children. US National Center for Health Statistics health examination surveys, cycles II and III. *Hypertension* 1984;**6**:307-14.
10 Persson PH, Weldner B-M. Intra-uterine weight curves obtained by ultrasound. *Acta Obstet Gynecol Scand* 1986;**65**:169-74.
11 Theorell T, Knox S, Svensson J, *et al*. Blood pressure variations during a working day at age 28: effects of different types of work and blood pressure level at age 18. *J Human Stress* 1985;**11**: 36-41.
12 Fleiss JL. *Statistical methods for rates and proportion*. 2nd ed. New York: John Wiley, 1973:212-25.
13 Thulin T, Bengtsson B, Scherstén B. Assessment of casual blood pressure variations. *Postgrad Med J* 1978;**54**:10-5.
14 Langford H, Watson RL. Prepregnant blood pressure, hypertension during pregnancy, and later blood pressure of mothers and offspring. *Hypertension* 1980;**2**(suppl 1):130-3.
15 Svensson A, Sigström L, Andersch B, *et al*. Low erythrocyte Na^+/K^+ ratio in children with mild blood pressure elevation and a positive family history of hypertension. *Journal of Hypertension* 1984;**2**(suppl 3):473-5.
16 Kotchen JM, Kotchen TA, Cottrill CM, Guthrie GP Jr, Somes G. Blood pressure of young mothers and their first children 3-6 years following hypertension during pregnancy. *J Chronic Dis* 1979;**32**:653-9.
17 Chesley L, Cosgrove S, Annito J. A follow-up study of eclamptic women: fourth periodic report. *Am J Obstet Gynecol* 1962;**83**:1360-72.
18 Keirse MJNC. Epidemiology and aetiology of the growth retarded baby. *Clin Obstet Gynaecol* 1984;**11**:415-36.
19 Trudinger BJ, Giles WB, Cook MC, Bambardieri J, Collins L. Fetal umbilical artery flow velocity waveforms and placental resistance: clinical significance. *Br J Obstet Gynaecol* 1985;**92**:23-30.
20 Dawes GS. *Foetal and neonatal physiology*. Chicago: Year Book Medical Publishers, 1968:68-72.
21 Giles WB, Trudinger BJ, Baird PJ. Fetal umbilical artery flow velocity waveforms and placental resistance: pathological correlation. *Br J Obstet Gynaecol* 1985;**92**:31-8.
22 Gennser G, Vetter K, Sindberg Eriksen P, Huch R, Huch A. Ultrasonic evidence for altered pulsatile dynamics in the aorta of growth retarded fetuses. *Clinical and Experimental Hypertension* 1984;**3**:300.

(Accepted 2 February 1988)

Alcohol consumption in Dundee primigravidas and its effects on outcome of pregnancy

NABEEL D SULAIMAN, C DU V FLOREY, D J TAYLOR, S A OGSTON

Abstract

In a population based cohort study information on the consumption of alcohol was obtained from 95% of the 952 consecutive primigravidas who lived in the Dundee district and attended for antenatal care between May 1985 and April 1986. Before realising that they were pregnant more than 90% drank alcohol and 53% were cigarette smokers. During the first four months of pregnancy, however, the proportion of women drinking and smoking fell to 56% and 44%, respectively. Alcohol consumption of more than 120 g absolute alcohol/week (12 or more standard drinks) during pregnancy was related to shorter gestational age (−2·6 weeks), smaller head circumference (−18 mm), shorter (−21 mm) and lighter (−499 g) babies, and lower Apgar scores at five minutes (−0·4, all $p<0·01$). After adjustment for the effect of smoking, social class, mother's size, and other confounding factors, however, an alcohol intake of more than 120 g/week was significantly related only to shorter gestational age (−2·0 weeks, $p<0·001$) and lower Apgar score at five minutes (−0·2, $p<0·05$). Alcohol intake in the region of 100-119 g/week was significantly related to smaller head circumference (−12 mm, $p<0·05$). Analysis by type of beverage consumed suggested that beer rather than wine or spirits was associated with a poorer outcome.

As there was no detectable effect on pregnancy of alcohol consumption below 100 g/week, it is suggested that health education should be directed towards mothers who drink more than this amount.

Introduction

Interest in the effects of maternal alcohol consumption on the fetus has grown since the publication of a description of the morphological features of the fetal alcohol syndrome.[1] These features include growth retardation, mental retardation, and a characteristic facial appearance, in addition to systemic anomalies. There now seems to be little doubt that excessive drinking throughout pregnancy gives rise to the fetal alcohol syndrome in some women's offspring. The question of how much social or moderate drinking is safe, however, has yet to be answered satisfactorily. Some studies have shown fairly low consumption to have adverse effects on birth weight,[2-4] spontaneous abortion,[5 6] stillbirths,[7] and neonatal behaviour,[8] whereas others, in different populations and with different techniques, have found no important effect.[9 10] The overall conclusion from these studies is that the effect of a mother's social drinking during pregnancy on her offspring is at most limited.

This study's main aim was to estimate the level of alcohol consumption at which an adverse effect on the outcome of pregnancy is detectable. We investigated the effect of different levels of alcohol consumption both before and during pregnancy on various outcome measures in a cohort of primigravidas.

Ninewells Hospital and Medical School, Dundee DD1 9SY

NABEEL D SULAIMAN, MB, MPH, PhD candidate, department of community medicine

C DU V FLOREY, MD, FFCM, professor, department of community medicine

D J TAYLOR, MD, MRCOG, senior lecturer and honorary consultant, department of obstetrics and gynaecology

S A OGSTON, MA, MSC, lecturer in statistics, department of community medicine

Correspondence to: Dr Sulaiman.

Subjects and methods

The sample consisted of all primigravidas living in Dundee district whose first antenatal visit fell between 1 May 1985 and 30 April 1986. Dundee is served by only three antenatal clinics, and all women are delivered in this hospital. The sample was thus determined by the population, with no appreciable private obstetric care or cross boundary flow to other care systems.

The size of the sample was estimated, based on the expected differences in birth weight between the offspring of abstainers and those of drinkers. Assuming a 1:4 ratio of the size of these two groups, a sample size of 800 would allow a true difference of 100 g at the 5% level of significance to be detected with 80% power.

The mothers were informed of the nature of the study and invited to take part at their first antenatal visit. For organisational reasons the mothers were interviewed at their next visit (commonly at 16 weeks) to obtain demographic data and a history of beverage consumption and tobacco smoking before and during pregnancy. The questions about alcohol were included among those about coffee, tea, and soft drinks. An aliquot of blood was included in the usual antenatal blood collection and used to estimate blood alcohol concentration, γ-glutamyltransferase activity, and plasma thiocyanate concentration (a measure of beer drinking as well as of cigarette smoking). The questions included the quantity, frequency, and variability items from the questionnaires of Jessor *et al*,[11] Cahalan *et al*,[12] and A P Streissguth (personal communication). The answers were later converted to the average amount of absolute alcohol in g consumed daily (1 ml absolute alcohol=0·8 g; one standard drink≈10 g absolute alcohol). Binge drinking during pregnancy was measured with Cahalan's volume variability index[12] (H M Barr, personal communication).

At a second interview, during the first visit in the third trimester, the mothers were asked about drinking and smoking habits since the previous interview. Their dietary habits were estimated quantitatively during the second interview with the Seattle questionnaire (A P Streissguth, personal communication). This asked about how many servings in a typical day were taken of dairy products, high protein food, fruit and vegetables, and cereal. Most of the interviews (88% of the first and 74% of the second) were performed by a trained, non-smoking, female fieldworker in her 40s who was a social drinker.

Finally, information was collected about the progress and outcome of the pregnancy from the mothers' and infants' hospital records. All births occurred at this hospital, so it was possible to use a single electronic scale to weigh every infant and placenta (Seca 727 Digital Baby Scale). The gestational age at birth was calculated from a routine ultrasound examination at around 18 weeks of gestation and by clinical assessment of the neonates with Dubowitz's scoring method.[13] The two measures of gestational age were highly correlated (r=0·83); the first was used to maximise the number of observations in the analyses.

TABLE I—*Sample size and response*

		No (%) of women
Sample:		
Booked		952
Left area		9
Refused		13
Abortions		29
Completed first interviews		901 (94·6)
Second interviews:		
Completed		830 (92·1)*
Lost (including miscarriages, stillbirths, those who left area)		71
Maternal and infant records:		
Completed records:		865 (96·0)*
Singleton live births	846†	
Twin live births	9	
Stillbirths	10	
Missing records:		36
Miscarriages	18	
Left area	17	
Mother died	1	

*Based on 901 completed first interviews.
†Analyses related to outcome variables based on these 846 observations.

TABLE II—*Number (percentage) of mothers by alcohol consumption before and during pregnancy*

Alcohol consumption (g/week)	Before pregnancy	Early pregnancy	Late pregnancy
0	86 (10)	401 (45)	539 (65)
1-	429 (48)	427 (47)	274 (33)
50-	95 (11)	26 (3)	7 (1)
70-	120 (13)	28 (3)	5 (1)
100-	42 (5)	6 (1)	2 (0)
≥120	129 (14)	13 (1)	3 (0)
Total	901 (100)	901 (100)	830* (100)

*Remaining 71 women were lost to second interview.

STATISTICAL METHODS

Zero order Pearsonian correlation coefficients were calculated between alcohol consumption and various outcomes and confounding factors, and the Spearman rank correlation was used to calculate the coefficients for the sex of infants. Least squares multiple regression procedures were used to determine the most highly correlated predictive and confounding factors for seven quantitative outcome variables—namely, gestational age, placental weight, birth weight, crown-heel length, occipitofrontal circumference, and Apgar scores at one and five minutes. Logistic regression was used to identify the predictors of two qualitative outcome variables—namely, mid-trimester abortion and stillbirth rate. The relation was investigated between each outcome variable and the mother's age, her alcohol and cigarette consumption before and during early and late pregnancy, maternal and paternal height, diet, drug ingestion, coffee drinking, and medical conditions such as hypertension or diabetes during pregnancy. Gestational age was used as a confounding variable in all the analyses except when it was used as a dependent variable. The sex of the infant was included, as it is strongly related to infant size.

Stepwise regression was used to screen all independent variables to identify their contribution to each outcome. The significant predictors, particularly the alcohol and smoking variables, were further analysed with various user selected models. In these analyses the mother's social class was coded into four indicator variables. The first was coded as 1 if the mother was in social classes IIIM, IV, or V; otherwise the code was 0. Similarly, the other three variables were coded 1 if the mother was unemployed, single, and unclassifiable, respectively; otherwise they were coded 0. If the mother came from social classes I, II, or IIINM all four variables were coded zero. Each alcohol variable before and during early and late pregnancy was first analysed as a continuous variable and then coded into four indicator variables[4] denoting alcohol consumption in the ranges of 1<50, 50<100, 100<120, and ≥120 g/week, corresponding to mild, moderate, heavy, and very heavy drinking, respectively. If the mother was a non-drinker all four variables were coded 0.

Results

Table I shows the number of respondents according to period of observation. Over 90% response was obtained throughout the study. Table II shows the drinking patterns before and during pregnancy. Before pregnancy was recognised more than 90% of the mothers were drinking some alcohol and about one fifth were drinking ≥100 g absolute alcohol/week. During the first four months of pregnancy, however, the proportion of mothers still drinking had dropped to just over 55%, and only 1% were drinking appreciable amounts of alcohol. The trend towards abstention continued during the third trimester. There was no significant difference between the drinking habits in early pregnancy of those who were reinterviewed during the third trimester (n=830) and those who were not (n=71). When asked about their abstention or reduction in consumption a subsample of over 230 mothers gave as their main reasons the baby's health, nausea and vomiting, bad taste or smell, or both, and lack of opportunity.

Abstention from smoking showed much less change. Before pregnancy was recognised 47% of the sample were non-smokers. During the first and third trimester abstention increased to 56% and 59%, respectively. Of the quarter of the sample who smoked more than 15 cigarettes a day, almost 80% smoked fewer cigarettes after finding out that they were pregnant.

Table III shows the relation between social class and consumption of alcohol, tobacco, and illicit drugs during pregnancy. More than half of the women in each class drank some alcohol during pregnancy except for those whose husbands were unemployed. The largest proportion of drinkers was in social class IV. There did not seem to be a consistent relation between abstention and social class. There was, however, a continuous trend from

TABLE III—*Number (percentage) of mothers consuming alcohol, tobacco, and drugs at first interview by husband's social group*

	Social class							
	I (n=31)	II (n=103)	III (n=284)	IV (n=104)	V (n=55)	Armed forces and students (n=17)	Unemployed (n=211)	Single or unclassified (n=96*)
Alcohol	18 (58)	56 (54)	156 (55)	70 (67)	31 (56)	9 (53)	99 (47)	61 (64)
Tobacco	1 (3)	23 (22)	102 (36)	49 (47)	26 (47)	6 (35)	124 (59)	64 (67)
Drugs	0	1 (1)	2 (1)	0	0	0	8 (4)	4 (4)

*Of these, 90 were single mothers.

classes I to V of increasing proportions of women who smoked during pregnancy, and the unemployed and single mothers and unclassified group smoked more than those in social class V. The reported use of illicit drugs was very low and was concentrated among the unemployed and single mothers and unclassified group.

Table IV shows the correlation coefficients between two measures out of alcohol consumption, birth weight, gestational age, and confounding factors. Cigarette smoking was clearly related to a lower birth weight.

REGRESSION ANALYSIS

Relations with alcohol consumption

Significant predictors of gestational age, occipitofrontal circumference, and Apgar scores at five minutes are given for the alcohol variables entered into regression analyses alone (table V) and with confounding factors (table VI). For each independent variable in table VI two regression coefficients are given—the unstandardised (B) and the standardised (β). The standardised coefficient provides a sensible way of comparing the relative effect on the dependent variable of each independent variable ($\beta_{YX}=B_{YX}(S_x/S_y)$, where S is the standard deviation).

Before adjustment for confounding factors (table V) very heavy alcohol consumption during the first four months of gestation was significantly related to lighter (−499 g) and shorter (−20·9 mm) babies, smaller head circumference (−18·3 mm), shorter gestational age (−2·56 weeks), and lower Apgar scores at five minutes (−0·4; all p<0·01). In addition, heavy consumption was related to smaller head circumference (−13·7 mm; p<0·05). After adjusting for confounding factors (table VI), heavy consumption remained significantly related to smaller head circumference, and very heavy consumption was still significantly related to shorter gestational age and lower Apgar scores at five minutes. Mild consumption, however, was related to higher Apgar scores at one minute (not shown), and moderate consumption was related to higher Apgar scores at five minutes. Alcohol consumption before pregnancy was recognised was weakly and negatively associated with placental weight (p<0·05) but was not related to the prevalence of stillbirth.

The regression analyses were repeated by type of beverage. Consumption of wine, beer, and spirits both before and during pregnancy was analysed with codings similar to those for total alcohol. Heavy and very heavy consumption of beer before pregnancy was recognised and during the first four months of gestation was related to a poorer outcome. The consumption of wine and spirits was not related to adverse outcome except for moderate consumption of spirits before pregnancy was recognised, which had a weak negative relation with placental weight. No significant relation was found between binge drinking and any outcome variable.

Alcohol consumption during the second trimester and the beginning of the third trimester, recorded at the second interview, was unrelated to any of the outcomes.

Relations with other variables

Birth weight, crown-heel length, and occipitofrontal circumference were all significantly related in the expected directions to cigarette smoking, gestational age, and sex of the infants. Mother's height was positively related to these outcomes, although in the case of occipitofrontal circumference it did not reach significance. Both father's and mother's height were independently related to child's length. Matenal weight, independent of height, was positively related to gestational age, placental weight, and infant size.

Social class was related to three outcome variables at the 10% level of significance. Infants born to mothers in social classes IIIM, IV, and V had lower placental weights and smaller head circumferences, and unemployed mothers tended to have lighter babies compared with women in social classes I to IIINM.

There was no relation between total alcohol consumption and γ-glutamyltransferase activity, confirming the findings of others, although beer consumption was related to γ-glutamyltransferase activity (r=0·08). Only one mother had detectable concentrations of alcohol in her blood. Serum thiocyanate concentration was related to beer consumption (r=0·17) and cigarette smoking during early pregnancy (r=0·73).

TABLE IV—*Correlation coefficients for alcohol consumption and selected variables*

	Infant (n=846)			Mother (n=901)			
	Gestational age	Birth weight	Sex	Smoking	Height	Age	Alcohol consumption during pregnancy
Alcohol consumption:							
Before pregnancy	0·01*	0·01*	−0·03*	0·10***	0·10***	0·13***	0·49***
During pregnancy	−0·05*	−0·04*	0·03*	0·16***	0·05*	0·06*	
Age	0·04*	0·07**	−0·05*	−0·14***	0·12***		
Height	0·05*	0·17***	0·01*	−0·12***			
Smoking	−0·11***	−0·24***	−0·04*				
Sex†	−0·01*	−0·15***					
Birth weight	0·60***						

*p>0·05; **p<0·05; ***p<0·01.
†Spearman rank correlation coefficients. Other coefficients are zero order Pearsonian.

TABLE V—*Regression coefficients (SE) of five outcome variables and their relation to alcohol consumption as reported at first interview*

Consumption of alcohol	Birth weight (g) (multiple R=0·11*)	Crown-heel length (mm) (multiple R=0·10)	Occipitofrontal circumference (mm) (multiple R=0·16***)	Gestational age (weeks) (multiple R=0·16***)	Apgar score at five minutes (multiple R=0·14**)
Very heavy	−499 (155)**	−20·9 (7)**	−18·3 (4·4)***	−2·56 (0·56)***	−0·4 (0·12)**
Heavy	−109 (226)	−9·3 (11)	−13·7 (6·4)*	−0·20 (0·81)	0·06 (0·16)
Moderate	−9·5 (80)	−1·1 (4)	1·8 (2·3)	0·09 (0·29)	0·10 (0·05)
Mild	4·2 (38)	−0·2 (2)	−0·4 (1·1)	0·01 (0·14)	0·04 (0·02)
Constant	3277 (27)***	504·2 (1·3)***	46·3 (0·8)***	39·9 (0·09)***	8·9 (0·02)***

95% Confidence limits=Regression coefficient±1·96 (SE).
*p<0·05; **p<0·01; ***p<0·001.

Discussion

This study is similar to other studies on this subject in many respects, but it has several methodological advantages. Firstly, Dundee is isolated geographically from other centres of obstetric care, so the sample of women that we obtained was population based and less subject to the bias of samples selected where women can

TABLE VI—*Regression analysis of relation of gestational age, occipitofrontal circumference, and Apgar scores at five minutes to significant (p<0·10) predictor variables*

Independent variable	Regression coefficient	95% Confidence interval	Standardised regression coefficient	Significance
Gestational age (weeks) (multiple R=0·31; p<0·001)				
Very heavy drinking	−2·09	−3·2 to −1·0	−0·13	p<0·001
Placenta praevia	−3·26	−5·1 to −1·4	−0·11	p<0·001
Placental abruption	−2·68	−3·6 to −1·7	−0·18	p<0·001
Maternal weight	0·0	0·01 to 0·03	0·11	p<0·001
Cigarettes (>1/day)	−0·03	−0·05 to −0·01	−0·08	p<0·05
Occipitofrontal circumference (mm) (multiple R=0·69; p<0·001)				
Cigarettes (5-10/day)	−2·9	−5 to −0·8	−0·07	p<0·01
Heavy drinking	−12·4	−22 to −2·8	−0·06	p<0·05
Sex	−6·1	−7·7 to −4·5	−0·19	p<0·001
Gestational age	4·9	4·5 to 5·3	0·61	p<0·001
Mother's weight	0·13	0·05 to 0·2	0·08	p<0·01
Social class IIIM, IV, or V	−2·1	−4·2 to 0·04	−0·05	p<0·10
Very heavy drinking	−5·9	−12·6 to 0·8	−0·05	p<0·10
Apgar scores at five minutes (multiple R=0·25; p<0·001)				
Very heavy drinking	−0·23	−0·5 to −0·01	−0·07	p<0·05
Moderate drinking	0·13	0·01 to 0·24	0·07	p<0·05
Cigarettes (15-20/day)	−0·15	−0·3 to −0·02	−0·07	p<0·05
Placental abruption	−0·42	−0·6 to −0·2	−0·14	p<0·001
Gestational age	0·02	0·01 to 0·03	0·10	p<0·01
Mild drinking	0·06	0·01 to 0·11	0·07	p<0·05

choose between clinics taking part in the study and those outside it. Secondly, because all women were delivered in the same place it was possible to weigh the infants and the placentas on a single scale. To improve accuracy an electronic scale, designed to give a steady reading even when the child was moving, was used. Thirdly, for most pregnancies gestation was assessed from routinely performed ultrasound at about 18 weeks. We also recruited only primigravidas to avoid problems arising from relations between parity and birth weight and between birth order and neurodevelopment.

The relation we found between very heavy consumption of alcohol and gestational age confirms the findings of others.[14-16] An effect on head circumference has also been found by Davis *et al*[17] and Streissguth *et al.*[18] The relation between heavy and very heavy drinking during pregnancy and lower Apgar scores is consistent with the findings of Streissguth *et al*,[19] who observed a significant association between lower Apgar scores at one minute (although not at five minutes) at a level of alcohol consumption of two drinks or more a day (equivalent to our category of very heavy drinking). On the other hand, we found mild and moderate drinking significantly associated with higher Apgar scores. We feel that these last findings are likely to be due to chance, as such an effect cannot be explained by current knowledge of the biological action of alcohol.

The relation between beer consumption before pregnancy and smaller infant size should be interpreted with caution because only seven women were very heavy drinkers during pregnancy and nine women were heavy drinkers of beer before realising that they were pregnant. Nevertheless, this finding of a possible harmful effect of heavy or very heavy beer drinking on infant size supports the findings of Kaminski *et al*[7] and Kuzma and Sokol.[3] They postulated several reasons for the differential effect of beer, including the nitrosamine and thiocyanate content of beer, the differential reporting of beer rather than wine or spirits, and that beer drinkers came from lower social classes.

As our study has the advantages mentioned earlier, our results may reflect more closely the real relation between social and heavy drinking during pregnancy and the development of the offspring. Our analyses have shown that only drinking more than 100 g absolute alcohol/week is consistently associated with an adverse outcome. From the 92% of our sample who were either non-drinkers or consuming less than 50 g absolute alcohol/week we conclude that social drinking at a low level is very unlikely to have a harmful effect on the fetus.

The associations that we have observed between alcohol consumption and outcome, though statistically and clinically significant, are weak. Alcohol consumption alone accounted for no more than 2·5% of the variation in any outcome variable (table V). This was nevertheless substantially greater than that observed by Kuzma and Sokol[3] and Plant,[10] who showed that alcohol consumption explained 0·1% and 0·5%, respectively, of the variation in their outcome variables. The small proportion of variation explained by the alcohol variables results from the fairly small numbers of heavy drinkers in the sample. Nevertheless, we would advise women who are planning to become pregnant to limit their alcohol consumption (beer in particular) to below 10 drinks/week.

We recommend that a short questionnaire on the quantity of alcohol and the type of drink consumed before and during early pregnancy should be included when taking the history of pregnant mothers during their first contact with the maternity clinic. This may be used to identify the high risk group, who may then be offered health education. Education about the dangers of alcohol for the remainder is unlikely to be cost beneficial and is probably unnecessary.

This study was supported by grant No 699 from the Scottish Hospitals Endowment Research Trust. Dr Sulaiman was sponsored by the Iraqi Government and by the Overseas Research Students (ORS) Award Scheme, administered by the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom. Our special thanks go to Mrs M Geber, who interviewed the mothers, and to all the staff in the antenatal clinics in Dundee.

References

1 Jones KL, Smith DW. Recognition of the fetal alcohol syndrome in early infancy. *Lancet* 1973;ii:999-1001.
2 Little RE. Moderate alcohol use during pregnancy and decreased infant birth weight. *Am J Public Health* 1977;67:1154-6.
3 Kuzma JW, Sokol RJ. Maternal drinking behavior and decreased intrauterine growth. *Alcoholism: Clinical and Experimental Research* 1982;6:396-402.
4 Wright JT, Macrae KD, Barrison IG, Waterson EJ. Effects of moderate alcohol consumption and smoking on fetal outcome. In: Porter R, O'Conner M, Whelan J, eds. *Mechanisms of alcohol damage in utero.* Ciba Foundation Symposium No 105. London: Pitman, 1984:240-53.
5 Harlap S, Shiono PH. Alcohol, smoking and the incidence of spontaneous abortion. *Lancet* 1980;ii:173-6.
6 Kline J, Shrout P, Stein Z, Susser M, Warburton D. Drinking during pregnancy and spontaneous abortions. *Lancet* 1980;ii:176-80.
7 Kaminski M, Rumeau C, Schwartz D. Alcohol consumption in pregnant women and the outcome of pregnancy. *Alcoholism: Clinical and Experimental Research* 1978;2:155-63.
8 Streissguth AP, Barr HM, Martin DC. Maternal alcohol use and neonatal habituation assessed with the Brazelton scale. *Child Dev* 1983;24:1109-18.
9 Marbury MC, Linn S, Monson R, Schoenbaum S, Stubblefield PG, Ryan KJ. The association of alcohol consumption with outcome of pregnancy. *Am J Public Health* 1983;73:1165-8.
10 Plant M. *Women, drinking and pregnancy.* London: Tavistock, 1985.
11 Jessor R, Graves R, Hanson RC, Jessor S. *Society, personality, and deviant behaviour: a study of tri-ethnic community.* New York: Holt, Reinhart and Winston, 1968.
12 Cahalan D, Cisin IH, Crossley HM. *American drinking practices: a national study of drinking behavior and attitudes.* New Jersey: Publications Division, Rutgers Centre of Alcohol Studies, 1969.
13 Dubowitz LMS, Dubowitz V, Goldberg C. Clinical assessment of gestational age in the newborn infant. *J Pediatr* 1970;77:1-10.
14 Berkowitz GS, Holford TR, Berkowitz RL. Effects of cigarette smoking, alcohol, coffee and tea consumption on preterm delivery. *Early Hum Dev* 1982;7:239-50.
15 Tennes K, Blackard C. Maternal alcohol consumption, birth weight and minor physical anomalies. *Am J Obstet Gynecol* 1980;1:774-80.
16 Hingson R, Alpert JJ, Day N, *et al.* Effects of maternal drinking and marijuana use on fetal growth and development. *Pediatrics* 1980;70:539-46.
17 Davis PJM, Partridge JW, Storrs CN. Alcohol consumption in pregnancy: how much is safe? *Arch Dis Child* 1982;57:940-3.
18 Streissguth AP, Barr HM, Martin DC. Offspring effects and pregnancy complications related to self-reported maternal alcohol use. *Dev Pharmacol Ther* 1982;5:21-32.
19 Streissguth AP, Martin D, Martin J, Barr H. The Seattle longitudinal prospective study on alcohol and pregnancy. *Neurobehav Toxicol Teratol* 1981;3:223-33.

(Accepted 16 February 1988)