Birth weight from pregnancies dated by ultrasonography in a multicultural British population

Mark Wilcox, Jason Gardosi, Max Mongelli, Caroline Ray, Ian Johnson

Abstract

Objective—To produce standard curves of birth weight according to gestational age validated by ultrasonography in the British population, with particular reference to the effects of ethnic origin.

Design—Retrospective analysis of computerised obstetric database.

Setting—Three large maternity units associated with Nottingham University with over 16 000 deliveries a year.

Patients—41 718 women with ultrasound dated singleton pregnancies and delivery between 168 and 300 days' gestation.

Main outcome measures—Length of gestation, ethnic origin, parity, maternal height and weight at booking, smoking during pregnancy; the effect of these variables on birth weight.

Results—Birth weights from ultrasound dated pregnancies have a higher population mean and show less flattening of the birthweight curve at term than those of pregnancies dated from menstrual history. Significant differences were observed in mean birth weights of babies of mothers of European origin (3357 g), of Afro-Caribbean origin (3173 g), and from the Indian subcontinent (3096 g). There were also significant interethnic differences in length of gestation, parity, maternal height, booking weight, and smoking habit which affected birth weight. The ethnic differences in birth weight were even greater when the effect of smoking was excluded.

Conclusions—Birthweight standards require precise dating of pregnancy and should describe the population from which they were derived. In a heterogeneous maternity population the accurate assessment of an individual baby's weight needs to take the factors which affect birthweight standards into consideration.

Introduction

The standard curves of birth weight that are commonly used in Britain are adjusted for gestational age as well as sex and parity.¹⁻³ Gestational age needs to be known accurately to calculate individual birthweight centiles correctly. These population standards were derived before routine ultrasound scanning allowed accurate dating of each pregnancy, and they had to rely on dates based on the last menstrual period. Use of menstrual history is unreliable,^{4,5} even when it is apparently known with certainty.⁶ Other factors recognised as important when assessing birth weight include maternal characteristics such as height, weight at booking, parity, and race or ethnic group.^{1,7-9} Using an obstetric computerised database of pregnancies dated by routine ultrasonography, we analysed the effect that these variables have on birth weight and present birthweight standards for a representative sample of a heterogeneous maternity population.

Patients and methods

Since 1986 three large maternity units in the east midlands (University and City Hospitals in Nottingham and Derby City Hospital) have progressively computerised their records of antenatal, intrapartum,

and postpartum care. The units deliver a total of 16 000 women annually from a well defined catchment area, with little flow out of the area and less than 1% of home deliveries. The method of data collection was as described elsewhere but was extended to the end of December 1991.⁹ Data from in utero transfers, multiple pregnancies, stillbirths, and congenitally abnormal babies were excluded. Also excluded were cases (7.5%) in which gestational age was not confirmed in an ultrasound scan by 24 weeks, which was taken as the latest gestational age for reliable dating.¹⁰ This left a total of 41 718 cases with gestational age confirmed by ultrasonography and delivery between 168 and 300 days. Most of these women (39 131; 93.8%) had a scan by 20 completed weeks. From 13 weeks onwards (39 930; 95.5% of cases) the gestational age assignment was by biparietal diameter measurement (in mm), from which gestation in weeks and days was derived according to charts by Campbell.¹¹ For earlier gestations, the length from crown to rump was used to derive the gestational age.¹²

Maternal ethnic group was recorded by origin as European (mainly English), Afro-Caribbean, Indian subcontinent, and other. The population was thus divided into four ethnic groups and analysed for maternal size, parity, gestational length, birth weight, fetal sex, and maternal smoking habit. Smoking was recorded as number of cigarettes smoked a day at booking and grouped into four categories (0, 1-9, 10-19, 20 or more). Maternal height and weight at booking were expressed and analysed as continuous variables. The gestational age at delivery was first expressed in days for analysis and then transformed into completed weeks to facilitate comparison with previously published birthweight standards. Most consultant firms had a policy of offering induction of labour 10 to 14 days after the expected date of delivery.

The database was transferred from mainframe to personal computer and analysed with individually compiled computer programs and a statistical package.¹³ The distribution of birth weight was analysed at completed weeks of gestation. The raw birthweight centiles from 26 weeks onwards were smoothed by weighted polynomial regression to the sixth power of gestational age. The weighting consisted of the inverse of the coefficient of variation at each week—that is, standard deviation divided by mean birth weight. The differences between ethnic groups were examined by analysis of variance.

Results

A check for bias in reporting gestational age at the booking ultrasound scan—that is, rounding off to full weeks—showed a fairly even distribution: the full week as an integer was recorded in 15.6% of cases, +1 day was recorded in 14.0%, +2 days in 13.6%, +3 in 14.0%, +4 in 14.4%, +5 in 14.0%, and +6 in 14.4%.

Table I presents the mean, standard deviation, and skewness of the distribution of birth weight at each completed week of gestation. The overall mean gestational age was 276.1 days (SD 13.4) and the mode 280 days; the distribution had a skewness of -2.1. The Kolmogorov-Smirnov test showed significant non-normality for the negatively skewed distribution of

Department of Obstetrics and Gynaecology, Nottingham University, Queen's Medical Centre, Nottingham NG7 2UH
Mark Wilcox, senior registrar
Jason Gardosi, senior lecturer
Max Mongelli, research fellow
Caroline Ray, research assistant
Ian Johnson, professor

Correspondence to:
Mr J Gardosi, Perinatal Research and Monitoring Unit, Queen's Medical Centre, Nottingham NG7 2UH.

BMJ 1993;307:588-91

preterm birth weights between 24 and 33 weeks' gestation ($p = 0.05$), as well as the positive skew for 34 to 36 weeks ($p < 0.05$) and 37 to 42 weeks ($p < 0.001$).

The empirical and smoothed centile values are shown in table II. Figure 1 gives the weighted regression curves for the 10th, 50th, and 90th centiles of birth weight according to gestational age. The relation of the 10th and 90th centile curves to the median curve illustrates the changing skewness with gestational age. Information on ethnic group was incomplete in 1503 files (3.6%), leaving 40 215 cases for this analysis. Table III presents the results of analysis of variance according to ethnic origin, showing the ethnic differences for mean birth weight, maternal physique (height and booking weight), parity, smoking habit, and length of gestation.

As gestational length may be affected by smoking, deliveries at 40 completed weeks were selected to compare mean birth weights of babies of smokers and non-smokers in different ethnic groups (table IV). The effect of smoking on birth weight was found to be dose related: at 40 weeks' gestation the mean birth weights in the four categories were 3580 g (non-smokers), 3416 g (1-9 cigarettes a day), 3374 g (10-19), and 3377 g (20 and more).

Discussion

A large database of pregnancies dated by ultrasonography allows description of the factors which influence birth weight in a multicultural population, including ethnic group, maternal height, maternal weight at booking, and smoking habit as well as the baby's sex and length of gestation. Gestational age is the most important variable affecting birth weight. The menstrual history may be unreliable because of irregular cycles or an inability to remember dates.^{4,5} Inclusion only of women who report certain menstrual histories may lead to a sample that is not representative of the whole population. Even when the dates seem to be known with certainty, close questioning shows confounding factors in over 50% of cases.⁶ Further problems are how to deal with cases when menstrual and scan dates disagree, which dates to use, whether to average them, and whether to exclude the cases in which one of these values is missing. Whereas in prospective studies a strict protocol for a best clinical estimate may allow inclusion of all mothers,¹⁴ dating by ultrasonography alone has been recommended to reduce error in epidemiological analysis.¹⁵ In our database a bias may be due to the exclusion of those women (7.5%) who booked too late for accurate dating of their pregnancy by ultrasonography.

FIG 1—Weighted regression curves for 10th, 50th, and 90th centiles of birth weight according to completed weeks of gestation ($n = 41\ 712$)

TABLE I—Birth weights by gestation according to early ultrasound scan ($n = 41\ 712$)

Gestation (weeks)	Males		Females		Total	Mean (SD) birth weight (g)	Skewness*
	No	Mean (SD) birth weight (g)	No	Mean (SD) birth weight (g)			
24	11	738 (94)	4	690 (80)	15	725 (91)	0.37
25	9	867 (68)	6	847 (101)	15	859 (80)	-0.12
26	15	963 (166)	10	918 (130)	25	945 (152)	0.10
27	27	1096 (198)	15	1021 (136)	42	1069 (180)	-0.37
28	27	1181 (226)	21	1087 (225)	48	1140 (228)	-0.17
29	34	1336 (271)	28	1207 (219)	62	1278 (255)	-0.26
30	28	1622 (308)	29	1507 (311)	57	1563 (312)	-0.93
31	59	1733 (307)	50	1611 (393)	109	1677 (353)	-0.21
32	81	1947 (403)	61	1755 (408)	142	1864 (415)	-0.23
33	110	2201 (334)	104	2065 (392)	214	2135 (369)	0.06
34	197	2370 (382)	162	2257 (386)	359	2319 (387)	0.20
35	359	2591 (414)	289	2532 (454)	648	2565 (433)	0.19
36	654	2821 (444)	593	2748 (409)	1 247	2786 (429)	-0.02
37	1590	3053 (445)	1465	2942 (436)	3 055	3000 (444)	0.15
38	3153	3250 (424)	3249	3153 (421)	6 402	3201 (425)	0.14
39	5345	3421 (421)	5177	3313 (412)	10 522	3368 (420)	0.24
40	5689	3596 (441)	5678	3466 (417)	11 367	3531 (434)	0.25
41	3347	3725 (443)	2875	3591 (428)	6 222	3663 (441)	0.20
42	678	3814 (468)	483	3667 (458)	1 161	3753 (469)	0.12

* $p = 0.05$ For cases grouped 24 to 33 weeks' gestation; $p < 0.05$ for cases grouped 34 to 36 weeks' gestation; and $p < 0.001$ for cases grouped 37 to 42 weeks' gestation.

TABLE II—Empirical and smoothed birthweight centiles for gestation

Gestation (weeks)	Empirical centiles			Smoothed centiles		
	10th	50th	90th	10th	50th	90th
26	712	930	1188	718	934	1151
27	770	1085	1308	747	1055	1302
28	800	1160	1402	813	1195	1473
29	886	1320	1621	913	1354	1662
30	1134	1580	1912	1044	1528	1867
31	1150	1700	2060	1202	1717	2087
32	1200	1920	2317	1385	1918	2319
33	1685	2145	2600	1587	2128	2558
34	1840	2310	2780	1803	2344	2803
35	2059	2575	3060	2027	2562	3048
36	2250	2790	3320	2253	2778	3290
37	2450	2980	3540	2472	2987	3522
38	2670	3200	3740	2678	3185	3740
39	2850	3350	3900	2859	3365	3937
40	3000	3520	4100	3006	3522	4107
41	3120	3650	4220	3108	3649	4241
42	3152	3740	4360	3152	3737	4331

DATING BY ULTRASONOGRAPHY

Two effects of certain gestational dates are higher term birth weights and reduced flattening of the birthweight curve when compared with previous studies based on best guess estimates for gestational age (fig 2). Whereas the birth weights found by Lubchenco *et al* are lighter because their population lived at relatively high altitude,¹⁶ the mean birth weights at term and overall in the studies of Thompson *et al*¹ and Yudkin *et al*¹⁷ are also lower than those in ours. A more recent study of over 17 000 birth weights in Germany also showed flattening at term; menstrual histories were confirmed by ultrasonography but no details are given about the gestational age and method of scan dating or the proportion of cases this applied to.¹⁷

A relation between inaccurate dates and flattening of the weight curve at term has been noted previously,¹⁸ and our data suggest that graphs of birth weight by correctly dated gestational age are more linear. This effect may be related to real compared with assumed length of pregnancy. In our study ultrasound dating resulted in a lower mean length of gestation than dating by menstrual history (276 v 279 days, respectively). This predominantly lengthening effect of menstrual dates on true gestational age is well recognised,^{19,20} and similar discrepancies between ultrasound and menstrual dates have been reported from smaller studies.⁶ This error would result in many term and post-term birth weights from menstrual data to be plotted against later points in gestation, which would be an explanation for undue terminal flattening of the birthweight curve.

Dating by ultrasound scan classified 7.2% of deliveries as preterm (fewer than 259 days) and 2.2% as post-term (more than 294 days). In contrast, 6.6% and 9.3% respectively of certain menstrual history dated pregnancies delivered preterm and post-term. Use of scan dating has therefore reduced the deliveries classified as post-term to less than a quarter of its previous proportion. A pregnancy that is post-term by menstrual history is much more likely to have wrong dates than be truly overdue.

Another effect of precise dating relates to the distribution of birth weights at each gestation, illustrated by a comparison of the coefficients of variation—that is, standard deviation divided by mean weight expressed as a percentage. At 37 and 42 weeks our data show coefficients of 14.8% and 12.5%, respectively, lower than those derived at the same gestations from Thompson *et al* (16.0, 14.3)¹ and Lubchenco *et al* (16.2, 16.1).¹⁶ Yudkin *et al* presented separate values for boys and girls, which precludes overall comparison, but for boys alone our coefficients of variation at 37 and 42 weeks (14.6, 12.3) are smaller than those calculated from their data (15.2, 13.3).³

TABLE III—Differences by ethnic origin for all cases coded for ethnic group (n = 40 215)

	English/ European	Afro- Caribbean	Indian or Pakistani	Other	Total
No (%)	37 336 (92.8)	1008 (2.5)	1547 (3.8)	324 (0.8)	40 215
Mean (SD) birth weight (g)	3 364.8 (550.9)	3198.8 (559.5)	3091.8 (519.0)	3236.5 (528.7)	3 349.1 (552.9)
Mean (SD) gestation (days)	276.3 (13.1)	273.6 (15.0)	273.0 (12.5)	274.9 (14.0)	276.1 (13.2)
Mean (SD) maternal height (cm)	162.5 (6.3)	163.0 (6.1)	157.8 (5.9)	158.9 (6.6)	162.3 (6.4)
Mean booking weight (kg)	65.9 (12.5)	67.9 (12.6)	59.6 (11.1)	60.7 (12.0)	65.7 (12.5)
No	36 150	966	1503	318	38 937
Parity (No (%)):					
0	16 065 (44.4)	407 (42.1)	463 (30.8)	127 (39.9)	17 062 (43.8)
1	12 751 (35.3)	316 (32.7)	445 (29.6)	108 (34.0)	13 620 (35.0)
2	4 945 (13.7)	149 (15.4)	284 (18.9)	49 (15.4)	5 427 (13.9)
3	1 613 (4.5)	63 (6.5)	148 (9.8)	22 (6.9)	1 846 (4.7)
≥ 4	776 (2.1)	31 (3.2)	163 (10.8)	12 (3.8)	892 (2.5)
No	35 750	958	1479	314	38 501
Smoking (No of cigarettes/day) (No (%)):					
None	25 700 (71.9)	679 (70.9)	1449 (98.0)	260 (82.8)	28 088 (73.0)
1-9	4 194 (11.7)	161 (16.8)	20 (1.4)	34 (10.8)	4 409 (11.5)
10-19	4 677 (13.1)	102 (10.6)	9 (0.6)	14 (4.5)	4 802 (12.5)
≥ 20	1 179 (3.3)	16 (1.7)	1 (0.1)	6 (1.9)	1 202 (3.1)

TABLE IV—Mean birth weights (g) of babies delivered at 40 completed weeks of gestation to smokers and non-smokers in each ethnic group

Ethnic group	Non-smokers		Smokers		Total	
	Birth weight	No	Birth weight	No	Birth weight	No
European	3593	7390	3394	2541	3542	9 931
Afro-Caribbean	3457	169	3351	67	3427	236
Indian or Pakistani	3339	282	3403	3	3340	285
Other	3391	63	3405	13	3394	76
Total	3580	7904	3393	2624	3533	10 528

FACTORS AFFECTING BIRTH WEIGHT

The observed negative skewness in the preterm period is consistent with the suggestion that babies with growth retardation may be born earlier than those of appropriate size.^{21 22} The positively skewed distribution we observed at later gestations is, however, not explained by an association between prematurity and growth retardation as many more babies are born at term. We have also shown that it is probably not due to a systematic rounding error in gestational age at the booking scan. One possibility may be that the dating charts themselves are not accurate for this population.

Table III shows a clear link between ethnic group and birth weight, as well as variables such as maternal physique, length of gestation, and parity. For example, mothers from the Indian subcontinent tend to be smaller, to have more children, and to deliver earlier than their European counterparts. These

FIG 2—Median birth weight according to completed weeks of gestation in four studies

factors are known to be independent variables affecting birth weight⁸ and contribute to the overall weight difference between ethnic groups. Differences are also apparent between Europeans and the unclassified ethnic group ("other"), although this group was too small and heterogeneous for meaningful comparisons.

Another striking feature is the effect of smoking (tables III and IV), which may act independently and also as a marker for other factors affecting fetal growth.²³ Again, there is considerable intercultural difference. Almost 30% of women of European and Afro-Caribbean origin admitted to smoking, while less than 3% of Indians and Pakistanis did. In both the European and Afro-Caribbean subgroups smoking considerably reduced birth weight. The largest reduction was seen in Europeans, who were also the heaviest smokers (table III). When we excluded this apparent growth retarding effect of smoking by comparing non-smokers only (table IV) we found an even greater ethnic influence on birth weight.

Several pathological factors and events in pregnancy are recognised as affecting birth weight—for example, pre-eclampsia and diabetes mellitus. With the exception of smoking, however, they are rare and seem to make little impact on overall population characteristics.

Clinical implications

- Ultrasound dating of pregnancy is required to derive gestational age for an accurate assessment of birth weight
- A pregnancy that is considered post-term by menstrual history is four times more likely to have wrong dates than be truly post-term
- Birthweight standards depend on the characteristics of the population from which they are derived
- Variation in birthweight standards between different ethnic groups need to be considered when assessing individual babies
- The average difference in birth weight between babies of smoking and non-smoking mothers is just under 200 g

CONCLUSION

Birthweight standards evidently vary with ethnic or cultural characteristics as well as with maternal height, weight, and parity and the sex of the baby. All such physiological factors need to be considered when assessing an individual birth weight, and we have therefore refrained from producing charts which can include only some of these variables, such as sex and parity. This can be done by calculating a customised birthweight centile in reference to a normal range which is adjusted by computer for each pregnancy to allow for non-pathological variation.⁸ Alternatively, birthweight can be expressed as an individualised birthweight ratio—that is, the ratio of actual to expected weight calculated for each baby.⁹ A generalised standard of weight for gestational age has limited application in assessing individual birth weight. As a descriptive population standard, it is meaningful only if it includes details of the heterogeneity of the sample.

- 1 Thomson AM, Billewicz WZ, Hytten FE. The assessment of fetal growth. *Journal of Obstetrics and Gynaecology of the British Commonwealth* 1968;75: 903-16.
- 2 Car-Hill R, Pritchard C. *The derivation and exploitation of birthweight standards*. London: Macmillan, 1985.
- 3 Yudkin PL, Aboualfa M, Eyre JA, Redman CWG, Wilkinson AR. New birthweight and head circumference centiles for gestational ages 24 to 42 weeks. *Early Hum Dev* 1987;15:45-52.
- 4 Campbell S, Warsof SL, Little D, Cooper DJ. Routine ultrasound screening for the prediction of gestational age. *Obstet Gynecol* 1985;65:613-20.
- 5 Hall MH, Carr-Hill RA. The significance of uncertain gestation for obstetric outcome. *Br J Obstet Gynaecol* 1987;92:452-60.
- 6 Geirsson RT, Busby-Earle RMC. Certain dates may not provide a reliable estimate of gestational age. *Br J Obstet Gynaecol* 1991;98:108-9.
- 7 Grundy MFB, Newman GB. Birthweight standards in a community of mixed racial origin. *Br J Obstet Gynaecol* 1978;85:481-6.

- 8 Gardosi J, Chang A, Kalyan B, Sahota D, Symonds EM. Customised antenatal growth charts. *Lancet* 1992;339:283-7.
- 9 Wilcox MA, Johnson IR, Maynard PV, Smith SJ, Chilvers CED. The individualised birthweight ratio: a more logical outcome measure of pregnancy than birthweight alone. *Br J Obstet Gynaecol* 1993;100:342-7.
- 10 Campbell S, Trickey N, Whittle M. *Report of the RCOG Working Party on Routine Ultrasound Examination in Pregnancy*. London: Chameleon, 1984.
- 11 Campbell S. Growth of fetal biparietal diameter during normal pregnancy. *Br J Obstet Gynaecol* 1971;78:513-9.
- 12 Robinson HP, Fleming JEE. A critical evaluation of sonar "crown-rump length" measurements. *Br J Obstet Gynaecol* 1975;82:702-10.
- 13 SPSS Incorporated. *Statistical package for the social sciences PC+*. Chicago: SPSS, 1988.
- 14 Hall MH. Definitions used in relation to gestational age. *Pediatric and Perinatal Epidemiology* 1990;4:123-8.
- 15 Geirsson RT. Ultrasound instead of last menstrual period as the basis of gestational age assignment. *Ultrasound in Obstetrics and Gynecology* 1991;1: 212-9.
- 16 Lubchenco LO, Hansman C, Dressler M, Boyd E. Intrauterine growth as estimated from liveborn birth-weight data at 24 to 42 weeks of gestation. *Pediatrics* 1963;32:793-800.
- 17 Roemer VM, Buehler K, Kieback DG. Gestationszeit und Geburtsgewicht. 1. Mitteilung: Intrauterine Wachstumskurven. *Z Geburtshilfe Perinatol* 1990; 194:241-53.
- 18 Chamberlain R, Chamberlain G, Howlett B, Claireaux A. *British births 1970*. Vol I. London: Heineman, 1975:48-88.
- 19 Persson PH, Kullander S. Long-term experience of general ultrasound screening in pregnancy. *Am J Obstet Gynecol* 1983;146:942-7.
- 20 Waldenström U, Axelsson O, Nilsson S. A comparison of the ability of a sonographically measured biparietal diameter and the last menstrual period to predict the spontaneous onset of labour. *Obstet Gynecol* 1990;76:336-8.
- 21 Persson P-H. Fetal growth curves. In: Sharp F, Fraser RB, Milner RDG, eds. *Fetal growth: proceedings of the 20th study group of the Royal College of Obstetricians and Gynaecologists*. London: RCOG, 1989:13-25.
- 22 Weiner CP, Sabbagha RE, Vaisrub N, Depp R. A hypothetical model suggesting suboptimal intrauterine growth in infants delivered preterm. *Obstet Gynecol* 1985;65:323-6.
- 23 Anderson HR, Bland JM, Peacock JL. The effects of smoking on fetal growth. In: *Proceedings of symposium on effects of smoking on the fetus, neonate and child*. London: Independent Scientific Committee on Smoking and Health, Ciba Foundation, 1990.

(Accepted 24 June 1993)

Gastric cancer: a curable disease in Britain

H M Sue-Ling, D Johnston, I G Martin, M F Dixon, M R J Lansdown, M J McMahon, A T R Axon

Abstract

Objective—To determine whether more vigorous efforts aimed at earlier diagnosis allied to radical surgical resection lead to improved survival of patients with gastric cancer.

Design—Prospective audit of all cases of gastric cancer treated during 1970-89.

Setting—Department of surgery, general hospital.

Subjects—493 consecutive patients with gastric adenocarcinoma.

Main outcome measures—Operative mortality, postoperative morbidity, and five year survival after radical potentially curative resection.

Results—207 (42%) patients underwent potentially curative resection. The proportion of all patients in whom this was possible increased significantly ($p < 0.01$) from 31% in the first five year period to 53% in the last five year period. The proportion of patients who had early gastric cancer rose from 1% to 15% ($p < 0.01$) and stage I disease rose from 4% to 26% ($p < 0.001$). After potentially curative resection, mortality 30 days after operation was 6%. Operative mortality decreased from 9% in the 1970s to 5% in the 1980s. Likewise, the incidence of serious postoperative complications decreased from 33% in the 1970s to 17% in the 1980s ($p < 0.01$). Five year survival was 60% in patients who underwent curative resection, 98% in patients with early gastric cancer, and 93%, 69%, and 28% in stage I, II, and III disease respectively. By the late 1980s five year survival after operation was about 70%.

Conclusions—These findings suggest that an increasing proportion of patients with gastric cancer

could be diagnosed at a relatively early pathological stage when about two thirds are curable by means of radical surgery.

Introduction

Gastric cancer is the fourth commonest cause of death from cancer in the United Kingdom, after cancer of the bronchus, colon and rectum, and breast, and still accounts for about 10 000 deaths each year.¹ In Britain, as in much of the West, the results of treatment of gastric cancer have always been poor²⁻⁵ and even in recent years have shown little sign of improvement.^{6,7} Thus, in a large population based study from the west Midlands Allum *et al* found that five year survival for all patients with gastric cancer was 5%, and even after potentially curative resection it was only 20%.⁷ Moreover, these authors found that the stage of disease was usually advanced at the time of diagnosis and had not changed much throughout the 25 year period of review. From 1957 to 1981 fewer than 1% of patients presented with stage I disease, and curative resection was possible in only 20-25% of patients. Operative mortality was 16% after potentially curative resection and 25% after palliative resection. Not surprisingly, therefore, a diagnosis of gastric cancer in Britain has come to be regarded by doctors and patients alike as virtually a sentence of death.

In Japan, by contrast, the results of treatment of gastric cancer are much better: more than half the patients have stage I disease at presentation, operative mortality is only 1-3%, and five year survival after curative resection is over 60%.^{8,9} Furthermore, Japanese results are improving; patients treated in the

Academic Units of Surgery and Pathology and Department of Gastroenterology, Centre for Digestive Diseases, The General Infirmary, Leeds LS1 3EX
H M Sue-Ling, consultant surgeon
D Johnston, professor of surgery
I G Martin, registrar
M F Dixon, reader in pathology
M R J Lansdown, senior registrar
M J McMahon, reader in surgery
A T R Axon, consultant physician

Correspondence to: Mr Sue-Ling.

BMJ 1993;307:591-6