



Yearly Changes in Stillbirth Rates of Zygotic Twins in Japan, 1975-1994

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Abstract. The stillbirth rates decreased to 2/3 for MZ male twins, 1/2 for MZ female twins, and under 1/2 for DZ twins for both sexes during the 19-year period from 1975 in Japan. The stillbirth rate was significantly higher in MZ males than MZ females in each year, whereas stillbirth rates of DZ twins for both sexes indicated similar values during that period. After 1986, stillbirth rates were more than 2 times higher in MZ twins than in singletons and in DZ twins. The higher stillbirth rate of MZ twins as opposed to DZ twins could be related to monochorionic twin pairs in MZ twins. The stillbirth rate decreased more drastically in twins for both zygosity than in singleton births during the 34-year period from 1960. However, declining rates of stillbirths may be attributed to medical care during twin pregnancies. Recommendation of an optimum day to give birth for twin pregnancy is 37-38 weeks for Japanese women.

Key words: Stillbirth rates, Twins, Zygosity, Trends, Maternal age, Gestational age, Birthweight

INTRODUCTION

According to Imaizumi et al. [1], the stillbirth rates for both MZ and DZ twins in Japan gradually decreased during the period from 1960 to 1967 and in 1974. The rate was higher in MZ than DZ twins, and higher in males than female twins. The stillbirth rate decreased to 1/2 during that period in MZ and DZ twins.

The present study deals with yearly changes in the stillbirth rate of zygotic twins. It also deals with the effect of maternal age, gestational ages, and birthweight on stillbirth rates of twins.

MATERIALS AND METHODS

Vital statistics data on twin births in Japan has been available in computer files since 1968. In this study, the computerized data between 1975 and 1994 was analyzed. The birth and fetal death certificate records include information on parental ages, place of residence, sex of twin births, date of birth or fetal death, period of gestation, occupation of the head of household, and others. Fetal death is defined as that which occurred at 12 completed weeks of gestation and over.

Registration of births (live births and stillbirths) has been made on an individual basis, with more than one record for each multiple pregnancy. In order to identify each pair of twins we used the information on date of birth, place of residence (codes for prefecture, health center, and city or town within the prefecture), ages of both parents, and occupation of the head of household. There were a total of 406,350 twin births (364,554 live births and 41,796 stillbirths) during that period. First we sorted out all the records using the above key fields, and then checked adjacent records for their identity. If two adjacent records were exactly identical for the used fields, they were judged to be the co-twins from a pair. With this criterion we identified 193,695 pairs (387,390 births, or 95.3% of the total twin births), 128 births with more than two identical records, and 18,832 unpaired births. In order to obtain more pairs allowing possible errors in registration, we repeated the pairing procedure three times for the remaining unpaired cases. At the second cycle, we excluded from the keys the occupation of the head of household. At the third cycle we allowed for a maximum of 10 days' difference between birth dates of co-twins. At the fourth cycle we allowed for one year or just 10 year-difference for one of the parental ages. Finally we identified 198,924 pairs of twins (97.9% of the total twin births). The number of zygotic twins was estimated by using the Weinberg method [3].

In Japan, the gestational age before 1979 was termed in months, and after that in weeks. Analyses according to gestational age were done only with the data on twins during the period from 1979 to 1994. As for the birth order of twins, analyses were done using the data on individual twins during the entire period.

RESULTS

Yearly changes in stillbirth rates of twins by zygosity and birth order

Table 1 shows the number of twin deliveries and stillbirth rates of twins in each zygosity according to survival states of twins during the period from 1975 to 1994. Stillbirth rates for MZ and DZ twins decreased significantly year by year during that period, where the rate was significantly higher in MZ twins than in DZ twins in each year.

Table 2 shows yearly changes in stillbirth rates of twins according to sex and zygosity during the period from 1975 to 1994. Stillbirth rates were 0.159 for MZ male twins and 0.112 for MZ female twins in 1975, and decreased to 0.106 and 0.054, respectively, in 1994. Thus stillbirth rates decreased to 2/3 for MZ male twins and to 1/2 for MZ female twins during the 19-year period from 1975, where the rate was significantly higher in male twins than in female twins in each year. Similarly, the rates for both DZ male and female twins were 0.067 and 0.064 in 1975, and decreased to

Table 1 - Monozygotic and dizygotic twin deliveries according to survival states of twins and stillbirth rates for zygotic twin and singleton births, 1975-1994

Year	Monozygotic twin deliveries						Dizygotic twin deliveries						Singletons	
	2LB	LB, FD	FD, LB	2FD	Total	SR*	2LB	LB, FD	FD, LB	2FD	Total	SR*	SR*	
1975	6337	181	68	894	7480	0.136	3404	56	24	200	3684	0.065**	0.050	
1976	6052	172	52	777	7053	0.126	3318	84	16	202	3620	0.070**	0.052	
1977	6218	199	69	776	7262	0.125	3410	44	16	218	3688	0.067**	0.051	
1978	5963	181	46	731	6921	0.122	3378	64	18	164	3624	0.057**	0.048	
1979	6000	205	50	730	6985	0.123	3426	66	22	170	3684	0.058**	0.047	
1980	5758	195	66	610	6629	0.112	3398	60	16	170	3644	0.057**	0.046	
1981	5734	178	62	589	6563	0.108	3292	52	22	160	3526	0.056**	0.048	
1982	5708	176	67	585	6536	0.108	3316	54	14	152	3536	0.053**	0.048	
1983	5663	162	68	566	6459	0.105	3282	68	14	126	3490	0.048**	0.045	
1984	5633	167	64	586	6450	0.109	3232	46	16	134	3428	0.048**	0.045	
1985	5447	141	46	541	6175	0.103	3140	40	20	124	3324	0.046**	0.045	
1986	5063	119	46	535	5763	0.107	3122	40	14	108	3284	0.041**	0.045	
1987	5050	125	47	518	5740	0.105	3104	40	12	66	3222	0.029**	0.044	
1988	4980	124	59	465	5628	0.099	3110	52	8	122	3292	0.046**	0.043	
1989	4825	109	39	411	5384	0.090	3202	30	20	104	3356	0.038**	0.042	
1990	4497	99	40	398	5034	0.093	3384	32	10	114	3540	0.038**	0.041	
1991	4489	94	53	372	5008	0.089	3632	36	12	114	3794	0.036**	0.039	
1992	4626	77	35	358	5096	0.081	3838	38	16	104	3996	0.033**	0.038	
1993	4565	104	35	312	5016	0.076	4130	54	16	104	4304	0.032**	0.036	
1994	4901	94	58	360	5413	0.081	4798	62	22	96	4978	0.028**	0.033	

SR*: Stillbirth rate; **: Significant at 1% level

0.029 and 0.027, respectively, in 1994. Thus the stillbirth rates decreased to under 1/2 for both sexes, where stillbirth rates for both sexes showed similar values during that period.

Table 3 shows the stillbirth rates of twins according to sex and birth order at twin delivery during the period from 1975 to 1994. The stillbirth rate was significantly higher in the 2nd-born twins than in the 1st-born twins for males during the period of 1979-1984 and for females during the period of 1979-1989. After that, the rate was also higher in the 2nd- than the 1st-born twins, but the difference between the rates for birth order of twins was not always significant in each sex. The stillbirth rate decreased to 60% for both birth orders of male twins and to 43% for female twins during the 15-year period from 1979.

Table 2 - Stillbirth rate of twins according to sex and zygosity, 1975-1994

Year	Male twins			Female twins		
	MZ	DZ	Total	MZ	DZ	Total
1975	0.159	0.067	0.133	0.112	0.064	0.102
1976	0.158	0.070	0.135	0.092	0.070	0.090
1977	0.149	0.066	0.126	0.101	0.069	0.094
1978	0.139	0.059	0.116	0.104	0.054	0.090
1979	0.144	0.059	0.121	0.101	0.058	0.090
1980	0.133	0.058	0.112	0.089	0.056	0.083
1981	0.133	0.058	0.113	0.082	0.054	0.078
1982	0.135	0.057	0.112	0.080	0.049	0.074
1983	0.124	0.051	0.105	0.086	0.045	0.077
1984	0.137	0.046	0.112	0.081	0.050	0.073
1985	0.133	0.048	0.110	0.071	0.045	0.066
1986	0.129	0.040	0.103	0.083	0.042	0.071
1987	0.137	0.029	0.104	0.072	0.028	0.059
1988	0.125	0.049	0.101	0.072	0.044	0.065
1989	0.115	0.039	0.089	0.065	0.038	0.058
1990	0.127	0.038	0.096	0.056	0.038	0.053
1991	0.108	0.036	0.083	0.069	0.037	0.058
1992	0.105	0.034	0.079	0.054	0.032	0.048
1993	0.094	0.032	0.070	0.057	0.033	0.048
1994	0.106	0.029	0.071	0.054	0.027	0.042

Stillbirth rate by maternal age and zygosity

Table 4 shows yearly changes in stillbirth rates of twins according to zygosity and maternal age during the period from 1975 to 1994. The rate for MZ twins decreased significantly year by year in each maternal age group, whereas the rate for DZ twins decreased only significantly year by year in maternal age groups between 25-29 years and 35-39 years.

Figure 1 shows the relationship between the stillbirth rate of zygotic twins and maternal age during the period from 1975 to 1994. The stillbirth rate of twins was higher in the MZ twins than the DZ twins in each maternal age group. The stillbirth rate of twins was the highest in the maternal age group of the < 20 years and followed by the > 40 years for both zygositys. The lowest rate was seen in the maternal age group of 30-34 years for MZ twins and of 25-29 years for DZ twins.

Table 3 - Stillbirth rate of twins according to sex and order of twins, 1979-1994

Year	Male twins			Female twins		
	1st-born	2nd-born	χ^2	1st-born	2nd-born	χ^2
1979	0.111	0.129	7.94 **	0.081	0.098	9.10 **
1980	0.102	0.122	10.04 **	0.072	0.094	16.17 **
1981	0.104	0.122	8.32 **	0.071	0.084	5.81 *
1982	0.106	0.119	4.29 *	0.068	0.080	5.24 *
1983	0.096	0.114	8.74 **	0.071	0.082	4.46 *
1984	0.106	0.119	4.18 *	0.065	0.080	8.25 **
1985	0.104	0.115	3.13	0.058	0.074	9.96 **
1986	0.095	0.111	6.09 *	0.064	0.078	6.10 *
1987	0.096	0.112	6.38 *	0.052	0.066	7.90 **
1988	0.093	0.110	7.77 **	0.059	0.072	5.74 *
1989	0.084	0.094	2.67	0.052	0.065	6.84 **
1990	0.090	0.103	4.20 *	0.049	0.057	2.61
1991	0.078	0.088	3.03	0.053	0.063	3.43
1992	0.074	0.085	3.98 *	0.044	0.051	2.50
1993	0.067	0.073	1.33	0.039	0.056	14.56 **
1994	0.066	0.076	4.41 *	0.040	0.044	1.02

*: Significant at 5% level; **: Significant at 1% level

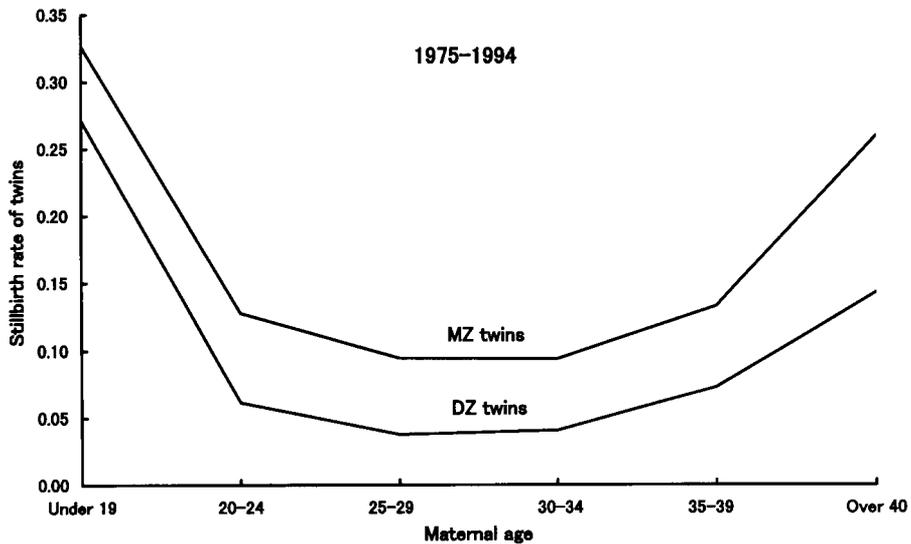


Fig. 1 - Stillbirth rates among MZ and DZ twins according to maternal age during the period from 1975 to 1994.

Table 4 - Yearly changes in stillbirth rate of twins according to zygosity and maternal age, 1975-94

Year	Maternal age				
	-24	25-29	30-34	35-39	40+
MZ twins					
1975	0.152	0.121	0.134	0.191	0.450
1976	0.152	0.113	0.115	0.160	0.488
1977	0.164	0.115	0.106	0.130	0.250
1978	0.147	0.105	0.118	0.213	0.348
1979	0.155	0.102	0.123	0.177	0.406
1980	0.157	0.098	0.093	0.137	0.394
1981	0.130	0.098	0.092	0.202	0.270
1982	0.127	0.097	0.104	0.127	0.337
1983	0.137	0.094	0.091	0.145	0.163
1984	0.131	0.090	0.118	0.136	0.142
1985	0.139	0.080	0.096	0.153	0.382
1986	0.164	0.087	0.094	0.124	0.346
1987	0.145	0.091	0.082	0.154	0.313
1988	0.145	0.077	0.090	0.139	0.229
1989	0.132	0.078	0.073	0.103	0.250
1990	0.122	0.089	0.080	0.089	0.145
1991	0.129	0.083	0.067	0.096	0.162
1992	0.114	0.080	0.058	0.105	0.095
1993	0.109	0.067	0.066	0.085	0.115
1994	0.122	0.061	0.080	0.085	0.159
DZ twins					
1975	0.072	0.052	0.068	0.171	0.150
1976	0.076	0.052	0.085	0.167	0.182
1977	0.076	0.046	0.080	0.207	0.333
1978	0.069	0.048	0.064	0.066	0.050
1979	0.048	0.052	0.061	0.136	0.333
1980	0.092	0.033	0.058	0.160	0.167
1981	0.048	0.044	0.066	0.090	0.417
1982	0.101	0.038	0.043	0.081	0.136
1983	0.076	0.037	0.042	0.084	0.143
1984	0.101	0.031	0.035	0.086	0.417
1985	0.075	0.045	0.030	0.059	0.143
1986	0.068	0.032	0.028	0.092	0.100
1987	0.038	0.026	0.026	0.037	0
1988	0.080	0.039	0.037	0.052	0.176
1989	0.052	0.033	0.035	0.061	0.029
1990	0.080	0.029	0.029	0.045	0.225
1991	0.093	0.022	0.031	0.053	0.080
1992	0.057	0.029	0.030	0.023	0.065
1993	0.073	0.024	0.028	0.033	0.100
1994	0.045	0.032	0.017	0.029	0.091

Table 5 - Number of twin pairs according to survival state and gestational age, 1979-1994

Survival state	Gestational age (weeks)	Year																
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	
LB-LB	-23	8	6	10	6	9	8	8	10	18	8	8	12	15	16	15	22	
	24-27	60	67	79	95	86	102	85	96	75	98	108	141	112	121	108	166	
	28-31	307	274	297	274	251	288	265	262	237	274	260	268	277	303	334	384	
	32-35	1320	1403	1263	1243	1273	1291	1182	1132	1199	1229	1261	1252	1300	1368	1453	1700	
	36-39	5927	5845	5957	5974	6022	6038	5981	5725	5725	5761	5717	5646	5845	6123	6291	6939	
	40+	1804	1561	1420	1432	1304	1138	1066	960	900	900	720	673	562	572	533	494	488
Total	9426	9156	9026	9024	8945	8865	8587	8185	8154	8090	8027	7881	8121	8464	8695	9699		
LB-FD	-23	2	5	5	10	3	13	6	8	4	4	2	1	8	5	5	9	
	24-27	31	19	20	16	21	21	26	13	18	26	19	22	22	25	23	31	
	28-31	38	50	48	39	48	28	35	43	31	34	33	38	39	41	49	50	
	32-35	65	80	76	78	70	66	64	42	54	66	66	54	61	50	59	74	
	36-39	151	148	145	145	158	162	122	114	130	125	91	84	77	75	90	106	
	40+	71	58	35	45	25	28	16	21	18	15	9	11	8	8	20	11	
Total	358	360	329	333	325	318	269	241	255	270	220	210	215	204	246	281		
FD-FD	-23	656	593	607	617	610	679	597	646	617	607	593	607	555	546	513	526	
	24-27	182	146	137	120	117	66	111	80	59	48	52	53	47	41	34	43	
	28-31	75	51	45	50	33	25	30	22	33	30	11	20	24	19	9	21	
	32-35	51	44	41	25	29	39	30	28	17	23	20	16	13	5	9	11	
	36-39	54	38	34	48	38	39	28	30	23	17	15	12	11	11	8	15	
	40+	14	10	10	10	8	10	9	2	5	2	1	3	2	2	2	0	
Total	1032	882	874	870	835	858	805	808	754	727	692	711	652	624	575	616		

LB: Live births; FD: Fetal death.

Table 6 - Yearly changes in stillbirth rates of twins according to zygosity and gestational age, 1979- 1994

Year	Gestational age (weeks)						
	Total	-23	24-27	28-31	32-35	36-39	40+
MZ twins							
1979-80	0.117	0.985	0.730**	0.251**	0.072**	0.026**	0.026
1981-82	0.108	0.978	0.641**	0.196**	0.063**	0.024**	0.024**
1983-84	0.107	0.978	0.547**	0.173**	0.058**	0.024**	0.023**
1985-86	0.105	0.979	0.547**	0.169**	0.059**	0.016**	0.015
1987-88	0.102	0.977**	0.416	0.177**	0.047**	0.016**	0.018**
1989-90	0.091	0.989**	0.356**	0.122**	0.043**	0.012**	0.010
1991-92	0.085	0.961	0.353**	0.171**	0.034**	0.008**	0.013*
1993-94	0.078	0.962**	0.302**	0.120**	0.032**	0.010**	0.015
DZ twins							
1979-80	0.058	0.980	0.573	0.113	0.017	0.008	0.019
1981-82	0.054	0.977	0.375	0.115	0.016	0.007	0.014
1983-84	0.048	0.975	0.278	0.059	0.022	0.009	0.008
1985-86	0.044	0.971	0.316	0.050	0.011	0.009	0.011
1987-88	0.038	0.929	0.333	0.061	0.015	0.008	0.003
1989-90	0.038	0.943	0.207	0.063	0.018	0.005	0.008
1991-92	0.035	0.944	0.164	0.023	0.011	0.004	0.004
1993-94	0.030	0.900	0.179	0.035	0.015	0.005	0.006

The difference between stillbirth rates of MZ and DZ twins was statistically significant at 5% level (*), or 1% level (**).

Effect of gestational age on stillbirth rates of zygotic twins

Table 5 shows the number of twin deliveries according to survival states of twins and gestational age groups during the period from 1979 to 1994. Table 6 shows yearly changes in stillbirth rates of twins according to zygosity and gestational age group during that period. Before 23 weeks of gestation, the stillbirth rates ranged 0.96-0.99 in the MZ twins and 0.90-0.98 in the DZ twins between 1979-1980 and 1993-1994. The rate decreased significantly year by year in the DZ twins, but not in the MZ twins. With exceptions for 3 periods, the differences between stillbirth rates for MZ and DZ twins were not significant in each year-period. The exceptions were for the periods of 1987-1990 and 1993-1994. The stillbirth rates of gestational age groups for 24 weeks and over decreased significantly year by year for both zygositys. An exception was at 32-35 weeks of gestation in DZ twins. The stillbirth rate was the lowest at 36-39 weeks of gestation and followed by 40 weeks of gestation and over for both zygositys, where the difference between the lowest and the second lowest stillbirth rates was not large for

both zygositys. With an exception, the difference between stillbirth rates of MZ and DZ twins was statistically significant from 24-27 weeks to 36-39 weeks in each two-year group. The exception was at 24-27 weeks in the period of 1987-1988. As for 40 weeks and over, the difference between stillbirth rates of MZ and DZ twins was statistically significant in the periods of 1981-1984, 1987-1988, and 1991-1992.

Figure 2 shows the relationship between stillbirth rates of twins and gestational ages for 35 weeks and over in the 3 periods: 1979-1984, 1985-1989, and 1990-1994. The rate was the lowest at 38 weeks in each period. The second lowest stillbirth rate of twins was seen at 39 weeks for the earlier two periods and for 37 weeks for the latest period. The third lowest rate was seen at 40 weeks for the former periods and 39 weeks for the latter period. Therefore, in the latest period, the second lowest stillbirth rate of twins shifted to a shorter gestational age compared with the earlier periods.

Effect of birthweight on stillbirth rates

Table 7 shows stillbirth rates of zygotic twins according to birthweight for a twin pair during the period from 1979 to 1994. With 5 exceptions, stillbirth rates of zygotic twins decreased statistically significantly with the year in each group of birthweight of twins. The exceptions were at birthweight over 6,000 g in MZ twins, and 3, 001-4, 500 g and 5, 501-6, 000 g in DZ twins. During the 14-year period from 1979-1980, the stillbirth rate decreased from 24% for the MZ and 34% for DZ twins at under 2,000 g to 66% for the MZ twins at 4,001-4,500 g and 80% for the DZ twins at 4501-5500 g.

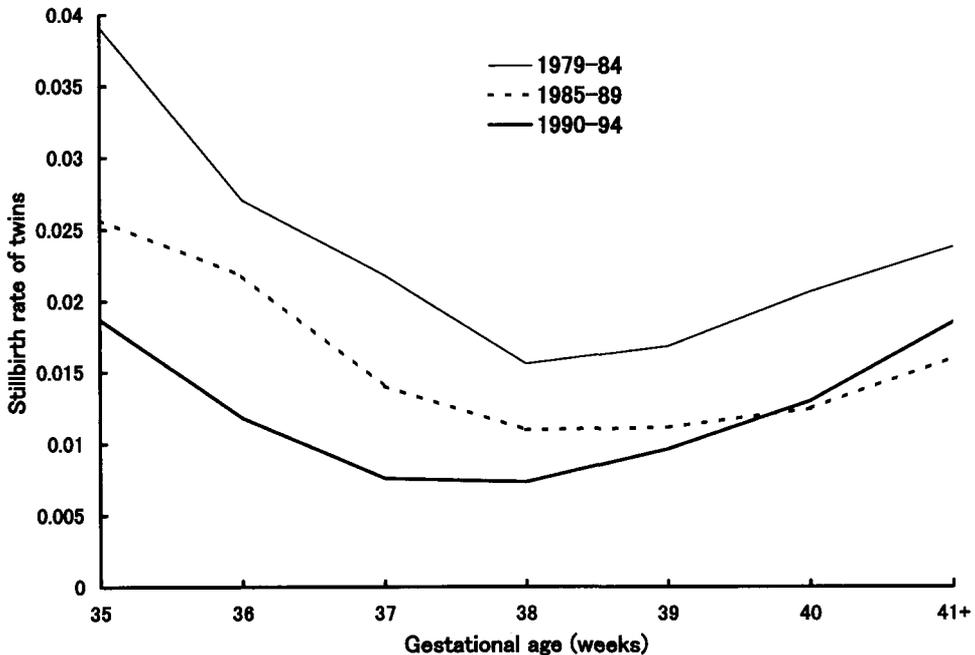


Fig. 2 - Stillbirth rates of twins according to gestational age in three periods: 1979-1984, 1985-1989 and 1990-1994.

Table 7 - Stillbirth rate of zygotic twins according to birth weight of twin pairs, 1979-1994

Year	≤ 2000	2000-	2500-	3000-	3500-	4000-	4500-	5000-	5500-	6000 <
Monozygotic twins										
1979-80	0.848	0.286	0.172	0.115	0.052	0.029	0.017	0.015	0.015	0.018
1981-82	0.806	0.229	0.155	0.095	0.047	0.030	0.015	0.015	0.014	0.014
1983-84	0.786	0.262	0.172	0.076	0.045	0.026	0.017	0.012	0.011	0.013
1985-86	0.761	0.214	0.143	0.077	0.039	0.020	0.010	0.011	0.008	0.007
1987-88	0.743	0.195	0.142	0.074	0.046	0.015	0.010	0.008	0.005	0.016
1989-90	0.692	0.163	0.095	0.041	0.027	0.018	0.007	0.007	0.006	0.016
1991-92	0.665	0.156	0.113	0.065	0.017	0.010	0.005	0.006	0.003	0.007
1993-94	0.646	0.118	0.097	0.043	0.028	0.010	0.007	0.007	0.006	0.008
Dizygotic twins										
1979-80	0.793	0.207	0.081	0.047	0.022	0.011	0.010	0.005	0.005	0.011
1981-82	0.763	0.175	0.066	0.027	0.027	0.011	0.006	0.005	0.003	0.005
1983-84	0.718	0.085	0.098	0.035	0.037	0.016	0.004	0.004	0.003	0.002
1985-86	0.723	0.100	0.073	0.024	0.029	0.006	0.008	0.003	0.008	0.004
1987-88	0.679	0.103	0.063	0.037	0.014	0.009	0.004	0.003	0.003	0.003
1989-90	0.621	0.087	0.030	0.049	0.022	0.004	0.003	0.002	0.001	0.000
1991-92	0.595	0.057	0.017	0.017	0.014	0.008	0.002	0.001	0.001	0.000
1993-94	0.522	0.078	0.030	0.024	0.009	0.007	0.002	0.001	0.003	0.000
RC (MZ)	-0.0144**	-0.0111**	-0.0058**	-0.0045**	-0.0022**	-0.0016**	-0.0009**	-0.0007**	-0.0008**	-0.0005
RC (DZ)	-0.0183**	-0.0088**	-0.0049**	-0.0009	-0.0013	-0.0005	-0.0005*	-0.0003**	-0.0002	-0.0007**

RC: Regression coefficient; * Significant at 5% level; ** Significant at 1% level.

Table 8 - Stillbirth rate of twins according to gestational age and weight at birth, 1979-1994

Weight at birth	Gestational age (weeks)						
	Total	-23	24-27	28-31	32-35	36-39	40+
≤2000	0.7456	0.9676	0.4605	0.3297	0.5057	0.5000	–
2000-	0.1821	0.7083#	0.2915	0.1233	0.2686	0.4143	0.5000#
2500-	0.1178	0.5000#	0.3125	0.0777	0.1120	0.3097	0.3400
3000-	0.0655	0.8333#	0.7000#	0.0550	0.0451	0.1212	0.1968
3500-	0.0336	0.5000#	0.4167#	0.0707	0.0238	0.0405	0.0729
4000-	0.0159	–	0#	0.1351	0.0153	0.0146	0.0331
4500-	0.0086	–	0#	0.0909#	0.0108	0.0074	0.0175
5000-	0.0073	–	–	0.1875#	0.0245	0.0062	0.0106
5500-	0.0065	–	–	0#	0.0439	0.0051	0.0099
6000 <	0.0090	–	–	–	0.2222	0.0072	0.0100

: The number of twin pairs is under 12.

Effect of gestational age and birthweight on stillbirth rates

Table 8 shows stillbirth rates of twins according to gestational age and birthweight for a twin pair during the period from 1979 to 1994. At birthweight less than or equal to 3,000 g, the stillbirth rate of twins was the lowest in 28-31 weeks of gestation. At 3,001-4,000 g, the stillbirth rate was the lowest in 32-35 weeks, and at birthweight over 4,000 g, the stillbirth rate was the lowest in 36-39 weeks. Therefore, the lowest stillbirth rate was seen in 28-39 weeks of gestation according to birthweights of twin pairs. The lowest stillbirth rate of twins was 0.51% at 5, 501-6, 000 g and 36-39 weeks. The second and third lowest rates were 0.62% at 5, 001-5, 500 g and 0.72% at over 6,000 g, respectively, in 36-39 weeks.

DISCUSSION

According to Imaizumi et al. [1], stillbirth rates of twins in Japan were 0.27 for MZ twins and 0.224 for DZ twins in 1960. Then the stillbirth rate in 1994 decreased to one quarter for the former twins and one tenth for the latter twins during the 34-year period from 1960. As for single pregnancies in Japan, stillbirth rates were 0.098 in 1960 and 0.034 in 1994, where the rate decreased to one third during that period. From Table 1, the stillbirth rate was higher in DZ twins than singletons from 1975 to 1984 whereas the rate was higher in singletons than DZ twins after 1986. In 1975, the stillbirth rates for MZ and DZ twins were 2.7 times and 1.3 times higher than that for singletons, respectively. The corresponding values in 1994 were 2.5 and 0.82, respectively. After 1986, stillbirth rates were 2.1-2.5 times higher in MZ twins than singletons and 2.2-3.6 times higher in MZ twins than in DZ twins. Therefore, an improvement in the stillbirth rate of

DZ twins had been achieved at the same level as for singletons after 1986. The higher stillbirth rate of MZ twins as opposed to DZ twins could be related to monochorionic twin pairs. The stillbirth rate decreased more drastically in twins for both zygosity than in singleton births during the 34-year period from 1960. Declining rates of stillbirths may be attributed to medical care during twin pregnancies.

From this study, risk factors for the stillbirth rate of twins were maternal age groups for the < 20 years and the > 40 years (Table 4), shorter gestational age (Table 6) and lower birthweights (Table 7). Among twin deliveries, the proportions in maternal age groups for the < 20 years and the > 40 years increased from 0.61% and 0.94% in 1975 to 0.67% and 1.05% in 1994, respectively. The proportions in 12-23 weeks of gestation decreased from 6.2% in 1979 to 5.3% in 1994. As for birthweights of twin pairs, the proportion under 2,000 g decreased from 6.8% (1403/20639) in 1979-1980 to 5.8% (1131/19513) in 1993-1994. Therefore, the risk factors for the stillbirth rate of twins slightly decreased during that period. Thus the declining stillbirth rate of twins could be attributed to antenatal and perinatal medical care.

According to Luke [2], the lowest stillbirth rate of twins was 0.33% at 2500-2800g and 36-37 weeks during the period from 1983 to 1988 in the USA. On the other hand, in the present study, the lowest stillbirth rate of twins was 0.51% at 5,501-6,000g for a twin pair and 36-39 weeks during the period from 1979 to 1994. Certificate records on the fetal death in Japan are obtained after the beginning of the 12th week of fetal life, but those in the USA after the 24th week of gestation. Furthermore, the birthweight was for a twin pair in the former population and a twin individual for the latter. However, in spite of different definitions of the fetal death and of the birthweight of twins, the lowest stillbirth rate is seen in a similar category of birthweights and gestational age group for both studies. From a standpoint of lower risk in the stillbirth rate of twins (Table 8), recommendation of the optimum day to give birth for twin pregnancy is at 37-38 weeks of gestation for Japanese women.

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