

## Sex Ratio of Twin at Birth and its Significance in Population Management

### SEXE-RATION A LA NAISSANCE DES JUMENTS ET SON IMPORTANCE DANS LA GESTION DES POPULATIONS

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#### Abstract

In clue of twins, this paper studies the sex ratio of twin at birth and its functions in population science, explores to exploit deeply the information of twin birth in China which was hidden in data structure of Censuses and bearing investigations, and raises the possibilities of analyzing the natural sex ratio at birth and evaluating the reliability of sex ratio at birth in China. The goal of this paper is to give a suggestion for exploiting and studying the data of the sixth Census deeply.

**Key words:** Twin; Sex ratio at birth; Census; Population Management

#### Résumé

Dans les idées de jumeaux, ce document étudie le sex-ratio à la naissance de jumeaux et de ses fonctions dans les sciences de la population, il explore profondément à exploiter les informations de naissance de jumeaux en Chine, qui était caché dans la structure des données des recensements et des enquêtes portant, et soulève la possibilité d'analysant le sex-ratio à la naissance naturelle et d'évaluer la fiabilité des sex-ratio à la naissance en Chine. L'objectif de ce texte est de donner une suggestion pour l'exploitation et l'étude des données du Recensement de sixième profondément.

**Mots clés:** Jumeaux; Naissance du Sexe-ratio;

Recensement; Gestion de la population

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## 1. TWO QUESTIONS ABOUT SEX RATIO AT BIRTH

Since 1980s, the sex ratio at birth in Chinese population has rise continuously, and become a serious and realistic social problem affecting China's population public management and population policy. This phenomenon attracted the government, the public and scholars from home and abroad wide concern. Although lots of studies have been done on the features, causes and consequences of the sex ratio at birth in China (Zeng, Tu, et al., 1993), the opinions about the level of the sex ratio at birth in China and its deviation degree remain controversial (CHEN, ZHAI, 2007). It is generally believed that the sex ratio at birth is co-determined by biological factors and man-induced factors, under natural condition, or without the influence of man-induced factors on the sexes at birth, sex ratio at birth is relatively stable. Since childbearing in China is usually affected by traditional culture, family planning policy and gender preference, especially the abuse of modern technique for sex identification and induced abortion, it leads to the change of sex ratio at birth abnormally. Therefore, the deviation degree of sex ratio at birth from natural condition, to some extent, can reflect the acting strength of man-induced factors (such as society, culture) on sex ratio at birth. The scholars in vital statistics and population public management are of great concern to these questions. Researches on these questions consequentially involve two basic and important issues:

the reliability of the sex ratio at birth in population and the evaluation criterion of sex ratio deviation at birth.

There are two ways of reflecting the level of sex ratio at birth in China: the statistical level and the true level. The statistical level may be got from the statistical results of censuses, sample surveys of population and bearing, etc. It is available, but not always true. The true level is the objective existing sex ratio at birth, and it is accurate, but not available. In censuses and birth surveys, respondents might be affected by traditional culture, family planning policy and gender preference, they sometimes conceal and omit birth information about a certain gender (that is usually female), which lead to the systematic errors in statistics and the false increase of sex ratio at birth. The false increase is different from the real increase of sex ratios at birth resulted from sex-selective abortion. Therefore, the statistical results may not be used directly to draw conclusions. It is necessary to analyze and test the data quality of statistical results to judge the errors, and then estimate the "relative" true level of sex ratios at birth. The main techniques of analyzing and testing the data quality of statistical results are: data structure analysis, system data consistency test, the post-enumeration survey in census. The post-enumeration survey in census is the most direct and most reliable method among them. China carried out the post-enumeration survey in each census. Data quality is the basis and key of all studies on sex ratio at birth, but it is not sufficient in the studies on data quality of sex ratio at birth in China, and even the data of the post-enumeration survey on the previous Censuses released by the Government lack of detailed survey content. In fact, the results largely limit the utilization of census data and the adjustment of data deviation. With the development of China's economy and society, the complexity and difficulty of the censuses and birth surveys increase greatly, and the evaluation and analysis of the data quality of censuses and birth surveys will become increasingly prominent and important, we should strengthen the study and innovation on the analytical techniques of demographic data quality.

The deviation of sex ratio at birth is contrast to the natural one, and the natural sex ratio at birth is the basis for judgment of deviation. The characteristics of the natural sex ratio at birth in China is always lack of research, so in the literature, the natural sex ratio at birth in China is assumed to be 107 which is used as a criterion for comparison. The reason is that, according to a large number of surveys and statistics, in the case of sufficiently large sample size, the normal range of human natural sex ratio at birth is from 102 to 107. The sex ratio at birth in China is historically high and its deviation degree from normal condition should be compared with the upper limit of the normal range (ZHAO, 2007). In fact, this method lacks of scientific basis. Many studies indicate that the natural sex ratios at birth in different races and groups are different, and the range of the difference is between

102 and 107, which is the result of race and group adaptive evolution, so their natural sex ratios at birth are relatively genetically stable (United Nations, 1955). But many domestic scholars mistake the differential range as the statistics fluctuation of the sex ratio at birth based on large size sample surveys, without considering that the natural sex ratios at birth in different groups are different. Each group has a characteristic expectancy of natural sex ratio at birth, which is generally from 102 to 107 among all groups. For example, the expectancy in Caucasian is 106 (James, 1987). Wu Cangping (WU, 1988) and Jiang Zhenghua (JIANG, 1994) thought that the high sex ratio at birth in China has consistency in history, and its natural sex ratio at birth may have its particularity, and its expectancy may be higher than 107, up to 108 or so.

Expectancy of natural sex ratio at birth is demographic biological characteristics, it can provide an ideal control system for the analysis and evaluation of sex ratio deviation at birth, therefore it has significance in demography and population public management. Because the previous sex ratio at birth in China was not serious enough to become social problems, the studies for the natural sex ratio at birth in Chinese population was ignored. In addition, China lacks of systematic and historic vital registration, maternal bearings in hospital were not random, so it was difficult to obtain complete and systematic sex data at birth suitable for scientific research. In actual surveys, the sex registrations at birth were affected by man-induced factors in different degrees because of traditional cultures, family planning policy, gender preference and selective abortion, the results of surveys could not really reflect the natural status. Therefore a new breakthrough in technology and methodology is expected to use for studying the natural sex ratio at birth in China.

## 2. EPIDEMIOLOGICAL RESEARCH ON TWINS

It is a new attempt that the natural sex ratio at birth in China and its functions in the population public management are studied in the view angle of twins. As many features of twins are appropriate for the research in this field, especially in the realistic situation, to study the sex ratio at birth in China by twins has an important significance. The reasons are as follows: at first, twins belong to sporadic population, the twin birthrate in China is about 0.8%, and sex ratio of twins at birth can be regarded as a random sample of overall sex ratio at birth. Secondly, in Chinese thought about giving birth, twin birth is often regarded as a more important birth event, and the registration quality of twin birth is much higher than that of singleton birth in censuses and surveys. Thirdly, due to the features of twin pregnancy, man-induced abortion for twin will be great harmful to the pregnant women, the

possibility of selective man-induced abortions is much smaller. Therefore, the twin sex ratio at birth is much closer to natural status, which can provide an ideal control system for analyzing the abnormalities of the sex ratio at birth in China.

It has been generally interested in twins. Since Galton, there have been large amounts of researches on twins, but most twin-related studies concentrated on human physical characteristics, physiological development, behavioral psychology and complex diseases and so on. However, the researches on the epidemiological and demographic characteristics of twins were very few and even unbalanced. After 1980s, twin-related researches increased gradually, some detailed researches have been done in industrialized countries such as in Europe, the United States, especially in Northern Europe (Pison, Couvert, 2004). In Asia, Japan, South Korea and Taiwan, the epidemiological features of twins were tracked (Imaizumi, Nonaka, 1997). The studies on twin epidemiology in Chinese population have not reported until recent years. It showed that human twin birth rate is low, but a big difference among races and groups. The twin birth rate in Negroid is highest for 1.5~5%, lower in Caucasus for 0.9~1.3%, lowest in Mongolia for 0.6~0.8%. For the last century, the continuous and significant changes in twin birth rate occurred in some industrialized countries. Especially in the last 30 years the twin birth rate increased reversely, it makes scholars in demography, healthcare, and reproductive medicine pay more attention to this trend.

The studies on Chinese twin epidemiology began in 1920s, after that, there was little relevant literature about it. Based on author's recent consulting, up to October in 2010, the literature with keywords 'Twinning Rates in Chinese Population' or similar words were no more than 50. Except for the author, almost scholars got twin samples from the productive records in hospital or school surveys, and they only got a small amount of twin samples in these methods. In addition, their results differed from each other, for example, the twin birth rate varied from 0.19% to 1.55% (GAN, LIU, 2000). In recent years, the author utilized the demographic data and methods to analysis the relationship between twin birth rates and demographic factors in China (such as maternal age, geographic distribution, differences between urban and rural areas) (GAN, ZHENG, 2002; GAN, WU, et al., 2007), which provided a new idea for studying epidemiological and demographic characteristics of twins.

The key to study epidemiological characteristics of twins is to obtain sufficient samples of twins. There are 3 ways to obtain twin samples: (1) the birth records in hospital or population surveys; (2) the establishment of twin database; (3) national vital registration systems, censuses, national sampling surveys for population and reproduction and so on. Although many countries, such as North Europe, UK, USA, Australia, Italy, the Netherlands

etc, have established their twin databases. For example, Sweden set up the world's largest twin sample database, where had nearly 140,000 pairs of twins (GAN, WU, et al., 2007). Since 2001, China has established National Twin Registry System based on the populations of northern and southern areas and urban and rural areas. The former two ways have obvious limitations in studies on the epidemiological and demographic characteristics of twins. The sources of twin samples from the third way are the most suitable methods to study the demography of twins. Since each country has its national condition, some countries have their different ways to obtain twin samples. In Europe, especially the Northern countries, the comprehensive vital registration systems have been established early; which become the important sources of twins. The earliest countries obtaining twin information from national vital registration system were Sweden (started in the mid 18th century), Finland, Denmark and France (starting in the mid 19th century. LI, Gao, Lv, et al. 2006). The United States released the National Vital Statistics Report and its analysis reports every year, which contained specific information of twin births (Martin, Hamilton, Sutton, Ventura, 2006). In Korea, since 1981, it also released the birth statistics report including twin information. It should be noted that although the phenomenon of sex preference existed in Korea and it had a high sex birth rate, the twin sex ratio at birth was normal. According to the data released by the National Statistical Office of Korea, among 2000 and 2002, the sex ratio at birth was 110, while the twin sex ratio at birth in the same period was only 103.

China has the most population in the world, it has to devote large amount of work force and financial supports to carry out nationwide census and fertility sampling survey at a regular interval. The purposes of census and survey are to accurately comprehend the current situation and their changing trends of China's population and fertility, in order to offer the foundation for government making policies of population and fertility and plans of economic and social development. As no sufficient attention was paid to the functions of twins, special investigation items about twin birth have not been set in the design scheme of censuses and surveys yet, and the twin birth information has rarely been launched. However, the twin birth information was contained in the design scheme and the data structure of censuses and surveys, and it could be extracted from them by proper techniques. The data of the twins born in 1989 in China was developed from the Chinese Fourth Census, which was the only national twin report in China, while the data of several other censuses and fertility sampling surveys have not been processed with this method. Regrettably, the twin birth data from the Fourth Census were current investigation data, and the content was relatively simple, there were only 2 statistical tables, no other more details were given, which limited scholars to further utilize and study the twin information.

Except for the author, almost no one has ever developed the twin information. Nevertheless, the author found that the depth development of the twin information from the original database of census and survey had not only significance but also great potential value.

### 3. DEVELOPMENT OF TWIN RESOURCES AND ITS FUNCTION IN POPULATION MANAGEMENT

The Censuses and the sampling surveys for population and fertility, the latter were conducted by National Population and Family Planning Commission of China (NPFPC), are two main sources of large scale of demographic data in China. The original data from the Censuses and the sampling surveys for population and fertility stored up rich information of twin births. As the original databases of the Censuses have been sealed, only 1% of the sampling databases of the third, fourth and fifth Censuses are available. Meanwhile the databases of population and fertility surveys conducted by NPFPC are also available, there have been six surveys, including the national population and fertility sampling survey in 1982, the national birth control sampling survey in 1988, the national information system sampling survey for family planning management in 1992, the national population and reproductive health survey in 1997, the national family planning and reproductive health survey in 2001, and the national population and family planning sampling survey in 2006. But the sizes of the samples varied from dozens of thousand to over 2 million.

Population and fertility sampling survey belongs to a kind of retrospective investigation, it records all historical bearing information of the investigated woman. The results about twins can represent the historical status of twin production, which can be used to study the dynamic changes of twin demographic characteristics. The Census belongs to a current survey, and it records women's bearing status a year or year and a half before the registration, which can reflect the demographic characteristics of twins birth in time profile. Two types of information can be used for different purposes, and their results are complementary.

In order to exploit the information of twins from the databases of national fertility sampling surveys and 1% sampling databases of the third, fourth, and fifth censuses, we need to analyze the questionnaire design bills and the database structure of the censuses and surveys. The hidden information of twins will be disclosed from the time records of maternity productions. So we can obtain more information about the demographic characteristics of twins from women who gave birth to twins.

The reliability of data quality of twins is the foundation and condition for studying the natural sex ratio at birth in China. Only if the twin births and sex registration were

affected less by man-made factors, or the sex birth of twins was near natural status, the sex ratio of twins at birth could provide an objective and reliable system of control and comparison for us to study natural sex ratio at birth in China and analyze the deviation degree of the sex ratio at birth in China.

According to biological principles of twin incidence, we can evaluate the reliability of data quality of twins. The twins are divided into two types: Monozygotic twins (MZ) and Dizygotic twins (DZ), the opposite-sex pairs of twins belong to DZ twins, the same-sex pairs of twins are MZ or DZ twins. The zygotic types of twins can be classified by means of the Weinberg difference method. Based on the biological principles, the MZ twin incidence rate is less influenced by heredity and environment factors, and it keeps steady relatively. But the DZ twin incidence rate has something to do with the maternal childbearing age and order. Therefore, by analyzing the sex composition of twins and the levels and features of twin incidence rates in the perspective of biological principles, we can evaluate the reliability of data quality of twins in China.

The main contents of studying the demographic characteristics of sex ratio of twins at birth include followings: analyzing its geographical distribution and its differential features between urban and rural areas, and its relationship with maternal childbearing age, birth order, and maternal educated level, as well as the comparison of the demography characteristics of the sex ratio of twins at birth at different periods and in different countries, so as to reveal systematically the nature and features of the sex ratio of twins at birth in China

Sex ratio of twins at birth has the important functions in demography and population management theory. By the research of sex ratio of twins at birth, we can study the natural sex ratio at birth in Chinese population, analyze the data quality of the sex ratio at birth in China, and evaluate the deviation degree of the sex ratio at birth in China. Twin information can even be used to evaluate the data quality of population and fertility in the censuses and sampling surveys, because twin information was extracted from the Censuses and surveys, the sample source of twins can be regarded as re-sampling from samples of the censuses and surveys, twin data are not only a part of the internal data structures of the censuses and surveys but also have the partial functions of the post-enumeration surveys in the censuses. This can be used for the inspection of data quality in censuses. In addition, twin birth rate is related to the demographic information of female fertility, and the epidemiological features of twin incidence abide by biological principle strongly, especially the birth rates of MZ twins keep quite stable, so by analyzing the features of birth rates of MZ twins, we can evaluate the data quality of population and fertility in the censuses and surveys. On the other hand, the change of twin birth rate is mainly determined by the birth rate of DZ twins, and DZ twin incidence

involves the factors of female's reproductive physiology, endocrinology, prenatal care and the quality and quantity of male's sperm, therefore, by tracking the dynamic progress of the demographic characteristics of twin birth rate, we can evaluate the influence of the social progress on the reproductive health of Chinese population to some extent. It should be point out, in recent decades, with the wide application of artificial reproductive technologies, the incidence rates of twin and multiple pregnancies rise, and they have some influences on the demographic characteristics of twins, which provide a new and practical subject for the research on epidemiology and the population management.

## CONCLUSION

Censuses belong to national behaviors. The primary process of the data resources of census determines the direction of the follow-up usage and research. China carried out its sixth national census in 2010, and will be conducting the primary process of the original data. Scholars focus on the data quality of the Census and the deviation degree of sex ratio at birth (HU, 2008). However, we are still used to the traditional methods for resolving these questions nowadays. It needs to bring forth a new idea in demography and population public management that the information of twin birth is exploited from the design scheme and database structure in censuses and large surveys, and then a set of methods is set up based on the above information in order to analyze the data quality of censuses and surveys, and evaluate the deviation degree of sex ratio at birth. Up to now, the studies on these fields in China is still in blank. It suggests that we may use 1% sampling databases of the Censuses along with national fertility sampling survey database as the objects to explore the methods and ways of exploiting the twin birth information involved in the large demographic database and analyzing the nature and features of the sex ratio of twins at birth and the natural sex ratio at birth in Chinese population, the aims are to set up the models and techniques of analyzing the data quality of census and evaluate the deviation degree of sex ratio at birth in clue of twins, and apply them on the analysis and depth development of the sixth national census data.

The development of twin resource in China could also help people deepen their knowledge on the functions of censuses and fertility surveys, and pay more attention to the depth development and utilization of census and survey data. Especially by studying the functions and roles of twins in China in demography and population public management, it will arouse scholars to further concern the twin research, and promote the depth of studies on twin

interdisciplinary.

## REFERENCES

- Zeng Y. Tu P. Gu BH. (1993). Causes and Implications of the Recent Increase in the Reported Sex Ratio at Birth in China. *Population and Development Review*, 19(2), 283-302.
- CHEN Wei, ZHAI Zhenwu (2007). Sex Ratio at Birth in China in the 1990s: How High Did It Really Climb? *Population Research*. 31(5), 1-8.
- ZHAO Kaibin (2007). The Statistical Features and Control of Sex Ratio. *Statistical Research*. 24(10), 92-94.
- United Nations (1955). Method of Appraisal of Quality of Data for Population Estimates Manual II ST/SOA/Series A. 23.
- James, WH. (1987). The Human Sex Ratio. Part I: A review of the Literature. *Human Biology*. 59, 721-752.
- WU Cangping (1988). The Studies on Sex Ratios in China. In eds. Liu Zheng. *The Studies on the Problem of Chinese Population*, pp.110-148. Beijing: Renmin University of China Press.
- JIANG Zhenghua (1994). Correct Understanding Population Situation, Scientific Planning Develop Aim. *Population and Family Planning*. 6, 10-13.
- Pison G. & Couvert N. (2004). The Frequency of Twin Births in France: the Triple Influence of Biology, Medicine and Family Behavior. *Population-E*, 59(6), 765-794.
- Imazumi Y. & Nonaka A. (1997). The Twinning Rates by Zygosity in Japan, 1975-1994. *Acta Geneticae Medicae et Gemellologiae*. 46, 9-22.
- GAN Jianping, LIU Shiwang (2000). The Influence of Maternal Ages on the Birth Rates of Twins in China. *Acta Anthropologica Sinica*, 19(4), 305-312.
- GAN Jianping, ZHENG Jian (2002). Regional Distribution of Birth Rates of Twins in China. *China Public Health*, 18(6), 658-659.
- GAN JP. WU ZH. TU ZM. & ZHENG J. (2007). The Comparison of Twinning Rates between Urban and Rural Areas in China. *Twin Research and Human Genetics*, 10(4), 633-637.
- Swedish Twin Registry*. [http://www.meb.ki.se/twinreg/index\\_en.html](http://www.meb.ki.se/twinreg/index_en.html). 2009-12-20.
- LI LM. Gao WJ. Lv J. Cao WH. Zhan SY. (2006). Current Status of the Chinese National Twin Registry. *Twin Research and Human Genetics*, 9(6), 747-752.
- Martin JA. Hamilton BE. Sutton PD. Ventura SJ. (2006). Menacker F. & Kirmeyer S. Births: Final Data for 2004. *National Vital Statistics Reports*, 55(1), 1-101.
- HU Guihua (2008). Suggestion to the Estimation of Sample Size for the Post-Enumeration Quality Survey of China Census in 2010. *Application of Statistics and Management*, 27(6), 992-996.