Changes in Twinning Rates in South Korea: 1981–2002

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The present study investigates the twinning rate trends in South Korea for the years 1981 to 2002 utilizing the birth record data from the South Korea National Statistical Office. The twinning rates between 1981 and 1991 remained nearly constant and were slightly less than 10 twin individuals, that is, approximately five pairs per thousand births. Since the early 1990s, however, the twinning rate has increased sharply and reached 19.30 twin individuals, that is, around 10 pairs per thousand births in the year 2002. Application of the Weinberg method to birth data for the years 2000 to 2002 revealed that the dizygotic twin rate in South Korea increased almost threefold between 1981 to 1991 and 2002. In the 1980s the effect of maternal age on twinning rates appeared to be minimal. In the 1990s, however, increases in twinning rates occurred more markedly among older mothers than among younger mothers. We speculate that the rapid rise in twinning rates in South Korea in the 1990s is probably attributable to the spread of Assisted Reproductive Technologies among older mothers who seek treatments for infertility. The present study also examined whether residing in industrial areas is associated with multiple births in the South Korean population. The results did not support the recent finding of higher twinning incidence in industrialized regions.

It is well known that compared to African or European populations, Asian populations have lower twinning rates. According to Bulmer's classic review (1970), the dizygotic (DZ) twinning rates among Asian populations are generally less than four pairs per thousand births, whereas the monozygotic (MZ) twinning rates are about three and half pairs per thousand, as in other populations. Recently, however, increases in twinning rates have been documented in many Asian countries (Shek et al., 1997). Up until 1988 in Japan, for example, the MZ and DZ twinning rates were around four and two pairs per thousand respectively. After 1988, however, the rates increased to four pairs per thousand for both MZ and DZ twins (Imaizumi, 1992; Imaizumi & Nonaka, 1997). In Taiwan, the total twinning rates were in the range of four to six pairs per thousand until 1980, but thereafter increased sharply to approximately ten pairs per thousand in 1990 (Chen et al., 1992/1987; Chen et al., 1992).

The investigation of twinning rates in the Korean population is extremely rare. Pollard (1995) compared twinning rates among immigrants from 14 ethnic groups residing in California. Along with Thai and Vietnamese, Koreans showed the lowest twinning rate, around six pairs per thousand. The main purpose of the present study is to investigate the twinning rate trend in the South Korean population for the years 1981 to 2002 using national birth records. As twinning rates, especially DZ twinning rates, are known to be associated with maternal age, the twinning rates by maternal age were also examined for these cohorts.

Recently, Obi-Osius et al. (2004) argued that twinning rates might be associated with industrial air pollution. Obi-Osius et al. (2004) divided south Hesse in Germany into regions environmentally affected by toxic waste incineration, and those separated from industrial areas. They found a significantly higher incidence of twin births in the former regions. In order to examine whether these findings are supported in the South Korean population, this study selected six major industrial areas in South Korea and compared twin frequencies between the selected areas and the rest of the country.

Materials and Methods

Computerized records of all births in South Korea for the years 1981 through 2002 were obtained from the South Korea National Statistical Office.[1] As South Korean vital statistics tabulate births on an individual child basis indicating only plurality of birth and do not include sufficient information to uniquely identify a pair of twins, we counted twins individually rather than as a pair and estimated twinning rates as the number of individual twin births per thousand maternities.

In the year 2000, however, the South Korea National Statistical Office established a policy that

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more accurately recorded twin births. Consequently, whether both members of a twin pair complete birth registration has been examined and, if at all possible, records since then were kept pairwisely in the natality file. In addition, in recent years specific information on birth such as place of birth, parental birth date, parental age, educational level, and so forth has become available in the natality file. For these reasons, we were able to match twin pairs for more than 98% of all twin births from the natality file for the years 2000 to 2002. The Weinberg method was applied to the birth data for the years 2000 to 2002 and MZ and DZ twinning rates were estimated separately for these years.

Results

Changes in Twinning Rates, 1981–2002

Figure 1 illustrates the overall twinning rate and the twinning rate broken down by maternal age in South Korea for the period 1981 to 2002. As shown in Figure 1, the total twinning rate remained nearly constant between 1981 and 1991. The twinning rate over these 10 years was slightly less than 10 twin individuals, that is, approximately five pairs per thousand births. This rate was quite similar to the natural twinning rates typically found in Asian populations (Chen et al., 1987; Imaizumi, 1992; Pollard 1995).

From 1992 onward, however, the twinning rate begins to rise and in the year 2002 the rate reaches 19.3 twin individuals, that is, about 10 pairs per thousand births. The total twinning rate increased almost twofold between 1991 and 2002. Although twin births have increased drastically over the past 20 years, the overall births have declined sharply in the South Korean population (see Appendix). The num-ber of total live births in South Korea was approximately 870,000 in 1981. In 2002, however, it was around 490,000, documenting approximately a 36% decrease in total births from 1981 to 2002. These results suggest that the rise in twin births in the 1990s may be attributable to Assisted Reproductive Technologies (ART) adopted to overcome subfertility problems in the South Korean population.

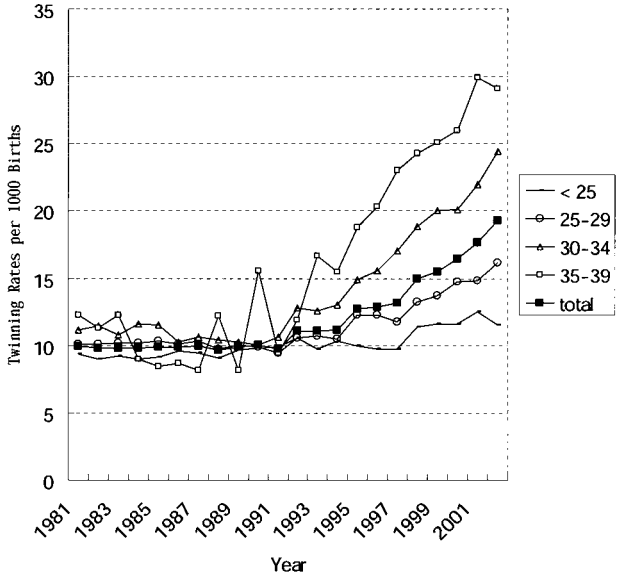

Figure 1

The total twinning rate and the twinning rate by maternal age in South Korea, 1981–2002.

Consistent with the trend in the total twinning rate, all maternal age groups in Figure 1 showed an increasing trend of twinning rates in recent years. Very large fluctuations in twinning rates were observed for mothers over 40 years of age over the 22 year period, perhaps due to relatively small numbers of deliveries in women over 40 years. For clarity, the twinning rates for mothers over 40 years were not included in Figure 1.

For mothers under 40 years, the twinning rates increased only slightly with age in the 1980s, suggesting that the effect of maternal age on twinning rates was minimal in the 1980s. In the 1990s, however, the effect of maternal age on twinning rates was clearly demonstrated. The lowest twinning rate was found in mothers below 25 years of age, and each successive age group up to the age of 40 years had a higher twinning rate. The slopes for mothers over 30 years were much steeper than the slope of the total twinning rate or the slopes for mothers under 30 years. This suggests that mothers over 30 years of age substantially contributed to raising the total twinning rate from the year 1991 onward. These maternal age effects on twinning rates were consistent with previous findings in western populations (e.g., Doherty & Lancaster, 1986).

Twinning Rates by Zygosity, 2000–2002

Figure 2 depicts the total, MZ and DZ twinning rates per thousand births in South Korea for the years 2000 to 2002 estimated on the basis of the Weinberg's differential method. As indicated in Figure 2, the rates of MZ birth during these three years were constantly around four pairs per thousand births. The rates of DZ twins, however, were around five pairs per thousand births in the years 2000 and 2001, and then increased to about six pairs in the year 2002.

The Weinberg method used in the present study assumes that the gender ratio at birth is 1:1. The estimated MZ and DZ rates are likely to be wrong if the assumption underlying these calculations is seriously violated in the South Korean population. In singleton births, the average gender ratio for the three birth cohorts from 2000 to 2002 in the South Korean population was 1.10:1.00 (male:female), whereas in twin births, the corresponding ratio was 1.02:1.00 (male:female). Thus, the assumption for the use of the Weinberg method was reasonably satisfied.

Twinning Rates by Regions

To investigate whether twinning rates are associated with exposure to industrial pollution, six industrial areas were selected and twinning rates in these areas were compared with those in the rest of the country.

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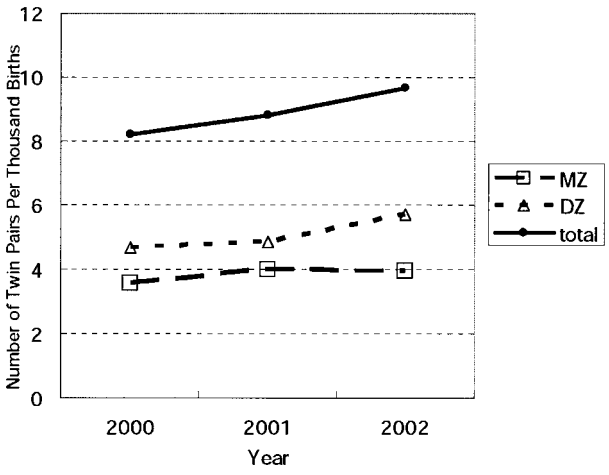

Figure 2

Total, MZ and DZ twinning rates in South Korea, 2000–2002.

The industrial areas selected were Ulsan, Pohang, Gumi, Changwon, Yeocheon, and Incheon. Industrialization began in these areas in the 1970s as part of the South Korean government's economic development plans. Twin frequencies were examined only for the birth years 1981 through 1991 as twins in these cohorts were likely to be the consequence of spontaneous twinning rather than ART. The average twinning rate per thousand births in the six areas for the years 1981 to 1991 was slightly lower than that of the rest of the country (9.80 vs. 9.90) or that in South Korea as a whole for the corresponding period (9.89). Thus, the finding that there is a higher incidence of twinning in industrial areas was not supported in the South Korean population.

Discussion

The incidence of twinning is complex and not completely understood. However, it has been shown that the incidence of multiple births has increased sharply for the past decades throughout developed countries (Imaizumi, 1998; Kiely & Kiely, 2001). Most twin researchers speculate that the recent rise in twinning rates is attributable to two factors: (1) treatments for infertility including both ovulation-inducing hormones and in-vitro fertilization (IVF); and (2) an upward shift in the maternal age distribution (Wilcox et al., 1996).

The present analyses indicate that the South Korean population has shown an increasing trend in twinning rates in recent years consistent with the trends observed in most developed countries. For the period 1981 to 2002, increases in twinning rates began in the early 1990s and most markedly among mothers aged 35 to 39 years. Until the early 1990s, twinning rates were constant around ten individuals per thousand births, that is, about five pairs per thousand. Assuming that the MZ twinning rate is about 3.5 to 4 pairs per thousand, the DZ twinning rate in the South Korean population would be about 1 to 1.5 pairs until the early 1990s. These results indicate that the South Korean population was relatively unaffected by the ART until the early 1990s.

The Weinberg's method applied to the twinning rate data for the years 2000 to 2002 yielded about four pairs of MZ twins and five to six pairs of DZ twins per thousand maternities. This suggests that the DZ twin rate increased almost threefold between 1981 to 1991 and 2002.

As noted earlier, there is evidence of a downward trend in national fertility in the South Korean population over the past two decades. During this period, the attitudes of South Korean women toward traditional family life underwent strong changes that affected the overall population fertility. High levels of education, the desire for financial independence and prevalent social activities among women of reproductive age have played an important role in modifying reproductive strategies. Currently, an increasing number of women of reproductive age pursue a single life, delay marriage and motherhood, and attempt to reduce family size. The mean maternal age at delivery increased from about 26 years in 1981 to over 29 years in 2002 and the number of children per household in South Korea fell to one of the lowest in the world (Korea National Statistical Office, 2003). Along with the recent psychosocial changes, this study suggests that the recent rise in twinning rates in South Korea is probably attributable to the spread of ART among older mothers who seek treatments for infertility.

The present study failed to support the previous finding that residing in an industrial area is a risk factor for multiple births. The present results were in line with a Swedish study (Rydhstroem, 1998) where no general increase of twin births was found in industrial regions. Although the mechanism for higher twinning incidence in industrial areas is not yet understood, it has been speculated that substances in toxic waste suppress estrogen levels in women resulting in higher gonadotrophin levels which, in turns, result in more eggs that could lead to fraternal twinning (Lloyd et al., 1988). It may be that toxic waste substances in the selected areas in the present study do not have sufficient levels of estrogenic properties. In addition, given that the natural DZ twinning rate is low in the South Korean population, the South Korean women may be at a lower risk of DZ twinning biologically and more resilient to toxic effects on DZ twinning. The present study is very limited in addressing these issues, however. To make firm conclusions about the association between twinning and exposure to toxic environments in the South Korean population, more sophisticated studies would need to be undertaken in the future.

In conclusion, evidence from the birth data in South Korea for the years 1981 through 2002 is con-

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sistent with other recent studies indicating the rise of DZ twinning rates. It is interesting to note that the DZ twinning rate, which has been traditionally less than half the MZ twinning rates, exceeded the MZ twinning rate in South Korea. So far, most twin studies have been conducted in western countries where twins are relatively prevalent. The important implication of the present finding is that with the rise of DZ twinning, population-based twin studies are now feasible in South Korea. The present analyses serve as background for future large scale twin studies in the South Korean population.

Endnote

Before 1981, the information contained in birth records was not computerized in South Korea.

Acknowledgments

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Appendix

Table 1.

Total and Twin Birth Statistics for South Korea, 1981–2002

Year	Total births	Total number of twins	Rates per thousand births[a]
1981	871,603	8712	10.00
1982	864,715	8484	9.81
1983	772,809	7607	9.84
1984	678,803	6651	9.80
1985	691,173	6869	9.94
1986	638,097	6322	9.91
1987	625,851	6266	10.01
1988	635,057	6147	9.68
1989	608,033	6044	9.94
1990	651,888	6542	10.04
1991	711,567	6953	9.77
1992	733,322	8128	11.08
1993	718,766	7965	11.08
1994	723,781	8092	11.18
1995	716,598	9098	12.70
1996	660,201	8529	12.92
1997	645,753	8528	13.21
1998	640,126	9561	14.94
1999	616,322	9566	15.52
2000	636,780	10,604	16.65
2001	557,228	9892	17.75
2002	494,625	9618	19.45
Total	14,893,098	176,178	

Note: [a] Twinning rates are defined as the number of twin individuals per thousand confinements.

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