

# Deaths in the first 20 years and problems of the sex ratio at birth

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In previous papers we have examined the current increase in longevity, particularly marked in women, and discussed some of the factors likely to be responsible for this [1-3]. We concluded that in adult life unhealthy life-styles were important in males and probably accounted for the fact that their life-span had not increased as much as that of females.

Particular emphasis was laid on smoking, alcohol, obesity and the reduction of physical activity in the male on retirement. In support of this view we pointed out that where the life-style of men is less divergent from that of women, as occurs in the Amish community in the USA [2] and in kibbutzim in Israel [3], the longevity of men approximates more closely to that of women. These seemingly reasonable conclusions, however, left us with two problems which are considered in this article.

The first problem relates to the causes of death in the 0 to 20 age group, where the lethal factors in the older cohort can be virtually excluded. Here again more boys must die than girls, because the sex ratio at birth is 105:100 and does not approach unity in England and Wales until between the ages of 45 to 54 years [1]. We find that drink, cigarettes and obesity are replaced in the young group by infant deaths, trauma and suicide, which are strongly male-orientated. It is clear that, from birth to old age, males are more at risk than females. What is often not appreciated is that more than half the total deaths under the age of 20 years occur during the first year of life, and of these again more than half take place during the first month of life.

The second problem is the fundamental question of why the sex ratio at birth is 105 males to 100 females, and how this is achieved. The usual explanation is that the primary conception rate is in favour of males because Y sperm are more motile than X sperm, but results from *in vitro* fertilisation and other arguments cast some doubt on this [4].

## Method

Population changes and the causes of death in the first

two decades of life have been analysed in England and Wales in each decennial year from 1934 to 1984 using the Registrar-General's Annual Returns [5] and data from the Office of Population Censuses and Surveys (OPCS) [6].

## Results

Table 1 shows the population of men and women under the age of 20 years in England and Wales for each decennial year, their mortality and the number of deaths for each sex that occurred under one year of age. The reasons for death by systems or cause are also given.

At all times in the population aged less than 20 years the number of males exceeds that of females as shown in Fig. 1. The total mortality for both sexes fell dramatically between 1944 and 1954, and has declined more gradually since. At all decennial years the mortality of boys has exceeded that of girls. This reduction in mortality is almost certainly the result of antibiotics in the control of infectious diseases (Fig. 2). Figure 1 also shows that, particularly since 1954, the majority of deaths in both sexes has occurred before the first year of life.

Other points in Table 1 can be summarised as follows:

1. Deaths from diseases of the respiratory system fell dramatically between 1934 and 1954, and have shown a progressive decline ever since (Fig. 2).
2. Deaths from diseases of the digestive and circulatory systems have also declined. The latter may be related to the marked reduction in the prevalence of rheumatic fever and an increase in the successful treatment of bacterial endocarditis.
3. The number of deaths from congenital abnormalities, 90 per cent occurring during the first year of life, has more than halved since a peak in 1944 (Fig 3) and the mortality has always been greater in males than females.
4. The death rate from neoplasms has not changed in the past 50 years (Fig. 3) and is slightly higher in males than in females.
5. Deaths from injuries and poisoning, including road traffic accidents and suicide, fell (except for the

\*Professor Whitfield died on 18 February 1987

**Table 1.** A 60-year study of mortality in England and Wales by systems or cause of death in those aged under 20 years. (Figures in parentheses are the mortality rate per 10,000 of the sex at risk under the age of 20 years).

		1934	1944	1954	1964	1974	1984
Population under 20 years (millions)	M	7.76	5.93	6.52	7.42	7.70	7.00
	F	7.60	5.77	6.26	7.06	7.30	6.63
Total number of deaths under 20 years	M	38,150(49)	29,006(49)	14,035(22)	14,699(20)	10,183(13)	6,386(9)
	F	31,434(41)	22,442(39)	9,970(16)	10,173(14)	6,726(9)	4,185(6)
Number of deaths under one year	M	20,000(26)	19,162(32)	9,955(15)	10,011(13)	6,138(8)	3,443(5)
	F	14,945(20)	14,293(25)	7,205(12)	7,434(11)	4,321(6)	2,594(4)
<i>Causes of death</i>							
1. Infections	M	8,895(11.4)	3,518(5.9)	546(0.8)	221(0.3)	408(0.5)	115(0.2)
	F	9,332(12.3)	3,748(6.5)	474(0.8)	203(0.3)	279(0.4)	101(0.2)
2. Respiratory system	M	6,795(8.9)	4,694(7.9)	1,743(2.7)	1,781(2.4)	1,233(1.6)	366(0.5)
	F	5,335(7.0)	3,631(6.3)	1,324(2.1)	1,361(1.9)	810(1.1)	278(0.4)
3. Digestive system	M	3,550(4.6)	3,121(5.3)	708(1.0)	636(0.9)	175(0.2)	55(0.1)
	F	2,664(3.5)	2,231(3.9)	475(0.8)	461(0.7)	141(0.2)	46(0.1)
4. Central nervous system	M	2,118(2.7)	1,320(2.2)	427(0.7)	522(0.7)	361(0.5)	307(0.4)
	F	1,635(2.2)	957(1.7)	297(0.5)	386(0.5)	247(0.3)	207(0.3)
5. Circulatory system	M	718(0.9)	351(0.6)	167(0.3)	99(0.1)	159(0.2)	132(0.2)
	F	853(1.1)	390(0.7)	163(0.3)	95(0.1)	103(0.1)	109(0.2)
6. Congenital anomalies	M	2,178(2.8)	2,596(4.4)	1,908(2.9)	2,269(3.0)	1,662(2.3)	1,139(1.6)
	F	1,784(2.3)	2,073(3.6)	1,768(2.8)	2,030(2.8)	1,557(2.1)	933(1.4)
7. All injuries & poisoning	M	2,765(3.6)	3,733(6.3)	1,723(2.6)	2,687(3.6)	2,068(2.7)	1,658(2.4)
	F	1,445(1.9)	2,151(3.7)	767(1.2)	1,093(1.5)	897(1.2)	588(0.9)
Road traffic accidents	M	no record	877(1.5)	601(0.9)	1,383(1.9)	1,112(1.4)	941(1.3)
	F	no record	442(0.8)	223(0.4)	441(0.6)	427(0.6)	313(0.5)
Suicide	M	69(8.9)*	43(7.3)*	39(6.0)*	73(9.8)*	48(6.2)*	91(13.0)*
	F	41(5.4)*	7(1.2)*	17(2.7)*	35(5.0)*	29(4.0)*	21(3.2)*
8. All neoplasms	M	321(0.4)	310(0.5)	603(0.9)	667(0.9)	561(0.7)	408(0.6)
	F	263(0.3)	259(0.5)	458(0.7)	494(0.7)	419(0.6)	306(0.5)

(\*mortality expressed as per million at risk)

wartime years) between 1934 and 1954, presumably because of improved industrial health and safety measures (Fig. 4). The mortality from road accidents, apart from a fall in 1954, has disappointingly remained unchanged during the 50 years for which records are available (Fig. 4). Deaths from injury, poisoning and road accidents have been consistently and strikingly higher in males than in females.

6. Although the rate fluctuates considerably, of those under 20 years old more than twice as many young men commit suicide as women (Table 1). The lowest level in males was recorded in 1944, since when it has risen substantially.

## Discussion

The causes of death given in Table 1 must be looked upon as generalisations which do not take into account errors in death certification [7-9]; these must be substantial when so many deaths occur under the age of one year.

### Decreased mortality

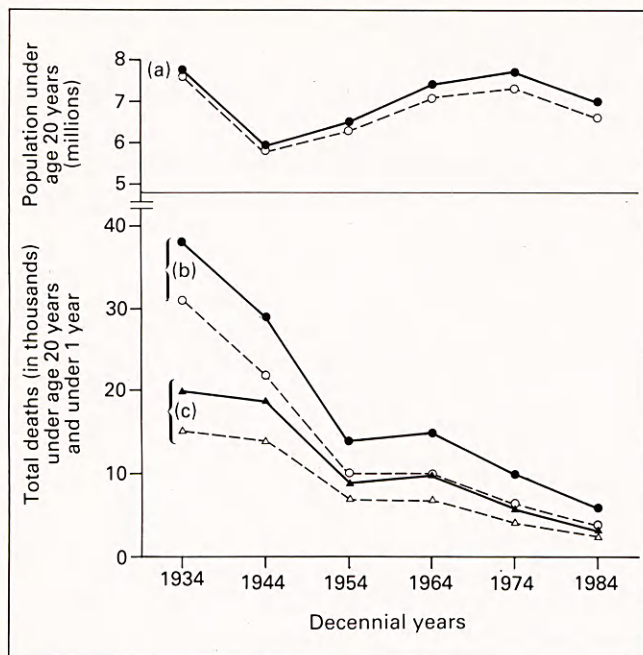
The striking reduction in mortality from many diseases (Table 1) over the last 50 years must be attributable to environmental factors such as better living standards and improved medical care, particularly the introduction of

antibiotics. Genetic influences will have had only a minimal effect because of the speed of improvement in life-span.

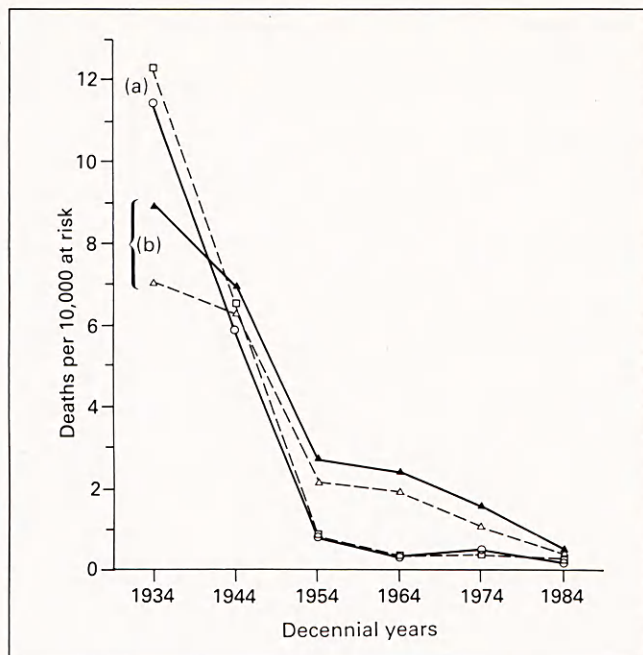
The downward trend in deaths from congenital abnormalities may in part stem from genetic counselling, and antenatal screening which may result in the termination of pregnancy if severe abnormality is detected. Certainly, improved antenatal care, as for women with diabetes, reduces congenital abnormalities in the offspring [10]. Equally, improved postnatal care enables many with congenital cardiac, neurological and other defects to survive when, half a century ago, they would have died. The category of congenital anomalies is necessarily heterogeneous. Anencephaly and spina bifida are more common in females and hypertrophic pyloric stenosis is essentially a male disorder. Against the claim that selective abortion is responsible for the reduced mortality from some congenital disorders, the fall in the incidence of neural tube defects, for example, has been as dramatic in Eire, where abortion is illegal, as it has been in England and Wales [11].

### Excess male mortality

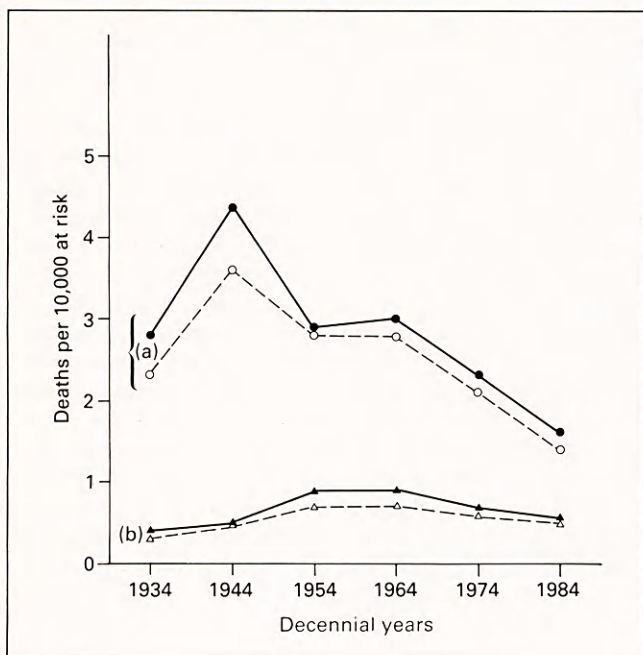
At each of the decennial years 1934-1984, more males than females under the age of 20 years died. There were 27,529 more male than female deaths in an overall



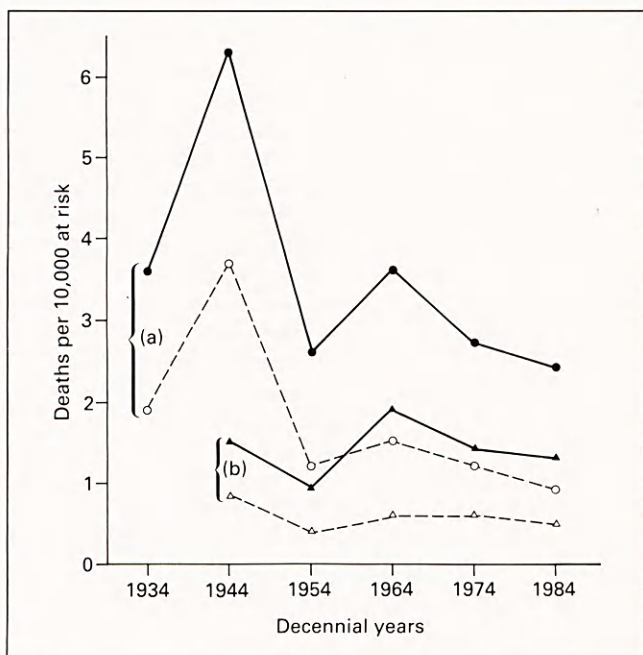
**Fig. 1.** (a) The total population (in millions) of those aged less than 20 years in England and Wales; (b) the number of deaths (in thousands) of those aged less than 20 years and (c) those aged less than 1 year at each decennial year 1934 to 1984. Solid line — males; dashed line — females.



**Fig. 2.** The mortality rate per 10,000 at risk in males and females aged under 20 years from (a) infections and (b) respiratory diseases in England and Wales for each decennial year 1934–1984. Solid line — males, dashed line — females.



**Fig. 3.** The mortality rate per 10,000 in males (solid line) and females (dashed line) aged under 20 years from (a) congenital abnormalities and (b) neoplasms in England and Wales for each decennial year 1934–1984.



**Fig. 4.** The mortality rate per 10,000 at risk in males (solid line) and females (dashed line) aged under 20 years (a) from injury and poisoning, and (b) from road traffic accidents in England and Wales for each decennial year 1934/44–1984.

mortality of 197,389 (Table 2). Of this excess, 20,157 males died of the 'common' disorders shown in Table 2.

With the exception of deaths due to infections and circulatory disorders, which showed a small female excess of 434 and 87 respectively, there was an excess of male deaths due to respiratory (3,873), digestive (2,227), central nervous (1,326), congenital (1,607) and neoplastic diseases (671).

Just under a third of the male excess (7,693) was due to 'unnatural causes', namely injuries, poisoning, road traffic accidents and, although numerically much less, suicide. In large measure this cause of mortality must be attributed to industrial hazards and the greater use of motor bicycles and cars by young men as compared with young women. Why more young men commit suicide is unclear, and without further information cannot with certainty be attributed to drug abuse, alcoholism or unemployment.

**Table 2.** Analysis of the main causes of death for the six decennial years (1934-84) in males and females under the age of 20 years.

	Males	Females	Total	Male excess
Number of deaths under 20 years	112,459	84,930	197,389	+ 27,529
Number of deaths under one year	68,709	50,792	119,501	+ 17,917
<i>Causes of death</i>				
1. Infections	13,703	14,137	27,840	- 434
2. Respiratory	16,612	12,739	29,351	+ 3,873
3. Digestive	8,245	6,018	14,263	+ 2,227
4. Central nervous system	5,055	3,729	8,784	+ 1,326
5. Circulatory	1,626	1,713	3,339	- 87
6. Congenital	11,752	10,145	21,897	+ 1,607
7. All injuries & poisoning	14,634	6,941	21,575	+ 7,693
Road traffic accidents*	4,914	1,846	6,760	+ 3,068
Suicide	363	150	513	+ 213
8. Neoplasms	2,870	2,199	5,069	+ 671
Total for 1-8	79,774	59,617	139,391	+ 20,157

(\*1944-1984 only)

Clearly the number of deaths in young males is greater than in young females and reaches its maximum between the ages of 15 and 19 when the male:female mortality ratio is 2.7:1 [2]. Discounting injuries, road traffic accidents, war and suicides, the male mortality from 'natural' diseases is in general greater than in females. In part this may be due to environmental exposure but this does not explain the increased vulnerability of males to digestive, central nervous and congenital disorders.

Thus, in terms of longevity there is an advantage in being female in the first 20 years of life. In part, this is due to the different behaviour of young men compared with that of young women, but there is also a greater biological susceptibility to disease in males. The best evidence for this comes from infant mortality in the first

year of life. Here arguments that males, more than females, are encouraged to take risks and suppress fear or distressing symptoms can hardly be accepted. Furthermore, what happens in the first year of life seems a logical carry forward of the increased incidence of stillbirths and spontaneous abortions that occurs in male as opposed to female fetuses.

### *Sex ratio at birth*

Until recently, it has been generally held that the increased male to female sex ratio at birth is due to the lighter Y-bearing sperm moving faster than the heavier X-bearing sperm. However, although the numbers are small, the sex ratio as a result of *in vitro* fertilisation is approximately equal although it could be argued that the speed of movement ('swimming') of the sperm is not relevant in this procedure [4]. Furthermore, the movement of spermatozoa does not appear to depend on 'swimming'. Under the microscope they generally move in wide circles and there is no reliable evidence of anything in the female tract that would give them a sense of direction. Moreover, the time taken to reach the site of fertilisation, often only five minutes after coitus, is much too short for them to swim the distances involved. What appears to happen is that the spermatozoa are carried along by the irregular contractions of the walls of the Fallopian tubes in which there are cilia beating in the direction of the ovaries. There is, therefore, a current of fluid favouring the passage of spermatozoa to the site of fertilisation [12].

Irrespective of the exact mechanism, the greater likelihood of a male fetus must occur at or soon after conception because, as judged by amniotic fluid analysis at 15-18 weeks, the male to female ratio is 991:893 (1.11 to 1). Chorionic villus sampling, at 8-11 weeks, found the male to female ratio was 37:25 (1.48 to 1), (Marina Seabright, personal communication). The differences in these two ratios does not reach statistical significance.

The problem of the primary conception rate in favour of males remains unsolved. It is an intellectual challenge to explain how selection, initially favouring the development of a male conceptus, subsequently changes so that at birth the male:female ratio is only 105:100.

To achieve equal longevity of both sexes throughout life, it would seem that conception should be by *in vitro* fertilisation in a kibbutz or in an Amish community.

### *Acknowledgements*

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## Book review

*The Pond Report—A report of a working party on the teaching of medical ethics.* Edited by K. M. Boyd. IME Publications Ltd, London, 1987. 60pp. £7.50 (£12.50 overseas).

This quite brief report from the Institute of Medical Ethics, encouraged in its endeavour by the GMC and the Nuffield Foundation, follows two years of data gathering and deliberation by a Working Party covering a wide variety of approaches to the subject. In his preface, Sir Douglas Black expresses the hope that the Report will be widely read and referred to as "the Pond Report", admirable sentiments both, in view of the importance of the subject and of Sir Desmond's contributions as Chairman of the Working Party and for many years, since its earliest beginnings, to the London Medical Group. The questions posed are not new. The issue is not whether the subject should be taught, but rather by whom, how and how intensively. One suspects a good deal of inertia and some scepticism in many British medical schools, despite efforts to promote more multi-disciplinary teaching of medical ethics. This is in contrast to the situation in the USA where academic departments on the subject abound. The Working Party has attempted to evaluate the present position in Britain, by questionnaires to Deans and to representative medical students, supplemented by interview with some of the students. By its nature, this is a difficult exercise. Quality of teaching cannot be assessed from a timetable and it is particularly difficult to judge if most of the teaching is informal during or after ward rounds and given by interested clinicians; it might be excellent, just adequate or nonexistent under these circumstances. Despite a detailed appendix and a rather lengthy chapter describing replies, the Report in this part reads rather disjointedly although spiced with anecdotal comments, some of them entertaining and much to the point. The overall impression from the questionnaire data was of an over-interpretation of what was being achieved by the Deans and an under-estimation by students; but these perceptions would not be confined to the teaching of medical ethics.

Apart from recording replies from Deans and students, the Report goes over some familiar ground on definition

and scope but concludes with some firm recommendations. These appear largely uncontroversial. For instance, no specific syllabus is advised. Teaching should be integrated with clinical teaching around specific problems and should be exploratory and analytical rather than hortatory (I quote). No strong views are given on preclinical teaching of the subject, but a need is seen for clinical teachers to improve their 'vocabulary of ethics' to reduce vulnerability to accusations that they communicate badly or are inappropriately paternalistic. That need finds an echo in Jonathan Glover's contribution on the potential value of philosophy, which, since it is kind to doctors, perhaps bears repetition: "Doctors and philosophers have different strengths. Good doctors develop a sensitivity to the human consequences of different courses of action, an intuitive feel for the relative weight of different factors which they may not always be good at articulating in discussion. Watching doctors facing critics on Ian Kennedy's television programmes, it often seemed that they had more feel than their critics for what would matter to patients, but the critics ran rings round them in argument. I would choose Ian Kennedy as my lawyer but some of his victims as my doctor."

More controversial among recommendations is the suggested need for multidisciplinary teaching sessions at regular intervals, the disciplines to include moral philosophy, moral theology or law, on appropriate occasion contributions from nurses, chaplains, unspecified others and 'articulate and considered lay opinion.' Nor would many of us agree that there is really a need to include examination questions or essays on ethical issues in assessments leading to medical qualification.

Overall the Report did not convince me that it was going to change the face of British medical education; but I hope it will be widely read, not only by Deans and Members of Curriculum and Examination Committees, but most importantly by the clinicians who take day-to-day ethical decisions and teach students upon them. It might open their minds more widely, particularly if they turn to the most excellent contribution from Jonathan Glover of what philosophy can (and cannot) contribute in this difficult area.

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