis of fetal alcohol syndrome then under-

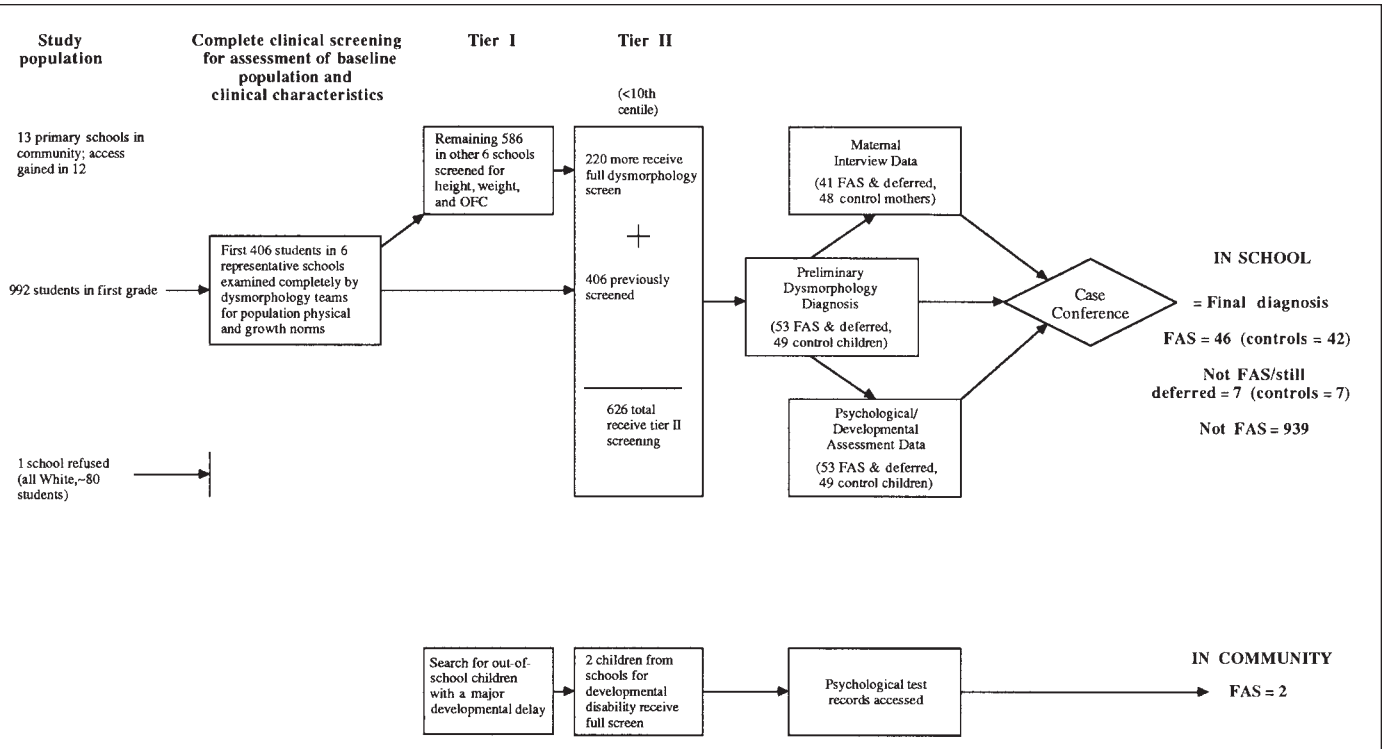

FIGURE 1—Methodologic flow of the Western Cape, South Africa, fetal alcohol syndrome study. OFC = occipitofrontal circumference; FAS = fetal alcohol syndrome.

went developmental testing and prenatal risk assessment.

Controls

Once subjects were identified, a control subject was selected for each, matched for sex, age, and classroom. Identical developmental and life skills testing was performed on subjects and control subjects with the Griffiths Intelligence and Development Test, a standard test translated to Afrikaans and used throughout South Africa.

Maternal Data

The mothers of the control children became the maternal controls. Structured maternal interviews contained 114 items: childbearing pattern; drinking patterns before, during, and after the index pregnancy; SES indicators; demographic variables; and other risk factors in the social context. Questions from prenatal risk factor questionnaires from the United States were rewritten for South Africa, locally relevant questions were added, questions were pilot tested with 6 local subjects, and adaptations were made.

The protocols used drinking questions that were designed to elicit accurate reporting of both "free" alcohol supplied as part of their work compensation, as was the custom in this province, and alcoholic beverages purchased. Photographs of standard beer and wine containers sold locally were shown to the respondents so that proper quantification of quantity, frequency, and variability of drinking was assessed in standard ethanol units. All interviews were administered in Afrikaans in the field by a public health nurse (J.C.).

Because mothers of children with fetal alcohol syndrome often lead chaotic lives, several were deceased or could not be located, as was common in other studies.[5,25] Specifically, 35 of the 48 mothers of the children with fetal alcohol syndrome were contacted and interviewed. For the remaining 13, some data were obtained for 11 via collaterals (usually relatives of the mother); no knowledgeable collaterals were located for 2 mothers. Six (12.5%) of the 48 mothers of children with fetal alcohol syndrome were deceased (1 in a house fire, 1 from pulmonary tuberculosis, and 4 from murder or other violent death), and 6 were nomadic or had moved from the area. Therefore, 2 children were given the diagnosis of fetal alcohol syndrome without alcohol exposure data per Institute of Medicine guidelines.[7]

Results

Table 1 summarizes the key variables for all children studied. A total of 992 children were examined: 52.8% male and 47.2% female. The mean age was 6.6 years. Basic anthropometric parameters established for the local children are also found in Table 1. The children averaged 116.2 cm in height, weighed an average of 21.1 kg, and had a mean occipitofrontal circumference of 50.8 cm. None of these measures or deviations are remarkable.

Subjects were primarily of the Coloured, or mixed ancestry, group; fewer than 5% were exclusively Black African, and fewer than 6% were White. This unique racial admixture necessitated the previously described assessment of local physical traits. For example, preliminary information suggested that the interpupillary and inner canthal distances in local subpopulations (e.g., Khoisan tribal background) were greater than United States norms, and in many children, the proximal portion of the philtral columns was smoother than found in the United States. Furthermore, mid-face hypoplasia was so commonly recorded that it was considered a normal variation in this population.

However, in none of the study population of fetal alcohol syndrome or deferred children did microcephaly (occipitofrontal circumference < 25%) and microphthalmos (palpebral fissure length < 25%) fall within the normal range. The phenotypes of the deferred cases on these and other measures were sufficiently abnormal to justify further inquiry for fetal alcohol syndrome because deferred cases had many fetal alcohol syndrome traits (see dysmorphology scores in Table 1). Conversely, a child with isolated microcephaly (or another

TABLE 1—Demographic and Growth Parameters for All Sub-A Children, Children With Fetal Alcohol Syndrome, Control Subjects, and Children With Deferred Diagnosis: Western Cape Community, South Africa

	All Sub-A Children (N = 992)	Children With Fetal Alcohol Syndrome (n = 46)	Control Children[a] (n = 42)	Children With Still-Deferred/Unconfirmed Diagnosis (n = 7)	*P*
Sex, %					
n	988	46	42	7	
Male	52.8	54.3	54.8	28.6	
Female	47.2	45.7	45.2	71.4	NS[b]
Age, y					
n	977	45	42	7	
Mean	6.6	7.0	6.7	6.6	
SD	0.73	0.84	0.67	0.54	NS[c]
Height, cm					
n	985	46	40	7	
Mean	116.2	109.5	115.7	109.5	
SD	6.15	6.06	6.68	3.43	<.000[c]
Weight, kg					
n	987	46	40	7	
Mean	21.1	17.8	20.8	17.9	
SD	3.46	2.34	2.41	1.10	<.000[c]
Occipitofrontal circumference, cm					
n	987	46	40	7	
Mean	50.8	48.5	50.9	49.7	
SD	1.60	1.46	1.42	1.39	<.000[c]
Dysmorphology score[d]					
n	582	46	40	7	
Mean	3.0	10.7	2.3	9.3	
SD	3.68	4.47	2.56	4.54	<.000[c]
Residence, %					
Urban	74	39 (n = 18)			
Rural	26	61 (n = 28)			<.001[b]

Note. Columns one and two provide all the necessary data for analysis of urban/rural patterns by indirect standardization of rates. NS = not significant.

[a]Data are for control subjects matched only to the children who received a *final* diagnosis of fetal alcohol syndrome. Control subjects matched to the children with a final deferred/unconfirmed diagnosis were eliminated from the analyses. Four children with fetal alcohol syndrome from the first grade could not be matched for age with first-grade control subjects because of advanced age.

[b]χ^2 test.

[c]Analysis of variance (F test).

[d]The dysmorphology score was assigned only to those children seen in the initial growth parameter assessment phase or in tier II screening and control subjects.

single trait) and no additional features of fetal alcohol syndrome was diagnosed as having microcephaly (or the isolated trait) and not given a preliminary or deferred diagnosis of fetal alcohol syndrome.

After the dysmorphology examination, 17 children had a preliminary diagnosis of fetal alcohol syndrome, and 36 had a deferred diagnosis. These 53, along with their matched control subjects, were the subjects of further research (Figure 1).

Final diagnoses were made only after all data were gathered in the 3 domains and case conferences were held. Developmental testing and maternal interview data were completed by other professionals and combined with dysmorphology examination results for a final diagnosis of fetal alcohol syndrome for 46 schoolchildren. Seven of the deferred children received a final diagnosis of "not fetal alcohol syndrome/still deferred" because they had either insufficient symptoms of fetal alcohol syndrome or a normal diagnosis. The 49 control children also were tested by the same diagnostic criteria; none had fetal alcohol syndrome or indicators sufficient for deferred status. However, because 7 of the control subjects were matched with children who were ultimately classified as not fetal alcohol syndrome/still deferred, they are not included in the data in Tables 1 and 2.

Table 1 also presents the demographic and growth parameters of all children who received a final diagnosis of fetal alcohol syndrome and their matched control subjects. A slightly higher percentage of the control subjects were males (54.8%) than of the children with fetal alcohol syndrome (54.3%), because 4 of the older subjects could not be matched with control subjects from the same grade in their school. The difference was not statistically significant. The average age was 7.0 years for children with fetal alcohol syndrome and 6.7 years for control subjects, indicating that children with fetal alcohol syndrome were, on average, already showing delay in school by the first grade. The mean age of the control subjects and subjects with fetal alcohol syndrome straddles that of all first graders (6.6 years). Height, weight, occipitofrontal circumference measurements, and dysmorphology scores for fetal alcohol syndrome and control subjects differed significantly, with deferred children similar to children with fetal alcohol syndrome. Mean dysmorphology scores were 10.7 (possible 0–35) for the children with fetal alcohol syndrome, 2.3 for control subjects, and 9.3 for the children with a still-deferred/unconfirmed diagnosis.

Scores on the neurodevelopmental tests (Table 2) were lower for children with fetal alcohol syndrome on each of the 3 composite measures. For mental age, performance IQ, and verbal IQ, the children with fetal alcohol syndrome scored 16 to 20 points lower on each. The overall mental age of children with fetal alcohol syndrome was 77.5 and that of control subjects was 95.3. In all measures, control subjects were close to average but below the South African average of 100, underscoring the importance of comparison with local norms.

Analysis of maternal drinking variables (Table 3) indicates that mothers of children with

TABLE 2—Neurodevelopmental Assessment of the Children Included in Case Conferences

	Children With Fetal Alcohol Syndrome (n=46)	Control Children[a] (n=42)	Children With Still-Deferred/Unconfirmed Diagnosis (n=7)	*P*
Mental age				
Mean	77.5	95.3	88.4	
SD	13.36	8.50	9.54	<.000[b]
Performance IQ				
Mean	74.1	94.2	84.4	
SD	11.13	13.56	11.97	<.000[b]
Verbal IQ				
Mean	71.7	88.3	79.5	
SD	12.45	9.66	15.87	<.000[b]

[a]Data are for control subjects matched only to the children with fetal alcohol syndrome. Control subjects matched to the children with a final deferred/unconfirmed diagnosis were eliminated from the analyses. Four children with fetal alcohol syndrome from the first grade could not be matched for age with first-grade control subjects because of advanced age.
[b]Analysis of variance (F test).

fetal alcohol syndrome reported much greater current use of alcohol and more drinking before the index pregnancy and during each trimester than mothers of control children. A majority of the women (controls and subjects) were current drinkers. The mothers of children with fetal alcohol syndrome reported current consumption of 12.6 drinks per week, compared with 2.4 for the control subjects, and more than 50% said that they drank more during the pregnancy that resulted in fetal alcohol syndrome. From the maternal questionnaire and interview, the context of life and drinking was explored. Mothers of children with fetal alcohol syndrome especially characterized the index pregnancy as a time in their lives when they had many life problems and drank more heavily.

Alcohol was the drug of choice; the use of other drugs, covered extensively in the interview, was low to nonexistent, except for tobacco. A high percentage of the mothers of both control children and children with fetal alcohol syndrome smoked tobacco during pregnancy (46.3% vs 87.9%; $\chi^2=8.96$, $P=.000$; odds ratio [OR]=14.8).

Prevalence Rates

The urban vs rural distribution of fetal alcohol syndrome cases (Table 1) was tested against the overall residence pattern of the schoolchildren through indirect standardization. Rather than 26% of the fetal alcohol syndrome cases coming from rural areas as predicted by residence, the data indicate that 61% (28) of the fetal alcohol syndrome cases were from rural schools, a significant departure from random distribution (OR=4.41). The rates of fetal alcohol syndrome are much higher in the rural areas.

The rate of fetal alcohol syndrome in the first graders screened was 46.4 per 1000. Furthermore, if the all-White school that did not allow screening had no fetal alcohol syndrome cases, the overall in-school rate of fetal alcohol syndrome was 42.9 per 1000. All children with fetal alcohol syndrome were Coloured or Black. The fetal alcohol syndrome rate for the children in the White school was zero; the Coloured/Black in-school rate was therefore 49.3 per 1000.

Because of poor school performance among children with fetal alcohol syndrome, 9 of the 46 first-grade children with fetal alcohol syndrome were older than most first-grade students (children in the targeted age range). Appropriate age ranges for calculating an age-based rate can be maintained through the elimination of older (≥8 years) first graders from the numerator and denominator. Subtracting the older children from the calculations yields an age-specific, in-school prevalence of 40.5 per 1000.

When the 2 additional fetal alcohol syndrome cases identified in the community (in schools for the developmentally delayed) in this age group (>5 years and <8 years) were considered, a total of 48 children with fetal alcohol syndrome were identified. The communitywide, age-specific rate was 39.2 per 1000 children aged 6 and 7 years. Therefore, the range of minimal prevalence rates for this community was 39.2 to 42.9 per 1000.

Discussion

Active case ascertainment of fetal alcohol syndrome through population-based screening has not been reported except among American Indian and Alaskan native populations.[5,6,8] To our knowledge, active case ascertainment methods have not been used previously in developing nations. Furthermore, screening all children in a particular school or grade has not been done before. Active case ascertainment can effectively and efficiently identify children with fetal alcohol syndrome ranging in age from 3 years to the early teens, particularly in relatively small populations. The interdisciplinary, multiple-domain, case–control design described here produces what we believe is complete, accurate, and reliable knowledge of the prevalence and characteristics of fetal alcohol syndrome. It does not provide the actual birth prevalence (incidence) of fetal alcohol syndrome of a population such as this because the effect of infant and child mortality rates (10 to 30 per 1000 in the Western Cape) on children with fetal alcohol syndrome cannot be assessed with these methods (J. Miles, Offices of the Provincial Administration of the Western Cape, Republic of South Africa; oral communication; January 2000).

Previous studies have left unanswered many questions about the epidemiology of fetal alcohol syndrome. Epidemiologic, clinic, and laboratory studies all indicate that major risk factors for fetal alcohol syndrome are associated with the mother's individual characteristics and her social milieu. Specific traits such as advancing maternal age; high gravidity and parity; early age at onset of regular drinking; length of drinking career; and quantity, frequency, and timing of maternal drinking during the child's gestation partially explain the prevalence of fetal alcohol syndrome.[26,27] Furthermore, SES is a major risk factor in the United States.[3,27–29] However, these variables have rarely been studied simultaneously in nonclinic populations. Rather, passive case ascertainment methods are commonly used with existing data sources that are often incomplete and selective.[30,31] This proactive methodology yielded rich epidemiologic data useful for prevention, and it identified "gold standard" cases for further research and clinical services.

The only other paper to report a higher rate of fetal alcohol syndrome was completed in Canada in a highly "disrupted" American Indian reserve with high unemployment, substantial outmigration of nondrinkers, and therefore a concentration of drinkers. Robinson et al.[32] used active case ascertainment methods and reported a rate of 120 children younger than 19 years per 1000 with fetal alcohol syndrome. In our study, more sophisticated and strict assessment measures were used in all domains (dysmorphology, intellectual development, and maternal interviews) for children at ages more suitable to the accurate diagnosis of fetal alcohol syndrome. Furthermore, this South African community is stable, not char-

TABLE 3—Substance Use by Mothers and Fathers of the Children Included in Case Conferences

	Mothers of Children With Fetal Alcohol Syndrome[a] (n = 35)	Mothers of Control Children[b] (n = 41)	Mothers of Children With Deferred/Unconfirmed Diagnosis (n = 6)	*P*
Current use of alcohol, drinks per week				
Mean	12.6	2.4	3.7	
SD	12.21	4.68	6.20	<.000[c]
Drinks consumed on Saturday				
Mean	7.3	1.9	1.8	
SD	6.17	2.84	3.25	<.000[c]
Drinking in months before pregnancy with index child, %				
Drank about the same (as current use)	25.7	45.0	50.0	
Drank less (than current use)	20.0	40.0	50.0	
Drank more (than current use)	54.3	15.0	0.0	<.005[d]
Drinking during first trimester of pregnancy with index child, %				
Drank about the same (as current use)	25.7	45.0	50.0	
Drank less (than current use)	17.1	40.0	50.0	
Drank more (than current use)	57.1	15.0	0.0	<.003[d]
Drinking during second trimester of pregnancy with index child, %				
Drank about the same (as current use)	22.9	50.0	50.0	
Drank less (than current use)	20.0	40.0	50.0	
Drank more (than current use)	57.1	10.0	0.0	<.000[d]
Drinking during third trimester of pregnancy with index child, %				
Drank about the same (as current use)	22.9	52.5	50.0	
Drank less (than current use)	25.7	42.5	50.0	
Drank more (than current use)	51.4	5.0	0.0	<.000[d]
Smoked during index pregnancy, %				
Yes	87.9	46.3	50.0	<.000[d]
Drinking habits of father of index child during the index pregnancy, %				
Nondrinker or light drinker	8.6	38.5	33.3	<.003[d]
Occasional or moderate drinker	5.7	23.1	0.0	
Frequent or heavy drinker	74.3	28.2	33.3	
Has had problems with alcohol	11.4	10.3	33.3	

[a]Mortality and mobility reduced the number of available mothers of children with fetal alcohol syndrome by 11. See "Methods" section of the text for details.
[b]Mothers of control children matched only to the mothers of children with fetal alcohol syndrome. Mothers of control subjects matched to the children with a final deferred/unconfirmed diagnosis were eliminated from the analyses.
[c]Analysis of variance (F test).
[d]χ^2 test.

acterized by social disruption, displacement, or selection by social pathology. It is an established community with a viable (yet low-wage) economy that is undergoing only moderate rates of modernization. Therefore, such a high rate of fetal alcohol syndrome is very worrisome. Many mothers in this community give birth to children with fetal alcohol syndrome compared with the relatively small number of US women (0.3 to 3.3 per 1000 women of childbearing age) who bear 1 or more children with fetal alcohol syndrome.[3,4,32,33]

This study and the race/ethnicity of the children with fetal alcohol syndrome provided insight into gross social influences on fetal alcohol syndrome. The research team was able to access all children in 11 predominantly Coloured and Black schools and 1 predominantly White school. Because of past apartheid policy (enforced segregation by race/ethnicity), darker-skinned peoples are overrepresented in the lower SES categories. This obviously has affected fetal alcohol syndrome rates, given that all of the children with fetal alcohol syndrome were Coloured, and within the Coloured group, those with the lowest SES indicators were overrepresented in the fetal alcohol syndrome cases.

Because virtually all of the women in this community had low SES, the community is at high risk for fetal alcohol syndrome, as suggested by studies from the United States.[3,33] Unknown is whether similar rates exist in other low-SES areas of South Africa. Some visits to informal settlements (squatter camps) on the fringe of the major South African metropolitan areas led us to believe that rates of fetal alcohol syndrome also may be elevated there. But this study clearly illustrates that the historical presence of the wine industry in the Western Cape and the drinking patterns that have developed have produced a high fetal alcohol syndrome rate.

Fetal alcohol syndrome was more common in the rural schools than in the urban schools. This may reflect increasing socioeconomic resources among urban dwellers, or urban areas may simply provide escape from a heavy-drinking social milieu. Clearly, residence on certain of the grape-growing, wine-producing farms is a grave risk factor.

All women likely underreported the extent of drinking. Owing to the residual Dop system and drinking pattern of many female farm laborers in this community, many did not report alcohol consumed that was not purchased, even though our instrument prompted them in several ways to report *all* consumption. Furthermore, respondents may have found it difficult to answer in standard drink units (even though pictures were used by the interviewer), because

alcoholic beverages are commonly shared from nonstandard containers. It was a challenge to use wording that would elicit exact reports of the quantities of alcohol consumed daily on the farms. Respondents, however, seemed able to recall and willing to report alcohol purchased in standard containers. Most drinking is binge drinking, and most alcohol was purchased on weekends because this is frequently the only time that women on the farms have the means to purchase it.

Thus, even though the current drinking quantities reported by both subjects and controls were not high in *absolute* standards, the most important interpretation of the data is the large *differential* between subjects and controls. There is no doubt, however, that these mothers drank sufficiently to produce verifiable cases of fetal alcohol syndrome as severe as we have seen anywhere in the United States.

The results of this study were presented to the schools, parents, and community leaders. The local school psychologist was provided the results of the testing to benefit individual children. Furthermore, a fetal alcohol syndrome prevention initiative based on the study findings was quickly initiated in the community with assistance from the National Institute on Alcohol Abuse and Alcoholism research team. The prevention coalition is headed by the mayor and regional officials in education, government, and public health. The comprehensive fetal alcohol syndrome prevention model of the Institute of Medicine[7] and other specific prevention techniques are being used.[26]

Conclusion

In this article we report the highest rate of fetal alcohol syndrome ever documented in a stable community and the specific conditions with which it is associated. Some South African public health professionals stated that this may be only one of several regional towns with similar problems. One might ask whether similar social and economic conditions produce problem drinking and fetal alcohol syndrome elsewhere in the developing world. The early stages of economic development, low education attainment, low SES, increased access to alcohol, and loss of folk and traditional culture may cause extreme alcohol misuse, which elevates the risk of fetal alcohol syndrome. Methods described here are applicable for research and for designing targeted prevention initiatives in populations elsewhere in the developing world. □

Contributors

P. A. May was the principal investigator of the National Institute on Alcohol Abuse and Alcoholism grant that funded this study. He oversaw all methodology and implementation of the study and was the major author of the first and all drafts. L. Brooke was the field coordinator of all the child clinic data, made the first entry of all data, consulted on data processing and sample characteristics, and edited all drafts. J. P. Gossage was the data manager of the project who processed and analyzed all data, produced and corrected the tables, and edited and provided suggestions for and rewrites of each draft. J. Croxford was the maternal interviewer and a field coordinator for the child data; she helped write all sections dealing with the maternal facts and data and edited all drafts. C. Adnams was responsible for the professional quality of all of the psychologic and neuropsychologic data; she worked on and edited the sections of the paper pertaining to child development. K. L. Jones was the senior dysmorphologist and clinical team diagnostician; he reviewed, edited, and provided suggestions on all drafts. L. Robinson helped write and edit the sections on clinical (child) screening methodology and edited all sections; he was a member of the clinical team that examined all of the children in the study. D. Viljoen was the South African co–principal investigator who made major suggestions on each of the drafts; he, along with P. A. May, was responsible for all phases of the research project in addition to serving as 1 of the 4 primary child diagnosticians.

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The protocols and consent forms used for human subjects were approved by the University of New Mexico Medical School (HRRC 96-209) and the College of Arts and Sciences (01-93-86-9908). They also were reviewed and approved by the Research Ethics Committee of the University of Cape Town, the Office for Protection From Research Risks of the National Institutes of Health, and a single site assurance committee in the Western Cape. All participating children in the study had active consent to participate granted from their parents or guardians.

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