Estimated Number of Multiplets Under 16 Years Using Two Sets of Census Data in Japan: 1990 and 1995

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Data for sets of multiples under 16 years of age were obtained from the population censuses of Japan in 1990 and 1995. These numbered 147,188 twin pairs, 1410 sets of triplets, 59 sets of quadruplets, and 3 sets of quintuplets in 1990, with the corresponding numbers in 1995 being 141,354, 2,211, 136 and 12, respectively. The total number of sets of multiples was 148,660 in 1990 and 143,713 in 1995. Twinning, triplet, quadruplet and quintuplet rates were estimated for each age. Rates of monozygotic twins and triplets remained constant age by age up to 15 years, while the dizygotic twinning rate, and rates of di- and tri-zygotic triplets decreased over the same period. Quadruplet and quintuplet rates also decreased. The accuracy of estimating number of multiples from census data is discussed using data on vital statistics.

Data on multiple births were obtained from Japanese vital statistics during the period from 1951 to 1998. With two exceptions, the number of multiplets after birth has not been obtained from vital statistics. These exceptions were data for individuals under one year of age in 1974–1975 (Imaizumi et al., 1981) and 1995–1998 (Imaizumi, 2000). However, data on private households in a census year can provide us with this number of multiplets. As far as I know, this is the first study to estimate the parameters of numbers of multiplets in this way. Information about multiplets after birth may provide foundation materials for public health policy and so on.

The purpose of this study is to estimate the number of twin pairs, triplet, quadruplet, and quintuplet sets under 16 years of age in 1990 and 1995. It also deals with twinning rates and triplet rates according to zygosity, and quadruplet and quintuplet rates in each age below 16 years.

Materials and Method

Japanese census data includes a code number for each household, individual codes within each household, relationship to the head of the household, place of residence (codes for prefecture and city, town or village within the prefecture), sex, date of birth (year and month), and age. Month of birth is classified into four categories: January–March, April–June, July–September, and October–December. In the present study, census data was only used from private households consisting of members of the household including a head of the household. If there are two or more persons of the same age under 16 years in the same household, these have been regarded as multiples. Two individuals of the same age have been judged as twins, three as triplets, four as quadruplets, and five as quintuplets. In comparison with data for the 1990 and the 1995 census, the twinning rate at each age in 1990 shifted to that for five years older in 1995.

Multiple birth data at birth was obtained from the *Vital Statistics for the Years 1975–1995* (Health and Welfare Statistics and Information Department, Ministry of Health and Welfare) which covers the entire population of Japan. The twinning rate from vital statistics in 1975 was then assumed to also be the rate at age 20 years in 1995, and so on. This twinning rate at each age obtained from vital statistics does not consider survival rate after birth. The same method was used for triplets, quadruplets, and quintuplets.

Results

Twins

Table 1 shows the number of sex-composition of twins and zygotic twinning rates in each age under 16 years in 1990 and 1995. The number of twin pairs under 16 years was 147,188 in 1990 and 141,354 in 1995, decreasing by 5,834 pairs over those five years. However, the number of unlike-sexed twins increased from 28,984 in 1990 to 30,341 in 1995, increasing by 1,357 pairs. Twinning rates by zygosity were estimated using Weinberg's method (Weinberg, 1901). The monozygotic (MZ) twinning rate remained constant age by age, whereas the dizygotic (DZ) twinning rate decreased age by age for both census years.

Figure 1 shows zygotic twinning rates between ages 5 and 20 years for the 1990 census and between ages 0 and 15 years for the 1995 census. Zygotic twinning rates indicated similar values between ages 5 and 15 years for both census years.

Figure 2 shows twinning rates according to age up to 20 years for census data and vital statistics. To compute the twinning rate from vital statistics, the number of live twin births divided by 2 was used as the numerator (data was obtained from Imaizumi, 2000). The number of total live births during the period from 1975 to 1995 was used as the denominator.

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Table 1

Sex-composition of Japanese Twins and Twinning Rate According to Zygosity in Each Age in 1990 and 1995.

Age (year)	1990				1995				1990		1995	
	MM	FF	MF	Total	MM	FF	MF	Total	MZ	DZ	MZ	DZ
0	3078	3152	1685	7915	3377	3488	2373	9238	3.7	2.8	3.8	4.0
1	3180	3244	1670	8094	3521	3489	2280	9290	3.8	2.7	3.9	3.8
2	3258	3298	1683	8239	3235	3316	2120	8671	3.7	2.6	3.7	3.6
3	3380	3385	1624	8389	3317	3165	2017	8499	3.8	2.4	3.7	3.3
4	3421	3309	1727	8457	3177	3226	1881	8284	3.6	2.5	3.7	3.1
5	3503	3675	1745	8923	3162	3266	1829	8257	3.8	2.4	3.7	3.0
6	3577	3742	1761	9080	3279	3376	1925	8580	3.7	2.4	3.7	3.0
7	3724	3817	1784	9325	3300	3317	1722	8339	3.8	2.4	3.7	2.6
8	3610	3701	1796	9107	3417	3405	1651	8473	3.7	2.4	3.8	2.5
9	3764	3868	1843	9475	3406	3306	1750	8462	3.8	2.4	3.6	2.5
10	3806	3813	1941	9560	3491	3672	1735	8898	3.6	2.4	3.8	2.4
11	3877	3996	1900	9773	3627	3758	1773	9158	3.7	2.3	3.8	2.4
12	4036	4106	1921	10063	3735	3854	1771	9360	3.7	2.3	3.9	2.4
13	4109	4226	1924	10259	3640	3711	1836	9187	3.7	2.2	3.7	2.4
14	4032	4182	2017	10231	3718	3846	1807	9371	3.4	2.2	3.8	2.4
15	4099	4236	1963	10298	3667	3749	1871	9287	3.3	2.0	3.5	2.3
Total	58454	59750	28984	147188	55069	55944	30341	141354	3.7	2.4	3.7	2.8
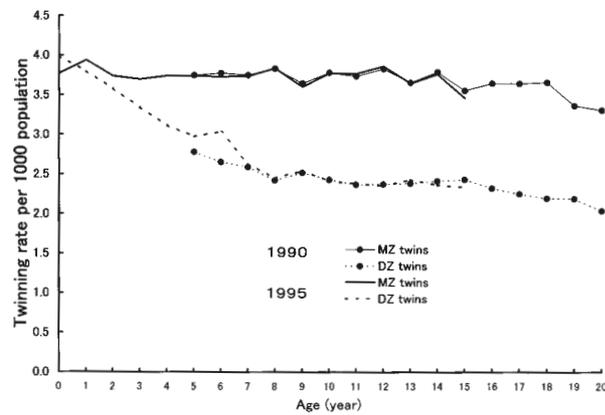
Figure 1

Zygotic twinning rates between ages of zero and 20 years in the 1990 and the 1995 census.
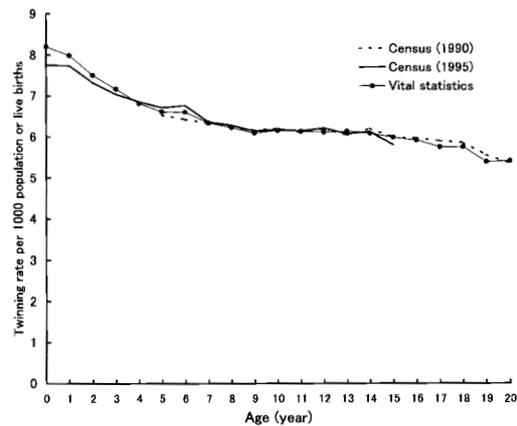
Figure 2

Twinning rates between ages of zero and 20 years from the census data and vital statistics.

Twinning rates at age 0 were 8.20 from vital statistics (Imaizumi, 2000) and 7.82 from the census in 1995 (Table 1). The odds ratio of twinning rates at age 0 years was 1.05 [95% CI 1.02–1.08], being significant at the 5% level. On the other hand, twinning rates obtained from vital statistics and from the census data were not statistically significant between ages 1 and 20 years (see Figure 2). Accordingly, the estimated twinning rate from the census data agreed with that from vital statistics in each age except for age 0 years.

Triplets

Table 2 shows the number of sex-composition of triplets and zygotic triplet rates in each age under 16 years in 1990 and 1995. The number of triplet sets under 16 years was

1,410 in 1990 and 2,211 in 1995, increasing by 801 sets during those five years. Triplet rates by zygosity were estimated using Allen's method (Allen, 1960). With the exceptions of ages 4, 11, and 13–15 years in 1990, and ages 10 and 11 years in 1995, trizygotic (TZ) triplets were more common than other triplet zygosities for each age. The MZ triplet rate remained nearly constant age by age for both census years. The DZ triplet rate slowly decreased age by age, whereas the TZ triplet rate rapidly decreased age by age for both census years.

Figure 3 shows zygotic triplet rates between ages 5 and 20 years for the 1990 census and ages 0 and 15 years for the 1995 census. Zygotic triplet rates between ages 5 and 15 years indicated similar values for both census years.

Table 2

Sex-composition of Japanese Triplets and Triplet rate According to Zygosity in Each Age in 1990 and 1995.

Age	1990 MMM	FFF	MMF	MFF	Total	1995 MMM	FFF	MMF	MFF	Total	1990 MZ	DZ	TZ	1995 MZ	DZ	TZ
0	26	27	33	42	128	48	39	95	79	261	16.1	20.8	68.5	14.3	30.0	174.7
1	24	18	39	32	113	48	44	72	88	252	7.9	20.0	61.8	22.2	29.9	157.7
2	21	38	22	27	108	45	33	74	59	211	26.3	19.4	37.3	19.5	26.7	131.8
3	20	26	26	34	106	41	45	69	46	201	13.2	18.5	47.2	31.2	24.7	110.5
4	20	35	20	16	91	33	30	50	57	170	25.2	18.3	22.7	14.8	23.3	102.5
5	24	22	14	20	80	26	30	31	41	128	18.0	18.3	19.3	18.6	22.2	63.2
6	25	26	24	13	88	32	23	60	52	167	20.1	17.7	21.4	6.4	22.6	102.6
7	22	28	24	13	87	18	36	20	27	101	19.0	18.2	20.7	22.7	19.6	34.7
8	28	27	30	22	107	18	23	26	33	100	19.2	17.4	34.4	9.6	18.7	45.8
9	20	27	20	15	82	19	35	20	18	92	17.0	18.3	18.4	23.9	18.3	24.6
10	20	24	15	23	82	26	23	14	20	83	13.9	17.3	20.2	20.1	18.2	19.4
11	15	28	14	17	74	25	26	22	13	86	14.3	17.0	14.0	20.4	17.9	19.4
12	23	21	16	25	85	22	28	27	15	92	12.3	16.4	21.1	17.8	18.2	25.1
13	20	21	13	11	65	28	26	29	22	105	13.5	16.1	7.5	18.6	17.7	33.2
14	18	25	8	9	60	19	27	21	13	80	15.4	14.8	2.5	16.7	17.8	17.8
15	10	22	10	12	54	20	23	16	23	82	8.3	13.5	6.2	13.3	16.2	21.7
Total	336	415	328	331	1410	468	491	646	606	2211	16.0	17.4	24.4	18.1	21.0	63.3
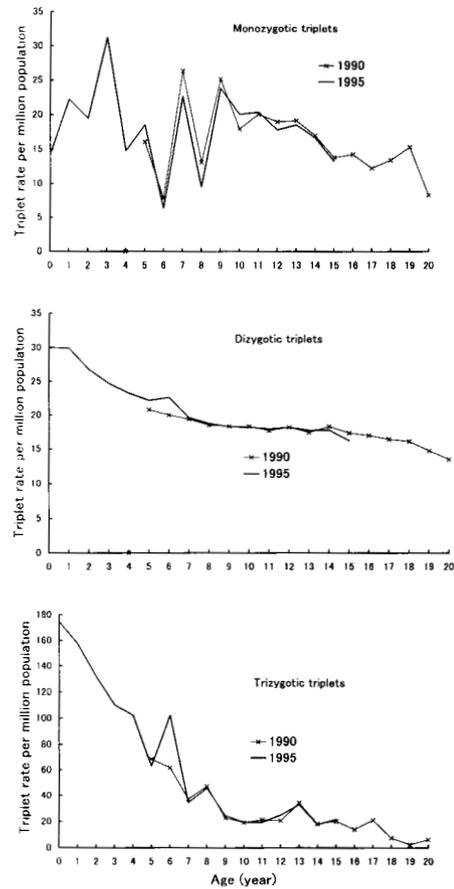
Figure 3

Zygotic triplet rates between ages of zero and 20 years in the 1990 and the 1995 census.
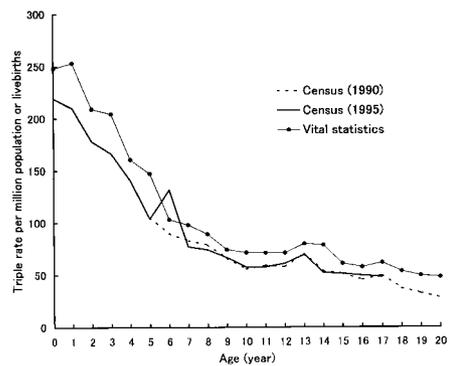

Figure 4

Triplet rates between ages of zero and 20 years from the census data and vital statistics.

Figure 4 shows triplet rates according to age up to 20 years for census data and vital statistics. To compute the triplet rate from vital statistics, the number of live triplet births divided by 3 was used as the numerator (data was obtained from Imaizumi, 2000). The number of total live births during the period

Table 3

Sex-composition of Quadruplet and Quintuplet Sets According to Age in 1990 and 1995.

	Age (year)																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
Quadruplets 1990																	
MMMM	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3
FFFF	0	0	2	0	1	1	1	0	0	0	0	2	0	0	0	0	7
MMMF	1	3	1	1	2	0	2	0	1	0	1	2	1	0	0	0	15
MMFF	0	2	4	2	2	1	1	0	7	0	0	2	1	0	0	0	22
MFFF	2	2	0	2	1	2	0	1	0	1	1	0	0	0	0	0	12
Total	3	8	7	6	6	4	4	2	8	1	2	6	2	0	0	0	59
1995																	
MMMM	1	1	2	3	1	0	1	0	1	0	0	0	1	0	0	0	11
FFFF	2	0	0	0	0	0	0	2	0	1	1	1	0	0	0	0	7
MMMF	5	8	0	5	4	1	3	1	1	2	0	2	0	0	0	1	33
MMFF	7	6	7	3	6	0	9	3	2	2	1	1	0	7	0	0	54
MFFF	3	4	2	4	5	2	3	0	2	1	2	0	1	0	1	1	31
Total	18	19	11	15	16	3	16	6	6	6	4	4	2	7	1	2	136
Quintuplets 1990																	
MMMFF	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
MMFFF	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	2
Total	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	3
1995																	
MMMMM	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
FFFFF	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
MMMMF	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
MMMFF	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	3
MMFFF	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	1	4
Total	0	1	5	3	0	0	1	0	0	0	0	0	0	0	1	1	12

from 1975 to 1995 was used as the denominator. Estimated rates of triplets were significantly higher from vital statistics than from the census data in 1995 for ages 1 (OR = 1.21, 95% CI:1.02–1.42), 3 (1.23, 1.02–1.48), 5 (1.41, 1.13–1.77), and 14 (1.50, 1.13–2.00) years (see Figure 4). At age 6 years, the rate was significantly higher from the census data than from vital statistics. With the exceptions listed above, triplet rates for vital statistics and census data indicated similar values in each age.

Quadruplets

Table 3 shows the number of sex-composition of quadruplet sets in each age under 16 years in 1990 and 1995. The number of quadruplet sets under 16 years was 59 in 1990 and 136 in 1995. Comparison of the data from the 1990 and the 1995 censuses reveals few differences between the number of quadruplets identified in each age cohort that was counted in both censuses (i.e. those ages 5 to 15 years in 1995). Exceptions to this were an additional 8 sets at age 6 in 1995 that were not identified at age 1 in 1990, and one fewer set at each of ages 7 and 13 years in 1995.

Table 4 shows the quadruplet rate according to like-sexed and unlike-sexed in each age in 1990 and 1995. The unlike-sexed quadruplet rate was generally higher than the like-sexed rate for each age in both census years. The only exception was the equal rate for like- and unlike-sexed quadruplets at age 7 years in 1990 and 12 years in 1995, which corresponds to the same quadruplet group in each case.

Table 5 shows the number of all live-born quadruplet sets at birth and the quadruplet rate per million live births during the period from 1975 to 1995. Figure 5 shows quadruplet rates according to age up to 20 years for both census data and vital statistics. The rate of quadruplets was similar between ages 7 and 20 years for both census years. With three exceptions (ages 6, 11, and 13 years) , the estimated quadruplet rate was higher from vital statistics than from the census data in each age.

Quintuplets

Table 3 also shows the number of sex-composition of quintuplets in each age under 16 years in 1990 and 1995. The number of quintuplet sets under 16 years was 3 in 1990 and 12 in 1995. Comparing the results from both census

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Table 4

Rates of Quadruplets According to Like-sexed and Unlike-sexed and Quintuplet Rates in Each Age in 1990 and 1995.

Age	Quadruplets						Quintuplets	
	1990			1995			1990	1995
(year)	Like-sexed	Unlike-sexed	Total	Like-sexed	Unlike-sexed	Total	Total	Total
0	0	2.5	2.5	2.5	12.6	15.1	0	0
1	0.8	5.6	6.4	0.8	15.0	15.8	0	0.8
2	1.5	3.8	5.4	1.7	7.6	9.3	0	4.2
3	0.7	3.7	4.5	2.5	9.9	12.4	0	2.5
4	0.7	3.6	4.4	0.8	12.4	13.2	0	0
5	0.7	2.1	2.8	0	2.4	2.4	0	0
6	0.7	2.0	2.7	0.8	11.8	12.6	0	0.8
7	0.7	0.7	1.3	1.5	3.1	4.6	0	0
8	0	5.3	5.3	0.7	3.7	4.5	0	0
9	0	0.7	0.7	0.7	3.6	4.4	0.7	0
10	0	1.3	1.3	0.7	2.1	2.8	0.6	0
11	1.2	2.4	3.7	0.7	2.0	2.7	0	0
12	0	1.2	1.2	0.7	0.7	1.3	0	0
13	0	0	0	0	4.6	4.6	0	0
14	0	0	0	0	0.7	0.7	0.5	0.7
15	0	0	0	0	1.3	1.3	0	0.6
Total	0.4	2.0	2.4	0.8	5.5	6.3	0.1	0.6

Table 5

Quadruplet and Quintuplet Rates per Million Live Births, 1975-1995.

Year of birth	Age (year) 1990	Age (year) 1995	Quadruplet sets No. of LLLL	Quadruplet sets Rate[a]	Quintuplet sets No. of LLLLL	Quintuplet sets Rate[a]
1995	–	0	24	20.2	1	0.8
1994	–	1	24	19.4	1	0.8
1993	–	2	13	10.9	6	5.1
1992	–	3	18	14.9	1	0.8
1991	–	4	17	13.9	2	1.6
1990	0	5	10	8.2	0	0
1989	1	6	9	7.2	1	0.8
1988	2	7	10	7.6	0	0
1987	3	8	11	8.2	0	0
1986	4	9	8	5.8	1	0.7
1985	5	10	6	4.2	0	0
1984	6	11	2	1.3	0	0
1983	7	12	4	2.7	0	0
1982	8	13	5	3.3	0	0
1981	9	14	4	2.6	1	0.7
1980	10	15	2	1.3	1	0.6
1979	11	16	7	4.3	0	0
1978	12	17	5	2.9	0	0
1977	13	18	0	0	0	0
1976	14	19	1	0.6	1	0.6
1975	15	20	1	0.5	0	0

L: Live-born; a: per million live births
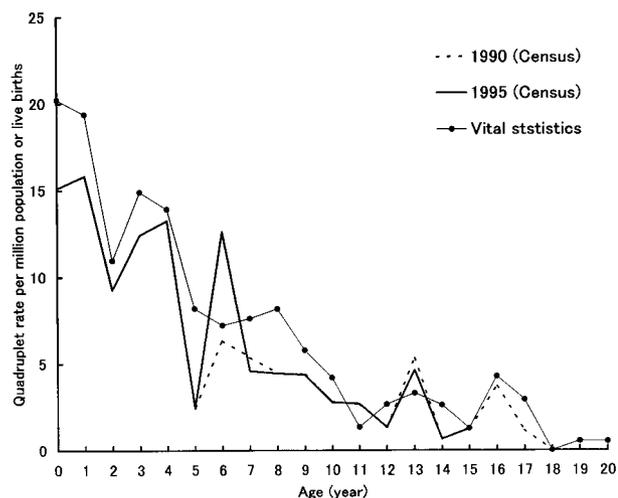
Figure 5

Quadruplet rates between ages of zero and 20 years from the census data and vital statistics.

years, there was only one age group (aged 6 years in 1995) where there were differences between the number of quintuplet sets identified in 1990 and in 1995.

Table 4 shows the quintuplet rate in each age under 16 years in 1990 and 1995, while Table 5 shows the number of all live-born quintuplet sets and the quintuplet rate per million live births during the period from 1975 to 1995. Comparison of census data and vital statistics shows, with two exceptions, that the quintuplet rate from vital statistics

provided the highest estimate at each age (see Table 4 and Table 5). The exceptions were at ages one and 3 years.

Discussion

In Japan, compulsory education is from elementary school to junior high school (between ages 6 and 15 years). After graduation from junior high school, the population is divided into those who obtain employment and those who proceed to senior high school. In isolated regions and the distant islands, some children live apart from their parents to attend senior high school or to get a job. For these reasons, estimation of the number of multiples was limited to the ages of 15 years or less in order to obtain accurate estimates.

The total number of live multiple births in each year obtained from vital statistics was from birth records for the time period between January 1 and December 31, whereas data on multiple sets from the census was based on a static population on October 1 each five years. Therefore, the data obtained from vital statistics and the census differ slightly from each other. In the present study, multiple birth rates in each age from vital statistics did not account for survival rate after birth, leading to higher multiple birth rates in vital statistics than in the census data (see Figures 2, 4, 5). With a few exceptions, the estimated twinning rates, triplet, quadruplet and quintuplet rates from the census data were in good agreement with those from vital statistics in each age. Accordingly, the census data provided good information about multiplets under 16 years.

In Japan, the proportion of families adopting children is very low compared with various foreign countries. The married couple where a child is already born does not tend to adopt another child. Therefore unrelated children of the same age are unlikely to be living together in a household.

In the present study, the estimated twinning rate from the census data agreed with that from vital statistics in each age group except age 0 years. With the one exception of the infant mortality rate of twins, mortality rates of twins may be lower up to 20 years of age in Japan. According to Imaizumi et al. (1981), the infant mortality rate in Japan was 4–5 times higher in twins than the general population during the period from 1974 to 1975. In the UK, mortality of twins remained significantly higher than that of the general population until age 5 years (Baird et al., 1998). As for triplets, with a few exceptions, mortality may be not so high. According to Imaizumi et al. (1981), the infant mortality rate was two-fold higher in triplets than twins in 1974. For quadruplets, the mortality rate seems lower up to 20 years, which might be related to intensive care of super twins during the neonatal period.

The number of twin pairs at five years of age was 8,257 at the 1995 census (Table 1). On the other hand, the number of twin pairs 0 years of age at the 1990 census was 7,915, which means that the maximum number of twin pairs were still alive at age 5 years at the 1995 census year should be 7,915. The differences between those numbers of twin pairs were –342 (7,915 vs. 8,257) at age 5 years. The corresponding differences between two census years were –486 at age 6 years, –100 at age 7 years, –84 at age 8 years, and –5 at age 9 years old. The smaller number of twin pairs at younger ages in the 1990 census compared with those in the 1995 census might be related to the following reasons. When one or both twins were hospitalized at the time of the census, it was not counted as a twin pair. This situation happens especially in infanthood, due to a higher proportion of very low birthweight babies among multiple births compared with singletons. Another possible reason is a higher rate of handicapped children among twins compared with singletons (Little & Bryan, 1988; Pharoah & Cooke, 1996). International immigration and emigration rates could also be responsible for the observed differences. However, these rates are very low in Japan, and are roughly equal.

Acknowledgements

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