invasive cancer of the cervix. Of the women who presented with invasive cervical cancer in British Columbia over the past 10 years, 69% were over age 50 and three fourths had not had a cytological examination before developing clinical symptoms. A small proportion of these patients had consulted their physicians for non-gynaecological problems before developing symptoms and had never had a cervical smear, which might have detected the disease at an earlier stage. If morbidity and mortality from cancer of the cervix are to be further reduced it is this segment of the population that must be reached and persuaded to participate in the screening programme.

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Changes in maternal age distribution and their possible impact on demand for prenatal diagnostic services

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Abstract

Between 1977 and 1985 there was a 65% increase in births to women aged 35 or more in England and Wales, but only a 15% increase in all births. Two factors of roughly equal importance were responsible for this differential increase. Firstly, the proportion of older women (35-44) among all women of reproductive age (15-44) increased from 28% in 1977 to 31% in 1985; and, secondly, in the same period the fertility rate for women aged 35-39 increased from 18.2 to 24.1 per 1000 and for women aged 40-44 from 4.1 to 4.6 per 1000.

The increased fertility rate among older women is not due to an extension of the reproductive period but to a delay in childbearing. This delay was seen in women married only once and also in those who had remarried.

As prenatal diagnosis for the exclusion of chromosome abnormalities is customarily offered to older mothers the increased numbers of women aged 35 or more and their increased fertility rate have important implications for the provision of obstetric and laboratory services. There were 51 859 live births to women aged 35 and over in 1985; the projected figure for 2001 is 85 000. If the use of prenatal diagnosis continues to increase facilities for about 70 000 prenatal cytogenetic analyses will be needed in 2001.

Introduction

The incidence of trisomy 21, as well as of other autosomal trisomies and sex chromosome aneuploidies, increases with maternal age. The effect becomes quite striking in mothers aged 35 or older.

There is a 0.26% risk of a woman aged 35 having a liveborn child with trisomy 21 and a 0.49% risk of her having a child with any chromosome abnormality. At age 45 these risks are 3.3% and 5.6%, respectively.¹

In many parts of the United Kingdom older mothers are offered amniocentesis or chorionic villus biopsy for exclusion of fetal chromosome abnormalities. Data relating to the rate of use of chorionic villus biopsy are not yet available, but those for amniocentesis show steady increases over the past decade. Ferguson-Smith reported that in the west of Scotland the use of amniocentesis by mothers aged 35 or over rose from 8% in 1976 to 28% in 1981.² Similarly, Walker and Howard recorded an increase from 27% in 1978 to 44% in 1983 in Liverpool.³ In Edinburgh in 1986 we estimate that about half the population of mothers aged 35 or over underwent amniocentesis.

An important factor to consider in estimating future requirements for prenatal diagnosis is the maternal age distribution of the population. This study was undertaken to investigate changes in the number of births among women 35 years or older in England and Wales between 1946 and 1985 and to identify factors influencing these changes that might affect the provision of prenatal diagnostic services in the future.

Subjects and methods

The data used in this study were obtained from the yearly publications entitled *Birth Statistics*, published by the Office of Population Censuses and Surveys.⁴ From these we obtained, for England and Wales, the number of births in each year of the study period to women in different age groups, with different numbers of marriages and different numbers of previous liveborn children. We also obtained fertility rates (mean number of live births per woman) and the estimated total numbers of women of different age groups in the population.

From these data we calculated the percentages of live births to women aged 35 or over for all women, women married only once, and women in their second or later marriage. Both for women married only once and for remarried women we calculated separately the percentages of first live births (live births to women who had had no liveborn children in their present or

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any previous marriage) to mothers aged 35 and over and the percentages of all births to mothers aged 35 and over to mothers with three or more previous liveborn children. Finally, we calculated the percentages of legitimate live births to married women aged 35 and over that were to women in a second or later marriage.

Results

Figure 1 shows the total number of live births in each year studied. There were peaks in the number of births in 1947 (immediately after the war) and again in 1964, after which there was a decline in the total number of births until 1977, since when there has been a gradual increase. Also shown in the

FIG 1—Total live births to all women and to women aged 35 years and over.

figure are the numbers of live births to women aged 35 and over. In comparison with the total number of live births these numbers are small, but it is interesting to note that between 1977 and 1985 there was a 65% increase in the number of live births to women in this age group but only a 15% increase in the total number of live births.

In figure 2 the percentage of live births that were to women over the age of 35 is shown. We have also plotted the percentage of women aged 35-44 of all those of reproductive age (15-44). Comparison of this curve with the lower curve in figure 1 indicates that the recent increase in the proportion of older women among all those of reproductive age has probably been an important factor influencing the increase in the number of births to older mothers.

FIG 2—Percentage of women aged 35-44 of all those aged 15-44 and percentage of all live births that were to women aged 35 years and over.

FIG 3—Percentage of legitimate live births that were to women aged 35 years and over in relation to all legitimate live births to once married women and to women in a second or later marriage.

TABLE 1—Fertility rates (number of live births per 1000 women) for women of different age groups

Year:	1960	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
Age:																										
35-39	46.4	48.1	48.6	48.4	49.8	48.1	45.3	43.2	40.3	37.3	34.7	32.8	28.9	24.5	21.5	19.9	18.6	18.2	19.5	21.3	22.3	21.7	22.8	23.1	23.6	24.1
40-44	13.8	14.1	14.1	13.4	13.0	12.6	11.7	11.2	10.4	9.5	8.6	8.1	7.1	6.1	5.4	4.8	4.4	4.1	4.2	4.4	4.3	4.4	4.2	4.4	4.5	4.6

After 1977 the fertility rate among women aged 35 and over increased (table 1), which would also have increased the number of births to older mothers. This increase in the fertility rate could be due to women delaying starting a family until they are older or to women having a larger family, particularly if they have children in a second or later marriage, or both. Unfortunately, no figures are available for the fertility rates in women married only once and in women who remarry or of the total numbers of these two groups of women. We obtained some information, however, about the change in the fertility rate from the following calculations.

Figure 3 shows the percentages of live births that occurred at the age of 35 and over to women married once and to those who were in a second or later marriage. For women married only once this percentage gradually declined to a minimum of 4.9% in 1977 and then increased to 7.3% in 1985. Among women in their second or later marriage this percentage increased from a minimum of 16.7% in 1977 to 24.1% in 1985.

Thus in both groups of women the percentage of births to women aged 35 years or over increased in recent years. If this increase was at least partly the result of women delaying starting a family until they were older we might expect an increase in the percentage of first live births that were to women aged 35 years or over. This was, in fact, the case. For women married only once the percentage of first live births to women aged 35 or over decreased from 3.9% in 1960 to 1.9% in 1977 and gradually increased to 3.1% in 1985. For remarried women the percentage was 22% in 1960, reached a minimum of 8.9% in 1977, and increased to 15.3% in 1985.

To investigate the possibility that the increased fertility in older women had been influenced by their having a larger family, particularly if they had been married more than once, we calculated the percentages of all live births to women aged 35 and over that were to women who already had three or more liveborn children. For women married only once there was a gradual decrease in this percentage from 45% in 1960 to 26% in 1985. For remarried

women the corresponding percentages were 50% and 29%. There was thus no evidence from these data that women were having more children by continuing to reproduce after the age of 35.

Interestingly, between 1946 and 1969 the proportion of all live births to married women aged 35 or over that were to women in a second or later marriage was 6.9-9.2%. Table II shows that between 1970 and 1985 this percentage rose nearly threefold, from 7.9% to 22.1%. As there is no evidence from our calculations that remarried women are having larger families than women who marry only once, this increased percentage presumably reflects the increased divorce and remarriage rate.

both groups we suspect that the decision to establish a career before having children was an important causative factor.

Data from the United States show similar trends to those reported here.⁵ The proportion of live births to older mothers increased from 4.4% in 1977 to 5.7% in 1985 and is projected to increase to 8.6% by the year 2000. Goodwin and Huether, however, though conceding that delayed childbearing is the "US fertility phenomenon of the 1980s," regard it as being less important than the change in the age structure of the population after the second world war. Our

TABLE II—Percentage of legitimate live births to married women aged 35 years and over who were in a second or later marriage

Year	1960	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
%	8.1	7.6	7.4	7.0	6.9	6.7	6.9	7.3	7.4	7.7	7.9	8.5	9.6	11.2	13.2	14.1	15.3	16.5	17.4	19.2	18.9	20.1	19.9	20.4	21.5	22.1

TABLE III—Estimated population, fertility rate, and number of live births for women aged 35 and over in 1977 and 1985

Age group of women (yrs)	1977			1985		
	Estimated population (1000s)	Fertility rate/1000 women	Total live births	Estimated population (1000s)	Fertility rate/1000 women	Total live births
35-39	1405.2	18.17	25 527	1842.0	24.10	44 393
40-44	1362.5	4.06	5534	1505.2	4.57	6882
≥45	1424.4	0.32	454	1393.9	0.42	584

It thus seems that the main factors causing the recent increase in the number of births to women aged 35 and over are probably the increase in the proportion of older women among those of reproductive age and the increased fertility rate among these women as a result of a delay in starting a family. We attempted to obtain an estimate of the relative importance of these factors. Table III gives the estimated population, the fertility rate, and the total number of live births for three groups of older women for 1977 and for 1985. The actual increase in the total number of live births over this period was 64.5%. From the figures in the table we can calculate that if there had been an increase only in the number of women over 35 between 1977 and 1985 and no increase in the fertility rate there would have been a 27% increase in the number of live births. If there had been an increase only in the fertility rate there would have been a 29.1% increase in the number of live births. The remaining increase of 8.4% is the result of the interaction of the two factors. Therefore it seems that the increase in the number of women aged 35 and over and their increase in fertility have been of about equal importance in increasing the number of live births to older women.

Discussion

The number of live births to older women (defined here as aged 35 and over) in England and Wales declined between 1946 and 1954 and then again between 1964 and 1977. In the whole period 1946 to 1977, however, the proportion of all births to older mothers decreased steadily, reaching a low point of 5.5% in 1977. Between that date and 1985 both the total number and the proportion of births to older mothers rose, to 51 859 and 7.9%, respectively.

A major factor influencing the trend after 1977 was the increased number of women in the 35-44 age category resulting from the baby boom after the second world war. The number rose from 2 767 700 to 3 347 200 between 1977 and 1985. If all women between the ages of 15 and 44 have the potential for childbearing the percentage in the older group (35-44) increased from 28.3% to 31.1%.

In addition to the increased number and proportion of older women in the population, there was a steady rise in the fertility rate for both 35-39 year olds and for 40-44 year olds between 1977 and 1985. Our results indicate that this was not the result of an extension of the reproductive period to produce larger families among women who had married more than once but the consequence of delayed childbearing. It is noteworthy that the proportion of first live births occurring to women aged over 35 increased sharply for women who had been married once and for women married more than once. In

data suggest that both delayed childbearing and changes in age structure are important.

Whatever the reasons for the increased proportion of older mothers having babies, there are considerable implications for the provision of services for prenatal screening for chromosomal abnormalities. The Office of Population Censuses and Surveys has produced estimates for the number of live births to women of different age groups for the years 1985 to 2023 (fig 4).⁶ Their

FIG 4—Projections based on mid-1983 figures of numbers of live births to all women and to women aged 35 years and over. (From 1996 to 2021 projections are in five year intervals.)

mid-1983 projections showed a rise in the number of live births to older mothers from 50 000 in 1985 to 85 000 in 2001, an increase of 63%. If this estimate is correct the number of women who might request prenatal screening will have more than doubled since 1977.

As public awareness of the potential benefits of prenatal diagnosis grows, its use among older mothers has increased.^{2,3,7} Alberman *et al* suggested that the maximum rate of use in the United Kingdom was

likely to be between 68% and 77%.⁸ This, however, was before the advent of chorionic villus biopsy, with its advantages of first trimester detection of fetal abnormalities. It would probably be wise to plan for a rate of use of at least 80% by the year 2001 and to have facilities in place for some 70 000 prenatal cytogenetic analyses.

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Portraits from Memory

25—Professor Robert Cruickshank, CBE (1899-1974)

JAMES HOWIE

In 1932 I left the bacteriology department of Professor John Cruickshank in Aberdeen University to spend the second year of a scholarship in the Glasgow University department of Professors Robert Muir and Carl Browning. When I took my farewell of John Cruickshank he said: "You must at once get in touch with my pupil Robert Cruickshank—no relation, but one of the nicest men I know. He will be a brother to you." I accepted this advice, began a lifelong friendship, and profited greatly from it.

Following fatherly footsteps

Robert was ready to be much more than a brother—indeed his role quickly became more like that of a father. Already I was really following in his footsteps. Eight years earlier he had held the same scholarship as I now had. We had both survived the stimulating but demanding experience of being postgraduate pupils of John Cruickshank, and had both of us gone on to work in Glasgow with Muir and Browning. "Don't wait to be put on to work on something," advised Robert. "Ferret out anything that interests you by yourself and get on with it. Unless you do that you'll get nowhere." This was good and accurate advice although, in the end, I was diverted to an investigation that was not my first choice. Every Sunday afternoon I had to visit Robert, enjoy the generous hospitality provided by him and his wife Peggy, and tell him where I had got to with the work I was doing. As the end of my scholarship approached Robert said: "Now you'd better follow my footsteps again and get a job in Belvidere Fever Hospital. There you'll meet the people of Glasgow's east end and learn what acute medicine really is. You'll never be a real hospital bacteriologist till you've seen the clinical side of fevers. And, as the most junior recruit, you'll be

taught by Cecilia Scott [portrait no 6] who has charge of the baby pneumonia ward and who keeps alive children that nobody else would give a chance of survival." This was in 1933-4, still a year before the sulphonamides changed the picture.

[Photograph reproduced from the *Journal of Medical Microbiology* by permission of Churchill Livingstone.]

clinical experience of fevers will make you useful to them. Second, try to work out if any infection has spread and how the spread may be arrested."

Camaderie at home and abroad

In later years Robert always insisted that the staff of his departments should also practise epidemiological microbiology and accept an educational function, especially in respect of food hygiene. Already in his Glasgow days he was reaching out towards epidemiological studies. In 1936 he left Glasgow Royal Infirmary and became director of the London County Council laboratory at the North Western Fever Hospital in London. With a loyal and enthusiastic staff, he became more and more concerned in his investigative work with the mode of spread and control of infections. In 1939-40 he suffered a serious and prolonged chest infection and counted himself lucky to survive. This testing experience greatly influenced him. He showed incredible kindness

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