

# Effects on birth weight of smoking, alcohol, caffeine, socioeconomic factors, and psychosocial stress

Oliver G Brooke, H Ross Anderson, J Martin Bland, Janet L Peacock, C Malcolm Stewart

## Abstract

**Objective**—To investigate the effects of smoking, alcohol, and caffeine consumption and socioeconomic factors and psychosocial stress on birth weight.

**Design**—Prospective population study.

**Setting**—District general hospital in inner London.

**Participants**—A consecutive series of 1860 white women booking for delivery were approached. 136 Refused and 211 failed to complete the study for other reasons (moved, abortion, subsequent refusal), leaving a sample of 1513. Women who spoke no English, booked after 24 weeks, had insulin dependent diabetes, or had a multiple pregnancy were excluded.

**Measurements**—Data were obtained by research interviewers at booking (general health questionnaire, modified Paykel's interview, and Eysenck personality questionnaire) and at 17, 28, and 36 weeks' gestation and from the structured antenatal and obstetric record. Variables assessed included smoking, alcohol consumption, caffeine consumption, and over 40 indicators of socioeconomic state and psychosocial stress, including social class, tenure of accommodation, education, employment, income, anxiety and depression, stressful life events, social stress, social support, personality, and attitudes to pregnancy. Birth weight was corrected for gestation and adjusted for maternal height, parity, and baby's sex.

**Main results**—Smoking was the most important single factor (5% reduction in corrected birth weight). Passive smoking was not significant (0.5% reduction). After smoking was controlled for, alcohol had an effect only in smokers and the effects of caffeine became non-significant. Only four of the socioeconomic and stress factors significantly reduced birth weight and these effects became non-significant after smoking was controlled for.

**Conclusions**—Social and psychological factors have little or no direct effect on birth weight corrected for gestational age (fetal growth), and the main environmental cause of its variation in this population was smoking.

## Introduction

Low birth weight remains the most important determinant of perinatal mortality and impaired later development world wide.<sup>1,2</sup> Psychological and social stress may be related to low birth weight and the consequent risk, as may social disadvantage and the intake of caffeine and alcohol. There is no general agreement, however, about the importance of any of these factors. Extensive reports on the effects of environment on birth weight contain only one almost universal finding—that smokers have smaller babies than non-smokers.<sup>3</sup> The possible effects of passive smoking are disputed. The plethora of data leaves a confusion of conflicting results and opinions about the influences of these factors on fetal growth and the

mechanisms by which they might operate to disturb it. Ensuring that the growth of the fetus is unrestricted is important, and efforts must be made to gain a better understanding of the factors that influence fetal growth in the hope that such understanding may be applied to reduce the associated hazards.

Existing reports on birth weight tend to fall into two broad categories. Firstly, there are those on large studies in which only a few factors have been examined and which have usually used case records and retrospective data. Secondly, there are those on small studies in which more detailed and prospective assessments have been used but which have lower statistical power. We conducted a comprehensive prospective examination of a large number of unselected white pregnant women to try to bridge the gap between these two categories of study.

The purpose of this first report of the study is to give an overview of the main findings and to examine the effects on fetal growth, as assessed by birth weight, of a range of biological, behavioural, and psychosocial factors, concentrating particularly on those subjects in which evidence is lacking or conflicting—for example, the influence of alcohol, caffeine, social factors, and stress. We intend to produce further reports concentrating on particular aspects of the data in depth.

## Subjects and methods

The study was conducted at St George's Hospital, a teaching hospital serving as a district general hospital in Wandsworth, an inner London borough. The sample comprised 1860 consecutive white women booking for antenatal care over 20 months. We excluded those who spoke insufficient English, booked after 24 weeks, had insulin dependent diabetes, and had a multiple pregnancy. The target sample size was 1500. This had been calculated as being sufficient to show with high power significant differences between subgroups (as small as 10% of the total) of 180 g. This is about the size of the reported effects of smoking and assumes a standard deviation of 500 g. It gives a reasonable power to examine interactions between smoking and other factors.

Interviews were conducted in a private room by trained research interviewers with a structured questionnaire, which had been tested previously in a pilot study of 130 women. The quality of interviews was monitored in a sample by a separate research worker by observation and subsequent review of tape recordings taken with the subject's permission. Interviews took place at booking (mean 14 weeks' gestation), three weeks after booking (mean 17 weeks), and at 28 and 36 weeks' gestation.

Data were obtained about marital state, whether the mother had a resident partner, educational qualifications and age at leaving school (for mother and partner), tenure of accommodation, amenities of household, structure of household, state of employment, and type of occupation. The social class of the mother and her father and of her husband or

London SW15  
Oliver G Brooke, MD, former  
professor of child health

Departments of Child  
Health, Clinical  
Epidemiology and Social  
Medicine, and Obstetrics  
and Gynaecology, St  
George's Hospital Medical  
School, London SW17 0RE  
H Ross Anderson, MD,  
professor of clinical  
epidemiology and social  
medicine

J Martin Bland, PHD, senior  
lecturer in statistics  
Janet L Peacock, MSC,  
statistician  
C Malcolm Stewart, MRCOG,  
research fellow

Correspondence to:  
Professor Anderson.

Br Med J 1989;298:795-801

cohabiting partner was coded according to the Registrar General's classification.<sup>5</sup> Net disposable income each week was assessed twice.

The current mood of the mother was measured on three occasions with the 28 item general health questionnaire.<sup>6</sup> This allowed us to assess anxiety and depression without including somatic symptoms and social dysfunction, which could be an effect of pregnancy rather than of mental illness. Previous psychiatric treatment was recorded. To measure stress an inventory of life events modified from Paykel's interview for recent life events was taken.<sup>7</sup> Satisfaction and happiness with accommodation, neighbours, and neighbourhood were recorded on a four point scale. The same method was used to measure perceived difficulties in overall finances and in affording accommodation, food, heating, and clothing.

We measured social support by asking about frequency of contact with friends, relatives, and neighbours and the availability of a confidant because of reported interactions with stress. Mothers were asked whether they had received any of a range of 13 types of social security benefit and whether they had been in contact with social welfare agencies, that is a social worker, marriage guidance counsellor, or probation officer.

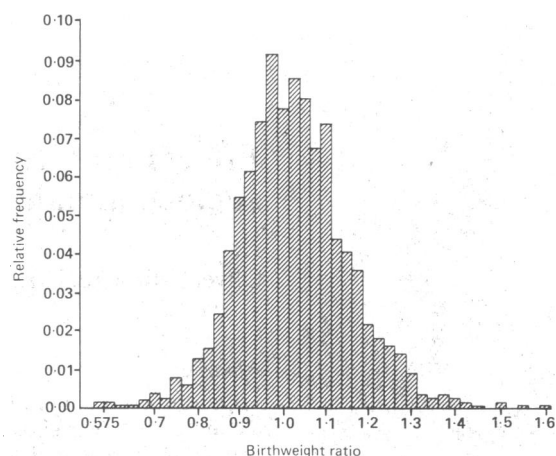
The mother was asked whether the pregnancy had been planned, whether she and her partner were happy about it, whether termination had been considered, whether contraception had been used in the year before conception, whether she had read any books about pregnancy, and whether her employer knew she was pregnant. At 36 weeks she was asked if she had missed any visits to the antenatal clinic.

The women completed an Eysenck personality questionnaire, which comprised "extraversion," "neuroticism," "psychoticism," and "lie" scales, at 17 weeks' gestation.<sup>8</sup>

Data on smoking and consumption of alcohol and drinks containing caffeine—coffee, tea, cocoa, and cola—were obtained at booking and at 28 and 36 weeks and related to the week before interview. History of previous smoking and inhalation habit were recorded at booking. Passive smoking was assessed by asking whether there were smokers in the household. Smoking habit was validated in a subsample of the study population by measuring the plasma thiocyanate concentration. Alcohol intake was determined from the type of drink consumed and its quantity converted to grams of alcohol a week with a standard method.<sup>4</sup> Total caffeine consumption each week was estimated on the basis that a cup of coffee contained 85 mg, of tea 50 mg, of cola 40 mg, and of cocoa 5 mg.

Obstetric data (including mother's age and parity) and fetal outcome were obtained from the structured obstetric record. Mother's height was measured at booking with a stadiometer (Holtain, Pembrokeshire). Birth weight was measured by the midwife within 30 minutes of birth with a spring balance (Marsden, London). Gestational age at delivery was calculated from the date of delivery, which was recorded by the obstetrician, based on dates of menstruation and results of early ultrasound examination (routine at the time of this survey).

The aim of the analysis was to examine factors affecting birth weight, which was chosen as a representative measure of fetal growth. The principal influence on birth weight is gestational age, but as it was not our prime objective to investigate length of gestation we corrected for varying gestational age when examining the other influences on fetal growth. The non-linear relation between birth weight and gestational age, combined with the relation between the mean and standard deviation of birth weight, made correction with a linear regression on gestational age or



Frequency distribution of birthweight ratio

on a function of gestational age questionable. This problem, and the solution described below, are discussed in detail elsewhere (J M Bland *et al*, in preparation). We used an external standard to adjust birth weight for variations in gestational age. The expected mean birth weight for each week of gestation was obtained from a large sample of births in Sheffield,<sup>9</sup> which was stratified to include large numbers of infants at early gestational ages. We could not use our own data to provide an internal adjustment<sup>10</sup> because the numbers of babies at early gestational ages were inadequate. In our study birth weight was expressed as a ratio of observed birth weight to expected mean birth weight for gestational age from the external standard. This produced a birthweight ratio with both mean and standard deviation independent of gestational age and of an approximately Gaussian form, which was suitable for use as the outcome variable in a least squares linear model (figure). This birthweight ratio was then adjusted for the biological factors parity, maternal height, and sex of infant by regression to give an adjusted birthweight ratio to be used as the outcome variable in the main analysis.

Because all the mean adjusted birthweight ratios were close to 1.0 differences between them were equivalent to percentage differences—for example, the difference between the mean adjusted birthweight ratios 1.04 and 1.01 is 0.03, which implies that the difference between the two mean birth weights is 3%. Our ratios are presented in the form of the equivalent birth weight for boys born at 40 weeks' gestation to a multiparous mother of average height.

The relations between birthweight ratio and other factors were tested by analysis of variance and regression analysis. The independent effects of the major factors were estimated with multiple regression. Statistical analyses were done with a commercial package (SAS)<sup>11</sup> and our own software.

We have presented some of the analyses in terms of confidence intervals, which generally are preferable to results of significance tests.<sup>12</sup> Because the number of social and psychological factors studied was so large and because they varied between dichotomous, multilevel, and quantitative data we decided that giving confidence intervals for all these was impracticable for one paper. For this overview of our findings we have therefore presented results for psychological and social variables in the form of means and have given results of significance tests.

## Results

### RESPONSE

A total of 1860 women were invited to take part in the study. Of these, 1513 (81%) were the subjects of most of the present analysis, having completed at least

TABLE I—Distribution of birth weight by sex of baby and maternal parity, height, and age

Factor	No in group	Mean (SD) birth weight (g)
<i>Babies</i>		
Boys	755	3408 (530.6)
Girls	758	3242 (525.4)
<i>Mothers</i>		
Parity:		
0	765	3266 (560.1)
≥1	748	3384 (500.0)
Height (cm):		
142-	190	3221 (499.4)
156-	373	3270 (541.9)
161-	489	3335 (482.9)
166-	299	3377 (561.8)
171-184	162	3445 (616.3)
Age (years):		
15-	99	3213 (600.4)
20-	378	3316 (525.8)
25-	532	3311 (542.4)
30-	356	3373 (528.8)
≥35	148	3355 (484.0)

the first two interviews. Losses were due to refusal to participate at the outset (136), spontaneous abortion (53), change of address (54), missing data on important biological variables (26), and missed interviews (56). Women who gave birth to macerated stillbirths (14) and infants with major congenital malformation (eight) were excluded. The number with complete data up to 28 weeks was 1463 and up to 36 weeks 1433, and when appropriate these numbers were used.

#### BIOLOGICAL VARIABLES

The mean crude birth weight was 3325 g and mean gestational age 39.4 weeks (276 days). When gestational age was adjusted for, the mean birthweight ratio was 1.006. Table I shows the relation between birth weight and important biological variables. The birth weight was greater in babies of women who were older, taller, and of higher parity. Boys were heavier than girls. For subsequent analyses birthweight ratio was adjusted to a maternal height of 160 cm, male baby, and parity of ≥1, giving a mean (SD) adjusted

birthweight ratio of 1.037 (0.127). There was no association between birthweight ratio and maternal age (table II), and thus no further adjustment was made for this factor.

#### SMOKING, ALCOHOL, AND CAFFEINE

Because smoking is the factor best established as relating to birth weight we examined its effects first (table III). There was a strong relation between birth weight and smoking (table III), with a difference in birthweight ratio between non-smokers and smokers of 15 or more cigarettes a day of 7%, equivalent to 241 g at 40 weeks' gestation. For smokers of one to 14 cigarettes a day the difference was 4% (140 g). Among non-smokers passive smoking was associated with a 0.5% reduction in birthweight ratio, but this was not significant. There was no apparent effect of inhalation. No differences were seen among non-smokers between those who had never smoked and those who had given up smoking. The mean (SD) thiocyanate concentration at booking for non-smokers and smokers in the subsample studied was 31.24 (10.70) μmol/l (n=96) and 74.07 (27.41) μmol/l (n=79) respectively, confirming the validity of the data on smoking. This difference was highly significant.

There was a significant trend towards lower birth weight with increasing consumption of alcohol (table IV); women consuming 100 g or more in the week before booking interview had a birthweight ratio of 0.039 (4%) less than non-drinkers, equivalent to 137 g at term. Similar and more significant trends were observed with increasing consumption of coffee and tea. Total caffeine consumption derived from coffee, tea, cola, and cocoa was significantly associated

TABLE II—Adjusted birthweight ratio\* by maternal age

Age (years)	No of mothers	Adjusted birthweight ratio (95% confidence interval)	Birth weight adjusted to 40 weeks (g)†
15-	99	1.042 (1.016 to 1.068)	3637
20-	378	1.042 (1.029 to 1.056)	3637
25-	532	1.026 (1.016 to 1.036)	3581
30-	356	1.045 (1.032 to 1.058)	3647
≥35	148	1.037 (1.016 to 1.059)	3619

\*Adjusted birthweight ratio was corrected for gestational age and then adjusted to maternal height 160 cm, male baby, and parity ≥1.

†Birth weight adjusted to 40 weeks was adjusted ratio multiplied by reference birth weight for 40 weeks.

TABLE III—Adjusted birthweight ratio\* and reported smoking habit for the week before interview at booking

Smoking habit	No of mothers	Adjusted birthweight ratio* (95% confidence interval)	Birth weight adjusted to 40 weeks (g)*	Significance for F ratio
Non-smoker	1022	1.053 (1.045 to 1.060)	3675	Non-smokers v smokers, p<0.001; never v ex-smokers, p=0.78
Never smoked	400	1.054 (1.042 to 1.066)	3678	
Ex-smoker	622	1.052 (1.042 to 1.062)	3671	
Smoker	491	1.004 (0.993 to 1.015)	3504	1.14 v ≥15, p=0.02
1-14 cigarettes/day	336	1.013 (1.000 to 1.027)	3535	
≥15 cigarettes/day	154	0.984 (0.964 to 1.004)	3434	
Non-smoker, passive smoking:				Passive smoking within non-smokers, p=0.56
Absent	595	1.055 (1.045 to 1.065)	3682	
Present	423	1.050 (1.038 to 1.062)	3664	
Smoker, passive smoking:				Passive smoking within smokers, p=0.38
Absent	134	1.012 (0.991 to 1.034)	3532	
Present	357	1.001 (0.988 to 1.014)	3493	

\*See footnote to table II.

TABLE IV—Adjusted birthweight ratio\* and reported consumption of alcohol, tea, coffee, and total caffeine for week before interview at booking

Factor	No of mothers	Adjusted birthweight ratio* (95% confidence interval)	Birth weight adjusted to 40 weeks (g)*	Significance for F ratio
Alcohol (g/week):				Difference across groups, p=0.27; linear trend for alcohol, p=0.04
0	759	1.042 (1.033 to 1.051)	3637	
1-	381	1.037 (1.025 to 1.050)	3619	
20-	249	1.032 (1.016 to 1.048)	3602	
50-	81	1.023 (0.996 to 1.051)	3570	
≥100	40	1.003 (0.964 to 1.043)	3500	
Tea (cups/week):				Difference across groups, p=0.03; linear trend for tea, p=0.004
0	211	1.050 (1.033 to 1.067)	3664	
1-	512	1.043 (1.032 to 1.054)	3640	
15-	645	1.034 (1.024 to 1.044)	3609	
≥43	140	1.012 (0.991 to 1.033)	3532	
Coffee (cups/week):				Difference across groups, p=0.008; linear trend for coffee, p=0.003
0	506	1.038 (1.027 to 1.049)	3623	
1-	549	1.041 (1.030 to 1.052)	3633	
8-	343	1.042 (1.028 to 1.055)	3637	
≥29	112	0.997 (0.974 to 1.021)	3480	
Total caffeine (mg/week):				Difference across groups, p=0.005; linear trend for caffeine, p=0.10
0	33	1.050 (1.006 to 1.093)	3664	
1-	547	1.050 (1.040 to 1.061)	3664	
1401-	617	1.034 (1.024 to 1.044)	3609	
≥2801	308	1.019 (1.005 to 1.033)	3556	

\*See footnote to table II.



TABLE V—Adjusted birthweight ratio\* and reported consumption of alcohol, tea, coffee, and total caffeine for the week before booking controlled for smoking habit reported at interview at booking

Factor	Non-smokers		Smokers		Significance of F ratio
	No of mothers	Adjusted birthweight ratio* (95% confidence interval)	No of mothers	Adjusted birthweight ratio* (95% confidence interval)	
Alcohol (g/week):					
0	548	1.050 (1.039 to 1.060)	211	1.020 (1.003 to 1.037)	Alcohol adjusted for smoking, $p=0.74$ ; smoking adjusted for alcohol, $p<0.001$ ; linear trend of alcohol within non-smokers, $p=0.31$ , and smokers, $p=0.003$
1-	258	1.052 (1.037 to 1.067)	123	1.007 (0.985 to 1.029)	
20-	148	1.061 (1.041 to 1.081)	101	0.990 (0.965 to 1.014)	
50-	50	1.056 (1.022 to 1.091)	31	0.970 (0.926 to 1.014)	
$\geq 100$	16	1.082 (1.020 to 1.143)	24	0.951 (0.901 to 1.001)	
Tea (cups/week):					
0	144	1.059 (1.039 to 1.080)	67	1.030 (1.000 to 1.060)	Tea adjusted for smoking, $p=0.32$ ; smoking adjusted for tea, $p<0.001$ ; linear trend of tea within non-smokers, $p=0.52$ , and smokers, $p<0.04$
1-	392	1.052 (1.040 to 1.064)	120	1.013 (0.991 to 1.036)	
15-	429	1.053 (1.041 to 1.065)	216	0.997 (0.981 to 1.014)	
$\geq 43$	53	1.046 (1.012 to 1.080)	87	0.992 (0.966 to 1.018)	
Coffee (cups/week):					
0	360	1.050 (1.038 to 1.063)	146	1.008 (0.988 to 1.028)	Coffee adjusted for smoking, $p=0.12$ ; smoking adjusted for coffee, $p<0.001$ ; linear trend of coffee within non-smokers, $p=0.51$ , and smokers, $p=0.04$
1-	394	1.050 (1.038 to 1.063)	155	1.017 (0.997 to 1.036)	
8-	221	1.065 (1.048 to 1.081)	122	1.000 (0.977 to 1.022)	
$\geq 29$	44	1.032 (0.995 to 1.069)	68	0.975 (0.945 to 1.005)	
Total caffeine (mg/week):					
0	31	1.049 (1.005 to 1.093)	2	1.061 (0.887 to 1.234)	Caffeine adjusted for smoking, $p=0.38$ ; smoking adjusted for caffeine, $p<0.001$ ; linear trend of caffeine within non-smokers, $p=0.79$ , and smokers, $p=0.32$
1-	442	1.051 (1.039 to 1.062)	105	1.050 (1.026 to 1.074)	
1401-	405	1.055 (1.043 to 1.068)	213	0.993 (0.976 to 1.009)	
$\geq 2801$	138	1.054 (1.033 to 1.075)	169	0.991 (0.972 to 1.010)	

\*See footnote to table II.

with birth weight, but there was no significant dose response trend. Table V shows the effect of these consumptions on birth weight after smoking was controlled for. For alcohol there was no evidence of an effect on birth weight among non-smokers; if anything the trend was in the other direction. For smokers, however, a strong effect of alcohol remained, amounting to a difference of 0.069 or 7% between non-drinkers and drinkers of 100 g or more a week. This was not explained by the relation between the amounts of alcohol and tobacco consumed. The effects of tea, coffee, and caffeine consumption became non-significant after smoking was controlled for. The relation between smoking and birth weight, however, remained significant after alcohol and caffeine consumption were controlled for.

#### PSYCHOSOCIAL AND STRESS FACTORS

Table VI (miniprint) shows the range of factors that may be broadly described as psychological or related to stress, though the distinction between these and some factors classified in table VII (miniprint) as socioeconomic is somewhat arbitrary. Only two factors were significantly associated with birth weight. Women who missed antenatal clinic visits had babies with lower birth weights, but this effect disappeared when smoking was controlled for. Women who thought that the quality of their relation with neighbours was less than satisfactory had babies with higher mean birth weight than others; furthermore, this persisted after smoking was controlled for.

Apart from these, there was little evidence for any relation between birth weight and psychosocial stress. There was no significant association between birth weight and mood states categorised as anxiety or depression by the general health questionnaire at any of the three interviews, nor any relation to psychiatric history. There was no relation with any of the personality factors measured by the Eysenck personality questionnaire or with any of the reported feelings about pregnancy. Whether the pregnancy was planned, whether either parent was happy about it, and whether a termination was considered did not influence birth weight.

In this study life events were regarded as a key indicator of stress but could not be measured until late in pregnancy, thus reducing the sample through early deliveries. Birthweight ratio showed a slight trend with life events, falling from 1.038 in those with no life events to 1.029 in those with three or more, but this did not reach significance.

Social support, in the form of contact with neighbours, friends, or relatives, and the availability of a particular confidant were not significantly related to birth weight.

#### SOCIAL AND ECONOMIC FACTORS

Factors associated with significantly lower birth weight were manual social class based on the mother's occupation, the mother's employer knowing that she was pregnant, lower school leaving age for the mother, and help with fares to hospital. All of these effects became non-significant after smoking was controlled for, whereas the effect of smoking remained highly significant after these effects were controlled for (table VII (miniprint)).

The relation between income and birth weight showed no clear pattern and was not significant. There was no relation between birth weight and receipt of most social security benefits, and women who thought that they had income difficulties did not have babies with significantly lower birth weights. No significant relation with birth weight was found with marital state or stability of the partnership. There was no relation with any of a wide range of social indicators (education, social class, housing tenure, and amenities).

#### Discussion

The influence of the environment is thought to be more important than that of constitution in determining variation in fetal growth.<sup>13</sup> Many studies have been published on the effects of environmental factors and birth weight, particularly the effects of smoking. Those studies that have been large enough to permit a proper analysis of the interaction of different influences either have been retrospective, and hence of limited value in some respects, or have failed to collect the required amount of data for logistical reasons. There has been a lack of reliable information on socioeconomic factors and on alcohol intake in those large studies that have concentrated on the effects of smoking. Studies in which a wide range of data have been collected with the intention of identifying the most important influences on birth weight have by and large been small (fewer than 500 subjects) and hence lacking in statistical power. The present study was able to collect a large amount of data on a substantial number of women. We particularly intended to try and identify factors that interfered with the growth of the fetus by causing stress to the mother. In this paper we were concerned not with the length of gestation, which

was controlled for, but with the growth of the fetus at any particular gestational age in relation to that of a reference population.

The principal findings of the study were as follows. The known and expected biological influences of

gestational age, maternal height, parity, and sex of baby were all confirmed. The effect of maternal age was not important after gestational age and maternal height and parity were controlled for. After adjustment for all these biological variables birth weight seemed to

## MINIPRINT TABLES VI AND VII

TABLE VI—Psychological and stress factors during pregnancy. Figures are numbers of women and mean adjusted birthweight ratios

Factor	Time of interview						p Value for F ratio
	Booking or 17 weeks (n = 1531)		28 Weeks (n = 1442)		36 Weeks (n = 1405)		
	N/No of subjects	Mean ratio	N/No of subjects	Mean ratio	N/No of subjects	Mean ratio	
General health questionnaire							
Anxiety score:							
0-1	464	1.015	478	1.013	404	1.028	Booking, p = 0.71; 28 weeks, p = 0.82; 36 weeks, p = 0.87
2-3	147	1.011	171	1.016	368	1.014	
4-6	154	1.019	295	1.016	306	1.014	
7-9	144	1.042	209	1.012	127	1.042	
Depression score:							
0	1089	1.016	1156	1.018	1179	1.014	Booking, p = 0.52; 28 weeks, p = 0.11; 36 weeks, p = 0.19
1	187	1.017	109	1.019	87	1.045	
2-3	127	1.052	91	1.011	82	1.012	
4	103	1.028	57	1.006	54	1.016	
Psychiatric history							
None	1209	1.018					p = 0.18
Not admitted to hospital	264	0.996					
Admitted to hospital	36	0.996					
Hypertic personality questionnaire							
Extroversion score:							
0-9	581	1.016					p = 0.06
10-13	380	1.016					
14-16	179	1.040					
17-19	567	1.016					
Neuroticism score:							
0-7	436	1.016					p = 0.48
8-10	318	1.046					
11-14	359	1.037					
15-17	396	1.011					
Psychosis score:							
0	248	1.048					p = 0.44
1	172	1.015					
2-3	544	1.013					
4	343	1.018					
Lie scale score:							
0-6	426	1.018					p = 0.91
7-9	600	1.019					
10-12	329	1.013					
13-15	354	1.017					
Happiness about pregnancy							
Very happy	1054	1.015	1256	1.016	1065	1.044	At first, p = 0.29; later, p = 0.74
Fairly happy	274	1.044	177	1.029			
Fairly unhappy	71	1.011	12	1.021			
Very unhappy	41	1.004	0				
Partner:							
Very happy	1091	1.013	1262	1.014			At first, p = 0.41; later, p = 0.85
Fairly happy	1245	1.048	154	1.041			
Fairly unhappy	62	1.012	9	1.012			
Very unhappy	15	1.028	5	1.070			
Termination considered							
No	1295	1.015					p = 0.91
Not requested	122	1.019					
Requested	27	1.041					
Contraception used							
None	409	1.012					p = 0.11
Oral	585	1.027					
Coil	116	1.049					
Cervical sheath	276	1.048					
Other	57	1.050					
Planned pregnancy							
Yes	1068	1.018					p = 0.15
No	177	1.027					
Mixed ethnic origin							
Smoker:							
No					536	1.002	Adjusting for smoking, p = 0.46; adjusting for years, p = 0.03
Yes					112	0.995	
Non-smoker:							
No					855	1.050	
Yes					105	1.044	
Books read about pregnancy							
Clive's books					211	1.028	p = 0.28
Clive's and others					271	1.040	
Other					176	1.028	
None					245	1.025	
Total No of life events							
0					662	1.018	p = 0.18.3
1					431	1.012	
2					179	1.029	
3					117	1.029	
Satisfaction with neighbourhood							
Very happy	701	1.014					p = 0.08
Fairly happy	622	1.041					
Fairly unhappy	85	1.019					
Very unhappy	14	1.007					
Satisfaction with accommodation							
Very satisfied	826	1.016					p = 0.66
Fairly satisfied	446	1.011					
Fairly unsatisfied	90	1.040					
Very unsatisfied	81	1.025					
Relationship with neighbours							
Very good	751	1.015					p = 0.02
Fairly good	438	1.040					
Fairly bad	18	1.058					
Very bad	7	1.044					
No contact	176	1.019					
Ability to manage on income							
No difficulty	868	1.019			304	1.017	17 weeks, p = 0.84; 36 weeks, p = 0.21
Slightly difficult	158	1.015			401	1.016	
Fairly difficult	138	1.011			132	1.016	
Very difficult	100	1.011			64	1.016	
Ability to afford food							
No difficulty	1224	1.018			1196	1.015	17 weeks, p = 0.59; 36 weeks, p = 0.28
Slightly difficult	159	1.027			132	1.025	
Fairly difficult	62	1.046			46	1.023	
Very difficult	30	1.013			21	0.991	
Ability to afford clothing							
No difficulty	815	1.019			828	1.014	17 weeks, p = 0.72; 36 weeks, p = 0.78
Slightly difficult	190	1.017			143	1.015	
Fairly difficult	140	1.016			164	1.015	
Very difficult	111	1.025			95	1.027	
Ability to afford heating							
No difficulty	1067	1.018			1064	1.016	17 weeks, p = 0.68; 36 weeks, p = 0.55
Slightly difficult	228	1.028			198	1.027	
Fairly difficult	105	1.017			81	1.026	
Very difficult	44	1.026			48	1.016	
Ability to afford new or marriage							
No difficulty	1155	1.016			1126	1.016	17 weeks, p = 0.41; 36 weeks, p = 0.64
Slightly difficult	180	1.028			171	1.025	
Fairly difficult	74	1.041			55	1.021	
Very difficult	53	1.061			33	1.021	
Contact with neighbours							
Daily	570	1.011					p = 0.61
Weekly	580	1.041					
Monthly	82	1.028					
Never	158	1.025					
Contact with friends							
Daily	474	1.016					p = 0.80
Weekly	725	1.018					
Monthly	56	1.013					
Never	187	1.020					
Contact with relatives							
Daily	650	1.015					p = 0.10
Weekly	721	1.013					
Monthly	45	1.019					
Never	6	0.965					
Presence of confidant							
Yes	1360	1.016					p = 0.40
No	79	1.023					
Contact with agencies							
None	1329	1.015					p = 0.55
Social worker	102	1.060					
Marriage guidance	4	0.979					
Probation officer	5	1.071					

TABLE VII—Socioeconomic and personal factors during pregnancy. Figures are numbers of women and mean adjusted birthweight ratios

Factor	Time of interview				p Value for F ratio	
	Booking or 17 weeks (n = 1515)	Mean ratio	28 Weeks (n = 1442)	Mean ratio		
Married state						
Married	1220	1.036				
Single	233	1.045			p = 0.60	
Other	80	1.033				
Stability of partnership						
Very satisfied			1252	1.032		
Fairly satisfied			126	1.048	p = 0.21	
Fairly unsatisfied			19	1.076		
Very unsatisfied			24	1.029		
Structure of household						
None of adults:						
I	42	1.043				
2	1281	1.033			p = 0.32	
3	100	1.039				
4	85	1.037				
5	55	1.039				
None of children aged 0-4 years:						
0	906	1.036				
1	522	1.035			p = 0.42	
2	86	1.051				
3	7	1.099				
4	1					
None of children aged 5-15 years:						
0	1212	1.036				
1	159	1.037			p = 0.90	
2	74	1.046				
3	25	1.048				
4	1					
Social class						
Mother:						
I	29	1.045				
II	462	1.042				
III Non-manual	700	1.040			p = 0.28	
III Manual	102	1.021				
IV	123	1.021				
V	55	1.015				
Smokers:						
Non-manual	339	1.002				
Manual	117	1.006				
Non-smokers:						
Non-manual	652	1.056			Adjusting for smoking, p = 0.19;	
Manual	141	1.033			adjusting for social class, p = 0.001	
Partner:						
I	164	1.045				
II	393	1.034				
III Non-manual	464	1.048			p = 0.12	
III Manual	472	1.027				
IV	144	1.055				
V	54	1.025				
Mother's father:						
I	115	1.046				
II	390	1.039				
III Non-manual	448	1.047			p = 0.57	
III Manual	472	1.036				
IV	143	1.027				
V	58	1.024				
Employment of mother						
Full time	628	1.039				
Part time	203	1.033			p = 0.67	
Has worked	638	1.035				
Never worked	14	1.047				
Student	4	1.116				
Worked during pregnancy:						
Yes			841	1.036		
No			565	1.011	p = 0.54	
Sorted working weeks:						
1-19			74	1.034		
20			80	1.034		
21			272	1.038	p = 0.96	
22			142	1.032		
23						
Employer's knowledge of pregnancy						
Smoker:						
Yes	196	1.004				
No	6	1.061				
Non-smoker:						
Yes	349	1.047			Adjusting for smoking, p = 0.09;	
No	44	1.074			adjusting for knowledge, p = 0.001	
Education						
Mother:						
Smoker:						
Minimum	113	1.000				
Above minimum	155	1.011			Adjusting for smoking, p = 0.79;	
Non-smoker:						adjusting for education, p = 0.001
Minimum	299	1.054				
Above minimum	622	1.052				
Partner:						
Minimum	643	1.037			p = 0.64	
Above minimum	669	1.041				
Qualifications of mother:						
Higher	806	1.043				
A level	107	1.052				
O level	541	1.038			p = 0.23	
Trade	58	1.035				
None	198	1.025				
Qualifications of partner:						
Higher	801	1.048				
A level	140	1.039			p = 0.08	
O level	579	1.029				
Trade	58	1.063				
None	281	1.027				
Weekly income (£)						
0	77	1.039	89	1.039		
1	56	1.024	87	1.008		
2	106	1.024	136	1.017		
3	201	1.024	231	1.022	17 weeks, p = 0.42;	
4	170	1.040	225	1.030	36 weeks, p = 0.14	
5	192	1.031	149	1.034		
6	168	1.048	134	1.056		
7	180	1.041	265	1.039		
Benefits						
Maternity grant:						
Yes			1517	1.033	p = 0.40	
No			89	1.045		
Maternity allowance:						
Yes			859	1.036		
No			547	1.031	p = 0.45	
Child benefit:						
Yes			499	1.034		
No			907	1.034	p = 0.90	
Child benefit increase:						
Yes			19	1.006		
No			1586	1.034	p = 0.10	
Family income supplement:						
Yes			18	1.025		
No			1587	1.034	p = 0.77	
Single parent's benefit:						
Yes			116	1.047		
No			1289	1.033	p = 0.24	
Unemployment benefit:						
Yes			88	1.037		
No			1517	1.034	p = 0.83	
Assistance with electricity:						
Yes			17	0.991		
No			1588	1.034	p = 0.17	
Free milk and vitamins:						
Yes			359	1.030		
No			1260	1.034	p = 0.69	
Fares to hospital:						
Smokers:						
Yes			12	0.955		
No			436	1.002		
Non-smokers:						Adjusting for smoking, p = 0.13;
Yes			4	0.992	adjusting for fares, p = 0.001	
No			1485	1.050		
Rent rebate:						
Yes			77	1.022		
No			1526	1.034	p = 0.41	
Rates rebate:						
Yes			77	1.024		
No			1526	1.034	p = 0.47	
Sickness benefit:						
Yes			41	1.026		
No			1565	1.034	p = 0.69	
Housing						
Tenure:						
Owner:			899	1.038		
Council rent			258	1.032		
Private rent			135	1.026	p = 0.77	
With parents			72	1.029		
Other			39	1.034		
Use of bathroom and kitchen:						
Self use			1855	1.034		
Shared			55	1.037		
None			12	1.114	p = 0.10	
How warm:						
Yes			1437	1.035		
No			8	1.008	p = 0.52	
Telephone:						
Yes			1248	1.038		
No			196	1.039	p = 0.06	



be affected by smoking and the consumption of alcohol, coffee, and tea, and total caffeine. The effect of passive smoking was small and non-significant, and there was no difference in birth weight between those mothers who had never smoked and those who had given up smoking before becoming pregnant. Because smoking had the largest effect and is widely accepted to be a causal factor it seemed reasonable to examine the effect of other consumptions after controlling for smoking. When this was done the effects of coffee, tea, and total caffeine consumption became non-significant and the effect of alcohol became confined to the group who smoked. The effect of smoking, however, could not be explained by either alcohol or caffeine consumption.

Of the large range of psychosocial factors examined, few were found to have a significant effect. Again, it seemed logical to re-examine significant associations after controlling for smoking, and when we did this the effects of all but one (getting on with neighbours) of the social and psychological factors became non-significant. Notably, we did not find any significant effects of anxiety or depression, life events, social support, social class, income, or tenure. The effect of smoking was not explained by social class or education.

This study shows again the importance of smoking as a determinant of birth weight. There is a considerable weight of evidence that this is so,<sup>3</sup> but in the background has been the possibility that the effect might be primarily related to social class or adversity (smoking being a class related habit<sup>14</sup>) or that smokers are in some way physiologically different from non-smokers (the constitutional hypothesis<sup>15</sup>). No existing study has entirely answered these points. Our data confirm the overriding importance of smoking and show that in our society, far from merely reflecting more fundamental social disadvantages, smoking is probably the main environmental factor (apart from mother's height) through which the effect of social class on birth weight is mediated. The data oppose the view that the effect of smoking is related to the smoker's constitution as there was no difference in the birth weight of babies whose mothers had given up smoking and those whose mothers had never smoked and there was evidence of a dose related effect of smoking on birth weight, as has been reported in other studies.<sup>16</sup> We cannot, however, completely rule out the possibility that women who gave up smoking or who smoked less than 15 cigarettes a day were a different group ("social" as opposed to "habitual" smokers) from those who smoked 15 or more cigarettes a day. Even if this were the case, however, it is unlikely to have been of much importance in determining birth weight in view of the absence of an effect of so many other social, psychological, and behavioural factors once the effect of smoking was accounted for. We were unable to confirm a recent finding from Denmark that passive smoking impairs fetal growth.<sup>17</sup> The results from the Danish study have been questioned directly by Trichopoulos,<sup>18</sup> and it seems from this and other work on passive smoking that misclassification in what was a retrospective study might account for the findings.<sup>19</sup> A later prospective study of 3891 women in the United States found that non-smokers exposed to passive smoking delivered infants with a mean birth weight 23.5 g lighter than infants of women not exposed to passive smoking.<sup>20</sup> This finding agrees closely with the 18 g difference observed in the present study.

The potential effect of alcohol is important because of current concerns about alcohol abuse in the general population<sup>21</sup> and because previous studies have shown an apparent effect of alcohol on fetal growth.<sup>22</sup> We found no evidence, however, for a negative influence of alcohol on birth weight among non-smokers, the

adjusted birth weight being if anything marginally increased in non-smoking drinkers. There was, however, a distinct effect of alcohol ingestion on birth weight among smokers, with a significant trend to lower birth weight with increased drinking. This raises the possibility of an interaction between alcohol and the constituents of tobacco smoke, an issue touched on in a study by Wright *et al* of the effect of drinking on the incidence of low birth weight.<sup>23</sup> Kline *et al* found inconsistent effects of alcohol on birth weight, but in general they showed that after allowing for smoking there was no important influence.<sup>24</sup> Sulaiman *et al* found that women who drank 120 g of alcohol or more a week had smaller babies, but this effect ceased to be significant after smoking was controlled for.<sup>25</sup> We think it possible that drinkers who also smoke may have different smoking habits from non-drinkers who smoke. We are trying to resolve this issue with further analysis concentrating on quantities smoked and constituents of the smoke. Our data do not support previous suggestions that caffeine, or beverages that contain caffeine, affect fetal growth,<sup>26</sup> a conclusion also reached by Linn *et al* after controlling for smoking in a large retrospective study.<sup>27</sup>

There seems little doubt from many studies around the world that social deprivation is associated with lowered birth weight, probably through an effect on maternal nutrition.<sup>28</sup> Earlier British studies have emphasised the importance of social class and factors related to social class such as income, housing, and educational attainment as determinants of birth size,<sup>29</sup> and a common factor in this may be stress.<sup>30-33</sup> Our data suggest that in an inner London borough in the mid-1980s social class has little or no effect on fetal growth after biological factors and smoking are controlled for. We found no indication that income, household amenities, social support, marital state or stability or partnership, employment, or educational qualifications were important. Another study of a smaller number of mothers from a middle class university town also failed to show any effect of social class on birth weight, though in that study income was an independent predictor.<sup>33</sup> In our study the only social factors that emerged from the preliminary analysis as having an apparent effect on fetal growth (maternal social class, age at leaving school, and help with hospital fares) became non-significant after smoking was controlled for. The lack of an effect of socio-economic factors can be explained plausibly by the fact that few British women are now sufficiently deprived to suffer from deficiencies of major nutrients, chronic infection, and so on, which was far from being the case in the 1950s, when many of the earlier data from the United Kingdom showing important social class effects were collected.

Psychosocial stress, measured here by adverse life events, poor social support, and perceived income difficulties, had little relation to birth weight in this study. Newton and colleagues found an excess of life events in mothers of small babies. This effect, however, became non-significant when adjusted for smoking, suggesting that if adverse life events do have an effect on birth weight it may be due to a resulting increase in smoking.<sup>34,35</sup>

Anxiety and depression had no relation to birth weight in this study. Istvan reported seven studies of anxiety and birth weight, only one of which found a relation between high anxiety and low birth weight.<sup>36</sup> The lack of influence of stressful social factors and adverse life events makes it unlikely that stress has an important effect on fetal growth. The observed trend in fetal growth with number of life events was not significant. Possibly analysis of particular events or groups of events may be more informative.

The implications of our study are that the effect of

stress on intrauterine growth is small compared with that of smoking. The provision of social support is not in itself likely to improve outcome in terms of fetal growth. If unrestricted fetal growth is to be achieved pregnant women should stop smoking. The effects of alcohol on fetal growth in those who smoke require further investigation, but for non-smokers there is little need to be concerned that intake within the range found in our study is harmful. Finally, we emphasise that our results apply only to fetal growth expressed as a continuous variable and should not be extrapolated freely to low birth weight or to other fetal outcomes such as mortality, congenital malformation, and preterm delivery. Possibly stress factors have more influence on gestational age, which the present analysis was not designed to detect.

We thank Professors R R Trussell and G V P Chamberlain and the clinic staff for facilitating the study; Rebecca Macnair for carrying out the pilot study; Professor E Paykel for advice on the measurement of stress; and all the interviewers. Financial support was received from a consortium of American tobacco companies.

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(Accepted 24 January 1989)

## Methotrexate dosage in patients aged over 50 with psoriasis

G M Fairris, A G Dewhurst, J E White, M J Campbell

**Royal South Hants Hospital, Southampton SO9 4PE**  
G M Fairris, MRCP, senior registrar in dermatology  
A G Dewhurst, MRCP, senior registrar in medicine  
J E White, FRCP, consultant dermatologist

**Medical Statistics and Computing, Southampton General Hospital, Southampton SO9 4XY**  
M J Campbell, PHD, senior lecturer

Correspondence to: Dr Fairris.

*Br Med J* 1989;298:801-2

Methotrexate has been used for over 20 years to treat severe psoriasis that cannot be adequately controlled by other means. The recommended dose is 10-25 mg orally once a week. The drug is well absorbed and is excreted mainly in the urine. It inhibits dihydrofolate reductase, and its most dangerous side effect is myelosuppression, which is partly dose related. We observed that psoriasis in elderly patients could be controlled with less than the recommended dose and investigated some of the factors associated with the dose needed.

### Patients, methods, and results

We identified 23 patients aged over 50 who were treating their psoriasis with methotrexate. All were taking the drug because their psoriasis could not be adequately controlled by topical treatment, etretinate, or psoralens and ultraviolet A. The minimum therapeutic dose of methotrexate was established in all patients by reducing their weekly dose until their

disease relapsed. We then increased the dose at intervals of one or two months until the psoriasis was controlled to the patient's satisfaction. The patient's age, weight, height, and concomitant drug treatment were noted. Venous blood was taken to measure haemoglobin concentration, mean corpuscular volume, white cell count, platelet count, and plasma urea and creatinine concentrations. The predicted creatinine clearance was then calculated<sup>1</sup>:

$$\text{Predicted creatinine clearance} = \frac{(140 - \text{age}) \times (\text{weight in kg}) \times (1.23 \text{ for men})}{\text{Serum creatinine in } \mu\text{mol/l}}$$

Serum creatinine in  $\mu\text{mol/l}$

The data were analysed with Pearson's correlation and linear regression. Fourteen patients were men and nine women. Their age ranged from 50 to 93, weight from 43 to 110 kg, and plasma creatinine concentration from 56 to 139  $\mu\text{mol/l}$ .

A significant correlation was found between the minimum therapeutic dose of methotrexate and both predicted creatinine clearance ( $r=0.76$ ,  $p<0.001$ ) (figure) and age ( $r=-0.74$ ,  $p<0.001$ ). The relation between dose and predicted creatinine clearance was shown by the linear regression equation:

$$\text{Dose} = 1.25 + (0.157 \times \text{predicted creatinine clearance})$$

Age and predicted creatinine clearance are clearly related, and putting age into the prediction equation