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THE SEX RATIO IN ANENCEPHALY

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It is shown that the well known excess of females in anencephalic births is statistically significant when compared with (a) the general population and (b) their normal sibs.

There is also a statistically significant difference between the sex ratio of anencephalic births and that of spina bifida births which suggests that there is a definite difference in the genetic component of their aetiology.

These results are discussed with reference to the genetics of anencephaly and spina bifida and a genetic model of the inheritance of the genetic component of anencephaly is given. The significance of a possible cytoplasmic factor is also considered.

Introduction

A number of authors (see Table 1) have observed an abnormal sex ratio in anencephalic births which takes the form of an excess of females. A lesser but still statistically significant excess of female births occurs in spina bifida (TIMSON, 1969). It is usually considered that the two conditions are related since they are both disorders of the central nervous system and they can occur in the same sibship (see Table 2). A pair of uniovular twins have been described one of which had spina bifida while the other was anencephalic (SMITHELLS, CHINN & FRANKLIN, 1964). These authors also found that there was no significant variation in the sex ratio of anencephalic births at different gestation times so that the possibility of an early higher rate of loss of male anencephalics seems to be excluded.

Observations

SEX RATIO OF ANENCEPHALIC BIRTHS

Data from the literature relating to a number of countries are given in Table 1. The sex ratio, which is here expressed as the percentage

TABLE 1

SEX RATIO OF ANENCEPHALIC BIRTHS

	Male	Female	Total	% Male	Area	Author
1	148	221	369	40.1	France	FREZAL et al. (1964)
2	12	27	39	30.8	Belfast	STEVENSON & WARNOCK (1959)
3	31	33	64	48.4	Singapore	SEARLE (1959)
4	24	42	66	36.4	Lund & Malmö (Sweden)	BÖÖK & RAYNER (1950)
5	9	55	64	14.1	Dublin	COFFEY & JESSOP (1955)
6	2	16	18	11.1	Eastern England	PENROSE (1946)
7	26	49	75	34.7	Groningen & Drenthe (Netherlands)	POLMAN (1951)
8	7	20	27	25.9	Southampton	WILLIAMSON (1965)
9	41	65	106	38.7	Victoria (Australia)	COLLMANN & STOLLER (1962)
10	98	223	321	30.5	Rhode Island (U.S.A.)	MACMAHON et al. (1953)
11	446	1222	1668	26.7	Scotland	RECORD & MCKEOWN (1949)
	117	249	366	32.0	Birmingham	
12	89	270	359	24.8	South Wales	CARTER et al. (1967)
13	52	125	177	29.4	Liverpool	SMITHELLS et al. (1964)
Total	1102	2617	3719	29.6	—	—
	2,075,920	1,959,963	4,035,883	51.4	England & Wales 1962–66	Registrar General (1968)

of males, ranges from 11.1% to 48.4% with a mean of 29.62%, a standard deviation of 5.77, and 95% confidence limits of 18.08 to 41.16%. The value of 51.4% males for children born in England and Wales in the years 1962–66 (Registrar General, 1968) is well outside these limits. The only value in Table 1 which approaches 51.4% is that from Singapore, 48.4%, which was obtained from a polytypic population (SEARLE, 1959). Two thirds of the anencephalic births in the Singapore series, however, were to Chinese mothers. They had an estimated frequency of only 0.62 anencephalic births per 1,000 births while Europeans living in Singapore had an estimated frequency of 2.14 per 1,000. It is possible therefore that anencephaly in the Chinese