Maternal Risk Factors for Fetal Alcohol Syndrome in the Western Cape Province of South Africa: A Population-Based Study

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Objectives. We defined risk factors for fetal alcohol syndrome (FAS) in a region with the highest documented prevalence of FAS in the world.

Methods. We compared mothers of 53 first-grade students with FAS (cases) with 116 randomly selected mothers of first-grade students without FAS (controls).

Results. Differences between case and control mothers in our study population existed regarding socioeconomic status, religiosity, education, gravidity, parity, and marital status. Mothers of children with FAS came from alcohol-abusing families in which heavy drinking was almost universal; control mothers drank little to no alcohol. Current and past alcohol use by case mothers was characterized by heavy binge drinking on weekends, with no reduction of use during pregnancy in 87% of the mothers. Twenty percent of control mothers drank during pregnancy, a rate that declined to 12.7% by the third trimester. The percentage who smoked during pregnancy was higher for case mothers than for control mothers (75.5% vs 30.3%), but the number of cigarettes smoked was low among case mothers. The incidence of FAS in offspring of relatively young women (28 years) was not explained by early drinking onset or years of drinking (mean, 7.6 years among case mothers). In addition to traditional FAS risk factors, case mothers were smaller in height, weight, head circumference, and body mass index, all anthropomorphic measures that indicate poor nutrition and second-generation fetal alcohol exposure.

Conclusions. Preventive interventions are needed to address maternal risk factors for FAS. (*Am J Public Health.* 2005;95:1190–1199. doi:10.2105/AJPH.2003.037093)

The search for specific maternal risk factors for fetal alcohol syndrome (FAS) has been ongoing for more than 2 decades via prenatal clinic[1–6] and epidemiological studies.[7–10] Population-based research is particularly helpful in identifying traits of the very highest-risk mothers—those who have borne children with full-blown FAS—and in designing prevention strategies.[10–14]

FAS has been associated with heavy, episodic (binge) drinking that produces high blood alcohol concentration (BAC); advanced maternal age; high gravidity and parity; unstable marital status; cigarette use; and use of other drugs.[5,15–18] In the United States, higher FAS rates are reported among Black and American Indian women, low–socioeconomic status (SES) groups, people with high scores on various alcohol abuse assessment tools, and women with alcoholic male partners.[19–24] Studies of mothers of children with fetal alcohol spectrum disorder (FASD; referred to by the Institute of Medicine[18] as FAS, partial FAS, alcohol-related birth defects, and alcohol-related neurodevelopmental deficits) point to a dose–response effect. The probability of anomalies such as microcephaly, craniofacial defects, and behavioral problems depends on the level of alcohol exposure as modified by certain maternal characteristics, such as those on which this article reports.[5,25–28] The rate of FAS in US children is 0.05 to 2.0 per 1000 births.[29] All levels of FASD affect, at minimum, 1% of the birth population.[30] The highest rates of FAS in the world have been reported in the Republic of South Africa. The rate of full-blown FAS alone has been reported to be 46 cases per 1000 births in the Western Cape Province.[8] Current research is documenting even higher rates in Western Cape Province [31] and high rates elsewhere in South Africa.[32]

FAS is associated with low SES among subpopulations[23,33] in developed and developing countries.[9,34] In South Africa,[8,35] mothers of children with FAS were of lower SES than were control mothers. In 1 US study that compared women of differing SES who consumed 12 drinks daily, the rate of FAS was 45 times greater in women of low SES than in women of middle and upper SES.[34]

In the United States, England, and Canada, 20%–32% of pregnant women drink, and in some European countries the rate is higher, exceeding 50%.[13–18,36–39] In the Western Cape Province, 34% of urban women and 46%–51% of rural women drink during pregnancy.[40,41] Maternal drinking during pregnancy varies among and within populations throughout the world.[33]

That alcohol abuse and FAS cluster in families implies both social and genetic influences in susceptibility.[10,42–44] Some alcohol-abusing families appear to escape many symptoms of FASD.[7,33,45] Families with 1 or more children with FASD experience serious physical and mental problems that pose a challenge to all types of service providers.[46] Because maternal risk for FASD involves an interaction of biological, familial, historical, social, and psychological factors,[46] research and prevention foci are interdisciplinary.[14]

In the general literature on alcohol abuse, maternal risk factors for FASD include smoking; abusing drugs; cohabiting with an alcoholic male partner; sexual dysfunction; having alcohol-abusing parents; initiating drinking at an early age; and having low self-efficacy, poor life goals, and few interests.[3,19,48–55] Protective factors identified as providing strong normative or cultural support for abstinence or light drinking include high education; reli-

giosity; and unique social, psychological, biological, and genetic traits.[9,35,56–58] Nevertheless, many risk factors for FASD are not well understood, and their explication is vital for prevention efforts.[14,59,60]

Background of the Region

We describe a study[9] of maternal risk for FASD in a town and its rural areas (population=45 225; 22% of the area is rural) in the Western Cape Province of South Africa. Most inhabitants are "Colored," defined as racially mixed individuals of African, European, and Asian descent. The town is similar to many others in this agricultural and wine-producing region. Heavy, episodic drinking has been the norm among laborers for generations. For several centuries, alcohol was provided daily to farmworkers as partial payment for work, a system known as the "dop" system, after the Afrikaans word for drink. Though this system of payment was formally outlawed by multiple statutes years ago, its effects persist. Local people who are forced to tolerate low pay, limited opportunity, and humble living conditions value alcohol as a favored commodity. Frequent binge drinking, defined as 3 or more drinks per episode of drinking, is common. South Africa researchers have documented high levels of alcohol abuse among male workers of the region.[61–64] Although no formal dop system survives, drinking heavily in groups on weekends and holidays remains a common form of recreation. Commercially produced beer and wine are cheap, readily available, and consumed by a population that, although poor, can allocate enough money to obtain and consume substantial quantities over short periods of time. This pattern results in high BAC values, placing fetuses at risk for FASD.[65–69] We refer to this pattern as the "dop legacy."

Maternal drinking was identified as a serious health problem in Western Cape Province in the mid-1990s.[70,71] Research confirmed high rates of FAS.[8,9,72] We describe risk factors for FAS to improve FAS prevention efforts in this and similar communities.

METHODS

Beginning in 1999, all children in the Sub-A (first grade) public school classrooms of the 12 public schools of this area were screened for height, weight, and head circumference. Children at or below the 10th percentile on height and weight and head circumference charts (n=300) were advanced to a second tier of the diagnostic process. Two teams of dysmorphologists, who were blinded to each child's medical history and to one another's findings, conducted a physical examination and measured all features of FAS, recording findings on a quantified dysmorphology checklist in which a high score indicates more FASD features.[8] Ninety-three children who exhibited physical symptoms of FAS that were less consistent or severe were administered psychological and life skills tests[72] to assess development.[19] Next, the biological mothers of these children were located and interviewed about maternal risks. In a formal case conference on each child, findings of all tests/examinations were reviewed, and final diagnoses were made. Sixty-four children were diagnosed with FAS. Maternal interviews were completed for 53 of the 64 mothers of children with FAS who were alive and who could be contacted. These interviews provided the data for our study.

All Sub-A children, with the exception of the 93 children suspected to have FAS, were eligible for selection as control children. One hundred forty-six were selected with a random-number table; their mothers were potential controls. Of these mothers, 30 were not included for the following reasons: 15 (10.3%) mothers could not be located or contacted, the children of 12 (8.2%) mothers were in foster or adoptive placement, and 3 (2.1%) mothers refused participation. The final control sample contained 116 mothers. The development of the children selected as control children was assessed in exactly the same manner as described for case children; none had major anomalies. All mothers were administered identical questionnaires and received incentive gift baskets of food staples.

The questionnaire was developed specifically for the Western Cape Province population by adapting items and techniques from studies in various US ethnic populations. After pilot testing and use with more than 100 women in a previous South Africa study,[9] this version contained 240 items. Mothers taking the questionnaire were asked to recall behavior and conditions before, during, and after gestation of the index child.

During our study, community residents had little knowledge about FAS and therefore little stigma regarding maternal drinking. Mothers did not know whether their children had FAS at time of interview, because diagnoses had not been finalized. Nevertheless, to establish rapport, nonthreatening questions were asked regarding birth and childhood, occupation, education, diet, reproduction, and general health. Alcohol consumption responses are more accurate in such a format, especially in the context of dietary questions.[73] Respondents were first asked about the drinking habits of their relatives and friends. The context, quantity, and frequency of the mother's current drinking were then explored by means of a 1-week, day-by-day log. Drinks were measured in standard ethanol units: 340 mL of beer, 120 mL of wine, or 44 mL of distilled spirits (5%, 11%, and 43% ethanol, respectively). Respondents were shown pictures of standard containers of local brands. Questions on current drinking became benchmarks for reconstructing maternal drinking during pregnancy, and for aiding in memory recall to accurately measure the amount of alcohol consumed, when the alcohol was consumed, and over what duration of time the alcohol was consumed. These questions were asked using the timeline-follow back method, a method that associates drinking with particular events, such as illness, holidays, and celebrations, to pinpoint the amount of drinking that occurred during each stage of pregnancy and during any celebrations or events that occurred while the woman was pregnant.[74,75]

Smoking was explored more directly, because smoking purchases and practices were more easily remembered and reported, because, unlike drinking, which, in this culture, occurs in groups where drinks are often shared, cigarettes are not shared; an individual must take time from any activities to construct a hand-rolled cigarette for smoking. Respondents were asked about tobacco consumed currently and during pregnancy. One hand-rolled cigarette in South Africa was found in pilot field trials to contain 1 g of tobacco; prerolled cigarettes were rare and

TABLE 1—Demographic, Socioeconomic, and Reproductive Characteristics of Mothers of Children With Fetal Alcohol Syndrome (FAS) (n = 54) and Randomly Selected Control Mothers (n = 116): South Africa, Wave II, 1999–2001

	Mothers of Children With FAS	Control Mothers	*P* (OR)
Age at interview, y, mean (SD)	35.9 (6.3)	34.5 (6.4)	NS[a]
Residence during index pregnancy, %			
Rural	66.0	20.9	
Urban	34.0	79.1	<.001[b] (7.36)
Educational attainment, y mean (SD)	5.0 (3.2)	8.7 (2.6)	<.001[a]
Frequency of church attendance, %			
Never	14.3	4.9	
Not very often (< 1 times per month)	49.0	17.5	
Often (1–2 times per month)	14.3	37.9	
Very often (1 time per week)	22.4	39.8	<.001[b]
Frequency of praying, %			
Never	5.6	0.9	
Not very often (< 1 time per week)	14.8	9.8	
Often (2–3 times per week)	53.7	22.3	
Very often (1 time per day)	25.9	67.0	<.001[b]
Religiosity index score,[c] mean (SD)	3.0 (0.9)	3.5 (0.7)	<.001[a]
Currently employed, %	69.8	66.7	NS[b]
Usual occupation, %			
Factory worker	9.6	17.7	
Farmworker	34.6	12.4	
Office worker	11.5	16.8	
Housewife	3.8	8.0	
Domestic (housekeeper, servant)	15.4	8.8	
Other	0.0	12.4	
Usually does not work	25.0	23.9	<.003[b]
Employment status, %			
Full-time	42.3	53.2	
Part-time	11.5	6.3	
Seasonal	15.4	9.0	
Unemployed[d]	30.8	31.5	NS[b]
Weekly income when working, mean (SD)			
Rands	105.5 (101.9)	252.9 (339.6)	.002[a]
US $	17.58	42.15	
Reproductive variables, mean (SD)			
Gravidity	3.5 (1.4)	2.8 (1.1)	<.000[a]
Parity, pre- and full term	3.3 (1.4)	2.7 (1.1)	.002[a]
Miscarriages	0.2 (0.5)	0.2 (0.5)	NS[a]
Still births	0.0 (0.0)	0.0 (0.2)	NS[a]
Living children	3.0 (1.2)	2.5 (1.0)	.002[a]
Age at birth of index child, y	28.0 (6.4)	26.1 (6.3)	NS[a]
Birth order of index child	2.8 (1.4)	2.1 (1.2)	<.001[a]
Marital status during pregnancy with index child, %			
Married	29.6	40.9	
Unmarried, living with partner	40.7	10.9	
Separated/divorced/widowed	1.9	1.8	
Single	27.8	46.4	<.001[b]

Note. NS = nonsignificant. The control group was used as referent.
[a]*t* test.
[b]χ^2 test.
[c]Combined values for frequency of church attendance and prayer.
[d]Combined categories of unemployed, not employed because of disability, and not employed and not looking for work.

were counted directly. Questions also assessed other drugs used. Body mass index (BMI) was calculated by means of the following metric formula[76]: weight in kilograms/(height in meters^2).

Interviews were conducted in Afrikaans, the primary regional language. Over 95% of the participants were Colored; the remainder were Blacks and Whites. We used Epi Info (US Centers for Disease Control and Prevention, Atlanta, GA) for analyses to compare groups with 2-tailed statistical tests ($P<.05$), and to calculate odds ratios (ORs). Pearson correlation coefficients were used. We compared the characteristics of mothers of children with FAS (case mothers) with the characteristics of randomly selected mothers with normal children (control mothers) from the same schools.

RESULTS

In this study, 54 of 64 mothers of children with FAS were located alive, and 1 declined an interview (1.9%), yielding 83% participation. After comparing characteristics of the children of the 53 case mothers interviewed with the characteristics of children of the 11 case mothers not interviewed, 1 significant difference was found. The head circumference percentile of children of mothers who were not interviewed was significantly larger (14.9 vs 6.1) than that of children of mothers who were interviewed. Height, weight, verbal and nonverbal ability, behavioral test scores, and dysmorphology scores were not significantly different for FAS children of mothers who were interviewed versus FAS children of mothers who were not interviewed. For the FAS children of mothers who were interviewed versus FAS children of mothers who were not interviewed, there was also 1 difference: dysmorphology scores for children of the interviewed mothers were higher than scores for children of the noninterviewed mothers (2.5 vs 1.4, $P=.034$). Otherwise, FAS children were similar on all physical and behavioral measures.

As can be seen in Table 1, 3 of the social and demographic variables were not significantly different for case mothers versus control mothers: age at interview, current employment, and full- or part-time employment.

However, case mothers were more likely than control mothers to be rural residents during index pregnancies (OR=7.36), to be employed on farms as their usual occupation (35% vs 12%), and to have lower incomes. Educational attainment of control mothers was 74% higher than that of case mothers (8.7 vs 5 years). Religious practices were scored significantly lower among case mothers (frequency of church attendance, praying, and mean religiosity index).

Case mothers had greater measurements than control mothers for gravidity, parity, living children, birth order of index child, and cohabiting when not married. Miscarriage and stillbirth rates did not differ. The difference in maternal age at birth of case children and control children approached significance ($P=.07$).

The quantity of alcohol consumed by fathers, mothers, brothers, and sisters of case mothers was significantly greater than for control mothers; fathers of case mothers drank more than fathers of control mothers (Table 2). More than 95% of the fathers of case children drank during the course of the study, consuming a reported 81 drinks per month during the index pregnancies.

There was no difference in the age at which women began drinking (Table 3). However, total past years of drinking at time of interview differed significantly (13.4 years for case mothers vs 3.7 years for control mothers, OR=8.14) and differed nonsignificantly when control group drinkers (21%), women who were currently drinking at the time of the interview or who had consumed alcohol in the week prior to the interview, were considered (13.4 vs 11.9 years). By the time of interview, 30.2% of case mothers had quit drinking, but a significant difference in current drinking remained between control mothers and case mothers.

Case mothers who drank at the time of the interview consumed 15.2 drinks per week (2.8 times the consumption rate for control mothers who drank); 96% binged in the week before the interview. About 90% of all alcohol was consumed on weekends by both groups. The standard for case mothers was much higher than for control mothers (13.1–11.2 drinks/week vs 2.9–4.7 drinks/week). Of case mothers, 39.6% drank more than the group mean of 12.6 drinks per week, and 24.5% drank 18 or more drinks per week. Only 1.8% of control mothers who drank consumed 12.6 or more drinks per week, and 6.4% consumed 6 or more drinks per week. Because most drinks were consumed on weekends, average daily consumption by case mothers on drinking days was 7.6 drinks if consumption took place over 2 days but 5.1 drinks if consumption took place over 3 days. At the time of interview, average daily consumption of the upper 25% of case mothers was 9.0–24.2 drinks if consumption took place over 2 drinking days and 6.0–16.1 drinks if consumption took place over 3 days.

During pregnancy, case mothers were significantly more likely than control mothers to drink during all trimesters. Case mothers drank at least as much in the months before pregnancy (90.3%) and in all trimesters as they did at the time of the interview.

Beer was the most consumed and favored beverage for both case and control mothers (59% vs 71%), followed by wine (45% vs 20%) and spirits (5% vs 6.5%). Four percent of the case mothers reported having had a problem with alcohol abuse (compared with 2% of the control mothers); 2% of case mothers had received treatment.

Smoking was common among both groups. No significant differences were found in age at which smoking commenced. Current smoking was 66% for case mothers and 30% for control mothers; however, quantity

TABLE 2—Reported Drinking Habits (No. Drinks per Month) of Family and Friends of Mothers of Children With Fetal Alcohol Syndrome (FAS) (n = 54) and Randomly Selected Control Mothers (n = 116): South Africa, Wave II, 1999–2001

	Mothers of Children With FAS		Control Mothers		*t* Test	
	Total Sample	Drinkers Only	Total Sample	Drinkers Only	Total Sample	Drinkers Only
Father						
No.	48	44	79	55	<.001	.012
Mean (SD)	63.3 (57.1)	69.0 (56.2)	31.7 (35.7)	45.5 (34.6)		
Mother						
No.	50	31	91	35	.027	NS
Mean (SD)	28.7 (36.9)	46.2 (37.3)	15.7 (30.7)	40.7 (38.0)		
First brother						
No.	44	39	82	50	.034	NS
Mean (SD)	51.8 (70.8)	58.4 (72.7)	28.8 (48.7)	47.2 (55.1)		
Second through sixth brothers						
No.	31	26	37	24	NS	NS
Mean (SD)	24.0 (25.7)	33.6 (26.9)	22.0 (29.6)	36.0 (29.9)		
First sister						
No.	37	24	69	21	.002	NS
Mean (SD)	23.7 (32.8)	36.5 (34.5)	7.9 (18.8)	26.0 (26.6)		
Second through sixth sisters						
No.	27	22	41	15	NS	NS
Mean (SD)	23.0 (20.8)	36.8 (33.7)	11.4 (24.9)	34.8 (33.2)		
Woman's best friend						
No.	32	13	64	13	.015	NS
Mean (SD)	12.3 (24.6)	30.4 (31.1)	3.2 (11.7)	15.6 (22.5)		
Father of index child during index pregnancy						
No.	49	47	96	70	<.001	.002
Mean (SD)	81.1 (81.7)	84.6 (81.7)	34.6 (45.9)	47.5 (47.8)		

Note. NS = nonsignificant.

TABLE 3—Drinking and Smoking Behaviors of Mothers of Children With Fetal Alcohol Syndrome (FAS) (n = 54) and Randomly Selected Control Mothers (n = 116): South Africa, Wave II, 1999–2001

	Mothers of Children With FAS		Control Mothers		*P* (OR)	
	Total Sample (n = 53)	Drinkers Only[c] (n = 35)	Total Sample (n = 109)	Drinkers Only (n = 19)	Total Sample	Drinkers Only
Drinking behavior						
Age first drank alcohol, y, mean (SD)	19.4 (4.5)		19.6 (4.6)		NS[a]	
Age began drinking regularly, y, mean (SD)	20.4 (4.3)		20.3 (3.7)		NS[a]	
No. years of drinking alcohol, mean (SD)	13.4 (7.3)		3.7 (5.7)		<.001[a]	
Current drinker, %	69.8[c]		21.1		<.001[b] (8.14)	
Current alcohol consumption (no. drinks per week), mean (SD)	12.6 (13.1)	15.2 (11.2)	1.0 (2.9)	5.4 (4.7)	<.001[a]	<.001[a]
Binge drinking (3+ drinks) 1 or more days during past week, %	69.6	96.4	5.5	31.3	<.001[b] (39.31)	<.000[b] (59.40)
Current alcohol consumption on weekends (i.e., Friday, Saturday, Sunday), mean no. drinks (SD)	11.1 (11.1)	13.6 (8.9)	0.9 (2.7)	5.0 (4.2)	<.001[a]	<.000[a]
Proportion of alcohol consumed during weekends, %	88.1	89.5	90.0	92.6		
Before pregnancy, %						
Drank about the same (vs current use)	61.5		19.4			
Drank less (vs current use)	1.9		2.2			
Drank more (vs current use)	28.8		9.7			
Did not drink	7.7		67.7			
Stopped during this period	0.0		1.1			
Drank during index pregnancy, %	92.4[d]		19.5			
During first trimester of pregnancy, %						
Drank about the same (vs current use)	54.7		11.7			
Drank less (vs current use)	5.7		3.6			
Drank more (vs current use)	32.1		4.5			
Did not drink	7.5		78.4			
Stopped during this period	0.0		1.8		<.001[b]	
During second trimester of pregnancy, %						
Drank about the same (vs current use)	52.8		8.1			
Drank less (vs current use)	5.7		2.7			
Drank more (vs current use)	34.0		2.7			
Did not drink	7.5		80.2			
Stopped during this period	0.0		6.3		<.001[b]	
During third trimester of pregnancy, %						
Drank about the same (vs current use)	54.7		5.5			
Drank less (vs current use)	1.9		5.5			
Drank more (vs current use)	32.1		1.8			
Did not drink	7.5		85.5			
Stopped during this period	3.8		1.8		<.001[b]	
Beverage of choice, %[e]						
Beer	58.5		19.6		<.001[a] (5.76)	
Wine	45.3		5.4		<.001[a] (14.62)	
Spirits	5.7		1.8		NS[a]	
Combination	1.9		0.9		NS[a]	
Ever had a problem with alcohol abuse, %	4.0		1.9		NS[b]	
Ever received treatment for alcohol abuse, %	1.9		0.0		NS[b]	
Smoking behavior						
Age first used tobacco, y, mean (SD)	18.3 (3.5)		18.6 (3.8)		NS[a]	
Age began smoking regularly, y, mean (SD)	18.5 (3.7)		19.3 (4.3)		NS[a]	

Continued

TABLE 3—*Continued*

Current smoker, %	66.0		30.1		<.001[b] (4.52)	
Current tobacco consumption, g/wk, mean (SD)	27.5 (32.0)	38.2 (32.4)	9.3 (17.1)	27.9 (19.1)	<.001[a]	NS[a]
Before pregnancy , %						
Smoked about the same (vs current use)	61.5		15.7			
Smoked less (vs current use)	7.7		10.2			
Smoked more (vs current use)	5.8		3.7			
Did not smoke	25.0		70.4			
Stopped during this trimester	0.0		0.0		<.001[b]	
Smoked during index pregnancy, %	75.5		30.3		<.001[b] (7.08)	
During first trimester of pregnancy, %						
Smoked about the same (vs current use)	58.5		14.8			
Smoked less (vs current use)	13.2		10.2			
Smoked more (vs current use)	5.7		2.8			
Did not smoke	22.6		71.3			
Stopped during this trimester	0.0		0.9		<.001[b]	
During second trimester of pregnancy, %						
Smoked about the same (vs current use)	62.3		13.5			
Smoked less (vs current use)	9.4		9.0			
Smoked more (vs current use)	5.7		3.6			
Did not smoke	22.6		72.1			
Stopped during this trimester	0.0		1.8		<.001[b]	
During third trimester of pregnancy, %						
Smoked about the same (vs current use)	64.7		12.6			
Smoked less (vs current use)	7.8		9.0			
Smoked more (vs current use)	3.9		3.6			
Did not smoke	23.5		73.0			
Stopped during this trimester	0.0		1.8		<.001[b]	
Current drinker and smoker, %	73.6		11.2		<.001[b] (22.07)	

Note. Sample sizes for drinking behavior were mothers of children with FAS, total sample, n = 53; mothers of children with FAS, drinkers only, n = 35; control mothers, total sample, n = 109; control mothers, drinkers only, n = 19. Sample sizes for smoking behavior were: mothers of children with FAS, total sample, n = 52; mothers of children with FAS. smokers only, n = 34; control mothers, total sample, n = 99; control mothers, smokers only, n = 33.

[a]*t* test.

[b]χ^2 test.

[c]Although 37 of the 53 women interviewed reported that they were current drinkers, only 35 had consumed alcohol during the past week. Therefore, the data on current quantity and frequency are based on the responses of the 35 women who reported current drinking.

[d]Four women whose children were diagnosed with FAS did not admit to drinking during the index pregnancy. When this inconsistency was revealed during the diagnostic case conferences, these women's children were reassessed. In 2003, 2 dysmorphologists confirmed diagnosis of FAS in each of the 4 cases, as did the doctors evaluating the results of psychological tests. Institute of Medicine criteria allow for a diagnosis of FAS without confirmation of maternal drinking.

[e]Percentage of beverages reported as favorites and reported as consumed exceeded 100%, because some mothers reported 2 favorites.

consumed by smokers in the 2 groups was not significantly different (38 vs 28 g/week). Rural women were more likely than town-dwelling women to smoke. Most women "rolled their own," and this practice, along with rural women's low income, tends to limit quantity of use. During pregnancy, 76.5%–77.4% of case mothers smoked. After we combined current drinking and smoking, 73.6% of case mothers reported both smoking and drinking (compared with 11.3% of control mothers).

General physical measurements (Table 4) revealed that case mothers were significantly smaller than control mothers on height, weight, head circumference, and BMI. Head circumference and weight were especially reduced for mothers of FAS children, as indicated by tests of significance. The significant negative correlation coefficients indicate that lower values on the mother's physical measures were associated with higher dysmorphology scores of their children: occipitofrontal circumference (–.29), weight (–.24), and height (–.23). In other words, the smaller mothers appear to be more likely to produce children with FAS than do the larger mothers.

DISCUSSION

Limitations and Strengths of the Study

In a previous maternal risk study in South Africa,[9] 35 of 46 (76%) mothers of children with FAS were located alive (13% had died), and 100% of those who were located agreed

TABLE 4—Anthropometric Measures of Mothers of Children With Fetal Alcohol Syndrome (FAS) (n = 54) and Randomly Selected Control Mothers (n = 116): South Africa, Wave II, 1999–2001

Variable	Mean (SD)			
	Mothers of Children With FAS	Control Mothers	P[a]	Correlation with Child's Dysmorphology Score (Total Sample)
Height, cm	154.3 (6.6)	157.1 (7.6)	.034	–.23
Weight, kg	59.6 (14.2)	67.9 (15.2)	.002	–.24
Occipitofrontal circumference, cm	53.8 (0.8)	54.7 (1.5)	.001	–.29
Body mass index	24.9 (5.5)	27.4 (5.9)	.019	–.17

[a]*t* test.

to an interview. Such high numbers located and participating are unparalleled in the FAS literature. However, this study of mothers of confirmed FAS children has limitations. Data were collected retrospectively for the previous 7 years. Accuracy of recall may be a problem despite our efforts to reconstruct accurate patterns from reports of current daily drinking and timeline-follow back methods. The study population also had limited formal education, which may have affected the quality of self-reported alcohol consumption data. Furthermore, the modal drinking pattern was binge drinking, which could have resulted in memory loss. However, retrospective reports of alcohol consumption have been found to be as accurate as[77] or even more accurate than prenatal clinic data, or at least to produce reports of higher drinking levels.[78,79] In addition, recent literature supports the use of day-by-day reporting and reconstruction of drinking histories,[80,81] including details such as BACs.[82] No retrospective methods, however, are believed to be as accurate as daily reporting systems to collect data on drinking outside prenatal settings.[80] Maternal drinking during pregnancy is a highly sensitive issue that affects validity. We believe that the questions, sequence, empathic style, and follow-back methods used in our study produced more accurate data (especially for heavy drinking) than have been collected in prenatal settings.[78,79]

In 2 waves of research in South Africa, only 1 of 90 mothers of children with FAS contacted has refused an interview. The proportion of women with FAS children not interviewed owing to death, migration, and refusal (20%) has been much lower than in US studies, and candid reporting seems likely in this population thus far. Because all case mothers in our study bore a child with FAS, we describe only the very-highest-risk mothers, as only a few other studies have done.[9,10] This study's detailed data on drinking among mothers of children with FAS are unique. Most studies of maternal drinking during pregnancy are among lower-risk women. Maternal risk is relative and variable between and among populations,[58] underscoring the importance of examining control groups from the same population. Risk for FAS births in a single population may not provide accurate measures of generalized or absolute risk (e.g., thresholds). Our findings may be most relevant for comparisons with populations of other developing nations.

Identified Risk of FAS

All of the women studied belonged to a population of a modernizing society characterized by generally low SES. However, compared with control mothers, case mothers had even fewer social resources, such as education, income, or spirituality. As in other studies, risk for FAS was associated with higher gravidity and parity and thus later-born children. Case mothers were more likely to be unmarried and to live with a male partner and had extended families, sexual partners, and friends who drank heavily. As evidenced from the control group drinking reported in interviews, frequent binge drinking was normative among 50% of men and less than 20% of women. Alcohol consumption was much greater for case mothers than for control mothers in all comparisons.

Control mothers were more likely to have been abstainers or light drinkers compared with case mothers, who showed significantly heavier drinking patterns and reported drinking at the same level (53%–55%) or higher during pregnancy (32%–34%) compared with current drinking levels. As noted previously,[8] South Africa case mothers often described stressful life events as causes of heavy maternal drinking during pregnancy. A higher risk for FAS clearly exists among those of the lowest SES.[8,9]

Dop Legacy

Most of the alcohol consumed was obtained commercially. Only 5% of the women in this study reported having received alcohol through the dop system (i.e., as payment for labor) in their lifetimes (14% of case mothers vs 1% of control mothers). Of the case mothers, 2% reported having received dop during the index pregnancy, and 0.7% reported having received dop at time of interview. Because of these low rates of actual historical and contemporary contact with the dop system among the study population, the contemporary drinking pattern is better characterized as a dop legacy than as a systematic issuance of alcohol to laborers, as stated in our introduction. Contrary to popular misconception, beer, not wine, is the beverage of choice and abuse.

Maternal Age, Nutrition, and Anthropomorphic Considerations

In a previous study in this community,[9] the mean age of mothers at birth of a child with FAS was low (26.7 ±7.6 years); this age was also relatively low in this sample (28.0 ±6.4 years). In both studies, the difference between case mothers and control mothers was not significant (P=.07, 2-tailed) despite the larger sample in our study. Maternal age at birth of FAS children was lower than that previously observed in populations in developed countries,[7,25,33] in which a significant difference is always reported between FAS case mothers, case mothers, and control mothers.[10,79] This lack of significance is unique in the literature and is not explained by early age at onset of drinking or drug use in this community.

Rather, it is substantially explained by duration, degree, and regularity of binge drinking during pregnancy, with some other unique cofactors, such as nutrition, body size, and general SES.

Nutrition and maternal body size may partially explain the low maternal age at birth of children with FAS, the high rates of FAS in this population, and the severity of FAS. Poor nutrition (lifelong and current), genetic influences, and multiple generations of fetal alcohol exposure likely contribute to the high rate of FAS. Case mothers were, on average, significantly smaller on all physical measures: height, weight, head circumference, and BMI. Maternal physical traits were negatively associated with their children's dysmorphology scores. Smaller, lighter mothers who engage in binge drinking may be less able to eliminate alcohol via first-pass metabolism, allowing more alcohol to enter the placenta and cause more fetal damage.[83] Conversely, heavier mothers have more adipose tissue to which alcohol can be distributed, thereby protecting the fetus. Undernutrition and frequent hunger during pregnancy were reported by more case mothers than control mothers (11.5% vs 4.6%). Finally, the findings of smaller average head circumference among case mothers and of heavier drinking among maternal grandmothers of FAS children raise questions about intergenerational prenatal alcohol exposure and damage.[10] Some mothers of FAS children appear to have FASD themselves; their alcohol abuse may originate in part from behavioral traits associated with FASD (e.g., impulsivity, poor judgment).

Protective Factors

Potential protective mechanisms with preventive implications for this population have been identified. Key protective factors were low gravidity and parity, larger body size, higher educational attainment and income, religiosity, nondrinking male partner, and adequate nutrition.

Prevention

Public health education on the dangers of maternal binge drinking is needed locally. Prevention is needed in the community, particularly in rural areas. Many risk factors identified are amenable to change via social improvement and proven techniques of alcohol treatment and birth control. New treatment and prevention emphasizing outreach in the highest-risk populations of the Western Cape Province can benefit from this research.[13,19] Prevention has been undertaken by health officials of Western Cape Province, but more resources for these efforts are needed. Despite efforts to establish initiatives in FAS prevention,[84] more awareness and activity are needed. Impediments to FAS prevention in South Africa are similar to those in the United States: salaries for full-time workers are lacking, and committed individuals cannot effectively transfer time and energy from other commitments to sustain FAS prevention activities.[12] Integrating alcohol use into prenatal screening[85] (with HIV and tuberculosis) could be a partial solution.[86] In Western Cape Province, the rates of all 3 of these problems are high, and each affects 4.5%–8% of the population.[87,88] Because our research indicates that FAS is increasing in the study community,[31] prevention is needed there and elsewhere in Western Cape Province and South Africa.[32] ■

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Contributors

P.A. May was the principal investigator and epidemiologist of the study and led the writing. J.P. Gossage was the data manager and data analyst for the entire project. L.E. Brooke was the program coordinator of the field research in the target community and oversaw clinical assessment and interviews. C.L. Snell, L.S. Hendricks, and A.S. Marais translated the questionnaire into Afrikaans and, with J. Croxford, completed all of the interviews of case and control mothers. D.L. Viljoen was co-investigator of the project, overseeing the South African medical, research, and programmatic operations.

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Human Participant Protection

Protocols and consent forms used were approved by the University of New Mexico, the National Institutes of Health Office of Protection From Research Risks, the ethics committee of the University of Cape Town, and a local, single-site assurance (oversight) committee. All mothers participating in the study provided active consent to participate, and each mother or legal guardian provided active consent for her child's participation in FAS screening.

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