Relative risks of low birthweight in Scotland 1980–2

R M PICKERING

From the Social Paediatric and Obstetric Research Unit, University of Glasgow, Lilybank Gardens, Glasgow G12 8R2

SUMMARY Routinely collected data for 187 000 Scottish singleton livebirths in 1980–2 were used to relate the risk of birthweight below 2500 g, 2000 g, 1500 g, and 1000 g to sex of infant and nine maternal factors. Maternal height was a major predictor of birthweight below 2500g but was less important in predicting birthweight in the lower intervals. A history of perinatal death and spontaneous abortion was important for all four intervals and was associated with most extreme risks for birthweight below 1000 g. The analysis confirms that the patterns of risk of birthweight below 2500g and 2000 g associated with social class, marital status, and maternal age and height found among the women of the 1958 cohort of British births are still applicable in the early 1980s.

Three major surveys, the National Survey of Health and Development¹ in 1946, the British Perinatal Mortality Survey² in 1958, and the British Births Survey³ in 1970 have established patterns of risk of low birthweight and preterm delivery associated with maternal, socioeconomic, and biological covariates in Britain. In a comparative study of birthweight in the latter two surveys,⁴ Peters *et al* performed identical analyses of covariance and found that, despite considerable changes in the maternal population and the management of labour and delivery, the same four covariates, maternal height, history of smoking, parity, and pre-eclampsia, were highly significant in both years. There have been major changes in fertility patterns and a continuing fall in perinatal mortality since the 1970 survey but no population based study of perinatal outcome has examined differentials in risk since these changes occurred.

In order to interpret the relation between maternal characteristics and birthweight it is important to examine the mediating effect of gestational age, a perinatal outcome closely related to birthweight. Differentials in risk of preterm delivery and birthweight controlled for gestational age were the subject of two earlier reports.^{5,6} In view of the role of birthweight, uncontrolled for gestational age as a summary measure of health at the start of life, and its increasing use as the basis of standardisation procedures for subsequent morbidity and mortality,⁷ it is interesting to examine, directly, the relation between maternal factors and birthweight.

This paper presents the results from a logistic regression model of the risk of birthweight below 2500

g, 2000 g, 1500 g, and 1000 g, associated with sex of infant and nine covariates describing women at the time of conception. Results are compared to earlier findings related to preterm delivery and the birth of a small-for-gestational age infant. The study is based on cross-sectional data from the Scottish obstetric population during 1980–2.

Materials and methods

Information was collected routinely on the Scottish Morbidity Record 2 (SMR2)⁸, a maternity discharge record which, during the three year study period, was completed for 98.3% of all births recorded by the Registrar General for Scotland. A small proportion (0.6%) were stillbirths and were excluded from the analysis as they may lose weight before delivery. Singleton livebirths of weight below 2500 g, 2000 g, 1500g, and 1000 g, representing 5.84, 1.89, 0.81, and 0.23% of the study population respectively, were examined.

Ten covariates available on SMR2 were examined in the study: these were sex of infant, marital status, social class, maternal height and age, history of spontaneous and induced abortion, caesarean section and perinatal death, and the number of previous livebirths. Marital status was categorised as married, separated, divorced, widowed, and other versus single. Social class on SMR2 was based on the Registrar General's scale I to V derived from the occupation of the husband or father of the child. Unknown social class, which comprised 22% of the study population, was recorded when there was insufficient information to assign social class or when occupation was stated as

the armed forces. Maternal height was categorised into three groups, <150 cm, 150–164 cm, and ≥ 165 cm, and maternal age into four groups, <18, 18–24, 25–34, and ≥ 35 years. A history of spontaneous abortion was examined by considering two groups of women: those with one previous abortion and those with two or more. History of previous induced abortion was based on the woman's statement of her obstetric history, and it might be expected that this variable is prone to understatement. A comparison of rates of a history of induced abortion reported on SMR2 with age-specific population rates reported to the Chief Medical Officer has suggested that the variable may be reasonably reliable.⁹ There were very few women with two or more previous induced abortions, and the covariate was dichotomised as none versus one or more, as were previous perinatal deaths and caesarean sections. The final covariate, number of previous livebirths, was categorised 0–2 versus ≥ 3 . By considering a high number of previous livebirths rather than high parity, the risk associated with three or more previous births should not be confounded by compensation for previous fetal losses. These last three covariates were relevant only to women who had had a previous birth, and the analyses were performed separately for primiparae and multiparae.

A few births (0.2%) did not have birthweight coded on the SMR2 document; altogether 5% of the population had information missing either for birthweight or for one or more of the covariates, and these cases were excluded from the analysis. Data from 80 276 primiparae and 106 362 multiparae were thus available for study. Women with unknown maternal height (4.9%) comprised the largest source of exclusions from the analysis. Among births to primiparae of unknown height 11.1% had birthweight below 2500 g compared with 6.8% among births to primiparae of known height. Similarly, births to multiparae of unknown height had a rate of birthweight below 2500 g of 7.6% compared to 4.9% among multiparae of known height. These differentials between the study population and the excluded cases represent a potential source of bias in the results relating to maternal height and the other covariates.

Odds ratios and associated confidence intervals were estimated from a logistic regression analysis¹¹ of birthweight in each of the four intervals. The significance of the covariates was assessed by likelihood ratio tests. Each covariate was investigated alone and controlled for the other covariates, and interactions between each pair of covariates were examined. The adequacy of the logistic model was examined by comparing actual low birthweight rates with expected confidence intervals based on cases with

similar predicted rates.

The logistic regression model overestimated the risk of low birthweight among births which, by virtue of their combination of sex and the maternal covariate values, were predicted to be at highest risk. In the analysis of birthweight below 2500 g, the risks for less than 0.5% of births were overestimated, while in the analyses of the lower birthweight intervals the risks for up to 5% were overestimated. However, in the analysis of birthweight below 1000g among multiparae, the risk to over 20% of births was overestimated by the logistic model. Where only small percentages are overestimated by the model, the odds ratios adequately describe the levels of risk experienced by the majority but should not be used to estimate extremes of risk in the population. When a greater proportion are overestimated the results are less reliable.

Results

Tables 1 and 2 present odds ratios for birthweight below 2500 g, 2000 g, 1500 g, and 1000 g associated with the ten covariates after controlling for the other covariates in the study, for primiparae and multiparae respectively. Female infants of both primiparae and multiparae experience increased risks of birthweight below 2500 g (17 and 26% respectively). At the lower three intervals, sex of infant did not have a significant impact.

The marital status of the mother was significantly associated with the risk of birthweight below 2500 g and 2000 g. Single primiparous mothers experienced a 28% increase in the risk of birthweight below 2500 g, and single, multiparous mothers experienced a 63% increase in risk compared to married women. The second socioeconomic covariate, social class, was associated with differences in the risk of birthweight below 2500 g, 2000 g, and 1500 g. Social class I-II, primiparous mothers experienced a 21% reduction in the risk of birthweight below 2500 g when compared to social class III, and social classes IV and V experienced an increase in risk of 15%. Similarly, social class I-II multiparae experienced a 35% reduction in the risk of birthweight below 2500 g and multiparae in social classes IV and V had risk increased by 16%. Women with unknown social class generally experienced similar risks to social classes IV and V.

Maternal height was one of the most important predictors of birthweight below 2500 g. Women of height less than 150 cm experienced a risk of low birthweight that was doubled, while women of height greater than 165 cm experienced a reduction in risk of approximately 40% when compared to women whose height was between 150 and 165 cm. Among primiparae similar, though less extreme gradients in

Relative risks of low birthweight in Scotland 1980–2

Table 1 Adjusted odds ratios of birthweights in primiparae, Scotland 1980–2

Covariate	<2500 g	<2000 g	<1500 g	<1000 g
Male	1.00	1.00	1.00	1.00
Female	1.17(1.11,1.24)	0.95(0.86,1.06)	0.99(0.84,1.16)	0.98(0.72,1.34)
Married	1.00	1.00	1.00	1.00
Single	1.28(1.18,1.39)	1.38(1.19,1.59)	1.18(0.93,1.48)	1.15(0.73,1.81)
Social class				
I–II	0.79(0.72,0.86)	0.84(0.71,0.99)	0.77(0.59,1.01)	0.87(0.53,1.43)
III	1.00	1.00	1.00	1.00
IV–V	1.15(1.07,1.24)	1.25(1.09,1.43)	1.23(1.00,1.52)	1.12(0.75,1.69)
Unknown	1.11(1.02,1.20)	1.18(1.03,1.35)	1.06(0.86,1.31)	0.93(0.61,1.42)
Height (cm)				
<150	2.21(1.97,2.47)	2.08(1.70,2.53)	1.39(0.97,1.99)	1.50(0.77,2.95)
150–164	1.00	1.00	1.00	1.00
≥165	0.61(0.57,0.66)	0.71(0.62,0.81)	0.71(0.58,0.87)	0.64(0.42,0.97)
Age (yr)				
<18	1.15(1.02,1.28)	1.39(1.15,1.68)	1.67(1.25,2.22)	1.56(0.87,2.77)
18–24	1.00	1.00	1.00	1.00
25–34	1.03(0.97,1.10)	1.10(0.97,1.23)	1.02(0.85,1.23)	0.85(0.58,1.22)
≥35	1.76(1.47,2.10)	1.96(1.46,2.63)	2.01(0.59,3.12)	1.86(0.81,4.28)
Previous spontaneous abortion				
0	1.00	1.00	1.00	1.00
1	1.30(1.18,1.43)	1.46(1.24,1.74)	1.78(1.39,2.28)	1.92(1.19,3.08)
≥2	2.01(1.66,2.43)	2.76(2.07,3.68)	3.25(2.14,4.93)	4.35(2.11,8.98)
Previous induced abortion				
0	1.00	1.00	1.00	1.00
≥1	1.20(1.08,1.34)	1.36(1.13,1.64)	1.49(1.13,1.97)	1.74(1.04,2.92)

risk were observed at 2000 g, 1500 g, and 1000 g. Some degree of increased risk was observed among multiparae of height <150 cm at all birthweight intervals but maternal height was not a significant factor in the models for birthweight below 1500 g and 1000 g.

Both primiparae and multiparae in the most frequently occurring age category (18–24 years for primiparae and 25–34 years for multiparae) experienced the lowest risk of birthweight below 2500 g, 2000 g, and 1500 g, and women at the extremes of the maternal age distribution experienced increased risk. Primiparae aged over 35 years experienced particularly high risks of all levels of low birthweight, as did multiparae aged less than 18 years.

Several obstetric factors were associated with risks which increased towards lower birthweights. A previous perinatal death was a major risk factor for multiparae, with a risk of 131% for birthweight below 2500 g, of 203% below 2000 g, of 254% below 1500 g, and of 317% below 1000 g. Primiparae with a history of one spontaneous abortion experienced a 30% increase in the risk of birthweight below 2500 g but a 92% increase below 1000 g. Those with two or more spontaneous abortions had a 101% increase in risk of low birthweight but a 335% increase below 1000 g. A similar pattern was observed among the multiparae. A history of induced abortions among primiparae was

associated with increasing risks of birthweight below the lower cutpoints. With the exception of birthweight below 1000 g, a similar pattern was observed for multiparae.

Of the final two covariates, a history of caesarean section was associated with small increases in the risk of birthweight below 2500 g, 2000 g, and 1500 g; a history of three or more livebirths was associated with a small increase in the risk of birthweight below 2500 g but not with lower birthweights.

Although several interactions between pairs of covariates were significant in the analysis of low birthweight, independent covariate effects were generally more important in explaining the association. Only the interaction in risk of birthweight below 2500 g between social class and maternal age among primiparae is presented here (table 3). Primiparae in social classes I and II experienced minimum risk of low birthweight in the 25–34 age group, social class III primiparae experienced minimum risk in the 18–24 age group, while in social classes IV and V it was primiparae aged <18 years who experienced minimum risk. A complementary differential in the association between maternal age and the risk of birthweight below 2500 g within maternal height groups was found for primiparae. Taller primiparae (≥165 cm) experienced minimum risk in the 25–34 age group, primiparae of height

Table 2 *Adjusted odds ratios (with confidence intervals) of birthweights in multiparae, Scotland 1980-2*

Covariate	< 2500 g	< 2000 g	< 1500 g	< 1000 g
Male	1.00	1.00	1.00	1.00
Female	1.26(1.19,1.33)	1.04(0.94,1.16)	1.02(0.85,2.22)	1.19(0.83,1.70)
Married	1.00	1.00	1.00	1.00
Single	1.63(1.40,1.89)	1.89(1.45,2.45)	1.46(0.92,2.34)	1.07(0.33,3.43)
Social class				
I-II	0.65(0.59,0.72)	0.81(0.68,0.96)	0.74(0.54,0.99)	0.84(0.48,1.48)
III	1.00	1.00	1.00	1.00
IV-V	1.16(1.08,1.25)	1.22(1.06,1.40)	1.23(0.98,1.55)	1.11(0.70,1.76)
Unknown	1.21(1.12,1.31)	1.19(1.03,1.38)	1.35(1.06,1.70)	1.06(0.65,1.74)
Height (cm)				
< 150	2.05(1.84,2.29)	1.56(1.25,1.94)	1.53(1.06,2.20)	2.08(1.07,4.04)
150-164	1.00	1.00	1.00	1.00
≥ 165	0.62(0.57,0.67)	0.74(0.64,0.85)	1.05(0.84,1.30)	1.14(0.75,1.75)
Age (yr)				
< 18	2.19(1.44,3.33)	2.93(1.53,5.63)	2.62(0.82,8.33)	0.10(0.00,231.98)
18-24	1.00	1.00	1.00	1.00
25-34	0.84(0.79,0.90)	0.83(0.73,0.94)	0.84(0.68,1.03)	0.85(0.57,1.28)
≥ 35	1.07(0.95,1.20)	1.30(1.07,1.58)	1.24(0.90,1.72)	0.51(0.22,1.19)
Previous spontaneous abortion				
0	1.00	1.00	1.00	1.00
1	1.24(1.15,1.34)	1.27(1.10,1.46)	1.47(1.16,1.85)	2.16(1.41,3.30)
≥ 2	2.04(1.83,2.27)	2.69(2.25,3.20)	3.52(2.70,4.59)	3.86(2.25,6.64)
Previous induced abortion				
0	1.00	1.00	1.00	1.00
≥ 1	1.32(1.19,1.47)	1.51(1.25,1.82)	1.80(1.35,2.41)	1.09(0.53,2.24)
Previous caesarean section				
0	1.00	1.00	1.00	1.00
≥ 1	1.15(1.05,1.26)	1.27(1.08,1.50)	1.32(1.01,1.72)	0.95(0.52,1.74)
Previous perinatal death				
0	1.00	1.00	1.00	1.00
≥ 1	2.31(2.10,2.55)	3.03(2.59,3.54)	3.54(2.78,2.51)	4.17(2.62,6.63)
Previous livebirths				
0-2	1.00	1.00	1.00	1.00
≥ 3	1.13(1.03,1.24)	0.98(0.82,1.16)	0.87(0.66,1.16)	0.95(0.58,1.70)

Table 3 *Adjusted odds ratios (with confidence intervals) for birthweight below 2500 g showing effects of social class and maternal age in primiparae in Scotland, 1980-2*

Maternal age (yr)	Social class			
	I-II	III	IV-V	Unknown
< 18	1.17(0.51,2.69)	1.49(1.20,1.84)	0.90(0.69,1.17)	1.11(0.95,1.29)
18-24	1.00	1.00	1.00	1.00
25-34	0.94(0.79,1.12)	1.04(0.94,1.14)	1.16(1.01,1.32)	0.96(0.83,1.11)
≥ 35	1.29(0.87,1.90)	1.83(1.37,2.45)	1.87(1.25,2.78)	2.09(1.43,3.03)

150-164 cm experienced minimum risk in the 18-24 age group, and short primiparae (<150 cm) experienced minimum risk in the <18 age group.

Discussion

Of the three British birth surveys, the most detailed

analysis of low birthweight was performed on the data of the 1958 survey.² An examination of the rates of birthweight below 2501 g and 2001 g showed that infants of both teenagers and women aged over 35 years were more likely to be of lower birthweights, as were the infants of single women, and substantial gradients of increasing risk were observed with

Relative risks of low birthweight in Scotland 1980-2

decreasing social class and maternal height. The results of this study, where comparison is possible, are in broad agreement with these findings.

The examination of low birthweight rates from the British Births Survey was uncontrolled for other covariates. When a separate analysis of mean birthweight was adjusted for various maternal characteristics, including smoking habit and pre-eclampsia, the impact of maternal age and social class on mean birthweight was reduced to borderline significance. These results are not directly comparable to the risks presented here. Some covariates may be characterised by changes in the risk of heavy infants, and such association could obscure increased risk of low weight infants in the analysis of mean birthweight.

An examination of the mediating effects on birthweight of various pathological conditions arising during pregnancy, available on the SMR2 record, was not undertaken in this analysis. The objective of this study was to document risk to pregnancy experienced by women in different demographic, obstetric, and social groups rather than to identify specific causal influences. In this context, pre-eclampsia, which was a controlling variable in the analysis of social class and maternal age from the 1958 survey data, should properly be treated as an alternative outcome of pregnancy.

The relation between social class and low birthweight is complex and ill understood. While acknowledging the limitations of the data, certain patterns of age-related risk within social classes do emerge. Primiparae in social classes I and II experienced minimum risk of low birthweight when aged 25-34 years, aged 18-24 years in social class III, and aged <18 years in social classes IV and V. A similar trend has been observed in the age at which minimum risk of stillbirth in first pregnancy is experienced related to educational achievement¹². A possible explanation for these observations is that women in differing social classes tend to begin childbearing at different ages, and that those beginning childbearing unusually late for their social class may have suffered difficulty conceiving or maintaining pregnancy and for this reason represent a higher risk group. Women who choose to postpone childbearing to their thirties may not suffer similarly increased risks.

In two other studies of these Scottish data,^{5,6} the risks of delivery before the 37th week of gestation, and the risks of birthweight below the 10th percentile of the birthweight distribution for each gestational age, were the subject of analysis. A summary of the findings of these studies is contained in table 4 and provides a basis for comparison with the risks of reduced birthweight in tables 1 and 2. Firstly, female infants experienced lower risks of preterm delivery but

increased risks of low birthweight, confirming the results of several other studies.^{3,11} Social class and marital status were associated with similar differentials in risk of the different types of prematurity, with single women and women in social classes IV and V experiencing highest risks. The importance of maternal height as a risk factor for low birthweight mainly derives from its association with birthweight standardised for gestational age, for which it was by far the major predictor. Maternal height had only a small impact on the risk of preterm delivery. Women at the extremes of the maternal age distribution experienced substantially increased risks of low birthweight and preterm delivery, but not of delivering a small-for-gestational-age infant. A history of spontaneous abortion was a major risk factor of the three types of prematurity, as was a history of perinatal death. The association of previous induced abortion with low birthweight was primarily through preterm delivery, and there was little change in the risk of a small-for-gestational-age infant following induced abortion.

Some of the covariates varied in their association with different measures of low birthweight. Maternal height, for example, was a major predictor of birthweight below 2500 g, but its influence on birthweight below 1500 g and 1000 g was much reduced; similarly, marital status and social class were associated with a decreasing differential in the risks of birthweight below 2000 g, 1500 g, and 1000 g when compared to the risk below 2500 g. Female infants and infants of multiparae with three or more livebirths only experienced increased risks below 2500 g; the risks associated with the other intervals were close to 1.0.

On the other hand, unfavourable aspects of a woman's obstetric history were associated with an increased chance of birthweight below 1500 g and 1000 g rather than below 2500 g so that, for example, the risk associated with previous spontaneous abortion or perinatal death increased steadily with decreasing birthweights. A similar trend was observed among women with a history of induced abortion.

These patterns suggest that some of the factors traditionally associated with the classic definition of low birthweight result in higher than expected numbers of birthweights in the 2000-2499 g category but do not contribute to an appreciable increase in the risk of lower birthweights. Among these are marital status, social class, maternal height, and a large number of previous livebirths. These variables are socially determined or, like maternal height, may reflect the social background of the woman. The sex of infant also fell into the group of variables that were associated with a moderate increase in the risk of this upper band of the low birthweight population. The

Table 4 Adjusted risk ratios (with confidence intervals) for various factors in preterm delivery and small-for-gestational age infants (SGA) in primiparae and multiparae in Scotland^{5 6}

Covariate	Primiparae		Multiparae	
	Preterm delivery*	SGA**	Preterm delivery*	SGA**
Male	1.00	—	1.00	—
Female	0.89(0.80,0.98)	—	0.85(0.77,0.94)	—
Married	1.00	1.00	1.00	1.00
Single	1.45(1.26,1.67)	1.20(1.12,1.30)	1.65(1.29,2.13)	1.39(1.22,1.57)
Social class				
I-II	0.84(0.71,0.99)	0.77(0.71,0.83)	0.75(0.64,0.88)	0.70(0.65,0.75)
III	1.00	1.00	1.00	1.00
IV-V	1.10(0.96,1.27)	1.20(1.12,1.28)	1.09(0.96,1.24)	1.19(1.12,1.57)
Unknown	1.14(1.00,1.31)	1.09(1.02,1.17)	1.18(1.03,1.34)	1.27(1.20,1.35)
Height (cm)				
<150	1.46(1.15,1.84)	2.18(1.97,2.42)	1.08(0.85,1.36)	2.21(2.03,2.41)
150-164	1.00	1.00	1.00	1.00
≥165	0.75(0.66,0.86)	0.50(0.47,0.54)	0.91(0.80,1.02)	0.52(0.49,0.55)
Age (yr)				
<18	1.47(1.21,1.77)	0.81(0.72,0.90)	3.61(1.91,6.79)	1.16(0.75,1.79)
18-24	1.00	1.00	1.00	1.00
25-34	1.13(1.00,1.27)	0.97(0.91,1.02)	0.83(0.74,0.93)	0.85(0.81,0.89)
≥35	1.81(1.30,2.53)	1.02(0.84,1.24)	1.20(1.00,1.44)	0.91(0.83,1.00)
Previous spontaneous abortion				
0	1.00	1.00	1.00	1.00
1	1.21(1.01,1.46)	1.01(0.92,1.11)	1.26(1.11,1.43)	1.07(1.00,1.13)
≥2	1.54(1.05,2.42)	1.22(1.00,1.51)	1.81(1.30,2.17)	1.43(1.30,1.58)
Previous induced abortion				
0	1.00	1.00	1.00	1.00
≥1	1.28(1.06,1.56)	0.97(0.88,1.08)	1.57(1.34,1.89)	1.05(0.96,1.15)
Previous caesarean section				
0	—	—	1.00	1.00
≥1	—	—	1.19(1.02,1.39)	0.93(0.86,1.01)
Previous perinatal death				
0	—	—	1.00	1.00
≥1	—	—	2.36(2.02,2.76)	1.31(1.19,1.44)
Previous livebirths				
0-2	—	—	1.00	1.00
≥3	—	—	1.26(1.09,1.45)	1.08(1.01,1.16)

*Relative hazards of delivery during the preterm period, 1981.

**Relative odds ratios, infants born after 36 weeks 1980-2. Birthweight standards were controlled for sex which was not included as a covariate.

second group of variables were related to aspects of obstetric history and showed a different pattern of association with higher risks of birthweight below 1000 g. A history of perinatal death and spontaneous abortion, both of which indicate poor performance in earlier pregnancies, are of this kind. A history of induced abortion also comes into this group, possibly reflecting cases where termination was a medical necessity rather than a form of late contraception. It should be borne in mind that these two groups of factors (social and obstetric) are interrelated, and the relative contribution of each to the risk of lowered

birthweight may be changing over time.

The author gratefully acknowledges the helpful comments on earlier drafts of this paper by Dr F A Boddy, Mr J F Forbes, and Dr D H Stone. The data which made this analysis possible were kindly supplied by Dr S Cole, Information Services Division, Common Services Agency, Edinburgh. The Social Paediatric and Obstetric Research Unit is funded by the Scottish Home and Health Department and the Greater Glasgow Health Board.

References

- ¹ Joint Committee of the Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee. *Maternity in Great Britain*. London: Oxford University Press, 1948.
- ² Butler N R, Alberman E D. *Perinatal problems*. Edinburgh: E and S Livingstone, 1969.
- ³ Chamberlain R, Chamberlain G, Howlett B, Claireaux A. *British births 1970, Volume I: The first week of life*. London: William Heinemann Medical Books, 1975.
- ⁴ Peters T J, Golding J, Butler N R, Fryer J G, Lawrence C J, Chamberlain G V P. Plus ça change: predictors of birthweight in two national studies. 1983; **90**: 1040-5.
- ⁵ Pickering R M, Murray G D, Forbes J F. Pre-term foetal life times in Scotland. *Population Studies* 1986; **40**: 115-27.
- ⁶ Pickering R M. Maternal characteristics and the distribution of birthweight standardised for gestational age. *Biosoc Sci* 1987; (in press).
- ⁷ Knox E G, Lancashire R, Armstrong E H. Perinatal mortality standards: construction and use of a health care performance indicator. *J. Epidemio Commun Hlth* 1986; **40**: 193-204.
- ⁸ Cole S K. Scottish maternity and neonatal records. In: Chalmers I, McIlwaine G(eds). *Perinatal audit and surveillance*. London: Royal College of Obstetricians and Gynaecologists, 1980.
- ⁹ Pickering R M, Forbes J F. Risk of pre-term delivery and small for gestational age infants following abortion: a population study. *B J Obstet Gynaec* 1984; **92**: 1106-12.
- ¹⁰ Cox D R. *The analysis of binary data*. London: Methuen, 1970.
- ¹¹ Hall M H, Carr-Hill R. Impact of sex ratio on onset and the management of labour. *Br Med J* 1982; **285**: 401-3.
- ¹² Resseguie L J. The artefactual nature of effects of maternal age on risk of still birth. *J Biosoc Sci* 1977; **9**: 191-200.