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## Twinning Rates in Japan, 1951-1990

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**Abstract.** Twinning rates in all of Japan for 1951-1968 and 1974-1990 were analyzed using data from vital statistics of Japan. The twinning rate per 1,000 births was 6.43 in 1951 and remained nearly constant until 1968, then decreased to 5.79 in 1974 and gradually increased to 7.00 in 1990. The MZ twinning rate increased slightly up to 1966, but decreased thereafter, whereas the DZ rate declined over the entire period. As for maternal age, the DZ rate increased up to the age group 35-39 and decreased thereafter. The same tendency is seen in the MZ rate, but the maternal age effect is less marked than in DZ twins. The same tendency is also seen in the overall rate for 1975-1985. As for geographical variations, the MZ and DZ rates were computed in each prefecture for 1955-1959 and in 1974. The DZ rate increased from a low level in the southwest of Japan to a high level in the northeast for both periods, whereas the MZ rate was rather constant in 1974 throughout Japan. As for seasonal variation, the highest rates per 1,000 births for MZ(4.56) and DZ(2.20) twins were seen in April, with the lowest rate in September (3.69) for MZ twins and in July (1.71) for DZ twins.

**Key words:** Twinning rates, Maternal age, Birth order, Induced ovulation

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## INTRODUCTION

In Japan twinning rates were estimated by Komai and Fukuoka [13] and Inouye [7], at 0.69% and 0.61%, respectively. Similarly, Imaizumi and Inouye [4] estimated the twinning rate during the period from 1951-1967 and in 1974. In these three studies the monozygotic twinning rate was around 0.4%. The present study deals with the secular changes, geographical and seasonal variations of twinning rates in all of Japan. It also deals with the effects of maternal age and birth order on the twinning rates.

## MATERIALS AND METHODS

The data was obtained from the vital statistics of Japan for the periods 1951-1968 and 1974-1990 [9]. Some of the following are the summary of results reported elsewhere [4,5,8].

## RESULTS

### Secular Changes of Twinning Rates

Fig. 1 shows the monozygotic (MZ) and dizygotic (DZ) twinning rates during the period from 1955-1967 and in 1974 [4]. The rates by zygosity were estimated using Weinberg's method. The MZ twinning rate increased slightly up to 1966, but decreased thereafter. The DZ rate declined throughout the entire period.



Fig. 1. Secular change of MZ and DZ twinning rates during 1955-1967 and in 1974. (After Imaizumi and Inouye [4]).

Table 1 shows overall twinning rates during the periods 1951-1968 and 1974-1990. The twinning rate per 1,000 births was 6.43 in 1951 and remained more or less constant up to 1968, then decreased to 5.79 in 1974 and gradually increased again to 7.0 in 1990.

Table 1 - Secular change of twin births, 1951-1968 and 1974-1990

Year	Livebirths		Total	Fetal deaths			Total	Twinning rate per 1,000 births
	Male	Female		Male	Female	Unknown		
1951	-	-	23,088	-	-	-	7,198	30,286
1952	-	-	21,326	-	-	-	6,688	28,014
1953	-	-	19,525	-	-	-	6,581	26,106
1954	-	-	18,869	-	-	-	6,441	25,310
1955	-	-	17,889	-	-	-	6,195	24,084
1956	-	-	17,410	-	-	-	6,040	23,450
1957	-	-	16,855	-	-	-	5,959	22,814
1958	-	-	17,386	-	-	-	6,248	23,634
1959	-	-	17,094	-	-	-	6,064	23,158
1960	8,198	8,353	16,551	3,157	2,484	126	5,767	22,318
1961	8,391	8,497	16,888	3,198	2,534	168	5,900	22,788
1962	8,623	8,640	17,263	3,104	2,397	144	5,645	22,908
1963	8,823	8,764	17,587	3,122	2,414	153	5,689	23,276
1964	9,646	9,375	19,021	2,889	2,275	151	5,315	24,336
1965	9,699	9,878	19,577	2,643	2,141	171	4,955	24,532
1966	7,626	7,731	15,357	2,391	1,787	161	4,339	19,696
1967	10,932	10,878	21,810	2,503	1,51	160	4,614	26,424
1968	10,321	10,201	20,522	2,190	1,797	185	4,172	24,694
1974	10,757	10,742	21,499	1,672	1,372	241	3,285	24,784
1975	10,342	10,273	20,615	1,590	1,162	243	2,995	23,610
1976	9,863	9,929	19,792	1,538	987	220	2,745	22,537
1977	10,026	10,189	20,215	1,449	1,057	232	2,738	22,953
1978	9,977	9,696	19,673	1,309	954	252	2,515	22,188
1979	9,659	9,783	19,442	1,324	968	273	2,565	22,007
1980	9,456	9,435	18,891	1,192	859	223	2,274	21,165
1981	9,351	9,275	18,626	1,188	783	255	2,226	20,852
1982	9,389	9,217	18,606	1,166	748	276	2,190	20,796
1983	9,222	9,229	18,451	1,079	765	302	2,146	20,597
1984	8,975	9,295	18,270	1,131	729	291	2,151	20,421
1985	8,718	8,894	17,612	1,073	631	295	1,999	19,611
1986	8,544	8,300	16,844	977	632	345	1,954	18,798
1987	8,337	8,428	16,765	968	528	375	1,871	18,636
1988	8,260	8,387	16,647	932	584	309	1,825	18,472
1989	8,174	8,278	16,452	802	513	380	1,695	18,147
1990	8,074	8,067	16,141	862	450	412	1,724	17,865

## Effect of Maternal Age and Birth Order on Twinning Rates

Fig. 2 shows MZ and DZ twinning rates by maternal age in the years 1960-1967 and in 1974. The DZ rate increased up to the age group 35-39 and decreased thereafter for both periods. The same tendency is seen in the MZ rate, but the maternal age effect is less marked than in DZ twins.

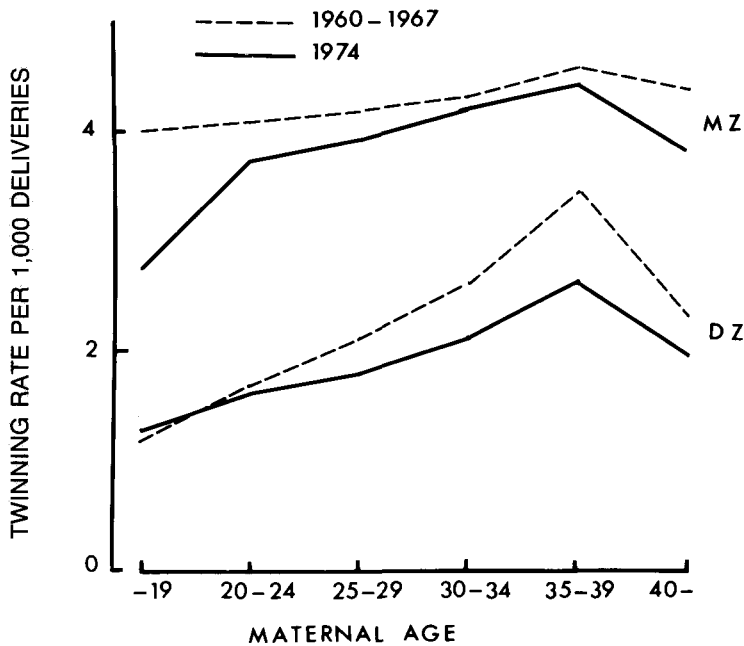


Fig. 2. MZ and DZ twinning rates by maternal age, 1960-1967 and 1974. (After Imaizumi and Inouye [4].)

Fig. 3 shows overall twinning rates by maternal age in the years 1960-1968, 1974, and 1975-1985. Here, the twinning rate also increased up to the age group 35-39 and decreased thereafter.

Fig. 4 shows MZ and DZ twinning rates in 1974 according to maternal age and birth order [8]. Both rates increased with birth order in mothers aged under 30 years, whereas in mothers aged between 30-34 years, the MZ rate increased from the second to the fifth birth and decreased thereafter, and the DZ rate either decreased or remained constant up to the fourth birth and increased thereafter. In mothers over 35 years of age, MZ and DZ rates increased with birth order except in the lowest birth order. Inouye and Imaizumi [8] performed the multiple regression analysis on the effects of maternal age and birth order on MZ and DZ twinning rates, using a linear and a quadratic model. In the

linear regression model, maternal age was the only factor significantly influencing the DZ rate, whereas there were no factors influencing the MZ rate. The square of the multiple correlation coefficients for MZ and DZ twins was 0.05 and 0.258, respectively. On

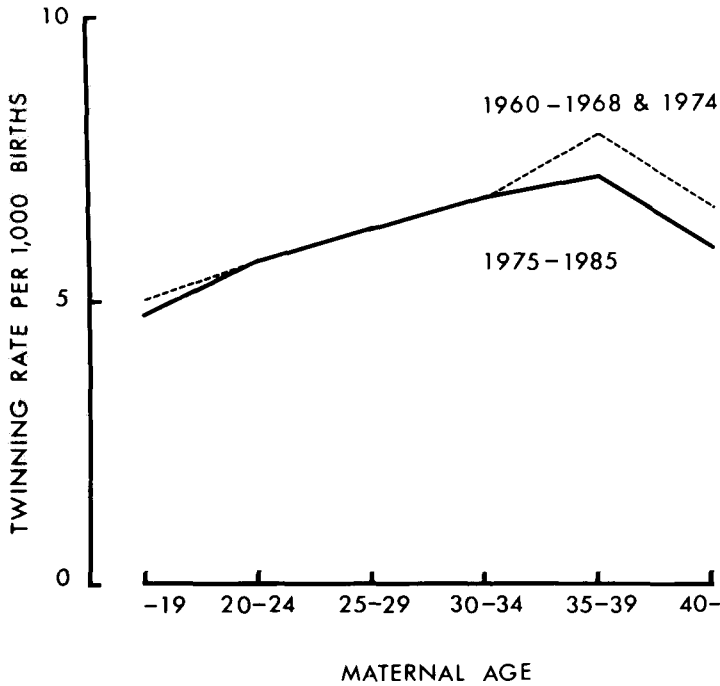


Fig. 3. Overall twinning rates by maternal age 1960-1968, in 1974, and 1975-1985.

the other hand, in the quadratic model, significant regression coefficients in quadratic terms for birth order and in interaction terms between maternal age and birth order were obtained for both MZ and DZ twins. The multiple correlation coefficients for MZ and DZ twins were 0.42 and 0.53, respectively.

### Geographical Variation in Twinning Rates

Fig. 5 shows MZ and DZ twinning rates in each prefecture for 1955-1959 and in 1974. The MZ and DZ rates increased from a low level in the southwest of Japan to a high level in the northeast for the years 1955-1959. This same increase took place in the DZ rate in 1974 whereas the MZ rate in that year was rather constant throughout Japan. In 1974 there was a positive correlation (0.095) between the DZ rate and the proportion of twins having multiple births among relatives [8]. Fig. 6 shows overall twinning rates

in each prefecture for 1951-1959 and 1975-1985. Excluding the Okinawa prefecture, there was a correlation coefficient of 0.26 between the rates for both periods — a value which is not significant at the 5% level. The rate for 1951-1959 increased from a low level in southwest Japan to a high level in the northeast, whereas the rate for 1975-1985 was fairly constant throughout Japan.

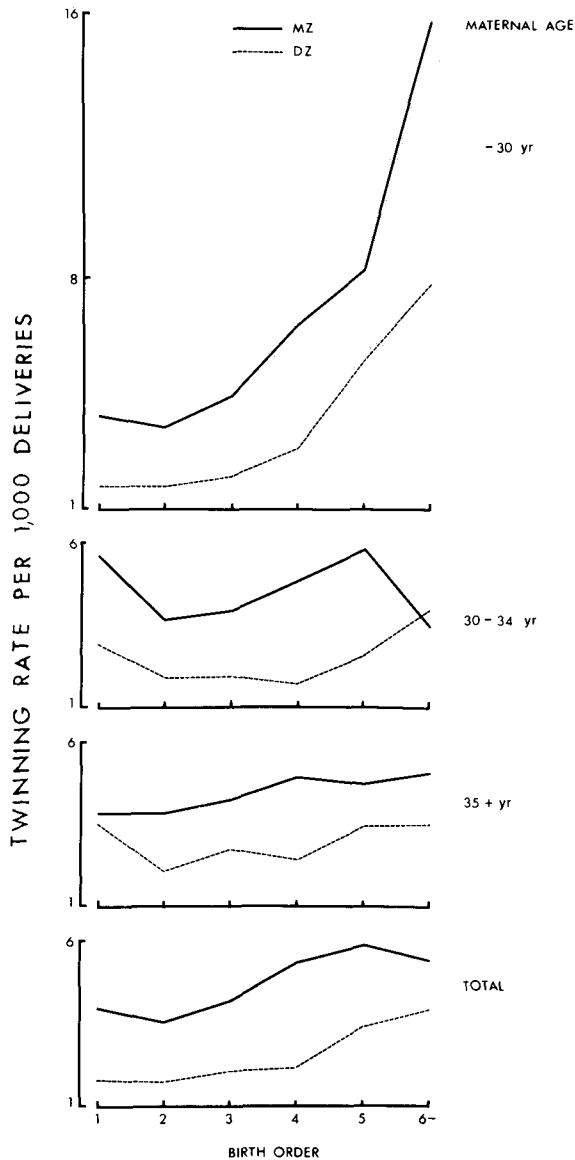
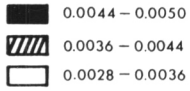
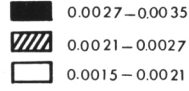


Fig. 4. MZ and DZ twinning rates according to maternal age and birth order in 1974. (After Inouye and Imaizumi [8])

MONOZYGOTIC TWINNING RATE, 1955-1959



DIZYGOTIC TWINNING RATE, 1955-1959



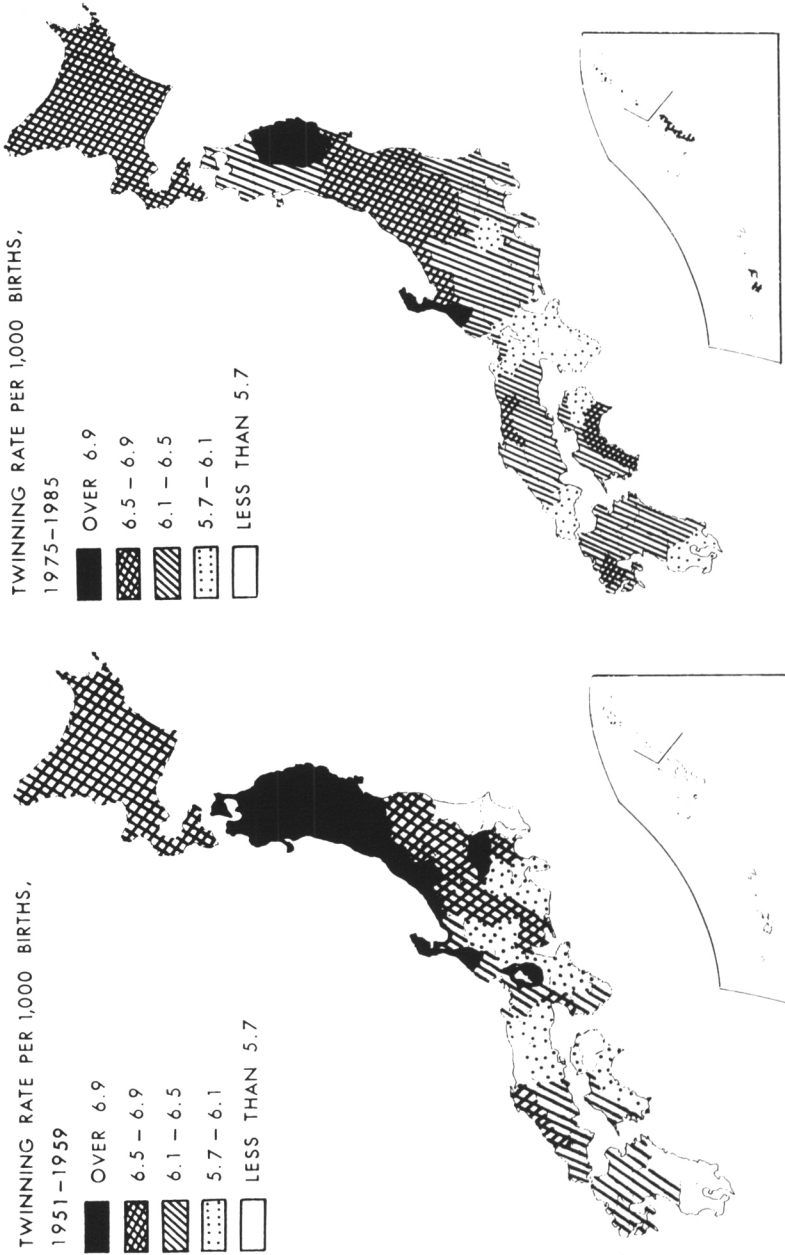


Fig. 6. Overall twinning rates in each prefecture 1951-1959 and 1975-1985.



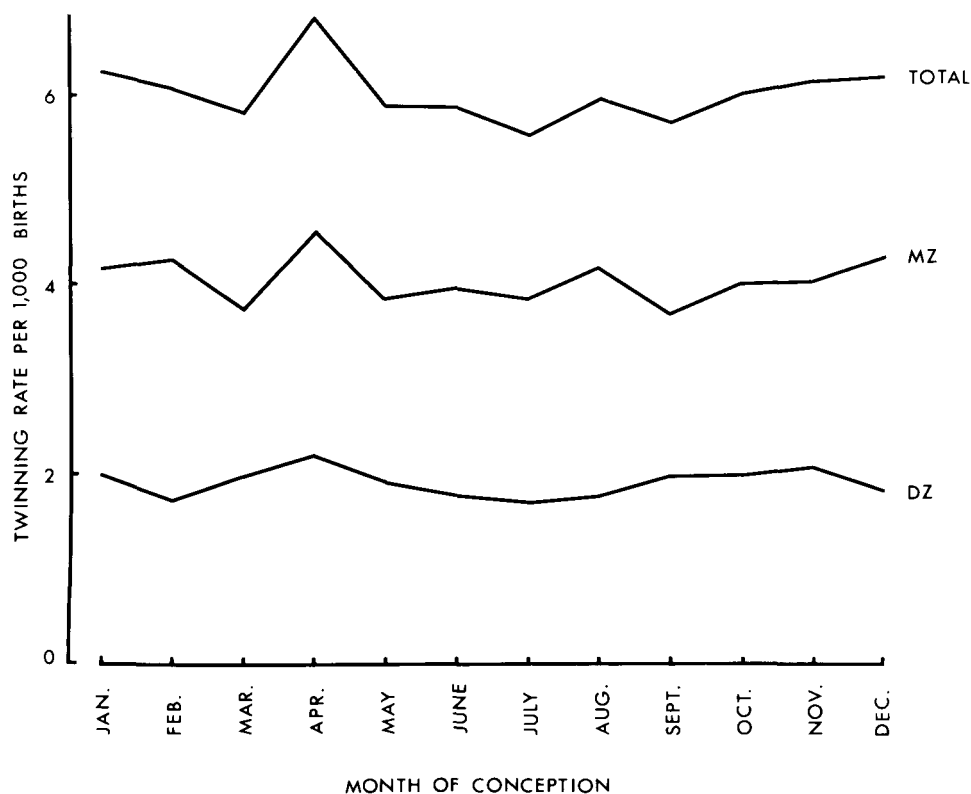


Fig. 7. Overall twinning rates according to the month of conception, 1974. (After Imaizumi and Inouye [5]).

### Seasonal Variation in Twinning Rates

Fig. 7 shows MZ and DZ twinning rates per 1,000 births according to the month of conception, which was allotted to be 38 weeks before expected fullterm delivery. The highest rates for MZ (4.56) and DZ (2.20) twins were seen in April, whereas the lowest rates were seen in September for MZ twins (3.69), and in July for DZ twins (1.71). The DZ rates per 1,000 births were 1.86 in winter (December to February); 2.04 in spring (March to May); 1.77 in summer (June to August); and 2.01 in autumn (September to November), respectively. Thus, it seems likely that twinning rates vary according to the season of conception, at least in DZ twins.

### DISCUSSION

In Japan, the MZ twinning rate per 1,000 births increased slightly from 3.88 in 1955 to 4.43 in 1966, then decreased to 3.90 in 1974. The DZ rate per 1,000 births declined steadily from 2.39 in 1955 to 1.86 in 1974. Similarly, in Taiwan the DZ rate declined steadily

from 2.7 in 1955 to 1.3 in 1975, and then gradually increased to 3.6 in 1984. Average twinning rates per 1,000 deliveries in Taiwan were 3.45 for MZ and 2.06 for DZ twins between 1955-1974, and the corresponding rates for 1975-1984 were 4.48 and 1.83, respectively [2]. Therefore, the twinning rate was higher for MZ than for DZ twins in both Japan and Taiwan. On the other hand, in Korea the twinning rates per 1,000 livebirths were 3.74 for MZ and 4.98 for DZ twins in 1958 [11], while the overall twinning rate was 10.42 per 1,000 deliveries from 1975-1984 [12]. In Japan, the overall twinning rate was 6.49 in 1986 and steadily increased to 7.00 in 1990. Therefore, it can be seen that overall twinning rates increased in Taiwan, Korea and Japan recently. Similarly, twin livebirths per 1,000 livebirths increased significantly year by year in the United States, Portugal, and Australia during the period 1977-1985 [6]. These higher twinning rates were attributed to the greater proportion of mothers treated with ovulation-inducing hormones.

Milham [14] suggested a relation between gonadotropins and the DZ twinning rate, and a high twinning rate related to a high blood gonadotropin level was reported by Nylander [16]. Soma et al [18] reported on the significantly lower plasma gonadotropin levels in Japanese women compared to those found in Nigerian women, who reportedly had a high twinning rate [16]. They suggested that the low DZ twinning rate in Japanese women might be related to their low output of gonadotropin. Also, twinning rates in Japanese migrants to California [17], Canada [3] and Hawaii [15] were lower and similar to those in Japan.

As for geographical variations, there are significant correlation coefficients among the latitude of the prefecture capitals on one hand and the MZ twinning rate (0.37) and DZ rate (0.52) for 1955-1959 and the DZ rate in 1974 (0.33), and the overall twinning rate for 1951-1959 (0.60) on the other hand. However, the coefficients between the latitude and the MZ twinning rate in 1974 (0.24) and the overall twinning rate for 1975-1985 (0.24) are not significant, at the 5% level. Therefore, before 1960 overall twinning rates increased significantly from a low level in the southwest to a high level in the northeast of Japan, but this tendency has changed recently, and the rate has become rather constant throughout Japan. Bulmer [1] reported that twinning rates increased from a low level in the southwest of Europe to a high level in the east — a somewhat similar pattern to both MZ and DZ rates reported by Chen et al [2] for Taiwan. The same tendency is seen in Japan [8,10], but recently this has changed due to the use of ovulation-inducing hormones.

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