The relationship between paternal smoking and sex ratio of children born in public maternity hospitals in Bandar Abbas (Iran)

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Original Article

Abstract

Introduction: Earlier studies throughout the world show that the ratio of live male births to live female births is declining. There are several factors associated with the reduction of male births including environmental pollutions, exposure to chemicals and smoking. The aim of this study is to determine the relationship between paternal smoking and sex ratio of children at public maternity hospitals in Bandar Abbas.

Methods: The present cross-sectional study surveyed public hospitals in Bandar Abbas (Iran) from 21 March 2010 to 20 March 2011. Data was collected by census method. Seven hundred thirty mothers eligible for the completed a questionnaire and provided required information. Then sex ratio was compared in two groups. Three hundred sixty five mothers lived with smoker spouse and 365 did not. Data analysis was done by SPSS statistical software using descriptive methods, Chi-square test and logistic regression analysis.

Results: Results showed that the spouses with lower education smoked cigarettes more than those with higher education. The difference was statistically significant ($P<0.0001$). Sex ratio for children with smoker father and the group with non-smoker father was 0.7 and 1.2, respectively; and the relationship was significant ($P<0.001$). Out of 365 smoker fathers, 283 cases smoked less than 20 cigarettes per day, and 82 smoked more than 20 cigarettes. The sex ratios for the babies with smoker fathers smoking less than 20 cigarettes and those smoking more than 20 cigarettes were 0.76 and 0.56, respectively.

Conclusion: Based on the study, it seems that smoking cigarette by parents during conception period may have a negative effect on the sex ratio. Therefore, the gender of the fetus tends to be female.

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Introduction:

Recent studies in different countries show that sex ratio – proportion of live male births to live female births which is generally about 102-108 male to 100 female – is declining (1-3). This may result in negative effects on the balance of the

population within country. Although the reasons for the decline are not fully understood, (4-8) several factors such as geographical region, parity, stress, environmental pollution and exposure to chemicals are attributed to sex ratio change (4-8). For instance, reduction of sex ration was observed in population exposed to dioxin, insecticides and pesticides. Moreover, it has been reported that parental smoking plays some role in reduction of sex ratio (1, 9-15). Although sex is genetically determined during conception, there are evidences that show sex ratio may be influenced by endogenous and exogenous factors. Hormone levels of the parents at the time of conception probably play some role in determining the sex of the offspring. Exogenous factors as parental stress and disease, exposure to chemicals and the life style of parents (smoking) may change the sex through influencing parental hormones. Moreover, the impact of on sperm quality may have a role in reducing sex ratio as Well. Studies have shown that smoking affects sperm index (concentration, motility, morphology). Furthermore, smoking may have harmful effects on embryo during implantation (7,8,13,16,17). Roozbahani et al reported that paternal smoking at the time of conception reduced sex ratio and; additionally, further reduction was observed in the cases who smoked more cigarettes (10). Moreover, Fukuda et al reported that parental smoking triggered reduced sex ratio in Japan. In this study, the sex ratio of non-smoking parents compared to parents smoking more than 20 cigarettes was respectively reported 1.214 and 0.823 (9). However, conflicting results have been reported on the effect of smoking on gender. (2,14,18,19). Therefore, considering the limited number of surveys on this topic in Iran, this study was carried out to investigate the relationship between paternal smoking and sex ratio.

Methods:

The present cross-sectional study surveyed public hospitals in Bandar Abbas (Iran) from 21 March 2010 to 20 March 2011. Data was collected by census method. Of the total women who visited the hospital for delivery in the study 730 postpartum mothers were studied out of which 365 cases were smoker parents(daily use for at least on cigarette and smoking it at least three months fertilization), 365 of whom were wives of non-smokers.

Inclusion criteria:

The study included those who expecting the first child, singleton, non-smoking mother and non-use of other tobacco products by either parents, lack of drug abuse and alcohol; monogamic man, lack of parents' systemic diseases, lack of taking ovulation-stimulating drugs, lack of parental exposure to chemicals, high temperature and severe stress three months before conception.

The tool for collecting data was a researcher-made questionnaire which included demographic information, smoking habit of the husband, and the gender of the newborn.

Then the husbands were classified into three groups: 1) non-smoking, 2) smoking less than 20 cigarettes, and 3) smoking more than 20 cigarettes. The sex ratio in different groups was then compared after sex determination of the newborns.

The questionnaire was validated by the professors of Midwifery Department at Bandar Abbas School of Nursing and Midwifery affiliated to Hormozgan University of Medical sciences. The reliability of the questionnaire was obtained through dividing the questions into halves and assessing the correlation between them.

Results:

The mean age of non-smoking and smoking fathers was 26.39 ± 4 and 27.12 ± 4.5 years old respectively. The mean age of fathers smoking less than 20 cigarettes was 26.8 ± 4 while fathers smoking more than 20 cigarettes had mean age of 28.1 ± 5.6 years old.

The comparison of the educational level of mothers with smoking husbands and those with non-smoking husbands revealed that the educational level of mothers with non-smoking husbands was significantly higher than the other one ($P<0.0001$). No significant statistical difference was observed regarding occupation and the place of residence in terms of smoking situation.

Out of 730 newborns, 378 cases were female (51.8%) and 352 male (48.2%). The frequency of the sex of newborns based on smoking cigarettes is shown in Table 1.

Table 1. Frequency distribution of the sex of newborns in smoking and non-smoking father

Smoking \ Sex	Female	Male	Total
Smoking Fathers	213 (58.4%)	152 (41.6%)	365 (100%)
Non-smoking fathers	165 (45.2%)	200 (54.8%)	365 (100%)

Sex ratio in the groups of non-smoking and smoking was respectively 1.20 and 0.76 respectively. The Chi-square test showed that there was a significant relationship between the sex of newborns and paternal smoking ($P<0.00001$). Moreover, the rate of odd ratio was 1.7 (CI: 1.27-2.28).

Table 2 shows the frequency of sex based on different habits of paternal smoking. The sex ratio of fathers smoking less than 20 cigarettes daily was 0.76 while it was 0.56 in those who smoked more than 20 cigarettes daily. Chi-square test showed a significant relationship between sex of newborns and the number of cigarettes per day ($P=0.001$). However, the test did not show any relationship between the period of smoking and the sex of newborns.

Table 2. Frequency distribution of the sex of the newborns based on different habits of paternal smoking

Smoking \ Sex	Female	Male	Total
Non-smoking	165 (54.8%)	200 (45.2%)	365 (100%)
Smoking less than 20 cigarettes daily	161 (56.9%)	122 (43.1%)	283 (100%)
Smoking more than 20 cigarettes daily	52 (63.2%)	30 (36.6%)	82 (100%)

Conclusion:

The results of this study showed that there was a significant relationship between the sex of newborns and paternal smoking. It also showed that sex ratio reduction from the non-smoking group to the group smoking more than 20 cigarettes was likely due to a direct relationship between paternal smoking and female newborn birth.

Almost similar studies in this area have reported similar results, So that the gender ratio decreased due to cigarette smoking by their parents. These results may indicate that paternal smoking has a role in the function of gonads and results in impairment of sperm production (8,9,15,20).

The results of our study, is so much close to the findings of Roozbahani et al. As stated earlier, the sex ratio of smoking group and non-smoking group was 0.76 and 1.20, respectively. Roozbahani et al also reported 0.77 and 1.27 respectively for smoking and non-smoking fathers. They reported sex ratio of 0.60 for those who smoked more than 20 cigarettes and it was 0.56 in our study. The similar results of the two studies may be due to almost the same number of cases, excluding factors affecting sex ratio in both the groups, similar inclusion criteria and also the samples were of the same race.

Heron and Ness did not observe any relationship between sex and smoking. The reason for the difference between this study and our study may be because of the inclusion criteria. We included those fathers with history of smoking from three months before conception while they included smoking before the diagnosis of pregnancy (14).

In the present study, it was found that there was a relationship between daily smoking habit and female newborn. It was in a way that the sex ratio decreased with daily paternal smoking increase. It may suggest that male embryo is more sensitive to destructive effects of smoking.

The results of the study by Fukuda and Voigt confirm the above finding. They also found that the increased number of cigarettes daily increased the ration of female offspring. There is a possibility of damage to sperm – carrier of chromosome Y – natural evolution and morphology in heavy smokers. Moreover, increased female embryo may be due to the enrichment of spermatozoids carrying chromosome X after heavy smoking (8,9,21). Although Parazzini et al did not observe clear relationship between daily smoked cigarettes and

male newborn, they reported decline of sex ratio (22).

In the present study, there was not a relationship between the duration of paternal smoking and the sex of newborn. It verifies the study by Mahanad et al. Based on our study, it seems the daily smoking rate, or in other words, concentration of tobacco in body involves in sex ratio, while duration of being exposed to smoking does not affect sex ratio.

One of the limitations of the current study was that our information about the exposure of fathers to toxins and chemical poisons particularly in rural areas was not enough.

At the end, since a male embryo from the view point of genetic content is weaker than a female embryo, male neonatal mortality is more common and accidents are also more in boys. According to the findings obtained from the present study, it may be possible to prevent the issues raised by sex ratio change through improvement prior to conception cares and awareness of society in this regard. It is also recommended that further studies carried out in this field.

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