Infant's sex, birth control policy and postpartum well-being: a prospective cohort study in Shanghai, China

Jing Hua[1]*, Liping Zhu[2]*, Wenchong Du[3], Li Du[2], Ting Luo[4], Zhuochun Wu[4]

*Co-Corresponding author:

Jing Hua, Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine P.O. 2699 Gaoke Road, 200042 Shanghai, China, Fax: 086-021-20261428, Email: szhuaj@hotmail.com, Jing Hua

Liping Zhu, Shanghai Maternity and Child Health Care Center, P.O. 339 Gaoke Road, 200042 Shanghai, China, 200042, Shanghai, China, Fax: 086-021-20261428, Email: shzhuliping@163.com

[1] The Women and Children's Health Care Department of Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine, 200042，Shanghai, China.

[2] The Research Office of Shanghai Maternity and Child Health Care Center, 200042，Shanghai, China.

[3] Psychology Division, Nottingham Trent University, Chaucer Building 4013, Burton Street, Nottingham, NG1 4BU, UK

[4] Health Statistics and Social Medicine Department of Public health School，Fudan University, 200002.

ABSTRACT

Objectives: The Chinese government loosed its birth control policy and allowed the parents to have the second child if both of the parent were from one-child family from 2001. We explore the association between infant's sex and mother's postpartum well-being, which may be moderated by birth control policy status in China.

Setting and Participants: We conducted a prospective cohort study in Shanghai City, one of the largest cities in China. A total number of 1730 childbearing women from 8 obstetric hospitals across Shanghai were included in the study at baseline, with 1503 women completing the survey 7 days postpartum in 2013.

Measures: The General Well-Being Schedule (GWBS) was used to assess maternal well-being at baseline and follow-up investigation in the study. Women's demographic, clinical characteristic, and well-being were measured at baseline. The maternal satisfaction and postpartum well-being were assessed in the follow-up survey.

Results The results of multivariable linear regression analyses showed that women who gave

birth to male infants were positively associated with the total score of maternal well-being, when the participated hospitals, maternal well-being at baseline, the socio-demographic characteristic, maternal and infant's health outcome were added to the adjustments (β=1.462, *P*<0.05). The association disappeared when the two-child policy status was added to be adjusted (*P*>0.05). The results of multiple logistic regression model showed that having a male infant was a protective factor of 'positive well-being' (OR=0.622, *P*<0.05), which was moderated by the two-child policy status (*P*>0.05).

Conclusions: Our results emphasize the importance in conducting intervention to increase the general well-being, especially for those with a female infant in a son preference society such as China, and enhance the necessity of sustainability of newly relaxed two-child policy which allows more couples to have the second child in China.

[Keywords] Infant's sex, Birth control policy, Postpartum well-being, China

Strengths and limitations of this study

- Our study has provided important clinical implications regarding the effect of birth control policy and gender preference on postnatal maternal mental health.
- Our study is the first one which has provided direct evidence on how a relaxation of birth control policy could positively increase new mother's mental health status.
- We recruited the participants at 29-30 weeks of gestation in low-risk primiparous women in order to avoid other possible confounders such as severe complication during pregnancy and the first child's sex which may influence a multiparous woman's well-being.
- Selection bias may exist in our study as 1.5% women who refused to take part in our study at baseline. And 13.1% were missing or excluded from the follow-up investigation. Women with higher level of psychological well-being during the pregnancy may be more likely to take part in our study and completing the follow-up investigation.

INTRODUCTION

Developing a sense of well-being and achieving competence in the maternal role are considered as critical components of maternal adaptation during the transition to motherhood.[1] Maternal psychology is also known to impact a child's physical[2] and mental health.[3,4] However, previous studies have shown the significant difference in maternal postpartum mental health when comparing different genders of newborn infants.[5,6] Women who gave birth to a female infant were at a higher risk of postpartum depression after adjusting for maternal age, education level, family income, living condition, gravidity, number of prenatal care visits, and mode of delivery. Fathers of male infants had significantly higher parenting satisfaction scores than fathers of female infants following the infant's birth.[7,8] This is in contrast to studies conducted in Western societies which did not find an association between fetal gender and postpartum psychology.[9]

The strong preference for boys is well known in Chinese culture because boys will carry their family lineage and may earn more income for family and society.[10,11] The gender preference has become a subject of considerable discussion since the one-child family policy was implemented in 1974.[10,11] The one-child family policy in China has been suggested to lead to a stronger male preference,[12,13] which may affect maternal psychological well-being when the male preference could not meet. Studies have shown that disappointment over baby gender is a significant risk factor of postnatal depression.[14] Under the one-child policy in China, the gender of newborn babies should play a more important role in affecting the mother's postnatal mental health status, because families could not have a second chance to have another child if they are not happy with the gender of the newborn baby. Unfortunately, there are limited studies exploring these relationships in Chinese culture.

In 2001, the Chinese government loosed its birth control policy and allowed the parents to have the second child if both of the parent were from a one-child family. The policy has been further relaxed which allows all couples to have two children since 2016. Therefore, the majority of Chinese families were under either one-child or two-child birth control policy status from 2001 to 2015. We conducted a prospective cohort study during 2013 in Shanghai City, one of the largest cities in China. We hypothesized that mothers with a male infant was positively associated with the higher level of postpartum well-being, but may be moderated by birth control policy status. The aims of the current study were: (1) to explore the association between infant's sex and mother's postpartum well-being including anxiety, depression, general health, positive well-being, self-control, vitality; and (2) to examine whether the birth control policy status would moderate the association.

MATERIALS AND METHODS

Participants

A prospective research design was used to collect data at two time points (baseline and follow-up). Eight obstetric hospitals were selected from 8 separate districts across Shanghai by convenience sampling. The childbearing women who attended antenatal clinics in the 8 selected hospitals were eligible for the study if they met the following inclusion criteria: (1) 29-30 weeks of gestation at recruitment; (2) primiparous; (3) singleton pregnancy. The exclusion criteria were: (1) personal, family-based psychiatric history; (2) presence of medical or obstetric complications (such as gestational diabetes and preeclampsia) before the final investigation; (3) fetal malformations; (4) unable to provide consent. 1902 childbearing women who were eligible

for the inclusion criteria were invited to take part in the study at baseline; 29 women were unable to provide the informed consent or refused to complete the questionnaire. A total of 1730 childbearing women were included in the cohortt, and finally 1503 women who completed the follow-up questionnaire with no missing information or fetal malformation were included in the final analysis (Figure 1). There were no difference of maternal age, education level, vacation and method of payment, or well-being level at baseline between the missing (n=227) and inclusion data (n=1503) (each $P>0.05$).

Measurements

The General Well-Being Schedule (GWBS) was used to assess maternal well-being at baseline (at 29-30 weeks of gestation of the recruited women) and follow-up investigation (7-14 days after birth) in the study. GWBS is an 18-item multi-dimensional scale developed by Harold Deputy and revised by Fazio Anthony;[15] which has been validated in American and Asian population.[16-19] Duan[20] has translated the GWBS scale into Chinese and reported its validation in China: the internal consistency (Cronbach's alpha coefficients of male and female were 0.91 and 0.95 respectively) and construct validity (the Pearson correlation coefficients between the scores of each item and total score were from 0.65 to 0.88) of GWBS were reliable in Chinese population. GWBS covers six dimensions of subjective feelings of psychological well-being: anxiety (nervousness; stress; strain; pressure; anxious, worried; upset; relaxed-tense), depression (sad; discouraged; hopeless; downhearted; blue; depressed-cheerful), general health (bothered by bodily disorders; health; concern; worry), positive well-being (good spirits; happy, satisfied; interesting daily life), self-control (firm control of behavior; emotions; afraid losing

mind; emotionally stable; sure of self) and vitality (waking, fresh, rested; feeling tired, worn out; energy level). All items refer to the experience of participants in the previous month. Items 1-14 are scored from 0 to 5, while items 15-18 are scored from 0 to 10. Items 1, 3, 6, 7, 9, 11, 15, and 16 are reverse scored. The scores of each dimension were summed by their corresponding items. The total score of GWBS was summed by the scores of six dimensions. The higher scores represent greater well-being. Proposed cutoffs (60, 72) representing three levels of well-being are 73–110 (positive well-being), 61–72 (moderate distress), and 0–60 (severe distress).

Procedure

The survey was conducted from May to October 2013. The questionnaires were filled out by women when they attended regular antenatal health education courses in the selected hospitals. Teachers of health education courses (usually the medical practitioner of the hospitals) were trained to brief through the aim of the current study and the questionnaires to the participants. The participants were asked to fill out the questionnaire individually in half an hour at the end of the courses according to the attached illustration. The teachers collected and placed all filled questionnaires in a sealed envelope and posted all original hard copies to the researchers. The follow-up investigation was conducted by a family interview on day 7-14 postpartum due to the Chinese tradition that a Chinese woman should remain at home for one month postpartum.

The study was approved by the ethics committees of the Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine (#2013-09). The study was carried out in accordance with the approved guidelines. The purposes of the study were explained to all

participants verbally. All participants signed an informed consent form prior to enrolling in the study. The participants were advised that they could withdraw from the study at any time they wished.

Statistical analysis

Data were analyzed using SPSS 17.0 program. Independent-samples t-tests and Chi-square tests were conducted to compare the two groups (women with male and female newborn infants) at the baseline. Multivariable linear regression analyses were used to assess the effects of infant's sex on delivery mode and maternal satisfaction, after adjusting for potential confounders including participated hospitals, socio-demographic characteristic, obstetric characteristic, infant's health outcome and one-child policy status. The multi collinearity problem was verified using the tolerance approach and the variance inflation factor. Any variable that had a tolerance value of less than 0.1 and a variance inflation factor greater than 10 was not included in the same regression model.[21] Multiple logistic regression models[22] were also used to analyze the effect of infants' sex on the levels of maternal wellbeing when the possible potential confounders were adjusted. A p-value of 0.05 was used for all tests of significance. There was no difference found for maternal age, education, vacation and method of payment, or well-being at baseline between the missing (n=227) and inclusion data (n=1503) (each $p>0.05$).

RESULTS

Among all of our 1503 participants, 781 (52.0%) gave birth to male infants (Male Group), 722 (48.0%) gave birth to female infants (Female Group). Table 1 shows the distribution of selected

socio-demographic, obstetric and children's characteristic characteristics among participants. The proportion of age, ethnicity, education, vacation, resident status, multiple gestation, and method of payment was equal between the participants in two groups (p>0.05). Difference of birth weight was found between the participants in two groups; and the rate of breastfeeding in first 24 hours in Female Group was higher than those in Male Group, with the p values of 0.05 (Table 1). At the baseline, there was no difference of degree of maternal welling-being (non-anxiety, non-depression, positive well-being and self-control) between two groups (each p>0.05; see Table 2).

However, during the postpartum period, only women who gave birth to male infants were positively associated with the total score of maternal well-being when confounders were not adjusted (β=1.570, 95% CI: 0.372 to 2.767, p<0.001). The association remained statistical significance when the participated hospitals and maternal well-being at baseline (β=1.482, 95% CI: 0.303 to 2.660, P<0.001), the socio-demographic characteristic (β=1.526, 95% CI: 0.341 to 2.710, P<0.001), obstetric characteristic (β=1.474, 95% CI: 0.293 to 2.656, P=0.014), infant's health outcome (β=1.474, 95% CI: 0.293 to 2.656, P=0.015) were added to the adjustments. However, the association was not statistically significant when the birth control policy status (two-child vs. one-child status) was added to be considered (1.497, -0.001 to 2.990, p=0.051; Table 3).

Similarly, the infants' sex were also related with the score of subscale of positive welling-being when not adjusting for (β=0.274, 0.050 to 0.499, p<0.001) or adjusting for the hospitals and maternal well-being at baseline (β=0.273, 95% CI: 0.048 to 0.497, p<0.001), and when the socio-demographic characteristic (β=0.303, 95% CI: 0.079 to 0.528, , p=0.008), obstetric

characteristic (β=0.297, 95% CI: 0.072 to 0.522 , *p*=0.010), infant's health outcome (β=0.295, 95% CI: 0.070 to 0.521, *p*=0.010) were added to be considered. However, the positive association disappeared when the two-child birth control policy were added to the adjustments (β=0.230, 95% CI:-0.048 to 0.508, *p*=0.104; Table 3).

We also found a lower depression level in women who gave birth to male infants when we did not adjust for any potential confounders (β=1.339, 95% CI: 1.051 to 1.626, *p*<0.001). These associations remained when the hospitals and maternal well-being at baseline (β=1.335, 95% CI: 1.050 to 1.621, *p*<0.001), socio-demographic characteristic (β=1.333, 95% CI: 1.046 to 1.620, *p*<0.001), obstetric characteristic(β=1.323, 95% CI: 1.036 to 1.610, *p*<0.001), infant's health outcome (β=1.321, 95% CI: 1.033 to 1.608, *p*<0.001) and two-child policy status (β=1.341, 95% CI: 0.990 to 1.692, *p*<0.001) were added to the adjustments (Table 3).

Additionally, the total score of GWBS was categorized into three levels (severe distress, moderate distress and positive well-being). The results showed that women who gave birth to male infants were only associated with the level of positive well-being (aOR=1.607, 95% CI: 1.034 to 2.499, *p*=0.035) when compared with the level of positive well-being after adjusted for hospitals and maternal well-being at baseline, socio-demographic characteristic, obstetric characteristic, and infant's health outcome. However, the association disappeared when two-child policy status was added into the adjustments (aOR=1.240, 95% CI: 0.674 to 2.281, *p*=0.489; Table 4).

DISCUSSION

The present study sheds light on the influence of infants' sex with maternal postpartum well-

being. To our knowledge, there are few studies with consideration of the change of birth control policy. Our study indicated that the women who gave birth to a male infant experienced less maternal postpartum depression and enjoyed higher postpartum well-being. However, the positive association between infant gender and postpartum well-being could be moderated by the two-child birth control policy status.

In our study, the distribution of demographic characteristics, obstetric characteristic and infant's health outcome (such as exceptionally high rates of caesarean section and breastfeeding) are consistent with the general obstetric populations in Chinese literature,[5,23,24] therefore, our sample is representative of the national population. There was no significant difference at baseline in maternal well-being between women who gave birth to male and female infants, which may be due to the truth that since 2002, parents are not allowed to identify the gender of the fetus before delivery, which is to avoid any gender selection.[25,26]

Our results suggest that giving birth of a male infant was related with less postpartum depression. The result is consistent to the previous studies that new mothers of female infants were at increased risk of developing postpartum depression,[5,6,12,14] while new mothers of males infants experience lower depression level in a society that values boys. Couples in China have a strong preference of sons due to not only economic but also social reasons.[27] For example, people usually rely on their offspring to support their retired life since the national pension system is not very well established in China;[28,29] and sons with higher income will be more capable of providing financial support compared to daughters since generally women gain less than men in China.[30] More important, only a son's offspring would be able to carry his father's surname to continue the family lineage. The negative reaction of family members towards the

birth of a female infant may subsequently affect their support of the mother, which may be a potential risk factor for postpartum depression within certain cultural groups.[5]

Our results further suggested that women who gave birth to a male have a more positive postpartum general well-being and higher-level well-being status. The general and higher level of well-being which was assessed by GWBS refers to anxiety, depression, general health, positive well-being, self-control, and vitality. It is biologically plausible that the brain and body respond to stress by an activation of the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system preparing the body to "fight or flight" .[31] Consequently, the higher level of psychological well-being and lower depression and anxiety may bring along the physical fitness including general health and vitality, and enhance the level of postpartum general well-being.

Interestingly, the associations between infant's sex and postpartum well-being disappeared when the two-child birth control policy status was added to the adjustments, suggesting that family which were allowed to have more than one child may moderate the effects of the association. This could be caused by either the potential financial benefit brought by two children (either sons or daughters), or being provided with a second chance to have a son.

The Chinese government has recently scrapped its one-child family policy, allowing all couples to have two children since 2016. The policy may bring in an interesting dynamics of maternal mental health. The effective of son preference on mother's postpartum well-being would be moderated by two-child status in more families since the policy was implemented. However, older mothers are on the rise due to the two-child policy in China.[32] Pregnancies after the age of 35 are associated with increased risks of preterm birth, gestational diabetes, placenta, amniotic fluid embolism, venous thrombosis, and genetic abnormalities in children and so on,[33] which may inversely bring about the challenges of maternal well-being.

CONCLUSION

Our study provided very important clinical implications regarding the effect of gender preference on postnatal maternal mental health. Our results emphasize the importance in

conducting intervention to reduce the risk of women's postpartum depression and enhancing general well-being, especially for those with a female infant in a son preference society such as China. Additionally, our study is the first one which has provided direct evidence on how a relaxation of birth control policy could positively increase new mother's mental health status. The significant change, however, will take time. The relaxation of policy creates some challenges on maternal health due to different reasons such as the increasing rates of older mothers induced by the policy change; and it is good to see that Chinese authorities have been committed to improving the country's maternal healthcare services to accommodate the possible negative effects on maternal health.

There was some possible bias exists in our study. We recruited the participants at 29-30 weeks of gestation because the baseline investigation conducted in different trimester may induce some potential confounders such as different health situation and maternal well-being at baseline. If we ask questions verbally in front of other family members in the postpartum interview, there would be an element of social desirability bias as their family may be upset if the newborn infants' mothers are not happy because they have had a male child. Therefore, we asked for the newborn infants' mother to fill out the questionnaires by themselves in the postpartum family interview. Moreover, we conducted the present study in low-risk primiparous women in order to avoid other possible confounders such as severe complication during pregnancy and the first child's sex which may influence a multiparous woman's well-being.[13,34]

The caution should be made when we generalize our results in general obstetric population based on a convenience sample. Selection bias may exist in our study as 29 women who refused

to take part in our study at baseline, and 227 were missing or excluded from the follow-up investigation (although there were no differences of demographic characteristics and psychological well-being at baseline between the 227 women with missing information or excluded from the final analysis and 1503 women who included in our final analysis). Women with higher level of psychological well-being during the pregnancy may be more likely to take part in our study and completing the follow-up investigation. Fortunately, the selection bias induced by non-response and loss to follow-up in a cohort study decline usually to under-estimate the effects (association). Our results may be only generalized to the advanced areas of China like Shanghai, but providing important clues for our nation-wide study in near future.

Acknowledgements The authors wish to thank the researchers and investigators from the 8 hospitals who participated in the distribution and collection of the questionnaires. We also thank Moneeza Walji for language editing.

Contributors JH and LZ were responsible for the study design, analysis of the study and approval of the submitted and final version. LD, WD and TL contributed to execution and analysis of the study. ZW contributed to revising the paper and approval of the final version.

Founding National Natural Science Foundation of China (81402687), the Science and Technology Commission of Shanghai Municipality (15495810500, 14411970900), and the key discipline of Shanghai three-year program of public health (15GWZK0401).

Competing interests None declared.

Ethics approval The study was approved by the ethics committees of the Shanghai First Maternity and Infant Hospital, Tongji University School of Medicine (#2013-09).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

Reference

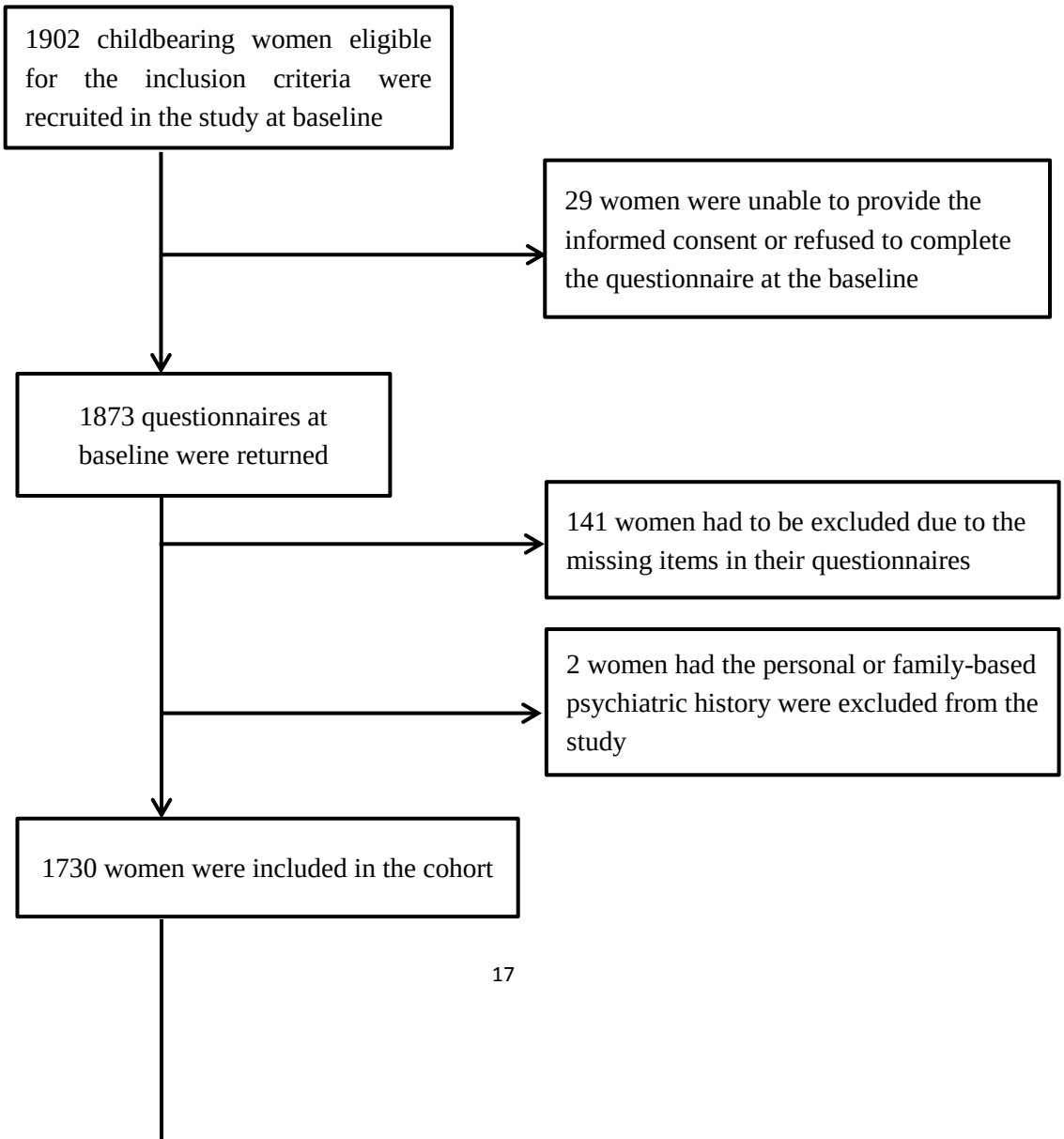
1. Gao LL, Chan SW, Sun K. Effects of an interpersonal-psychotherapy-oriented childbirth education programme for Chinese first-time childbearing women at 3-month follow up: randomised controlled trial. *International journal of nursing studies* 2012;**49**(3):274-81 doi: 10.1016/j.ijnurstu.2011.09.010published Online First: Epub Date]|.
2. Singla DR, Kumbakumba E, Aboud FE. Effects of a parenting intervention to address both maternal psychological wellbeing and child development and growth in rural Uganda: a community-based, cluster randomised trial. *The Lancet. Global health* 2015;**3**(8):e458-69 doi: 10.1016/S2214-109X(15)00099-6published Online First: Epub Date]|.
3. Luoma I, Tamminen T, Kaukonen P, et al. Longitudinal study of maternal depressive symptoms and child well-being. *Journal of the American Academy of Child and Adolescent Psychiatry* 2001;**40**(12):1367-74 doi: 10.1097/00004583-200112000-00006published Online First: Epub Date]|.
4. Jones TL, Prinz RJ. Potential roles of parental self-efficacy in parent and child adjustment: a review. *Clinical psychology review* 2005;**25**(3):341-63 doi: 10.1016/j.cpr.2004.12.004published Online First: Epub Date]|.
5. Xie RH, He G, Liu A, Bradwejn J, Walker M, Wen SW. Fetal gender and postpartum depression in a cohort of Chinese women. *Social science & medicine* 2007;**65**(4):680-4 doi: 10.1016/j.socscimed.2007.04.003published Online First: Epub Date]|.
6. Xie RH, He G, Koszycki D, Walker M, Wen SW. Fetal sex, social support, and postpartum depression. *Canadian journal of psychiatry. Revue canadienne de psychiatrie* 2009;**54**(11):750-6
7. Hudson DB, Elek SM, Fleck CM. First-time mothers' and fathers' transition to parenthood: infant care self-efficacy, parenting satisfaction, and infant sex. *Issues in comprehensive pediatric nursing* 2001;**24**(1):31-43
8. Elek SM, Hudson DB, Bouffard C. Marital and parenting satisfaction and infant care self-efficacy during the transition to parenthood: the effect of infant sex. *Issues in comprehensive pediatric nursing* 2003;**26**(1):45-57
9. Robertson E, Grace S, Wallington T, Stewart DE. Antenatal risk factors for postpartum depression: a synthesis of recent literature. *General hospital psychiatry* 2004;**26**(4):289-95 doi: 10.1016/j.genhosppsych.2004.02.006published Online First: Epub Date]|.
10. Ren XS. Sex differences in infant and child mortality in three provinces in China. *Social science & medicine* 1995;**40**(9):1259-69
11. Xu B, Rimpela A, Jarvelin MR, Nieminen M. Sex differences of infant and child mortality in China.

Scandinavian journal of social medicine 1994;**22**(4):242-8

12. Xie RH, Liao S, Xie H, Guo Y, Walker M, Wen SW. Infant sex, family support and postpartum depression in a Chinese cohort. *Journal of epidemiology and community health* 2011;**65**(8):722-6 doi: 10.1136/jech.2009.096651published Online First: Epub Date]|.
13. Li H, Yi J, Zhang J. Estimating the effect of the one-child policy on the sex ratio imbalance in China: identification based on the difference-in-differences. *Demography* 2011;**48**(4):1535-57 doi: 10.1007/s13524-011-0055-ypublished Online First: Epub Date]|.
14. Lee DT, Yip SK, Chiu HF, et al. Detecting postnatal depression in Chinese women. Validation of the Chinese version of the Edinburgh Postnatal Depression Scale. *The British journal of psychiatry : the journal of mental science* 1998;**172**:433-7
15. Fazio AF. A concurrent validational study of the NCHS General Well-Being Schedule. *Vital and health statistics. Series 2, Data evaluation and methods research* 1977(73):1-53
16. Nakayama T, Toyoda H, Ohno K, Yoshiike N, Futagami T. Validity, reliability and acceptability of the Japanese version of the General Well-Being Schedule (GWBS). *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation* 2000;**9**(5):529-39
17. Leonardson GR, Daniels MC, Ness FK, et al. Validity and reliability of the general well-being schedule with northern plains American Indians diagnosed with type 2 diabetes mellitus. *Psychological reports* 2003;**93**(1):49-58 doi: 10.2466/pr0.2003.93.1.49published Online First: Epub Date]|.
18. Taylor JE, Poston WS, 2nd, Haddock CK, et al. Psychometric characteristics of the General Well-Being Schedule (GWB) with African-American women. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation* 2003;**12**(1):31-9
19. Poston WS, 2nd, Olvera NE, Yanez C, et al. Evaluation of the factor structure and psychometric characteristics of the General Well-Being Schedule (GWB) with Mexican American women. *Women Health* 1998;**27**(3):51-64 doi: 10.1300/J013v27n03_04published Online First: Epub Date]|.
20. D R. The application of General Well-Being Schedule in university students. *Comptes rendus biologies* 1996;**4**:56-57
21. Lee KJ, Wiest MM, Carlin JB. Statistics for clinicians: an introduction to linear regression. *Journal of paediatrics and child health* 2014;**50**(12):940-3 doi: 10.1111/jpc.12597published Online First: Epub Date]|.
22. Campbell M. Multiple logistic regression models--what are they? *Midwifery* 2004;**20**(3):236-9 doi: 10.1016/j.midw.2004.06.004published Online First: Epub Date]|.
23. Hou L, Li G, Zou L, et al. [Cesarean delivery rate and indications in mainland China: a cross sectional study in 2011]. *Zhonghua fu chan ke za zhi* 2014;**49**(10):728-35
24. Tian X, Wu J, Li B, Qin M, Qi J. [Occurrence of cesarean section and related factors in 40 counties of China from 1978 to 2010]. *Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]* 2014;**48**(5):391-5
25. Nie JB. Non-medical sex-selective abortion in China: ethical and public policy issues in the context of 40 million missing females. *British medical bulletin* 2011;**98**:7-20 doi: 10.1093/bmb/ldr015published Online First: Epub Date]|.
26. Zhou C, Wang XL, Zhou XD, Hesketh T. Son preference and sex-selective abortion in China:

informing policy options. *International journal of public health* 2012;**57**(3):459-65 doi: 10.1007/s00038-011-0267-3published Online First: Epub Date]|.

27. Rui D. A Family-Oriented Decision-Making Model for Human Research in Mainland China. *The Journal of medicine and philosophy* 2015;**40**(4):400-17 doi: 10.1093/jmp/jhv013published Online First: Epub Date]|.
28. Pei X, Pillai VK. Old age support in China: the role of the state and the family. *International journal of aging & human development* 1999;**49**(3):197-212
29. Leung JC. Family support for the elderly in China: issues and challenges. *Journal of aging & social policy* 1997;**9**(3):87-101 doi: 10.1300/J031v09n03_05published Online First: Epub Date]|.
30. Gu B. The practice and enlightenment of the two-child policy regime. *Polish journal of microbiology / Polskie Towarzystwo Mikrobiologow = The Polish Society of Microbiologists* 2008;**32**(4):33-49
31. Tsatsoulis A, Fountoulakis S. The protective role of exercise on stress system dysregulation and comorbidities. *Annals of the New York Academy of Sciences* 2006;**1083**:196-213 doi: 10.1196/annals.1367.020published Online First: Epub Date]|.
32. Gong W, Xu DR, Caine ED. Challenges arising from China's two-child policy. *Lancet* 2016;**387**(10025):1274 doi: 10.1016/S0140-6736(16)30020-4published Online First: Epub Date]|.
33. Jolly M, Sebire N, Harris J, Robinson S, Regan L. The risks associated with pregnancy in women aged 35 years or older. *Human reproduction* 2000;**15**(11):2433-7
34. Gu B, Roy K. Sex ratio at birth in China, with reference to other areas in East Asia: what we know. *Asia-Pacific population journal / United Nations* 1995;**10**(3):17-42


1902 childbearing women eligible for the inclusion criteria were recruited in the study at baseline
29 women were unable to provide the informed consent or refused to complete the questionnaire at the baseline
1873 questionnaires at baseline were returned
141 women had to be excluded due to the missing items in their questionnaires
2 women had the personal or family-based psychiatric history were excluded from the study
1730 women were included in the cohort

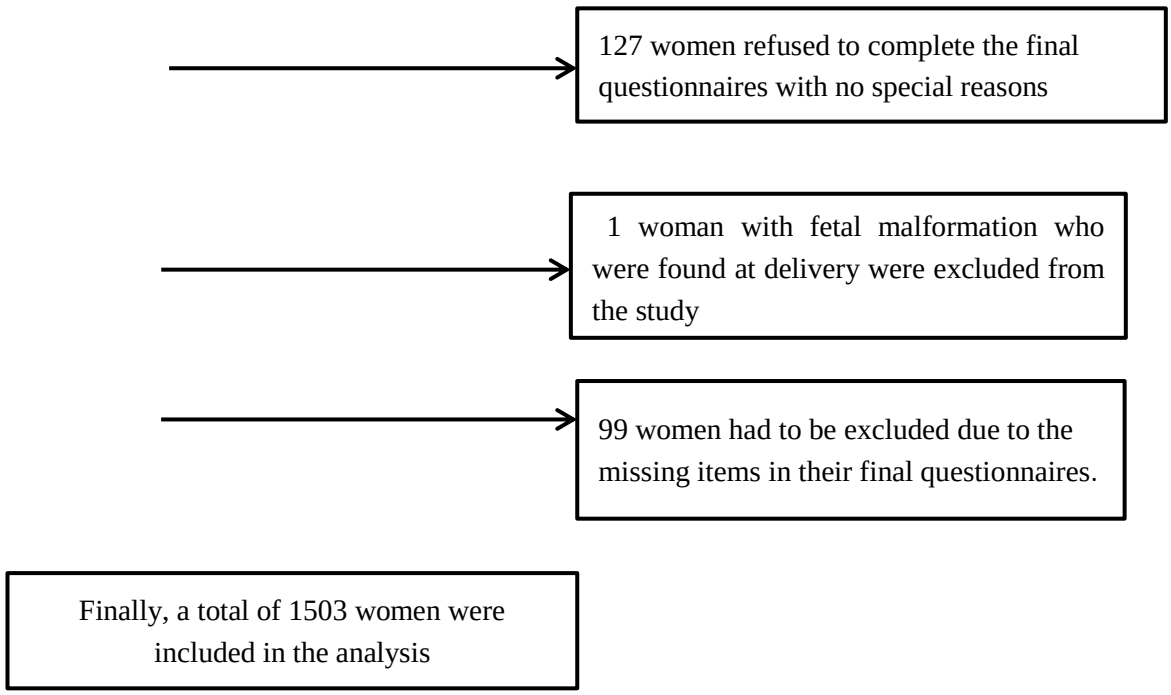


Fig.1. Number of women who completed the baseline and follow-up investigations

Table 1

Socio-demographic, obstetric and children's characteristic (n=1503)

Characteristic	Total n=1503; (n, %)	Male infant n=781; (n, %)	Female infant n=722; (n, %)	*P*
Socio-demographic characteristic				
Maternal age				
≤24	169(11.2)	95(12.2)	74(10.2)	0.485
25-34	1252(83.3)	645(82.6)	607(84.1)	
≥35	82(5.5)	41(5.2)	41(5.7)	
Education				
College or university	88(5.9)	52(6.7)	36(5.0)	0.054
Middle school	291(19.4)	165(21.1)	126(17.5)	
Primary school or below	1124(74.8)	564(72.2)	560(77.6)	
Vacation				
Company employee	321(21.4)	158(20.2)	163(22.6)	0.761
Private owner	106(7.1)	55(7.0)	51(7.1)	
Technician and liberal profession	614(40.9)	318(40.7)	296(41)	
Unemployed	281(18.7)	153(19.6)	128(17.7)	
Others	181(12.0)	97(12.4)	84(11.6)	
Method of payment				
Self-payment	490(32.6)	256(32.8)	234(32.4)	0.642
Government insurance	681(45.3)	346(44.3)	335(46.4)	
Private insurance	332(22.1)	179(22.9)	153(21.2)	
Resident status				
Resident women	794(52.8)	407(52.1)	387(53.6)	0.564
Migrant women	709(47.2)	374(47.9)	335(46.4)	
Obstetric characteristic				
Abortion				
0	1205(80.2)	617(79.0)	588(81.4)	0.106
1	221(14.7)	115(14.7)	106(14.7)	
≥2	77(5.1)	49(6.3)	28(3.9)	
Delivery mode				
Vaginal birth	764(50.8)	399(51.1)	365(50.6)	0.836
Caesarean section	739(49.2)	382(48.9)	357(49.4)	

Midwife-led delivery				
No	1069(71.1)	552(70.7)	517(71.6)	0.692
Yes	434(28.9)	229(29.3)	205(28.4)	
Infant's health outcome				
Preterm children				
No	1386(92.2)	719(92.1)	667(92.4)	0.817
Yes	117(7.8)	62(7.9)	55(7.6)	
Birth weight				
<2500g	24(1.6)	13(1.7)	11(1.5)	0.049
2500~3999g	1364(90.8)	699(89.5)	665(92.1)	
≥4000g	115(7.7)	69(8.8)	46(6.4)	
Breastfeeding in first 24 hours				
No	224(14.9)	130(16.6)	94(13.0)	0.049
Yes	1279(85.1)	651(83.4)	628(87.0)	
Birth control policy settings				
Two-child policy status [b]	483(32.1)	259(33.2)	224(31.0)	0.375
One-child policy status [c]	1020(67.9)	522(66.8)	498(69.0)	

a Pearson Chi-square test

[b] The family are allowed to have two child if both of the parents were from one-child families under the birth control policy during the study period

[c] The family are allowed to have only one child if one of or both of the parents were from multi-child families under the birth control policy during the study period

Table 2

Maternal well-being assessed by GWBS [a] at baseline (n=1503)

Characteristic	Total n=1503 ; Mean(SD)	Male infant n=781 ; Mean(SD)	Female infant n=722; Mean(SD)	*P*[a]
Anxiety	17.13(4.491)	17.21(4.574)	17.05(4.401)	0.505
Depression	15.22(6.055)	15.25(6.04)	15.19(6.076)	0.845
General health	5.82(2.492)	5.81(2.484)	5.84(2.503)	0.823
Positive well-being	7.79(3.335)	7.81(3.319)	7.77(3.354)	0.791
Self-control	9.30(2.699)	9.35(2.715)	9.24(2.683)	0.414
Vitality	13.41(4.193)	13.47(4.206)	13.35(4.18)	0.572
Total score	68.68(11.435)	68.91(11.692)	68.44(11.154)	0.427

[a] All items refer to a 1-month time frame. Items 1–14 are scored on a six-point rating scale, while items 15–18 are scored from 0–10. Items 1, 3, 6, 7, 9, 11, 15, and 16 are reversed scored. The Lower scores represent greater distress.

[b] Two independent sample t-test

Table 3

Effects of fetal sex on women's postpartum well-being (n=1503)

Outcome variables[g]	Total n=1503; M(SD)	Male infant n=781; M(SD)	Female infant n=722; M(SD)	β[a] (95% CI)	β[b] (95% CI)	β[c] (95% CI)	β[d] (95% CI)	β[e](95% CI)	B[f](95% CI)
Anxiety	19.48(3.778)	19.50(3.743)	19.47(3.812)	-0.035(-0.418, 0.347)	-0.055(-0.433, 0.323)	-0.046(-0.426, 0.335)	-0.051(-0.431, 0.329)	-0.056(-0.435, 0.323)	-0.155(-0.620, 0.310)
Depression	17.24(2.916)	16.54(2.868)	17.88(2.811)	1.339(1.051, 1.626)***	1.335(1.050, 1.621)***	1.333(1.046, 1.620)***	1.323(1.036, 1.610)***	1.321(1.033, 1.608)***	1.341(0.990, 1.692)***
General health	6.19(2.695)	6.21(2.755)	6.17(2.639)	-0.038(-0.311, 0.235)	-0.036(-0.309, 0.236)	-0.028(-0.301, 0.246)	-0.023(-0.296, 0.250)	-0.026(-0.300, 0.248)	0.192(-0.817, 0.571)
Positive well-being	10.56(2.22)	10.41(2.202)	10.69(2.231)	0.274(0.050 0.499)***	0.273(0.048, 0.497)***	0.303(0.079, 0.528)*0.008	0.297(0.072, 0.522)*0.010	0.295(0.070, 0.521)*0.010	0.230(-0.048, 0.508)0.104
Self-control	11.98(2.159)	11.98(2.167)	11.98(2.153)	-0.004(-0.214, 0.223)	-0.003(-0.221, 0.215)	0.029(-0.190, 0.247)	0.025(-0.194, 0.243)	0.030(-0.189, 0.249)	-0.112(-0.370, 0.146)
Vitality	15.22(3.057)	15.21(3.057)	15.23(3.059)	0.025(-0.284,0.335)	0.012(-0.294,0.319)	0.006(-0.302, 0.314)	-0.009(-0.316, 0.298)	-0.016(-0.324, 0.292)	-0.116(-0.507, 0.275)
Total score	80.66(11.847)	79.85(11.653)	81.42(11.983)	1.570(0.372, 2.767)***	1.482(0.303, 2.660)***	1.526(0.341, 2.710)***	1.484(0.303, 2.6656*0.014	1.474(0.293, 2.656)*	1.497(-0.001, 2.990)

[a] Not adjusted for any potential confounders
[b] Adjusted for hospitals and maternal well-being at baseline
[c] Adjusted for maternal well-being at baseline and socio-demographic characteristic
[d] Adjusted for maternal well-being at baseline, socio-demographic characteristic, and obstetric characteristic
[e] Adjusted for maternal well-being at baseline, socio-demographic characteristic, obstetric characteristic, and infant's health outcome
[f] Adjusted for maternal well-being at baseline, socio-demographic characteristic, obstetric characteristic, infant's health outcome and birth control policy settings
[g] The score of six dimensions and total score of GWBS

*p<0.05, **p<0.01, ***p<0.001

Table 4

Effects of fetal sex on levels of women's postpartum well-being (n=1503)

Total score of GWBS[g]	Total n=1503; n(%)	Male infant n=781; n(%)	Female infant n=722; n(%)	cOR[a] (95% CI)	aOR[b] (95% CI)	aOR[c] (95% CI)	aOR[d] (95% CI)	aOR[e] (95% CI)	aOR[f](95% CI)
73–110 (positive well-being)	1123(74.7)	593(52.8)	530(47.2)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
61–72(moderate distress)	302(20.1)	155(51.3)	147(48.7)	1.061(0.823,1.368)	1.071(0.821,1.397)	1.082(0.827,1.415)	1.069(0.816,1.403)	1.038(0.787, 1.368)	1.007(0.708,1.434)
0-60(severe distress)	78(5.2)	33(42.3)	45(57.7)	1.526(0.959,2.427)	1.494(0.923,2.418)	1.551(0.950,2.532)	1.514(0.921,2.487)	1.607(1.034,2.499)*	1.240(0.674,2.281)

[a] Crude Odds Ratio
[b] Adjusted Odds Ratio (adjusted for hospitals and maternal well-being at baseline)
[c] Adjusted Odds Ratio (adjusted for maternal well-being at baseline and socio-demographic characteristic)
[d] Adjusted Odds Ratio (adjusted for maternal well-being at baseline, socio-demographic characteristic, and obstetric characteristic)
[e] Adjusted Odds Ratio (adjusted for maternal well-being at baseline, socio-demographic characteristic, obstetric characteristic, and Infant's health outcome)
[f] Adjusted Odds Ratio (adjusted for maternal well-being at baseline, socio-demographic characteristic, obstetric characteristic, infant's health outcome and birth control policy status)
[g] The levels of wellbeing were grouped into three categories according to the total score of GWBS
*p<0.05, **p<0.01, ***p<0.001