Acta Genet Med Gemellol 46: 47-56 (1997)

The Twinning Rates and Epidemiological Characteristics of Births in Southeast Uttar Pradesh, India

K. Sharma

Department of Anthropology, Panjab University, Chandigarh, India

Abstract. Birth statistics over a period of 5 years were analyzed to study epidemiological characteristics of twinning in Southeast Uttar Pradesh, India. The data revealed higher incidence of breech twins (11.84% of all cotwins) as compared to breech single births (2.18%). But the perinatal mortality and caesarean section rates were similar in both twin and singleton pregnancies. The cumulative twinning rate over the studied period was 11.70 per 1000 live births. The MZ and DZ twinning rates were estimated respec-tively as 3.67 and 8.03 per mill. The mean maternal age of sampled mothers was 26.42 years with one standard deviation of 5.30 years. The twinning rate for mothers over 35 years of age was about four times higher than that in mothers younger than 20 years. Incidently, the twinning rate was the highest at parity four and a non-linear curve could more appropriately be fitted to the series of data. Seasonal variations were observed for both twin and singleton births. The highest frequency of births was observed from August through October. But seasonal index for twinning rate showed a clear bimodal distribution with peaks in April (223) and September (167).

Key words: Twinning, Epidemiological characteristics, Maternal age, Parity, Seasonality, India

INTRODUCTION

A host of biological, cultural and environmental factors have been documented as determinants of variation seen in twinning rates among human populations [3, 8,10, 11, 13-15, 20, 22, 25, 26]. Despite the voluminous literature on the topic, still twinning phenomenon is a subject of controversy and its many facets are not adequately understood. Recently with increasing use of ultrasounds and high speed scanners to detect early pregnancies, our knowledge of twinning frequency and prenatal pregnancy loss has increased considerably.

It is very interesting to note that about 25% of human pregnancies, including multiple, never reach term. It has been further estimated that about 12-15% of all live births are in fact started as twin embryos [5, 6]. This phenomenon of vanishing twins, where twin pregnancy ends in a single birth, has received a considerable attention during the last decade or so [17-19]. Such prenatal losses are not unique to multiple gestations, but perhaps occur randomly among all types of pregnancies depending upon various biological and environmental factors having bearing on embryogenesis. But multiple pregnancies are certainly at higher risk from a variety of sources [5-7, 16, 18].

In the light of these developments, epidemiological studies of births, including multiple, have become more relevant today. India provides a unique opportunity in this direction because it offers tremendous variability of cultural, social, ethnic and climatic factors. In such a milieu, microlevel studies would be more useful. Keeping this in mind, the present study was undertaken.

MATERIALS AND METHODS

The data for the present study were extracted from the hand written birth record register for the years 1984 through 1988. The records belonged to the hospital of Renukut. Renukut is situated at the southern tip of Mirzapur district, Uttar Pradesh – the most thickly populated state of India. Renukut is surrounded by the states of Madhya Pradesh on the south and west and Bihar on the eastern side.

The climate of Mirzapur witnesses roughly about five seasons of unequal duration in a year. A hot summer season from April to June; wet and humid rainy season from July to September; cool and dry autumn in October and November, cold winter season in December and January and pleasant spring season in February and March. The month of March is relatively warmer.

The birth statistics included information on maternal age, parity, type of delivery and place of residence, etc. Abortions were also recorded. However, authenticity of the information would depend upon the frame of mind of the recorder and that of patient/informer. The usual casualty in hospital records is the age of mother. The other inherent problem associated with hospital record is the differential admission criterion due to limitation of space.

Twinning rate has been expressed as the number of live twin births born per 1000 live births (mill). If one member (cotwin) of a pair was born alive, then the pair was included in the list of live twin births. Weinberg's difference method was used to estimate the numbers of monozygotic (MZ) twins in the total sample by subtracting the number of unlike sexed twin pairs from the number of like-sexed twin pairs assuming that half of the dizygotic (DZ) twin pairs are of unlike-sex. The estimates under Weinberg's difference method would be exactly right only when certain basic assumptions under the model are met [1]:

a) the sex ratio in the population is unity;

b) the twins are a random sample of the source population;

c) sex is not correlated within DZ pairs;

d) there is no sampling error.

The first basic assumption of equal sex ratio is usually never met in most human populations. But this does not cause any serious error and can thus be easily ignored. However, if sex ratio of a sample is known, then sex correction may also be applied. In the present sample, males constituted about 53% of the total live births. This inequality was removed through a sex correction. All DZ twin pairs were calculated by dividing the number of unlike-sexed twin pairs by twice the multiple of p and q; where p and q represented the proportion of male and female live births respectively.

Sampling error is inevitable in a small sample and this can completely invalidate an estimate of MZ and DZ twinning on the basis of sex concordance. Allen and Hrubec [2] particularly caution against this error when a twin sample is less than 35 pairs. They have suggested methods to minimize the impact of sampling variance on the estimated proportions of MZ pairs in such small series of twins. Taking a cue from them, proportions of MZ twins in the total sample of five years were calculated as previously mentioned, i.e. by employing Weinberg's difference method. The method gave the proportions of MZ twins in the total sample as 32% approximately. This fraction was used as a probable proportion of MZ twins in calculating yearly MZ twinning rate per mill. The other assumptions have been assumed to be true. The data were subjected to statistical analysis to draw conclusions. These tools have been explained in the following text wherever appropriate.

RESULTS AND DISCUSSION

Table 1 summarizes data on annual distribution of births, types and modes of deliveries from 1984 to 1988. Abortions constitute 3.72% of total birth records. Perinatal mortality rate (a sum of still births and early neonatal deaths) is slightly higher in twin pregnancy (26.3 per mill) than that in singleton pregnancy (19.64 per mill). These figures indicate marked improvement in obstetric management of the hospital patients as these results are comparable with statistics from many developed countries. For example in a Paris suburb (France), Papiernik et al [21] have reported 25.6 per mill twin perinatal mortality rate.

Perinatal mortality rates have been decreasing worldwide since 1940's. Puissant and Leroy [23] have shown decrease in total perinatal mortality of twins from 150 to 60 per mill from 1948 to 1981 in Belgium. In another standardized comparison [4], no significant difference has been reported between perinatal mortality in twins (140 per mill) and singletons (146 per mill), though the figures are towards higher side. From the above discussion, it can be concluded that, due to good obstetric management, differences in perinatal mortality between twins and singletons have generally been greatly reduced.

The data showed in Table 1 reveal no significant differences in caesarean section rates between twin and singleton pregnancies. Total breech presentations in twin births (11.84% of all cotwins) are exceedingly higher than those in single births (2.18%). But none of these twin breech presentations resulted in still birth or neonatal death despite the fact that all of these were vaginal deliveries. This particular finding partly lends support to observations of Chervenak et al [9] that for birth weight greater than 1500 gm, routine caesarean section for vertex breech twin gestation may not be necessary.

Table 1 - Epidemiological characteristics of births

Characteristics	Year					Total	
	1984	1985	1986	1987	1988	N	%
Birth record	628	635	666	771	738	3438	–
Abortion	42	39	9	26	12	128	3.72
Total births	586	596	657	745	726	3310	96.28
Total live births	576	586	643	731	713	3249	98.16
Singleton birth characteristics							
Total dead/stillbirths	10	10	14	14	13	61	1.84
Early neonatal deaths	1	1	2	–	–	4	0.12
Still and breech delivery	3	–	3	2	2	10	0.30
Still and LSCS delivery	–	1	1	–	5	7	0.21
LSCS and breech delivery	1	1	–	1	1	4	0.12
Total LSCS delivery	25	20	45	49	50	189	5.71
Total breech presentation	13	12	19	16	12	72	2.18
Premature births	5	2	1	6	4	18	0.54
Major congenital anomalies	–	1	–	2	1	4	0.12
Twin birth characteristics							
Twin births	8	7	8	7	8	38	1.15
Sex of MM	2	4	2	–	4	12	31.58
twins MF	3	–	2	5	3	13	34.21
FF	3	3	4	2	1	13	34.21
Breech presentation	–	1	–	5 *	1	9 *	11.84
LSCS delivery	–	1	–	1	–	4	5.26
Dead/Still births	–	–	1 *	–	–	1 *	1.32
Early neonatal deaths	–	–	–	–	1 *	1 *	1.32
Premature births	1	–	–	–	–	2 *	2.63
Twinning rate per 1000 live births	13.88	11.95	12.44	9.58	11.22		11.70
MZ twinning rate (MZTR)	4.44	3.82	3.98	3.06	3.59		3.67
DZ twinning rate (DZTR)	9.44	8.13	8.46	6.52	7.63		8.03

LSCS = Lower segment Caesarean Section; M = Male; F = Female

* Cotwins

https://doi.org/10.1017/S000156600000074X Published online by Cambridge University Press

Twinning rates

Table 1 also presents proportions of various sex combinations among twins and twinning rates by year and zygosity. The cumulative twinning rate is 11.70 per mill, while MZ and DZ twinning rates are 3.67 and 8.03 per mill respectively. These rates are lower than those reported [12] for the states of Uttar Pradesh (14.55), Bihar (13.10) and Madhya Pradesh (12.65). Razzaque et al [24] reported much lower twinning rate for Bangladesh rural population (9.56), though over the studied period it fluctuated between 7.8 and 11.2. These differences point out the necessity of undertaking carefully planned epidemiological studies to document factors responsible for differential twinning rates in these samples/populations.

MATERNAL AGE, PARITY AND TWINNING RATE

The results on relationship between maternal age, parity and twinning rates are summarized in Table 2. The highest twinning rate is observed for mothers in the age range of 40+, but the number of births in this age group is not adequate to draw any definite conclusion. Moreover, the maternal age in both instances of twin birth was 40 years. Hence, it can be concluded that the most productive age for twin births in this sample is between 35 to 40 years. Consequently, the data for the last two age groups were merged and results are presented in Figure 1. The twinning rate for mothers over 35 years of age is about four times higher compared to the mothers younger than 20 years.

A stepwise regression analysis was done between twinning rate as a dependent variable and maternal age and parity as independent variables. The maternal age alone explains about 70% variation in twinning rate as inferred from the value of multiple R^2.

Table 2 - Maternal age, parity and twinning rate

Maternal age	1		2		3		4		5		6+		Total		Twinning rate
	LB	TB	LB	TB	LB	TB	LB	TB	LB	TB	LB	TB	LB	TB	
15-19	179	1	22	–	2	–	–	–	–	–	–	–	203	1	4.93
20-24	565	3	333	7	152	1	41	–	2	–	–	–	1093	11	10.06
25-29	129	4	285	2	358	3	243	6	93	–	27	–	1135	15	13.22
30-34	15	–	58	–	136	–	163	4	101	1	72	–	545	5	9.17
35-39	1	–	21	–	42	1	66	1	44	1	69	1	243	4	16.46
40+	–	–	1	–	3	–	9	–	5	1	12	1	30	2	66.67
Total	889	8	720	9	693	5	522	11	245	3	180	2	3249	38	11.70
Twinning rate	9.00		12.50		7.22		21.07		12.24		11.11		11.70		–

LB = Live births; TB = Twin births

https://doi.org/10.1017/S000156600000074X Published online by Cambridge University Press

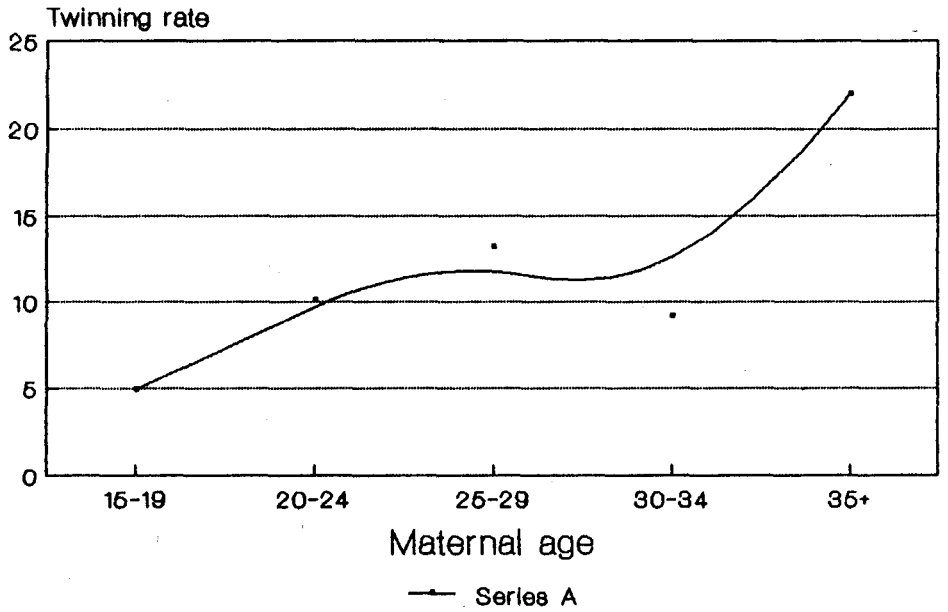

Fig. 1 - Maternal age and twinning rate.

These results are significant at 1% level of probability. Parity, the second variable, when added to the regression analysis accounts for additional 17% variation in twinning rates as the value of multiple R^2 is raised to 0.87 from 0.70. These results clearly show that, of the two independent variables, maternal age is the most crucial factor in twinning.

The results of association between parity and twinning rate are shown in Figure 2. The highest twinning rate is recorded at parity four. To analyse the trend relationship between parity and twinning rate, a non-linear curve has more appropriately been fitted to series of data. A second degree polynomial or parabola equation: $Y = 3.60 + 5.34$ (Parity) $- 0.67$ (Parity)^2, explains the observed relationship between twinning rate and parity (See Table 3).

Seasonality of twin births

The results on seasonality of births are presented in Table 4. Seasonal variations have been observed for both twin and single births. The highest frequency of births has been observed in the months of August through October. While for twin births, Figure 3 shows a bimodal distribution with two peaks in April and September respectively.

These 12 months would witness roughly five seasons. The results on twinning rate with reference to season are given in Table 5. The cumulative twinning rate is the highest in the summer season (18.68 per mill). Similar results were found in another study conducted in North Western India [26].

https://doi.org/10.1017/S000156600000074X Published online by Cambridge University Press

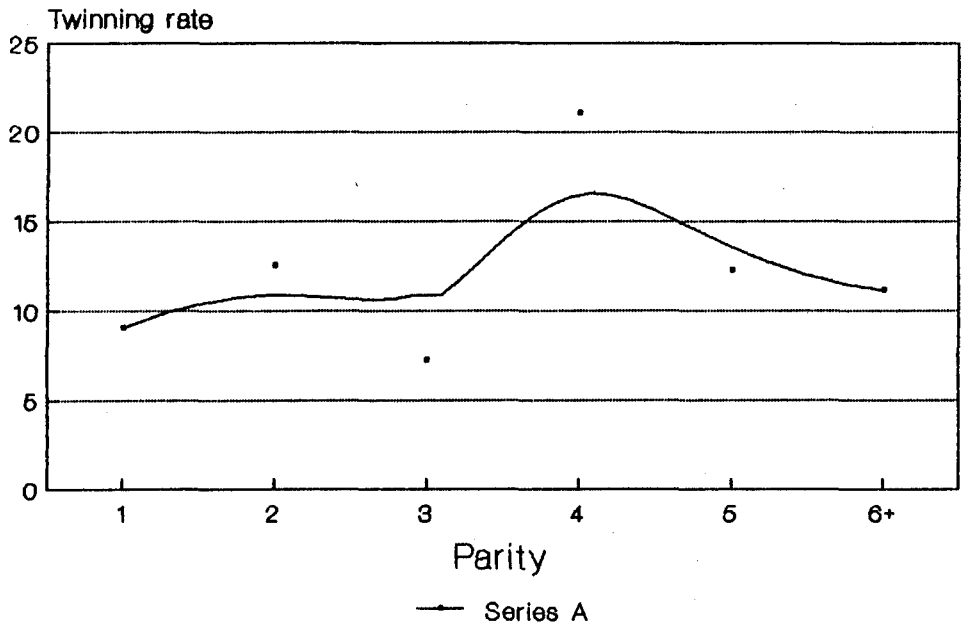

Fig. 2 - Parity and twinning rate.

Table 3 - Parity, maternal mean age and twinning rate

Parity	Mean maternal age				Twinning rate	
	Live births		Twin births		Observed value	Trend value
	X(yr)	SD	X(yr)	SD		$Y=a+bx+cx^2$
1	21.90	3.26	23.13	3.52	9.00	8.27
2	25.10	4.03	22.67	2.06	12.50	11.60
3	27.53	4.18	26.60	4.93	7.22	13.59
4	29.69	4.37	29.09	3.73	21.07	14.24
5	31.12	4.02	36.33	4.04	12.24	13.55
6+	33.83	4.09	38.00	2.83	11.11	11.52
Pooled	26.42	5.30	27.03	5.79	11.70	–

$Y = 3.60 + 5.34\ (Parity) - 0.67\ (Parity)^2$

This seasonal variation in twinning rates may be associated with the peculiarities of DZ twinning. Seasonal variations in pituitary gonadotrophin release is a well documented phenomenon and gonadotrophin levels have been reported to be associated with DZ twinning [8, 20].

https://doi.org/10.1017/S000156600000074X Published online by Cambridge University Press

Table 4 - Seasonality of births

Months	Birth records	Abortions	Still/ Dead	Live births	Twin births	Twinning rate per 1000 live births	Seasonal index of twinning rate
January	276	12 (4.35)	7 (2.54)	257 (7.91)	1	3.89	32.67
February	243	6 (2.47)	5 (2.06)	232 (7.14)	2	8.66	72.74
March	240	16 (6.67)	5 (2.08)	219 (6.74)	2	9.13	76.68
April	203	13 (6.40)	2 (0.99)	188 (5.79)	5	26.60	223.42
May	229	10 (4.37)	6 (2.62)	213 (6.56)	3	14.08	118.26
June	207	16 (7.73)	3 (1.45)	188 (5.79)	3	15.96	134.05
July	307	21 (6.84)	9 (2.93)	277 (8.53)	1	3.61	30.32
August	354	14 (3.95)	4 (1.13)	336 (10.34)	4	11.90	99.96
September	366	7 (1.91)	7 (1.91)	352 (10.83)	7	19.89	167.06
October	371	8 (2.16)	3 (0.81)	360 (11.08)	6	16.67	140.00
November	337	4 (1.19)	6 (1.78)	327 (10.06)	3	9.15	76.85
December	305	1 (0.33)	4 (1.31)	300 (9.23)	1	3.33	27.98
Total	3438	128 (3.72)	61 (1.77)	3249 –	38	11.70	1199.99

Figures in parenthese are percentages

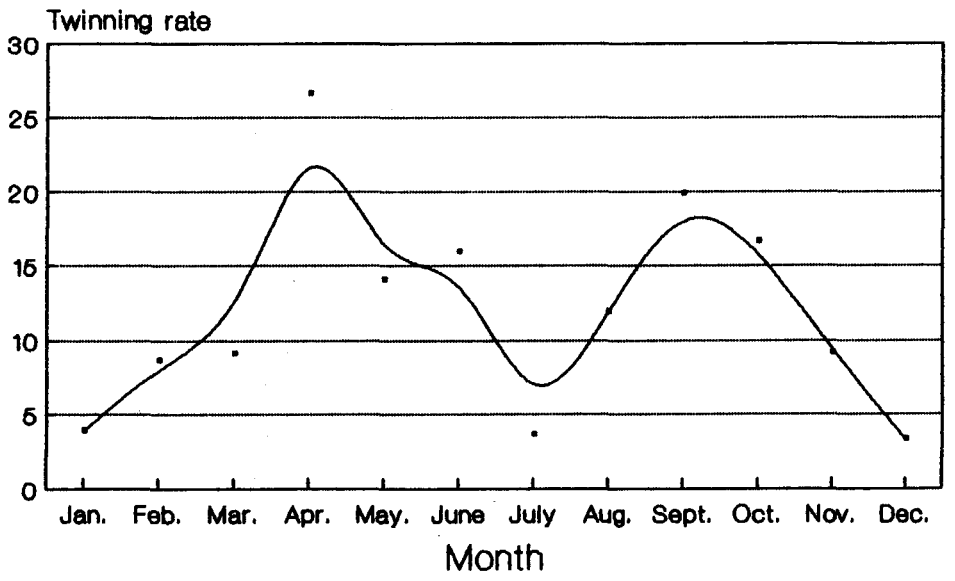

Fig. 3 - Seasonality of twin births.

https://doi.org/10.1017/S000156600000074X Published online by Cambridge University Press

Table 5 - Seasonal variation in twinning rate

Seasonal	Livebirths (LB)	Mean LB	Twin births	Twinning rate
Winter	557	278.50	2	3.59
Spring	451	225.50	4	8.87
Summer	589	196.33	11	18.68
Rainy	965	321.67	12	12.44
Autumn	687	343.50	9	13.06

REFERENCES

1. Allen G (1981): Errors of Weinberg's difference method. In Gedda L, Parisi, P, Nance WE (eds) Twin Research 3: Part A, Twin Biology and Multiple Pregnancy. New York: Alan R Liss, pp. 71 -74.
2. Allen G, Hrubec Z (1985): Zygosity partitioning of small twin samples. Acta Genet Med Gemellol 34: 167- 174.
3. Beiguelman B, Franchi-Pinto C, Krieger H, Magna LA (1996): Twinning rate in Southeastern Brazilian population. Acta Genet Med Gemellol 45: 317-324.
4. Bleker OP, Breur W, Huidekoper BL (1979): A Study of birth weight, placental weight and mortality of twins as compared to singletons. Br J Obstet Gynecol 86: 111-118.
5. Boklage CE (1990): Survival probability of human conceptions from fertilization to term. Int J Fertil 35: 75-94.
6. Boklage CE (1995): The frequency and survival probability of natural twin conceptions. In Keith LG, Papiernik E, Keith DM, Luke B (eds): Multiple Pregnancy: Epidemiology, Gestation and Perinatal Outcome. New York: The Parthenon Publishing Group, pp. 41- 50.
7. Bryan, EM (1986): The intrauterine hazards of twins [editorial]. Arch Dis Child 61: 1044-1045.
8. Bulmer MG (1970): The Biology of Twinning in Man. Oxford: Clarendon Press.
9. Chervenak FA, Johnson RE, Berkowitz RL, Grannum P, Hobbins JC (1984): Is routine cesarean section necessary for vertex-breech and vertex-transverse twin gestations? Am J Obstet Gynecol 148: 1-5.
10. Eriksson AW, Abbott C, Kostense PJ, Fellman JO (1995): Secular changes of twinning rates in Nordic populations. Acta Genet Med Gemellol. 44: 141-162.
11. Gedda L (1951): Studio dei gemelli. Rome: Edizioni Orizzonte Medico.
12. Goswami R, Goswami HK (1993): Changing trends in twinning. Acta Genet Med Gemellol 42: 289-294.
13. Imaizumi Y (1987): The recent trends in multiple births and stillbirth rates in Japan. Acta Genet Med Gemellol, 36: 325-334.
14. James WH (1976): Seasonality in twin births. Ann Hum Biol 3: 193-195.
15. Kamimura K (1976): Epidemiology of twin births from a climatic point of view. Br J Prerv Soc Med 30: 175-179.
16. Keith KG, Papiernik E. Keith DM, Luke B, eds (1995): Multiple Pregnancy: Epidemiology, Gestation and Perinatal outcome, New York: The Parthenon Publishing Group.
17. Landy HJ, Keith L, Keith D (1982): The vanishing twin. Acta Genet Med Gemellol 31: 179-194.
18. MacGillivray I, Campbell DM, Thompson B (1988): Twinning and Twins. New York: John Wiley and Sons.
19. Noble E (1991): Having Twins, 2nd edn. Boston: Houghton Mifflin.
20. Nylander PPS (1979): The twinning incidence in Nigeria. Acta Genet Med Gemellol 27; 45-49.

21. Papiernik E, Mussy MA, Vial M, Richard A (1985): A low rate of perinatal deaths for twin-births. Acta Genet Med Gemellol 34: 201-206.
22. Philippe P (1990): Twinning causative origin investigated by Sartwell's biometrical method. Am J Hum Biol 2: 107-115.
23. Puissant F, Leroy F (1982): A reappraisal of perinatal mortality factors in twins. Acta Genet Med Gemellol 31: 213-219.
24. Razzaque A, Ahmed K, Wai L (1990): Twinning rates in a rural area of Bangladesh. Hum Biol 62: 505-514.
25. Sharma K (1995): The frequency of twinning in India. Ind J Hum Genet: 63-70.
26. Sharma K (1997): The epidemiological characteristics of twinning in Northwest India. Int J Anthropol (In press).

Correspondence: Krishan Sharma, Department of Anthropology, Panjab University, Chandigarh, 160014 India.