
A Recent Rise in Twin Birthrates and Demographic Changes in Mothers of Twins in South Korea: 2003–2007

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Using the South Korean national live birth data for the years 2003 to 2007, monozygotic (MZ) and dizygotic (DZ) twin birth rates were estimated and analyzed by maternal age, and parents of twins and those of singletons were compared in their level of education. During this period, while the MZ twin birth rate showed no change, the DZ twin birth rate increased up to 9.4 pairs per thousand births. This rate is close to five times as high as the natural DZ twinning rate in the South Korean population. The highest twinning rate occurred among mothers aged 30 to 34 years, followed by mothers aged 25 to 29. These results represented the first evidence for the downward trend in ages of mothers of twins. In each year between 2003 and 2006, percentages of parents who completed college or higher level of education were higher in the twin than in the singleton group, suggesting that the parental socioeconomic level became higher in twins than in singletons. We speculated that these demographic changes occurred because assisted reproductive technology was more easily available among parents of high socioeconomic status. In their sampling strategies, twin researchers should consider our findings of recent changes in demographic characteristics of parents of twins as well as increased DZ twin birth rates.

Keywords: Twin birth rates, ART, South Koreans, maternal age, pregnancy, demographic

Population-based twin studies have been valuable sources of information about the genetic basis of complex diseases (Martin et al., 1997). Recently, twin birth rates, especially those of dizygotic (DZ) twins have been rising sharply across developed countries as a consequence of a wide spread use of assisted reproductive technology (ART; Eriksson & Fellman, 2007; Fellman & Eriksson, 2005; Imaizumi & Nonaka, 1997; Martin & Park, 1999). These increased birth rates of twins resulting from ART can produce changes in demographic characteristics of parents of twins, especially mothers of twins.

Whereas the rate of monozygotic (MZ) twinning is similar across human populations at approximately

three to four pairs per thousand births, the rate of natural DZ twin births varies significantly among different human populations (Bulmer, 1970). For example, in European Americans, about seven to eight pairs of DZ twinning occur per thousand births, while about 49 pairs of DZ twin pregnancies occur in Nigeria. Asians have a lower frequency of natural DZ twin births than any other human populations: only about two to four pairs of DZ twin pregnancies occur per thousand births (MacGillivray, 1986). These marked differences in twinning frequency are known to be due to racial/ethnic variations in the genetic predisposition, which is in part manifested through the levels of follicle-stimulating hormone (Nylander, 1981). Recently, however, because of the increasing use of ART, the incidence of DZ twinning is rising sharply in Asian populations also (Hur & Kwon, 2005; Imaizumi & Nonaka, 1997; Shek et al., 1997). Recent rises in DZ twin births are likely to occur among those couples who have financial resources to afford infertility treatments and have a better understanding of medical services that provide ART. Then, the socioeconomic status (SES) of parents of twins may be higher than that of parents of singletons.

Across all human populations, the incidence of twinning increases with the mother's age, up to ages 35–39 years, and then declines (Bulmer, 1970; Oleszczuk et al., 2001). Our previous investigation of twin birth rates in the South Korean population for the years 1981 to 2002 also demonstrated that mothers of the 35- to 39-year-old group had the highest twinning rate (Hur & Kwon, 2005). The rate of natural twinning rises to a peak at this age group largely because the level of gonadotropin increases with age, with maximum stimulation of follicles occurring at the age of approximately 37 (Danforth, 1990). As the number of twins resulting from ART

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increases, however, this traditionally observed distribution of the age of mothers of twins may have been changed recently.

There are three specific goals in our analyses. First, using national live birth record data for the years 2003 to 2007, we examined recent MZ and DZ twin birth rates in the South Korean population. Secondly, we compared the educational level among parents of twins and those of singletons born in recent 5 years in an attempt to determine whether the socioeconomic level is different between the two groups. Finally, we investigated ages of mothers of twins during recent 5 years to investigate if any change occurred.

Methods

We analyzed data in computerized records of all live births in South Korea for the years 2003 through 2006 from the South Korea National Statistical Office. Although the status of twin birth was indicated in each birth record, there was no information that uniquely identifies pairs of twins. In each record, however, the date of birth, sex, gestational age (weeks), and parental educational level, occupational level, age, date of marriage, and birth year and month were available. Using these data in each birth record, we matched approximately 97% of all twins born between the years 2003 and 2006. Triplets and higher-order births were excluded from our analyses. As computerized birth records for the year of 2007 were not available at the time of analyses, the annual summary of the 2007 national live birth data published by the South Korea National Statistical Office

(Korea National Statistical Office, 2008) was used in our analyses. However, as the information included in the annual summary was limited, the data for 2007 were not included in all of our analyses.

Results

Twin Birth Rates by Zygosity

The total MZ and DZ twinning rates per thousand confinements in South Korea for the years 2003 to 2007 were plotted in Figure 1. An estimate of the total number of DZ twins was made by doubling the number of opposite-sex twin pairs. The remainder was assigned to be MZ twins. This is known as Weinberg's differential method (Weinberg, 1901). This method assumes that the gender ratio at birth in the population is 1:1. The average gender ratio from 2003 to 2007 in the South Korean population was 1.08:1.00 (male: female) in singleton births and 1.04:1.00 in twin births, suggesting that the assumption of the Weinberg's differential method was satisfied.

The total twin birth rate was approximately ten pairs per thousand births in 2003. However, the rate was gradually increased to 11 pairs per 1000 in 2006, and then sharply rose to over 13 pairs per 1000 in 2007. While the rate of MZ births was constantly around four pairs per thousand births during this period, the trend of the DZ twin birth rate paralleled that of the total twin birth rate. The rate of DZ twin births steadily increased from about six pairs in 2003 to about seven pairs per thousand births in 2006, and then in 2007, it rapidly rose to 9.4 pairs per 1000. Thus, it was clear that the major part of the increase

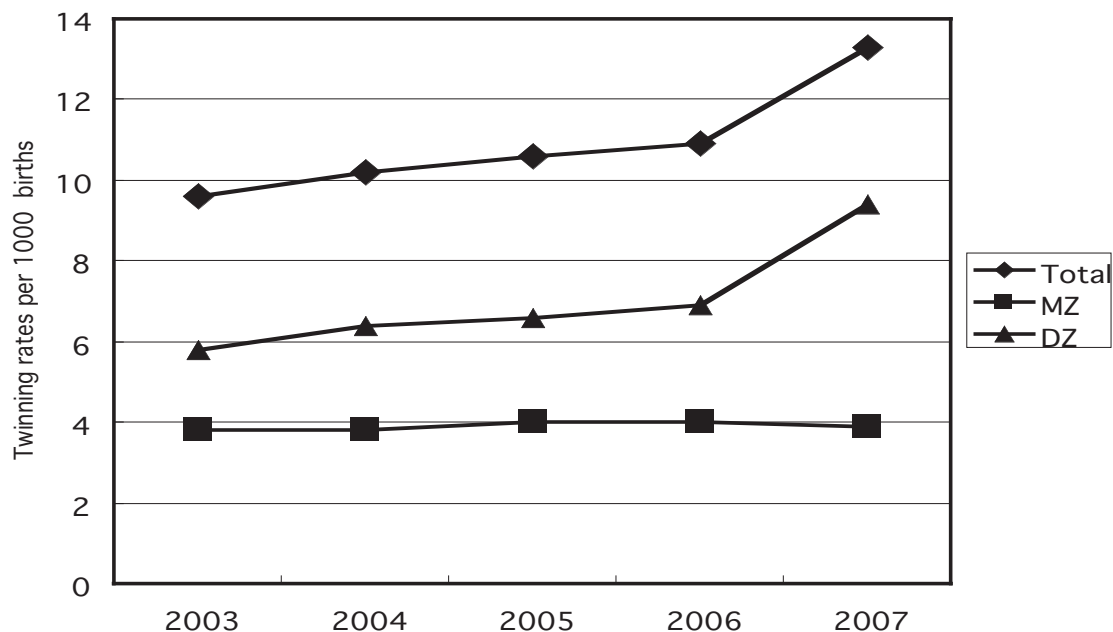


Figure 1

Total, MZ and DZ twinning rates in South Korea, 2003–2007.

Note: Twinning rates are defined as the number of twin pairs per thousand confinements.

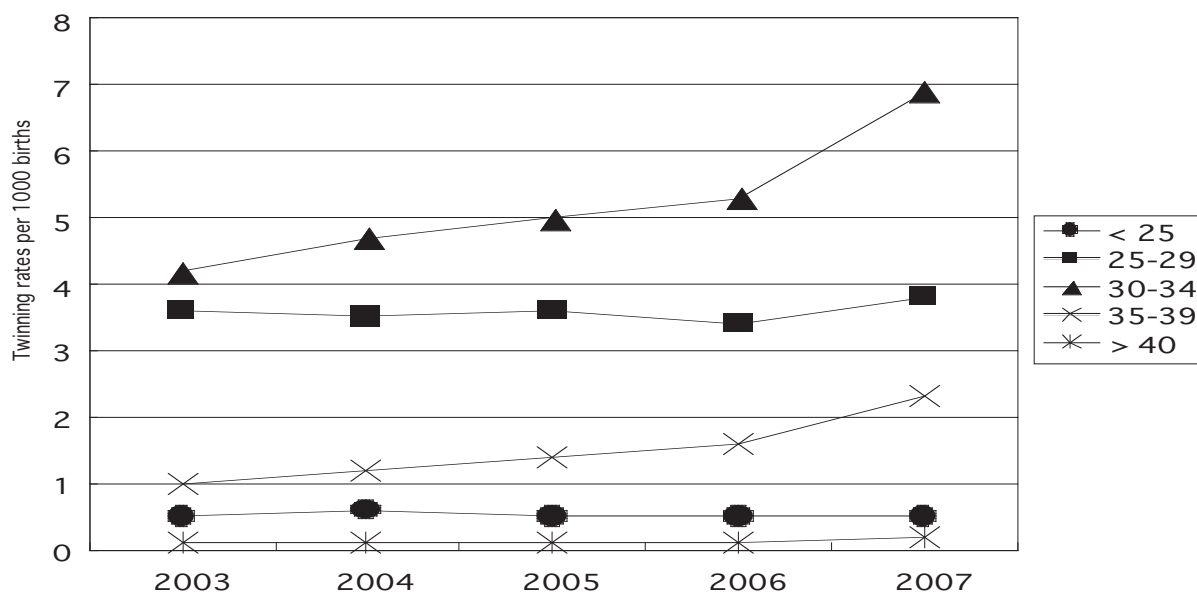


Figure 2
Total twinning rates by maternal age in South Korea, 2003–2007.
Note: Twinning rates are defined as the number of twin pairs per thousand confinements.

in total twinning rates in South Korea for the period 2003-2007 was due to an increase in DZ rather than MZ twins. The rapid rise in DZ twin birth rate in 2007 reflected a sharp increase in the number of total births in South Korea in 2007 (Korea National Statistical Office, 2008).

Twin Birth Rates by Maternal Age

Figure 2 depicts total twin birth rates for 2003–2007 by maternal age. Mother’s age was divided into five classes (< 25, 25–29, 30–34, 35–39, and > 40 years). Mothers of 40 years old and older and mothers under 25 years of age showed the lowest twinning rates of all five groups, which perhaps reflected relatively small numbers of deliveries for these age groups in current South Korean society. For mothers aged between 25–39, it was traditionally shown that the twinning rate increased progressively with age, and the highest twinning rate was found for mothers aged 35–39. Surprisingly, however, this maternal age effect

quite disappeared in our data. As indicated in Figure 2, mothers aged 30–34 had the highest twinning rate during the 5-year period, followed by mothers aged 25–29, and then mothers aged 35–39. The mean age of the mothers of twins born between 2003 and 2007 was 30.5 years with a standard deviation of 3.8 years, which was close to 29.6 years (*SD* = 3.9 years), the mean age of the mothers of singletons during the same period. These results clearly suggest that the ages of mothers of twins are in a downward trend recently.

The Educational Level of Parents of Twins and Singletons

The best measure of socioeconomic status in the South Korean birth record was parental education. Table 1 provides the educational level (%) of fathers and mothers of twins and singletons in each year between 2003 and 2006. The majority (97%) of the parents in the birth records for the years 2003–2006 indicated that they completed high school or higher level of education. Thus, in our analyses, we divided the level of

Table 1
The Level of Education (%) of Fathers and Mothers of Twins and Singletons in South Korea, 2003–2006

Year	Father				Mother			
	Twin		Singleton		Twin		Singleton	
	≤ HS	≥ Coll	≤ HS	≥ Coll	≤ HS	≥ Coll	≤ HS	≥ Coll
2003	41%	59%	44%	56%	50%	50%	51%	49%
2004	38%	62%	41%	59%	46%	54%	47%	53%
2005	35%	65%	39%	61%	41%	59%	44%	56%
2006	34%	66%	37%	63%	40%	60%	41%	59%
Total	37%	63%	41%	59%	44%	56%	46%	54%

Note: HS = equal to or lower than high school education; ≥ Coll = equal to or higher than college education.

education into two groups: equal to or lower than high school education (\leq HS) and equal to or higher than college education (\geq Coll). The level of education of fathers and mothers has rising steadily over the four years for both twin and singleton groups. Notable was that the percentages of fathers and mothers who completed the college or higher level of education were consistently higher for the twin than for the singleton group in each year during 2003–2006. On average, 63% of the fathers and 56% of the mothers of twins completed college or higher level of education, whereas only 59% of the fathers and 54% of the mothers of singletons did.

Discussion

During the years 2003–2007, while the MZ twin birth rate was constantly about four pairs per thousand births, the rate of DZ twin births increased from 6 to 9.4 pairs per 1000 in the South Korean population. A rate of 9.4 pairs of DZ twins per 1000 births is indeed close to five times as high as the natural DZ twinning rate in the South Korean population (Hur & Kwon, 2005). It is likely that the increasing use of ART in conjunction with delayed maternity currently common in South Korea contributed to this rise of twin birth rates in South Korea. The great majority of twin studies so far have been carried out in western countries partly because of low twin birth rates in Asian populations. Recent marked rises of DZ twin births in South Korea as well as in other Asian countries certainly increase feasibility of large scale twin studies in these populations. The extraordinary increase in twin births is a public health concern, however. The higher rate of preterm delivery of twins increases the risk of morbidity, mortality, and lifelong disability (Luke, 1994). In addition, twins are vulnerable to a variety of complications such as malformation and twin-to-twin transfusion syndrome. Maternal complications associated with twin pregnancies such as preeclampsia, postpartum hemorrhage, and death are also increased (Danforth, 1990).

Traditionally, mothers of the 35- to 39-year-old group have shown to have the highest twinning rates across different populations. However, our analyses showed that the highest twinning rate occurred to mothers of the 30- to 34-year-old age group, followed by mothers of the 25- to 29-year-old age group. The mean age of mothers of twins born between 2003 and 2007 was 30.5 years, which was only 0.9 years higher than the mean age of mothers of singletons during the same period. The small difference in age between mothers of twins and those of singletons is in part attributable to a recent upward shift of the maternal age distribution in South Korean society. Taken together, these findings suggest that recently, ages of mothers of twins became lower and close to those of mothers of singletons. It may be that waiting time to pregnancy for couples who seek infertility therapy has been shortened. To our knowledge, this is the first study to report a downward trend of ages of mothers of

twins. It would be interesting to replicate our findings in western countries using recent data. The reduced gap in age between mothers of twins and those of singletons certainly increases generalizability of the findings of twin studies to the population at large.

Our analyses suggest that parents of twins born recently are somewhat better educated than those of singletons in South Korea. Similar to our findings, recently an elevated level of education was also observed among mothers of multiples in the United States. Kiely and Kiely (2001) analyzed national live birth files in the United States in 1971–1977, 1990, and 1998 and found that the greatest increase in the rate of triplet over the three time periods occurred in university-educated women, while the smallest increase occurred in mothers who had not completed high school. As the cost for ART becomes lower, this social class difference between parents of twins and those of singletons may be reduced in the future. However, at present, SES of parents of twins appears to be higher than that of parents of singletons in South Korea and perhaps in other countries also. These findings implicate that the observation of higher SES among parents of twins in a population-based sample need not be evidence of sampling bias. However, these demographic characteristics of twins may limit generalizability of the results from twin studies to the population at large, especially when the variables under study are related to parental SES. Thus, in their sampling strategies, twin researchers should consider our findings of an elevated educational level among parents of twins.

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