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Epidemiological Characteristics of Twinning Rates in Taiwan

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Abstract. Delivery records of public hospitals and birth certificates of household registration offices were examined to study the epidemiological characteristics of twinning rate from 1955 to 1984 in Taiwan. The MZ twinning rate was consistently higer than the DZ rate during the study period. The DZ rate declined steadily from 2.7 per 1000 in 1955 to 1.3 per 1000 in 1975, and then gradually increased to 3.6 per 1000 in 1984. The MZ rate peaked periodically in 1956, 1966 and 1976, and gradually increased from 3.3 per 1000 in 1978 to 5.9 per 1000 in 1986. Both MZ and DZ rates were higher in urban than in rural areas and they were also higher in northern Taiwan than elsewhere in the island. While both MZ and DZ rates increased with maternal age and parity, the maternal age difference and the parity difference were more striking in DZ than in MZ rates. The international comparison also showed a greater racial difference in maternal age-specific DZ than MZ twinning rates; and the older the maternal age, the greater the international discrepancy in DZ rates.

Key words: Twinning rate, Epidemiology, Chinese population

INTRODUCTION

The decline of twinning rates during this century, due to a fall of DZ rates, has been observed in many countries [2,7,9,10,13,16,17,20,23,28,31]. Significant racial differences in DZ, more than MZ rates were reported by some investigators [20,23,24,29,31]. An increase of twinning rates by maternal age and parity was also frequently found [1,3-5, 7-13,16,20-23,28-29]. However, there were only few studies on twinning rates in the Chinese population. Early in 1936, the twinning rate in Taiwan was estimated to be 3.4 per 1000 [18]; a later study in 1968 showed a twinning rate of 5.7 per 1000 with a MZ:DZ

ratio of 3:2 [21]. Still, the secular effect and international difference of Chinese twinning rates remain to be elucidated. This study on twinning rates from 1955 to 1984 in Taiwan was thus carried out.

MATERIALS AND METHODS

Data Base

Data analyzed in this study were obtained from two different sources. The delivery records of each woman attended in public hospitals from 1955 to 1984 were examined and double-checked with the annual Health Statistics [26]. In order to further validate the information on maternal age, parity, and residence area, the birth certificates of household registration offices were further screened. As it was not feasible to check back birth certificates before 1975, only those for the years after 1975 were examined. Thus, the analysis of the secular trend was based on the data from 1955 through 1984, while the analysis of geographical variation, maternal age and parity, and international comparison were based on data from 1975 through 1984.

Public hospitals at the metropolis, municipality and county levels were all included to assure complete coverage. As women who delivered in these hospitals came from various residence areas and socioeconomic strata, they were considered to be a representative sample of the general population, the bias which might result from differential admission being minimal.

As it is mandatory to register all the events of marriage, birth, death and migration in Taiwan, birth certificates registered in household registration offices are unique in terms of completeness and accessibility.

In order to study interracial differences in twinning rates, maternal age-specific MZ and DZ twinning rates in Hungary [7], Ireland [8], Japan [13], United States [22], and Denmark [23] were compared with those of the present study.

Data Analysis

Twinning rates were expressed as the number of twin births per 1,000 deliveries. Based on the sex composition of the twin sample, numbers of MZ and DZ pairs were estimated by Weinberg's method [6]. In the analysis of the effects of maternal age and parity, direct adjustment was employed using the age-parity-specific composition of the local number of delivered women as the standard population composition.

RESULTS

Secular Trend

The annual MZ and DZ rates per 1,000 deliveries in Taiwan from 1955 through 1984 are shown in Table 1. DZ rates declined steadily from 2.7 per 1,000 in 1955 to 1.3 per 1,000 in 1975, and then gradually increased to 3.6 per 1,000 in 1984. MZ rates showed a different pattern with periodical peaks in 1956, 1966 and 1976; and also a gradual increase from 3.3 per 1,000 in 1978 to 5.9 per 1,000 in 1984.

Table 1 - Twinning rates per 1,000 deliveries by sex and zygosity in Taiwan, 1955-1984

Year	Total deliveries	Twin pairs delivered			Twinning rate	
		MM	MF	FF	DZ	MZ
1955	65061	156	88	139	2.7	3.2
1956	59311	161	64	146	2.2	4.1
1957	54929	155	58	133	2.1	4.2
1958	56234	154	72	142	2.6	4.0
1959	56497	143	65	143	2.3	3.9
1960	55047	146	68	138	2.5	3.9
1961	55168	128	70	121	2.5	3.2
1962	52836	138	62	91	2.3	3.2
1963	52340	136	54	113	2.1	3.7
1964	51806	124	55	99	2.1	3.2
1965	50587	114	50	119	2.0	3.6
1966	47281	124	38	129	1.6	4.5
1967	45574	112	46	109	2.0	3.8
1968	46658	115	52	84	2.2	3.2
1969	47370	115	49	91	2.1	3.3
1970	53966	83	44	78	1.6	2.2
1971	53886	93	42	103	1.6	2.9
1972	49483	83	36	95	1.5	2.9
1973	42502	75	28	50	1.3	2.3
1974	41271	90	29	85	1.4	3.5
1975	39973	104	26	82	1.3	4.0
1976	40304	86	28	112	1.4	4.2
1977	34875	84	32	72	1.8	3.6
1978	35876	81	35	73	2.0	3.3
1979	46644	112	37	104	1.6	3.8
1980	42995	115	32	91	1.5	4.0
1981	44442	118	36	128	1.6	4.7
1982	41522	123	36	145	1.7	5.6
1983	38574	147	45	121	2.3	5.8
1984	29981	107	54	125	3.6	5.9

Geographical Variation

The geographical variation of MZ and DZ rates per 1,000 deliveries in Taiwan from 1975 to 1984 is shown in Table 2. Comparison in areas of different socioeconomic development indicated the higest MZ (6.5 per 1,000) and DZ (2.2. per 1,000) rates in the metropolitan area and the lowest MZ (3.6 per 1,000) and DZ (1.6 per 1,000) rates in county areas. The discrepancy among areas of different socioeconomic development was greater in MZ than in DZ rates.

There also was a significant difference in different localities. Both the MZ and DZ rates were higest in northern Taiwan, and lowest in western Taiwan. The difference for MZ rates was greater than for DZ rates.

Table 2 - Geographical variation of twinning rates per 1,000 deliveries by sex and zygosity in Taiwan, 1975-1984

Geographic areas	Total deliveries	Twin pairs delivered			Twinning rate	
		MM	MF	FF	DZ	MZ
Socioeconomic development						
Metropolis level	96436	361	106	368	2.2	6.5
Municipality level	62126	181	61	176	2.0	4.8
County level	236624	535	194	509	1.6	3.6
Locality						
Northern area	159372	570	179	566	2.2	6.0
Southern area	81232	202	77	201	1.9	4.0
Eastern area	58021	138	43	135	1.5	4.0
Western area	96561	167	62	151	1.3	2.7

Maternal Age and Parity

The maternal age and parity-specific twinning rates are shown in Table 3. MZ rates increased with maternal age consistently in different parity classes and also increased with parity consistently in different maternal age classes. The parity-adjusted MZ rate was 3.8 per 1,000 for maternal age 15-19, and it was 5.0 per 1,000 for maternal age 35 and over. The maternal age-adjusted MZ rate increased from 3.9 per 1,000 for parity 1 to 5.0 per 1,000 for parity 5 or more.

DZ rates showed the same pattern as MZ rates with regard to maternal age and pari-

Table 3 - Twinning rates per 1,000 deliveries by zygosity, maternal age and parity in Taiwan, 1975-1984

Zygosity	Maternal age	Parity					Parity-adjusted rate
		1	2	3	4	5	
MZ	15-19	3.2	4.2	4.2			3.8
	20-24	3.6	4.0	4.5	4.8	4.8	4.1
	25-29	4.3	4.3	5.0	5.0	5.4	4.6
	30-34	4.5	4.8	4.8	5.1	5.6	4.8
	35-39	4.7	5.1	5.3	5.5	6.5	5.0
	Maternal age-adjusted rate	3.9	4.5	4.8	4.9	5.0	
DZ	15-19	1.2	2.3	0.5			1.7
	20-24	1.2	1.4	1.4	3.3	4.0	1.5
	25-29	1.4	1.6	1.8	3.0	3.9	1.8
	30-34	2.8	2.7	3.0	3.2	3.9	2.6
	35-39	3.3	3.0	3.9	4.2	4.1	2.9
	Maternal age-adjusted rate	1.5	1.8	1.9	2.9	3.1	

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ty. The older the maternal age, the greater the DZ rate; and the higher the parity, the higher the DZ rate.

International Comparison

Fig. 1 shows MZ rates per 1,000 deliveries by maternal age in Taiwan, Japan, United States, Hungary, Ireland and Denmark. The maternal age-specific MZ rates were highest in Hungary, but were not significantly different in the other countries compared. MZ rates increased with maternal age in Taiwan, Hungary and Denmark; but not in Japan, Ireland and the United States. However, most maternal age-specific MZ rates were within the range 2.0-5.0 per 1,000 deliveries in these countries.

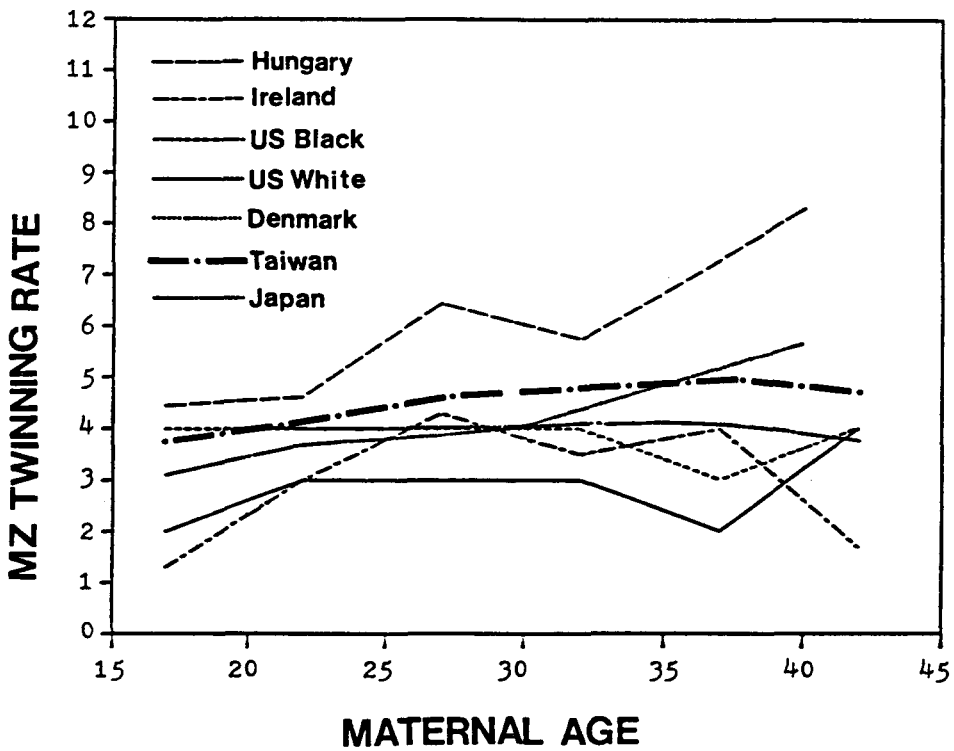

Fig. 1. International comparison of MZ twinning rates per 1,000 deliveries by maternal age.

Fig. 2 shows the DZ rates per 1,000 deliveries by maternal age in these countries. The highest DZ rates were observed in Hungary, while in Japan and Taiwan they were much lower than in European countries and the United States. In almost all of these countries, DZ rates increased with maternal age, but they decreased after maternal age 35 in certain countries. The international difference in DZ rates was much more striking than that in MZ rates. The maternal age-specific DZ rates ranged from 1.0 per 1,000 to 23.0 per 1,000; and the older the maternal age, the greater the international discrepancy.

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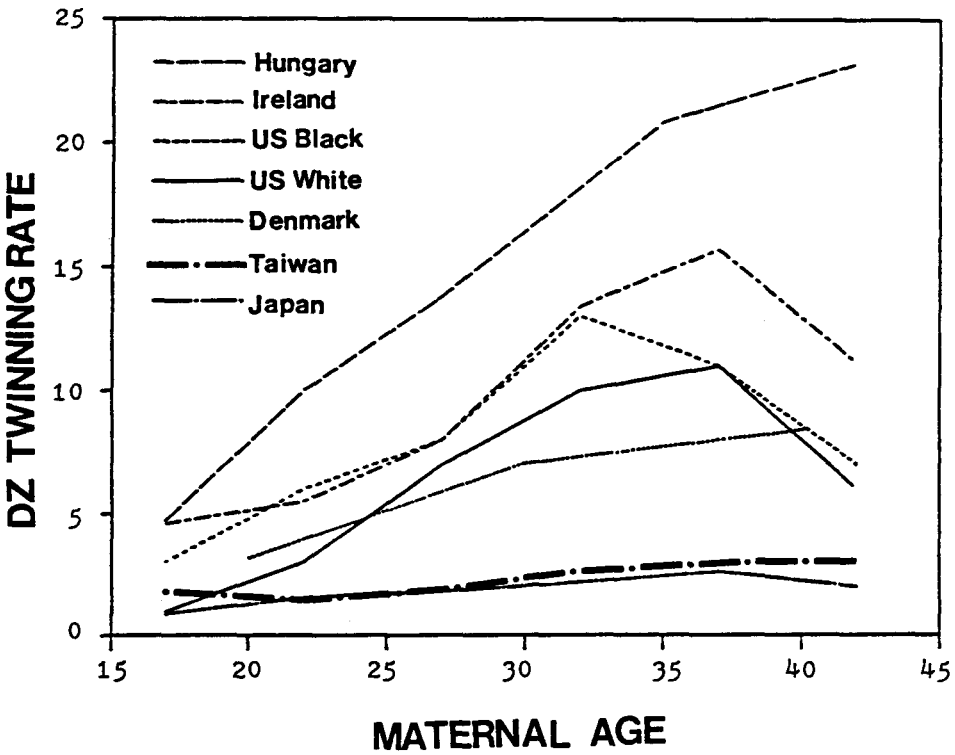

Fig. 2. International comparison of DZ twinning rates per 1,000 deliveries by maternal age.

DISCUSSION

A consistent decrease in twinning rates during this century has been reported in Australia [2], Hungary [7], Canada [9], Finland [10], Japan [13], Belgium, Netherlands, New Zealand, Norway, Sweden and Switzerland [15], Italy [16], United States [17], Germany [20], Denmark [23], Poland [28], and Czechoslovakia [31]. The decline was exclusively due to the fall of DZ rates. The decrease in DZ rates has been considered to be affected by changes in maternal age and parity [9]. However, other factors such as socioeconomic development, nutritional status, contraception, have also been assumed to contribute [10, 19,20,23].

This study showed a steady decrease in DZ twinning rates from 1955 through 1974. This decrease might be attributable to the decrease in parity and maternal age. Still, the average marital age and the age at first pregnancy remained at 20-24 years during this period. The gradual decrease in parity and maternal age resulted in a more striking decrease in the number of twin births than in total number of deliveries. However, during the period from 1975 through 1984, there was a significant shift of the average marital age and the age at first pregnancy from 20-24 to 25-29 as a result family planning programs in

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Taiwan. This might at least partly explain the increase of DZ rates in recent years. During the period from 1955 to 1984, there also were significant changes in socioeconomic developments and nutritional status in Taiwan. But these improvements could not explain the increase of the DZ rates after a long period of decline.

The MZ rate in Taiwan showed a periodical peak every ten years (1956, 1966 and 1976). This phenomenon deserves further investigation. The increase in MZ rates from 1978 to 1984 might partly be attributable to the intensive family planning program which resulted in higher proportion of old age pregnancies. Nevertheless, the secular change of MZ rates was not consistently observed in other populations.

The differences in MZ and DZ rates among areas of different socioeconomic development could largely be explained by maternal age and parity. The average marital age and age at first pregnancy were much higher in urban than in rural areas. Though there was a slightly greater proportion of high parity in rural than in urban areas, it was limited to mothers aged less than 35.

However, the differences in MZ and DZ rates among different areas are not readily explained by maternal age and parity alone. As the average marital age and age at the first pregnancy of women in various localities were not significantly different, other factors, including climate, geographical environment, life styles and dietary patterns, should be further explored.

The increase of the DZ rate by maternal age is common to all countries. Several explanations, including menopausal postponement [30], gonadotropin secretion [8,24], high coital rates [14], and overripeness of cocyte [25] have been proposed. Both genetic and environmental factors might be involved in the increase of MZ rates by maternal age. Twinning rates were found to increase with parity after adjusting for maternal age. This might be due to the change of the ovarian activities, hormone secretion, and intrauterine environment caused by previous pregnancies.

The racial difference in MZ and DZ twinning rates is an interesting phenomenon. DZ rates by maternal age are much lower among oriental than western and African populations. This cannot be explained by genetic factors alone: cultural background, coital rates, dietary habits, life styles, climate and geographical environment, gonadotropin secretion, and fecundability have also been considered [14,15,20,29]. Though racial differences in MZ rates are less striking than those in DZ rates, further investigations might be worthwhile.

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