Twinning rates in Tamilnadu

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SUMMARY A prospective study of human reproduction was conducted in Tamilnadu State, South India, from 1969 to 1975. This paper reports twinning rates and relates these to maternal age, parity, and consanguinity. Birth weights and other dimensions at birth and infant mortality are also studied. The overall twinning rate was 1 in 115 births. Dizygotic twinning rates increased significantly with maternal age and parity. The measurements at birth for like-sexed twin pairs were lower than that of unlike-sexed, but the mortalities did not differ significantly. Twins, in general, had a several fold increase in mortality as compared with singletons.

From their original connotation in mythology twins have now assumed greater importance in human biological and medical research, particularly in the understanding of genetic influence in the aetiology of disease. The frequency of twinning has varied from country to country, and within countries there have been variations and secular trends.¹⁻⁵ Such changes reflect both the biological and the social forces at play in the occurrence of plural births.

The epidemiology of twinning, especially by zygosity, has shown important associations with maternal and environmental factors.⁶⁻⁸ Because of the already high neonatal and infant mortalities among singletons in countries such as India,⁹ it is important to know if the twins are subjected to even greater mortality risks and to identify the major causes of death.

Except for an occasional study, most available data on twinning rates in India have been largely based on admissions to hospital which have tended to be selective and pose difficulties in interpretation on epidemiological aspects.^{10 11} There is therefore a need for more data on the prevalence of twinning based on population samples and to test if its relationship to known sociodemographic and other variables persist under the given conditions of any community. We describe the frequency and correlates of twinning based on a prospective study of rural and urban population samples in South India.

Material and methods

This investigation was conducted from 1969 to 1975 as part of a continuing study on human reproduction

in the North Arcot District of Tamilnadu State. The description of this district in terms of demography, climate, and other environmental factors have been reported earlier,¹² and were shown to be typical of that prevailing in other parts of southern India.

From the district headquarters town of Vellore, one third of the population was randomly chosen to provide the urban sample of 40 000 people. For the rural sample, 25 contiguous panchayats from one community development block 15 miles from the town were selected to provide about 50 000 people. Qualified women interviewers who were fluent in the local language (Tamil) visited every married woman in the reproductive age group once in five weeks to obtain data on menstrual periods in order to identify a "pregnancy" and to follow it up until termination. Details on outcome, congenital malformations, and anthropometrics were recorded for all deliveries within 48 hours of birth. Each liveborn birth was followed up at the end of one, two, three, six, nine, and 12 months to assess the physical growth and mortality during infancy. The interviewers were adequately trained and closely supervised.

The twinning rates were expressed as the ratio of the number of twins per 1000 deliveries. In view of differing genetic aetiology underlying monozygotic and dizygotic types of twins, the rates were estimated in terms of zygosity of the twin pair, using the Weinberg method.^{7,13}

To obtain clues to genetic factors in aetiology of a continuous variable such as birth weight, the intrapair (within) and interpair (between) variances or covariances are helpful.¹⁴ Thus if the intrapair and interpair variances for dizygotic twins are

significantly more than that for monozygotic twins, this would suggest a role for heredity in the aetiology, although the variances by themselves are not a measure of the degree of genetic determination. To measure the extent of similarity or "correlation" between members in a pair of twins relative to the amount of differences among pairs we used the "intraclass correlation coefficient" defined as:

$$r_I = \frac{\text{Interpair variance} - \text{intrapair variance}}{\text{Interpair variance} + \text{intrapair variance}}$$

Findings

A total of 11 103 pregnancies with gestation of 28 weeks or more were recorded, of which 10 695 were single liveborn, 312 were single fetuses born dead, and the remaining 96 were twin births. The twinning rate was thus 8.7 per 1000 deliveries and there was no significant difference between the prevalences in the rural and urban areas. Both infants were alive at birth in 86 pairs, only one was alive in five pairs, and in the remaining five pairs both were stillborn. Sixty six pairs were like-sexed (29 boys and 37 girls). Using Weinberg's differential method,^{7 13} the monozygotic and dizygotic twinning rates were 3.3 and 5.4 per 1000 deliveries respectively. The proportion dizygotic was thus 62.5%. The differences between these estimates computed separately for rural and urban women were not statistically significant.

The overall twinning rate (table 1) increased significantly with age ($p < 0.001$). The relationship to maternal age was negative in the case of monozygotic twinning rates ($p < 0.05$) and positive for dizygotic twinning rates or percent dizygotic ($p < 0.01$).

The overall rates of twinning were positively associated with parity ($p < 0.01$) (table 2). As in the case with maternal age, the monozygotic twinning rate was negatively associated with parity ($p < 0.01$) and the dizygotic twinning rate and percent dizygotic showed a positive trend ($p < 0.001$).

Table 1 Number of deliveries and twinning rates by maternal age

Maternal age (years)	Deliveries	Twinning rates			Percent DZ
		Total	MZ	DZ	
<25	5174	5.6	3.7	1.9	34.5
25-29	3057	10.5	4.6	5.9	56.3
30-34	1864	11.8	1.1	10.7	90.9
≥35	998	13.3	1.0	12.0	92.3
Regression of twinning on maternal age:		0.003±	-0.001±	0.004±	
b ± SE _b		0.0008	0.0004	0.0006	
Statistical significance		p<0.001	p<0.05	p<0.01	

MZ = Monozygotic.
DZ = Dizygotic.

Table 2 Number of deliveries and twinning rates by parity

Parity	Deliveries	Twinning rates			Percent DZ
		Total	MZ	DZ	
0	2129	3.3	2.4	0.9	28.6
1, 2	4166	10.1	6.2	3.8	38.1
3, 4	2773	7.9	1.4	6.5	81.8
≥5	2025	12.4	0.5	11.9	96.0
Regression of twinning on parity:		0.002±	-0.001±	0.004±	
b ± SE _b		0.0008	0.0004	0.0006	
Statistical significance		p<0.01	p<0.01	p<0.001	

MZ = Monozygotic.
DZ = Dizygotic.

The total twinning rates and monozygotic twinning rates declined with closeness of consanguinity (table 3), the latter attaining statistical significance ($p < 0.001$). The dizygotic twinning rates showed an insignificant positive trend.

Table 4 gives mean birth measurements by sex composition of twin pairs, the intrapair and interpair variances as well as the intraclass correlation coefficients.

Although, in general, the mean birth measurements of the like-sexed pairs were smaller than those of the unlike-sexed, the differences were not statistically significant.

As expected, the intrapair variances of like-sexed pairs were generally less than those of the unlike-sexed in both areas, although these differences failed to attain statistical significance. The interpair variances of the measurements between like-sexed and unlike-sexed twins also did not differ significantly.

The intraclass correlation coefficients were statistically significant for almost all measurements. As expected, the correlation coefficients of the like-sexed pairs were higher than those of the unlike-sexed, but the differences were not statistically significant with regard to birth measurements.

Table 3 Number of deliveries and twinning rates by parental consanguinity

Parental consanguinity	Deliveries	Twinning rates			Percent DZ
		Total	MZ	DZ	
Consanguineous:	4282	7.5	0.9	6.5	87.5
Uncle-niece	1270	5.5	0.8	4.7	85.7
First cousin	2340	7.7	0.9	6.8	88.9
Beyond first cousin	672	10.4	1.5	8.9	85.7
Non-consanguineous	6811	9.4	4.7	4.7	50.0
Regression of twinning on consanguinity:		-0.001±	-0.002±	0.0005±	
b ± SE _b		0.0008	0.0004	0.0006	
Statistical significance		NS	p<0.001	NS	

NS: Not significant.

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Table 4 Birth measurements of like-sexed (L) and unlike-sexed (U) twin pairs and intraclass correlation coefficients r_I

Measurement	Sex	Mean	Intrapair variance	Interpair variance	r_I
Weight (g)	L	2093	56 007.6	326 392.9	0.71
	U	2150	142 038.6	439 488.5	0.51
CHL (mm)	L	425	394.5	3 344.4	0.79
	U	439	798.8	2 862.7	0.56
CRL (mm)	L	286	126.4	1 672.6	0.86
	U	282	150.1	1 524.4	0.82
HC (mm)	L	314	336.2	632.0	0.31*
	U	319	216.1	990.6	0.64
CC (mm)	L	283	193.5	1 009.4	0.68
	U	299	330.0	1 087.5	0.53

* $p > 0.05$; all others $p < 0.05$.

Table 5 Perinatal and infant mortality rates by sex composition of twin pairs as compared with singletons

Mortality	Rate per 1000 at risk		
	Twin births		Singletons
	Like-sexed	Unlike-sexed	
Perinatal	380.0	333.3	62.7
Neonatal	359.0	333.3	45.5
Postneonatal	226.7	150.0	55.0
Infant	504.3	433.3	100.1

Table 5 gives perinatal and infant mortality rates by sex composition of the twin pairs. For comparison, these rates for singletons in the same populations during the study period are also shown.

All the rates for the like-sexed pairs were higher than those for the unlike-sexed in the rural area while it was so only for the postneonatal and infant mortality rates in the urban area. None of the differences in these mortality rates between the like-sexed and unlike-sexed pairs were statistically significant, however. When compared with singletons, the rates among twins are nearly six times more for perinatal deaths, eight times more for neonatal deaths, three times more for postneonatal deaths, and five times more for overall infant mortality.

Discussion

The rates of twinning per 1000 deliveries have varied from 4.1 in Sweden (1966) to 15.3 in the Irish Republic (1959), averaging 10.0 to 10.4 for most European countries.^{1,2} The Japanese and Oriental populations have, in general, lower twinning rates, ranging from four to six per 1000 deliveries,⁸ while black populations in the US have higher rates than the whites.⁷ The higher twinning rates are largely attributed to older maternal ages at parturition and higher orders of parity, both operating independently.^{6,7} In countries where these two maternal factors have declined over time there have been secular trends towards lower twinning rates.³⁻⁵

The relationship of maternal age and parity, however, varies by zygosity of twins. While monozygotic twinning rates, in general, are stable over different maternal ages and parities (about 3-4 per 1000), the dizygotic twinning rates seem positively correlated with maternal age and parity (1/1000 to nearly 15/1000).^{1,2} Such stable monozygotic rates over maternal factors seem to be true for several populations, while the trends seen for dizygotic twinning rates vary among different countries. The data from the present study in south India shows a rate of 8.7 which is closer to that seen in most North American and European countries but higher than that seen among Orientals. The percent dizygotic also tends to be more in line with that of the former and not as scarce as found among mongoloid populations.⁷ The trends for dizygotic twinning are the same with regard to maternal age and parity as are seen for most populations, but the negative association of monozygotic twinning to these factors is at variance. In India the median age at marriage is low and there are as many deliveries of overparity 3 to women under 35 as there are to women over 35.¹⁵ This might mask any specific associations with maternal factors. Another factor, oral contraception, which is known to have some influence on binovulation, is virtually non-existent in these populations. The role of climate has been emphasised by some authors but the evidence has not been conclusive.⁸ More in depth analysis to identify other variables seems indicated.

Previous studies in the area have shown a very high preference to consanguineous marriages (50% of rural and 30% of urban), of which a high proportion (80%) are between first cousins or closer relatives.¹² Since this practice has extended for several generations, the long term effects on gene frequencies will be towards elimination of specific recessive alleles from the population pool due to forces of selection. In view of the multifactorial aetiology of twinning, it was thought important to study the influence of consanguinity on twinning rates. The findings however, did not show specific

trends in twinning rates; perhaps because of the small samples studied. Since the history of inbreeding is much longer in the rural areas as compared with urban, the twinning rates for each area are best studied separately, if sufficient numbers are available.

The birth weight and other measurements of south Indian babies are lower than those found in other developing nations.¹⁶ Even so, the like-sexed twin pairs have relatively smaller measurements as compared with the unlike-sexed. This, however, had not significantly affected the mortality rate. It is possible that under conditions of very high infant mortality there are multiple factors, more environmentally induced, that need further study to determine actual hazards.¹⁷ The risks of mortality are several times more than that of the already high mortalities of singletons. The causes of such high mortality are both biological and social: low birth weights, young maternal ages, short intervals between successive pregnancies, coupled with poverty, ignorance, lack of prenatal care, wrong attitudes and practice during pregnancy, child birth, and puerperium all play a part in enhancing fetal and infant mortality. With increasing emphasis on maternal care and provision of necessary infrastructure for the delivery of health care, it is hoped that high risk pregnancies are identified promptly and cared for adequately to prevent such wastages in both single and twin births.

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