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## Changes in distribution of gestational age and birth weight among firstborn infants of Cardiff residents

ROBERT NEWCOMBE, IAIN CHALMERS

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### Summary

We studied data on firstborn singleton infants born to primiparous Cardiff residents during the decade 1965-1974. Both mean birth weight and gestational age at delivery fell appreciably during 1965-74. Changes in maternal age, height, smoking habits, or history of abortion did not explain these findings.

The increased proportion of infants weighing <2500 g may be explained by the overall reduction in gestational age at delivery, which, in turn, may have resulted from increased use of elective delivery during the second quinquennium.

### Introduction

A study<sup>1</sup> of neonatal practice and outcome among infants born to Cardiff residents during the decade 1965-1974 showed a significant shift in the distribution of birth weight and gestational age at delivery. During the second quinquennium relatively more infants were born weighing <2500 g and before completion of 36 weeks' gestation. Both these observed shifts persisted after further analysis within parity groups. Because low birth weight and preterm delivery are such important indicators of neonatal mortality and morbidity, we investigated these changes in greater detail.

Department of Medical Statistics, Welsh National School of Medicine, Cardiff CF4 4XN

ROBERT NEWCOMBE, MA, FSS, research fellow  
IAIN CHALMERS, DCH, MRCP, MRC research fellow

### Materials and methods

We used the Cardiff Births Survey<sup>2,3</sup> to study liveborn singleton infants of primiparous Cardiff residents delivered during the quinquennia 1965-69 and 1970-74. Cases were included if the date of the last menstrual period was certain and the birthweight, maternal age, height, smoking habits, and history of abortion (spontaneous or induced) were known. There were 12 357 such cases, almost equally divided between the two quinquennia. Restriction of the study population to primiparae removes the effect of the declining birth rate (which has resulted from a decrease in completed family size), and eliminates artefactual biases caused by reproductive compensation.<sup>4</sup>

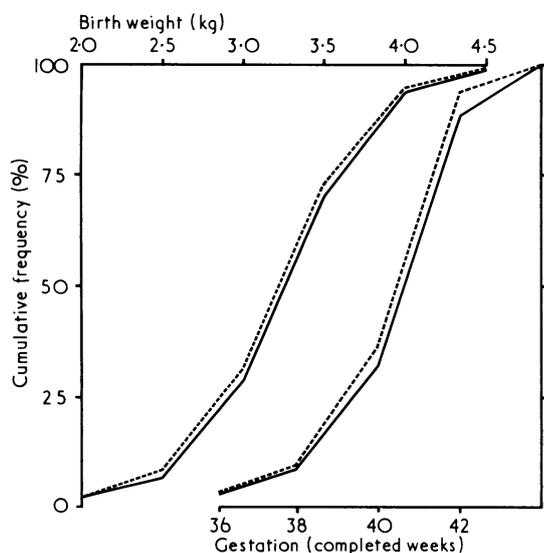
We analysed birth weight and gestational age in terms of mean and standard deviation because of the virtually parallel shift in cumulative frequency distributions (figure). We compared characteristics of the parturient populations in the two quinquennia by using the  $\chi^2$  test at one degree of freedom with Yates's correction (table I). To analyse further the decrease in mean birth weight and gestational age adjustment was made for each of the "explanatory" variables individually, and a summary variable taking 16 values representing all possible combinations of the dichotomies indicated in table I was used; *t* tests were performed using pooled variances from within quinquennia. Thus, for example, the fall in gestational age was calculated separately in non-smokers and smokers (by quantity smoked); a weighted mean was then formed, appropriate for a  $2 \times n$  analysis of variance.<sup>5</sup>

### Results

Table I shows how some characteristics of the primiparous population changed. The increased prevalence of a history of abortion may reflect a real change or a greater readiness to volunteer information on previous termination of pregnancy. There were relatively more teenage primiparae in the second quinquennium. The proportion of women who had never smoked increased slightly; among those who smoked, the mean number of cigarettes consumed daily increased, but this was partly offset by changes in cigarette size and composition.<sup>6</sup>

Both mean birth weight and mean gestational age at delivery fell appreciably (table II and figure). This cannot be explained by changes

in the explanatory variables, but examination of the fall in birth weight within one-week classes of gestational age suggests that it is likely to have been secondary to the fall in gestational age.



Cumulative frequency distributions of birth weight and gestational age of firstborn singleton infants of Cardiff residents 1965-9 (solid line) and 1970-4 (dashed line).

TABLE I—Changes in characteristics of primiparae resident in Cardiff 1965-1974

Characteristics	1965-9 (n = 6207)	1970-4 (n = 6150)	$\chi^2$	P value
Previous abortion ..	513 (8.3%)	721 (11.7%)	40.73	P < 0.001
Maternal age under 20 ..	1545 (24.9%)	1728 (28.1%)	16.15	P < 0.001
Never smoked ..	3317 (53.4%)	3446 (56.0%)	8.28	P < 0.005
Height < 1.57 m ..	1780 (28.7%)	1798 (29.2%)	0.44	NS

TABLE II—Crude and adjusted changes in mean gestational age and birthweight of firstborn singleton infants of Cardiff residents, 1965-9 and 1970-4

	Gestational age (weeks)	Birthweight (g)
Mean ( $\pm$ SD) 1965-9 .. ..	39.813 ( $\pm$ 1.724)	3207.6 ( $\pm$ 509.1)
Mean ( $\pm$ SD) 1970-4 .. ..	39.575 ( $\pm$ 1.667)	3175.5 ( $\pm$ 514.1)
Fall in mean value .. ..	0.238	32.1
t .. ..	7.80	3.49
Fall adjusted for:		
Abortion history .. ..	0.230	30.0
Maternal age .. ..	0.235	31.5
Smoking habits .. ..	0.234	29.0
Height .. ..	0.238	30.8
All of the above simultaneously	0.228	31.0
Gestational age .. ..		9.9

## Discussion

The changes we have described resulted in a 12% increase in the proportion of infants weighing less than 2500 g, and a 10% increase in those born before 36 completed weeks of gestation. Whatever the cause of this change, it must be interpreted as having tended to increase the risk of perinatal morbidity until proved otherwise.

We could not explain these observations by examining secular changes in maternal age, height, abortion history, and smoking habits. Another possible influence may have been the 1970 influenza epidemic. This epidemic was probably responsible for an increase in the incidence of low birth weight and prematurity among infants born during the second quarter of 1970.<sup>7, 8</sup> Nevertheless, we think that the impact of changes referable to a

period of three or four months is unlikely to have accounted for the differences between the two five-year periods which we have examined.

A further possible explanation may be the higher incidence of elective delivery in the second quinquennium (2237; 36.4% of all cases) compared with the first (1590; 25.6%). The investigation of this hypothesis is severely compromised by the effect demonstrated by Yudkin<sup>9</sup>: secular changes in the use of planned delivery are inevitably associated with changes in the characteristics of parturients and infants in both the planned and unplanned groups. Nevertheless, certain considerations tend to support the hypothesis as applied to these data: (1) the shift in the distribution of gestational age at delivery appears to have been the major determinant of the shift in the birth weight distribution; (2) the most striking element in the shift was the reduced proportion of deliveries at 42 weeks' gestation or later; (3) elective delivery occasionally results in unintentional prematurity<sup>10-13</sup>; (4) analysis of data published by the Committee on the Child Health Services<sup>14</sup> shows that the proportion of infants weighing between 2000 and 2500 g at birth increased significantly at national level during the decade we have examined; (5) the hypothesis is further supported by differences in the distribution of gestational age among infants delivered by obstetric teams operating different policies on elective delivery.<sup>3</sup>

The rationale underlying *selective* planned delivery is that a fetus compromised by its intrauterine environment should be delivered to the neonatal paediatricians in a condition which enables them to provide it with a superior environment. Clearly the weight of the fetus cannot influence this decision, and where facilities for good neonatal care exist gestational age seems to have become a less important criterion than hitherto.

Low birth weight and early gestational age are not, of themselves, measures of neonatal morbidity. It could be argued that the changes we noted in these variables may not have been accompanied by adverse changes in more direct measures of morbidity. Nevertheless, the incidence of respiratory distress syndrome has increased in our population,<sup>1</sup> a finding which is consistent with our data. A recent American study showed that 12% of the cases of respiratory distress syndrome referred to a major neonatal intensive care unit were born after elective delivery.<sup>13</sup> While we still cannot prove that an increased use of elective delivery caused the changes we have described, we feel that our findings emphasise the need for care in both the selection of cases for elective delivery and the assessment of their gestational and functional maturity.

This work was feasible because the Cardiff Births Survey constitutes a unique source of the necessary data. We are indebted to the many people who have contributed to the success of the project, and to the Welsh Office for continuing to fund it. We also thank Mrs Wynne Hockings for typing the manuscript.

Requests for reprints should be sent to Mr Robert Newcombe.

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