Short Communication

Twinning rate trend in a population sample from the city of São Paulo, Brazil

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Abstract

A retrospective study was carried out on a sample consisting of 89,491 deliveries occurred from 1979 through 1998, in the city of São Paulo, SP, Brazil. These deliveries included 935 twin and 26 triplet births. The mean incidence per 1,000 deliveries was estimated at 10.45 for twins (5.34 for dizygotic and 5.11 for monozygotic twins) and 0.29 for triplets. The average maternal age increased significantly during this period for both twins and singletons. The temporal variation in years significantly influenced the increase of monozygotic twins and of triplets. Temporal variation and maternal age significantly influenced the dizygotic twinning rate increase. An increased proportion of monozygotic twins born to mothers aged 31 - 35 years was also detected.

Introduction

The dizygotic twinning rate is positively correlated with maternal age and parity (Allen and Parisi, 1990; Beiguelman *et al*., 1996), as well as with assisted reproduction (Keith *et al*., 2000; Kiely and Kiely, 2001; Colletto *et al*., 2001). Prior to the widespread use of assisted reproduction techniques, a decrease in the dizygotic twinning rate had been observed in most of the urban populations studied (Beiguelman *et al*., 1996). The dizygotic twinning rate has remained unchanged, but lately some authors have observed a small increase in the frequency of monozygotic twin births (Bressers *et al*., 1987; Allen and Parisi, 1990; Beiguelman *et al*., 1996). This rise might be the consequence of residual effects of the long-term use of oral contraceptives, since they promote tubal motility depression and changes in the endometrial mucosa and in the oviduct epithelium (Bressers *et al*., 1987; Beiguelman *et al*., 1996).

This work aimed at estimating the variation in the incidence of multiple births in a sample of mothers belonging preferentially to the upper and middle socioeconomic classes, and the effects of non-genetic variables, such as the increase of maternal age, on the twinning rate.

Subjects and Methods

A retrospective study was carried out to investigate the twinning rate from 1979 through 1998 at Hospital Santa Catarina, in the city of São Paulo, Brazil. The population seeking medical attention at this hospital belongs to the upper and middle socioeconomic layers. During this period, 89,491 deliveries took place, 88,530 of them of singletons, 935 of twins, and 26 of triplets. These figures include stillbirths, except for fetuses weighing 500 g or less at birth which were excluded, since this weight range corresponds to a gestational age between 20 and 22 weeks, and therefore they were considered as abortions. All data were obtained from hospital records. The whole set of data was used to estimate the frequency of twin and triplet births in relation to the total annual deliveries. To compare the maternal age and gestational order of singletons and twins, all multiple births and five to six singleton births per month were considered, totaling 1,400 singletons. Zygosity tests were not performed, and the frequency of dizygotic (DZ) pairs was estimated by Weinberg's method. A stepwise multiple regression analysis model was used to study the influence of maternal age, gestational order, and temporal variation on multiple births. The independent variables were: maternal age, squared maternal age, gestational order, squared gestational order, maternal age times gestational order, temporal variation, and squared temporal variation. The comparison of maternal age and gestational order was performed using Kruskal-Wallis's non-parametric test (χ^2), followed by Dunn's multiple comparison test (Q). Spearman's correlation coefficient was used to verify the association of monozygotic twin birth with maternal age. The commercial software SPSS version 9.0 was used for the statistical analyses.

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Results

During the 20-year period (1979-1998) covered by this study, the average frequency of twins per thousand deliveries was 10.45, being 5.34 for DZ (dizygotic) and 5.11 for MZ (monozygotic). The estimated triplet rate was $0.29^0/_{00}$ (Table 1). Stepwise multiple regression analysis revealed that temporal and squared temporal variations had a significant influence on the MZ birth rate [MZR = 3.693 + 0.0806 x temporal variation + 0.0036 x (temporal variation)^2], while the DZ rate was significantly influenced not only by temporal and squared temporal variations, but also by maternal age and squared maternal age [DZR = 7.884 + 0.229 x (temporal variation)^2 - 0.371 x temporal variation + 0.0029 x (maternal age)^2 - 0.148 x maternal age]. Only the temporal variation had a significant influence [TriR = -0.485 + 0.0829 x temporal variation] on the triplet birth rate (Figure 1).

The maternal ages for singletons, twins and triplets were shown to differ statistically (Table 2). The maternal age for twins was significantly higher than that for singletons (Q = 3.57; p < 0.005), but the ages of mothers of triplets did not differ from those of singletons and twins (Q = 0.88; p > 0.50 and Q = 0.11; p > 0.50, respectively).

Over this 20-year period, the mean maternal age increased significantly for both singletons and twins, as shown by regression analysis. Temporal variation influenced significantly both singleton and twin birth rates (F = 43.65; p < 0.001 and F = 41.66; p < 0.001, respectively). Although the mean age of mothers of twins was
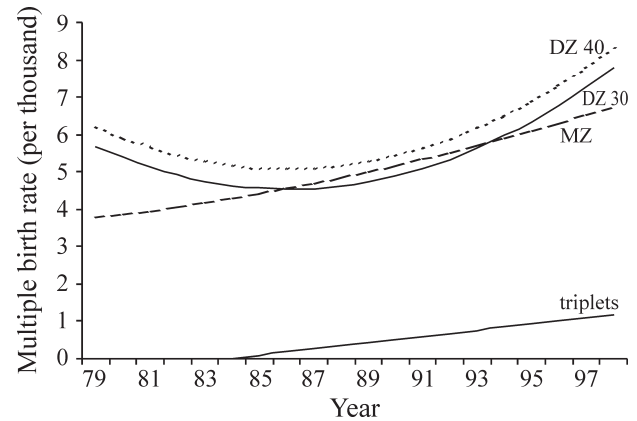

Figure 1 - Best-fit regression curves for the annual distribution rates of monozygotic (MZ) and dizygotic (DZ) twins, and triplets. As dizygotic twin rates are dependent on temporal variation (years) and on maternal age, two curves are shown, for mothers aged 30 (DZ-30) and 40 years (DZ-40).

Table 1 - Number of singleton, twin and triplet births from 1979 to 1998. (MM = male/male, FF = female/female, MF = male/female; rates per thousand: DZR = dizygotic twins, MZR = monozygotic twins, TR = total twins and TriR = triplets.

	Number of deliveries						Rates per thousands			
Year	Singleton	Twins	MM	FF	MF	Triplets	DZR	MZR	TR	TriR
1979	775	9	5	1	3	0	7.65	3.83	11.48	0.00
1980	1692	15	8	3	4	0	4.69	4.10	8.79	0.00
1981	2355	16	7	3	6	0	5.06	1.69	6.75	0.00
1982	3150	30	12	10	8	0	5.03	4.40	9.43	0.00
1983	3862	43	21	13	9	1	4.61	6.40	11.01	0.26
1984	3969	29	4	14	11	0	5.50	1.75	7.25	0.00
1985	4892	40	22	8	10	0	4.06	4.06	8.11	0.00
1986	5789	52	20	19	13	1	4.45	4.45	8.90	0.17
1987	5464	51	28	14	9	0	3.26	5.98	9.25	0.00
1988	6069	54	25	16	13	1	4.25	4.57	8.82	0.16
1989	6818	74	20	32	22	2	6.38	4.35	10.74	0.29
1990	6332	68	29	23	16	1	5.00	5.63	10.63	0.16
1991	5745	55	20	22	13	1	4.48	5.00	9.48	0.17
1992	4784	49	20	19	10	2	4.14	6.00	10.14	0.41
1993	4673	62	20	22	20	1	8.45	4.65	13.09	0.21
1994	4694	50	14	24	12	1	5.06	5.48	10.54	0.21
1995	4740	66	27	25	14	8	5.83	7.91	13.73	1.66
1996	5028	58	27	17	14	2	5.51	5.90	11.40	0.39
1997	4413	69	27	22	20	3	8.92	6.47	15.38	0.67
1998	3286	45	16	17	12	2	7.20	6.30	13.51	0.60
Total	88530	935	372	324	239	26	5.34	5.11	10.45	0.29

Table 2 - Maternal age means and standard deviations (SD), and gestational order for singletons, twins and triplets.

	Deliveries	Number	Mean	SD	Mean rank	χ^2	P
Maternal age	Singletons	1400	28.79	4.82	1134.7		
	Twins	926	29.57	4.90	1237.1	13.14	0.001
	Triplets	26	29.42	5.16	1252.6		
Gestational order	Singletons	1400	1.90	1.02	1173.0		
	Twins	926	1.96	1.08	1204.0	7.46	0.024
	Triplets	26	1.46	0.71	873.5		

higher than that of mothers of singletons, the slopes of the two regression lines did not differ significantly. The mean age of mothers of singletons changed from 27.73 ± 4.51 to 30.41 ± 4.99, while the age of mothers of twins increased from 28.13 ± 4.49 to 31.22 ± 5.58 years.

The gestational order differed among the three groups (Table 2), but a multiple comparison test showed that singletons did not differ from twins (Q = 1.07; p > 0.50) or from triplets (Q = 2.22; 0.10 > p > 0.05); the gestational order of triplets, however, was lower than that of twins (Q = 2.44; p < 0.05). Regression analysis showed a decreasing trend in the gestational order of twins, beginning in the 1990s.

Considering six maternal age groups ($\leq$20, 21-25, 26-30, 31-35, 36-40, $\geq$41), a negative correlation was observed between maternal age and the proportion of monozygotic twins among twin births of each group (93.1% in the age group $\leq$20, and 40.0% in the age group $\geq$41; $r_s = -0.829$; p = 0.042). When the two groups of mothers that comprise 65.9% of the total of twin births (25-30 and 31-35 years old) were analyzed with regard to gestational order, the proportion of monozygotic twins showed an unexpected distribution: up to the gestational order 3, the proportion was approximately constant in both groups; however, for gestational orders 4 or higher, the proportion of monozygotic twins increased among twins born to mothers 31-35 years old (Figure 2).
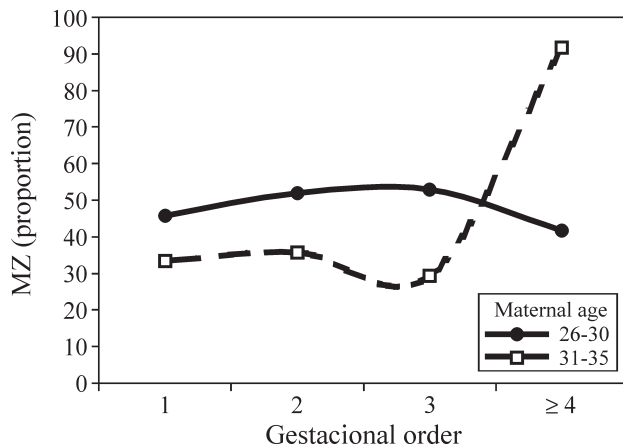

Figure 2 - Monozygotic twin proportions in two maternal age groups (26-30 and 31-35 years) according to gestational order.

The gestational ages in weeks varied significantly ($\chi^2 = 195.13$; d.f. = 2; p < 0.001) among singletons (39.06 ± 1.48), twins (36.90 ± 2.76), and triplets (30.37 ± 7.31). Low birth weight was found in 51.2% of twins and 88.2% of triplets.

Discussion

It is well established that maternal age is positively correlated with the dizygotic twin rate, but not with monozygotic twinning (Beiguelman *et al*., 1996; Steegers-Theunissen *et al*., 1998; Keith *et al*., 2000). Among people of the middle and upper socioeconomic classes, the access to assisted reproduction techniques is growing, and this is correlated with multiple pregnancies (Steegers-Theunissen *et al*., 1998; Keith *et al*., 2000; Colletto *et al*., 2001). So, we cannot discard the possibility of this fact contributing to the rise of the incidence of dizygotic twin and triplet births.

Gestational order has been previously shown to be positively correlated with the incidence of twinning (Allen and Parisi, 1990), but this was not found in this survey. Assisted reproduction techniques used in primigravidae in recent years may be the cause of the decrease of the mean gestational order of twins and triplets that we observed.

Previous studies have shown a decrease in the proportion of MZ pairs among twins as maternal age increases (Beiguelman *et al*., 1995), a finding corroborated by this study. Thus, the incidence of MZ twins in our sample should be expected to decline over time, due to the increased maternal age. The opposite, in fact, occurred, since the proportion of MZ pairs has increased during the 20-year period. This could be the consequence of long-term use of oral contraceptives with residual effects on the subdivision of the segmented zygote (Pinkerton and Carey, 1976; Bressers *et al*., 1987). Mothers aged 31 to 35 years with a gestational order equal to or higher than four (Figure 2), could have been on oral contraceptives longer than the younger ones.

Acknowledgments

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