ANALYSIS OF MULTIPLE BIRTH RATES IN JAPAN

IV. SECULAR TREND, EFFECT OF MATERNAL AGE AND GESTATIONAL AGE IN STILLBIRTH RATES OF TRIPLETS

Yoko IMAIZUMI¹ and Eiji INOUE²

¹ *Institute of Population Problems, Ministry of Health and Welfare, Tokyo 100, Japan*

² *Institute of Brain Research, University of Tokyo School of Medicine, Tokyo 113, Japan*

Summary Over-all stillbirth rate of triplets in Japan was slightly increased from 1951 to 1961 and markedly decreased thereafter up to 1968 and 1974. The stillbirth rate of triplets remained two to three times as high as that of twins and five to seven times as high as that of the general population during the period from 1951 to 1968 and in 1974.

Secular change of the stillbirth rate of like-sexed triplets indicated a similar tendency to over-all rate whereas the rate of unlike-sexed triplets remained almost constant for the entire period. For the entire period from 1955 to 1967 and in 1974, the difference between stillbirth rates of like- and unlike-sexed triplets is statistically significant at the 0.1% level, the rate being higher in like-sexed triplets than in unlike-sexed triplets, but sex of each triplet did not affect the stillbirth rate. The stillbirth rate in 1974 was the lowest in the first-born children (0.328), followed by the second (0.353) and the third (0.378), but the differences are not significant at the 5% level.

In like-sexed triplets the stillbirth rate decreased from the youngest maternal age group to maternal age group of 30-34 years, then markedly increased thereafter. The pattern is similar but more marked in unlike-sexed triplets.

The mean gestational age was the shortest in triplet sets all stillborn (23.3 weeks), whereas those of other categories of survival state were between 34.8 to 35.2 weeks.

INTRODUCTION

A higher stillbirth rate in twins than in single births is well documented. However, epidemiologic investigations of stillbirth rate of triplet births were scarcely carried out, because of a rare occurrence of triplet births (56 per million deliveries in Japan in 1974, Imaizumi and Inouye, 1980, and in the range of 109 to 148 per million in Caucasian populations, Bulmer, 1970).

The present study deals with overall stillbirth rate of triplet births in all of Japan during the period of 1951–1968 and 1974. It also deals with secular change of the stillbirth rate separately for like- and unlike-sexed triplets, and the effect of maternal age on stillbirth rates of triplets.

MATERIALS AND METHODS

The first source of data is annual volumes of "Vital Statistics of Japan for the Years 1951–1968 and 1974" (Health and Welfare Statistics and Information Department, Ministry of Health and Welfare). The statistics from 1951 to 1968 list the category of survival states of triplets: three live-born, two live-born and one still-born, one live-born and two still-born, and three still-born. The statistics from 1955 to 1967 provide data on like- and unlike-sexed triplet deliveries according to the category of survival states of triplets. The sex of the children and maternal age are given in the statistics from 1960 to 1967. Second source is "Survey on Socio-Economic Aspects of Vital Events-Plural Births", which provides data on triplet births in 1974. Details of the surveys have been reported elsewhere (Imaizumi and Inouye, 1979).

RESULTS

Secular change of stillbirth rate of triplets

Table 1 shows the number of triplet deliveries according to survival states of triplets during the period from 1951 to 1968 and in 1974. In the following analysis, stillbirth rate among total triplet deliveries was taken, where the number of sets of triplets with one still-born was divided by 3, and with two still-born was divided by 3/2. The stillbirth rate of triplets thus computed is also shown in Table 1 and Fig. 1. The highest stillbirth rate of triplets (0.6408) was seen in 1961 and the lowest rate (0.3790) in 1974. The rate slightly increased up to 1961 and markedly decreased thereafter. Correlation coefficient between the year and the stillbirth rate indicated a negative value ($r = -0.6542$) which is statistically significant at the 1% level. Figure 1 also shows secular trends of the stillbirth rates in twins and in the general population, which were taken from Imaizumi *et al.* (1980). The stillbirth rate of triplets remained more than two to three times as high as that of

Table 1. Secular change of stillbirth rate of triplets, 1951-1968 and 1974.

Year	3LB	2LB, 1SB	1LB, 2SB	3SB	Total	Stillbirth rate of triplet deliveries
1951	48	18	11	59	136	0.5319
1952	45	11	8	61	125	0.5600
1953	38	9	7	37	91	0.4908
1954	32	9	7	55	103	0.6084
1955	51	16	8	55	130	0.5051
1956	31	14	4	53	102	0.5915
1957	37	8	4	47	96	0.5451
1958	33	11	8	57	109	0.6055
1959	29	9	7	50	95	0.6070
1960	33	7	5	43	88	0.5530
1961	31	5	8	59	103	0.6408
1962	38	8	6	49	101	0.5512
1963	40	14	5	46	105	0.5143
1964	38	14	6	35	93	0.4695
1965	49	11	4	43	107	0.4611
1966	40	9	4	38	91	0.4799
1967	48	16	6	40	110	0.4485
1968	60	8	3	46	117	0.4330
⋮						
1974	72	5	5	42	124	0.3790

LB, live-born; SB, still-born.

Fig. 1. Secular change of stillbirth rates of triplets, twins and the general population during 1951-1968 and 1974.

twins and more than five to seven times as high as that of the general population.

Table 2 and Fig. 2 show secular trends of the stillbirth rates of like- and unlike-sexed triplets during the period from 1955 to 1967 and in 1974. Stillbirth rates of like- and unlike-sexed triplets were 0.4983 and 0.4533 in 1955, respectively, the difference being not significant at the 5% level. Significant difference at the 5% level was seen between stillbirth rates of like- and unlike-sexed triplets in 1957, 1960, 1962, 1963, 1965 and 1966, the former being always higher than the latter. Similar significant difference ($p < 0.001$) was seen between them, if the data from 1955 to 1967 and in 1974 are pooled. Stillbirth rate of like-sexed triplets increased slightly up to 1961 and decreased thereafter, and the figure in 1974 is 67% of that in 1955. On the other hand, the stillbirth rate of unlike-sexed triplets remained almost constant for the entire period, but the figure in 1974 is 88% of that in 1955.

Table 3 shows secular trends of the stillbirth rates of triplets according to the sex of each triplet during the period from 1960 to 1967 and in 1974. Sex difference is not significant in every year and in pooled data. In both sexes the stillbirth rates are gradually decreased with the years.

Stillbirth rate of triplets in 1974 was analysed according to birth order of tri-

Table 2. Like- and unlike-sexed triplet deliveries according to survival states of triplets and stillbirth rates among triplet deliveries, 1955-1967 and 1974.

Year	Like-sexed triplet deliveries						Unlike-sexed triplet deliveries					
	3LB	2LB, 1SB	1LB, 2SB	3SB	Total	Still- birth rate	3LB	2LB, 1SB	1LB, 2SB	3SB	Total	Still- birth rate
1955	39	14	7	41	101	0.4983	12	2	1	10	25	0.4533
1956	23	11	3	36	73	0.5708	8	3	1	16	28	0.6310
1957	25	6	4	37	72	0.5787	12	2	0	8	22	0.3939
1958	22	8	4	42	76	0.6228	11	3	3	13	30	0.5333
1959	24	6	5	41	76	0.6096	5	3	2	6	16	0.5208
1960	25	2	6	36	69	0.5894	8	3	1	6	18	0.4259
1961	26	5	4	52	87	0.6475	5	0	3	6	14	0.5714
1962	26	5	5	40	76	0.5921	12	3	1	8	24	0.4028
1963	30	11	3	40	84	0.5437	10	3	1	4	18	0.3148
1964	31	9	4	27	71	0.4601	7	5	2	8	22	0.5000
1965	35	10	3	36	84	0.4921	14	1	1	5	21	0.2857
1966	28	6	3	30	67	0.5075	12	3	1	6	22	0.3485
1967	40	10	4	28	82	0.4146	8	6	2	10	26	0.5128
⋮												
1974	52	4	4	24	84	0.3333	20	1	1	13	35	0.4000
Total	426	107	59	510	1,102	0.5309	144	38	20	119	321	0.4517

Fig. 2. Secular change of stillbirth rates of like- and unlike-sexed triplets during 1955-1967 and 1974.

Table 3. Stillbirth rate of triplets for males and females, 1960-1967 and 1974.

Year	Male			Female		
	No. of live births	No. of stillbirths	Stillbirth rate	No. of live births	No. of stillbirths	Stillbirth rate
1960	53	77	0.5923	63	68	0.5191
1961	55	102	0.6497	55	91	0.6233
1962	64	77	0.5461	72	87	0.5472
1963	78	74	0.4868	74	80	0.5195
1964	67	67	0.5000	81	64	0.4414
1965	78	63	0.4468	95	79	0.4540
1966	62	55	0.4701	80	70	0.4667
1967	85	58	0.4056	97	84	0.4641
⋮						
1974	98	65	0.3988	133	61	0.3144
Total	640	638	0.4992	750	684	0.4770

plets (Table 4). The stillbirth rate was the lowest in the first-born children (0.328), followed by the second (0.353) and the third (0.378), but the differences are not significant at the 5% level. The small number of triplet sets did not permit analysis according to birth order and sex.

The secular changes of stillbirth rate of triplets are analysed according to maternal age and sex during the period from 1960 to 1967 and 1974 (Fig. 3). In like-sexed triplets the stillbirth rates decreased with the years in the maternal age groups of 25-29 and over 30 years.

Table 4. Stillbirth rates of triplets according to birth order of triplets, 1974.

	Triplet			Total
	1st born	2nd born	3rd born	
No. of live births	80	77	74	231
No. of stillbirths	39	42	45	126
Total	119	119	119	357
Stillbirth rate	0.3277	0.3529	0.3782	0.3529

Fig. 3. Secular change of stillbirth rates of like- and unlike-sexed triplets according to maternal age during 1960-1967 and 1974.

Effect of maternal age and gestational age on stillbirth rate of triplets

Table 5 shows the number of triplet deliveries according to maternal age, sex and survival state during the period from 1960 to 1967 and 1974, from which were computed the stillbirth rates according to maternal age and sex. In like-sexed triplets the stillbirth rate decreased from the youngest maternal age group to maternal age group of 30-34 years, then markedly increased thereafter (Fig. 4). The pattern is similar but more marked in unlike-sexed triplets. In like-sexed triplets

Table 5. Stillbirth rates in like- and unlike-sexed triplets according to maternal age, 1960-1967 and 1974.

Maternal age	Like-sexed triplet deliveries						Unlike-sexed triplet deliveries					
	3LB	2LB, 1SB	1LB, 2SB	3SB	Total	Still-birth rate	3LB	2LB, 1SB	1FB, 2SB	3SB	Total	Still-birth rate
Under 25	71	18	15	79	183	0.5191	15	4	4	15	38	0.5000
25-29	143	27	17	147	334	0.5010	47	14	7	39	107	0.4517
30-34	63	13	3	63	142	0.4883	27	5	1	7	40	0.2333
Over 35	16	4	1	24	45	0.5778	7	2	1	5	15	0.4222
Total	293	62	36	313	704	0.5080	96	25	13	66	200	0.4150

Fig. 4. Stillbirth rates of like- and unlike-sexed triplets according to maternal age during the entire period of 1960-1967 and 1974.

the stillbirth rates are higher than those in unlike-sexed triplets in every maternal age group, but the difference was significant in the maternal age group of 30-34 years.

Table 6 shows the number of triplets according to survival state and gestational age. The shortest mean gestational age was seen in triplet sets all still-born (23.3 weeks), where all pregnancies ended before 32 weeks of gestation. Other categories of survival state indicated mean gestational ages between 34.8 to 35.2 weeks.

DISCUSSION

The present study is the first one which dealt with stillbirth rate of triplets, while a few previous studies below dealt with combined rate of stillbirth and neo-

Table 6. Frequency of triplet deliveries according to survival state and gestational age.

Survival state	Gestational age (weeks)						Total	Mean gestational age (weeks)
	12-23	24-27	28-31	32-35	36-39	Over 40		
3 live births	0	1	9	30	31	1	72	35.2
2 live births 1 stillbirth	0	0	0	4	1	0	5	34.8
1 live birth 2 stillbirths	0	0	1	2	2	0	5	34.8
3 stillbirths	24	12	6	0	0	0	42	23.3
Total	24	13	16	36	34	1	124	31.2
Stillbirth rate	1.0000	0.9231	0.4167	0.0741	0.0490	0	0.3790	

natal death. Record *et al.* (1952) reported the combined rate according to sex, birth weight and gestational age (after 28 completed weeks) in Scotland, England, and Wales. The rates were higher in males than females and were negatively correlated with birth weight and gestational age. Recently Itzkowic (1979) analysed the combined rate among a total of 59 sets in four hospitals and found it was lower (23.2%) than Record and Gibson's study (30.9%). Daw (1978) analysed the effect of maternal age on the combined rate of 14 triplet deliveries in England, and found the older triplet mother had a better chance of fetal survival than the younger mother. In the present study the stillbirth rate of triplets was between 0.6408 (1961) and 0.3790 (1974) during the period from 1951 to 1968 and in 1974. The decrease was apparent and significant, but remained two to three times as high as that of twins and five to seven times as high as that of the general population. Like-sexed triplets indicated a higher stillbirth rate than unlike-sexed triplets, but sex of each triplet did not affect the stillbirth rate. Birth order affects the stillbirth rate, but not significantly. In both like- and unlike-sexed triplets the maternal age affected the stillbirth rate; the rate was higher in younger mothers, decreased with maternal age up to 30 to 34 years and again increased.

If the secular change of the stillbirth rates of triplets is compared to that of twins, the stillbirth rates of like- and unlike-sexed triplets in 1974 were 57% and 94% of those in 1960, respectively, while the rates of MZ and DZ twins in 1974 were less than a half of those in 1960 (Imaizumi *et al.*, 1980), suggesting the improvement in triplets is less marked than twins. The effect of maternal age was similar to that in twins (Imaizumi *et al.*, 1980), but to a lesser degree.

Acknowledgment This investigation was supported in part by the Grant Aided by the Ministry of Health and Welfare of Japan for the Handicapped Children, 1979.

REFERENCES

- Bulmer, M.G. 1970. *The Biology of Twinning in Man*. Clarendon Press, Oxford.
- Daw, E. 1978. Triplet pregnancy. *Brit. J. Obstet. Gynec.* **85**: 505-509.
- Imaizumi, Y., and Inouye, E. 1979. Analysis of multiple birth rates in Japan. I. Secular trend, maternal age effect, and geographical variation in twinning rates. *Acta Genet. Med. Gemellol.* **28**: 107-124.
- Imaizumi, Y., Asaka, A., and Inouye, E. 1980. Analysis of multiple birth rates in Japan. II. Secular trend, and effect of birth order, maternal age and gestational age in stillbirth rate of twins. *Acta Genet. Med. Gemellol.* (in press).
- Imaizumi, Y., and Inouye, E. 1980. Analysis of multiple birth rates in Japan. III. Secular trend, maternal age effect and geographical variation in triplet rates. *Jpn. J. Human Genet.* **25**: 73-81.
- Itzkowic, D. 1979. A survey of 59 triplet pregnancies. *Brit. J. Obstet. Gynec.* **86**: 23-28.
- Japan, Ministry of Health and Welfare. Annual, 1951-1968. Vital Statistics, Health and Welfare Statistics and Information Department, Ministry of Health and Welfare, Tokyo.
- Japan, Ministry of Health and Welfare. 1977. Survey on Socio-economic Aspects of Vital Events-Plural Births, 1975. Health and Welfare Statistics and Information Department, Ministry of Health and Welfare, Tokyo.
- Record, R.G., Gibson, J.R., and McKeown, T. 1952. Foetal and infant mortality in multiple pregnancy. *J. Obstet. Gynaec. Brit. Emp.* **59**: 471-482.