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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 17 (7): 905-909, 2014
ISSN 1028-8880 / DOI: 10.3923/pjbs.2014.905.909

A Comparative Study about the Influences of Climatic Factors on Fertility Rate among the Healthy and Infertile Women in the North of Iran

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Abstract: Fertility rate is an important health issue in the world which has been influenced by different factors and attracts the researchers' attention. In this study influences of climate factors on fertility rate were investigated. In this analytical correlational study, relationship between climate factors and fertility rate among the healthy and infertile women who referred to Imam educational hospital in Sari, North of Iran, during 2006-2012 was investigated. Results indicated that climatic factors such as: Temperature ($r = -0.324$, $p = 0.005$), air pressure ($r = 0.2495$, $p = 0.031$) and rainfall ($r = 0.415$, sig<0.001) had relationship with healthy women' fertility rate, although, this relationship was not found in infertile women. Also, fecundity peak of infertile women similar to the fecundity peak of healthy women was during autumn. Considering influences of climate factors on fertility rate could be helpful for developing child birth strategies.

Key words: Climatic factors, fertility rate, infertility, Iran

INTRODUCTION

According to the published reports, the decrease in reproduction in 20th century is a problem all over the world and decline in the population growth rate has been its result (Lee, 2003; Morgan, 2003; Wilson, 2011). This decrease was less apparent in developing countries, but it is demonstrated that most of industrial countries will experience the negative population growth rate till 2040 (Morgan, 2003; Dorius, 2008). Alongside this reduction in population growth rate, increases in infertility rate are more apparent in recent decades. Infertility is a common health problem in the world that has influenced at least 15% of couples (80 million people) in reproductive age (Mosher and Pratt, 1991; Stanford, 2013), although, its incidence is so much more in some parts of the world such as Sub-Saharan Africa and also middle Asian countries (Inhorn and Serour, 2011; Hammarberg and Kirkman, 2012; Bonnett and Woodfield, 2013). Assisted Reproductive Technology (ART) is therapeutic methods that are used for couples who lose their natural fertility ability because of weakness or defect in the main factors of child formation. Generally ART is designed on the basis of imitation from natural reproduction method and the main difference of these two methods consists of removing a part of reproduction system function from physiologic viewpoint in ART method (Ferraretti *et al*., 2012; Hansen *et al*., 2013).

Researchers found that the specialized medical and technological facilities of ART centers and infertile couples' characteristics such as: Age of wife, amount of transferred ovum, estradiol level in the day of Human Chorionic Gonadotropine injection in the mid-cycle, sperm characteristics and duration of infertility period are important factors on ART rate success (Hansen *et al*., 2013; Van den Boogaard *et al*., 2014). Besides, it's documented environmental conditions such as climate factors have some influences on this issue (Inhorn *et al*., 2012; Pereira *et al*., 2012; Potts and Henderson, 2012). Climatic factors are variables that are effective in determining the weather condition and consisted of the main seven factors including: Temperature, humidity, air pressure, rainfall, wind, cloudy condition and horizontal viewing. Their amount are determined and recorded by observation in weather stations at certain times and it's possible to determine the weather condition in this way (Willems *et al*., 2012).

Influence of climate factors on human's fertility rate is an important issue which is less known and is determined through analyzing the seasonal patterns of

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birth rate in each region. This issue became propounded by Huntington in 19th century as the Climatic Determinism General Hypothesis and there is a general consensus on it. Some studies indicated the effects of temperature on fertility rate of normal couples either seasonally and temporarily or permanently (Potts and Henderson, 2012). Also it's reported sun light has some effects on seasonal intercourse frequency, availability of food sources and increases in women's energy level as well as sperm production process (Ellison, 1991; Lam and Miron, 1991; Currie and Schwandt, 2013).

There are limited studies which conducted about influences of climate factors on fertility rate in Iran, a country with various kinds of climates. Vahidi *et al.* (2012) during a study established in an ART center, in a hot and dry climate of Iran, reported spring is the peak season of fertility medical tourism as a result of photo period of this season and the climate comfort during it. The aim of this study is to investigate the influences of a Mediterranean humid and temperate climate on the fertility rate among the healthy and infertile women in this region.

MATERIALS AND METHODS

Setting and data collection: During this analytical correlational study, quantitative data processing was performed by inductive reasoning in seven years period between 2006 and 2012. This research was conducted in Sari in Mazandaran province, North of Iran, which is located in the eastern coast of Caspian Sea.

Study sample: Samples were two groups of women: the first group was infertile women which have referred to ART center of Imam educational hospital in this city for treatment of infertility. In this way, some of those (434 cases) who underwent ART procedures (either in vitro fertilization or intra uterine insemination) and have positive result of pregnancy test were included. The second group was healthy women (19002 cases) that have referred to same hospital for delivery (either normal delivery or cesarean section) in same period. In order to obtain fertility rate in this group, the date of delivery of these women was transferred to nine months before and use it as the monthly fertility rate of healthy women. The data were gathered through medical records archives and file profiles of samples by assistance an information checklist.

On the other hand to investigate climate factors, documents were gathered from governmental weather station in Sari which namely Dasht-e-Naz weather station at the same period. They consisted of monthly average of temperature; humidity; air pressure and rainfall.

Statistical analysis: The analysis of collected data was performed by SPSS version 17. Descriptive statistics were reported as relative and absolute frequency as well as mean and standard deviation. Moreover, relationship between the dependent variables (fertility rate in both groups of women) and independent factor (climate factors) were investigated through Pearson correlation coefficient and linear regression. In this case, $p<0.05$ was considered significant.

Ethical consideration: The ethical considerations of the present study were established by explanations of the purposes of the study to the Imam educational hospital chief and staffs in ART section and assuring them about the confidentiality and anonymity of the information as well as non-publishing the special information of ART center except just statistics related to present research. Permission for data collection was obtained from chief executive officers of the field of study too.

RESULTS

The mean monthly fertility rate of infertile and healthy women in this study was 4.51±3.07 and 227.16±29.20 respectively. Also, the monthly mean of temperature (18.175±7.47°C); humidity (74.65±4.42%); air pressure (1013.51±2.80 mill bar) and rainfall (63.38±4.94mm) were observed during the study period. Results showed there are significant relationship between climatic factors such as temperature ($r = -0.324$, $p = 0.005$), air pressure ($r = 0.249$, $p = 0.031$) and rainfall ($r = 0.415$, $p<0.001$) and fertility rate in healthy women, although in infertile women this relationship was not probed (Table 1).

Results of linear regressions of these relationships are showed in Fig. 1-3. As it's demonestrated in Fig. 1, there is a reverse relationship between temperature and fertility rate of healthy women and a direct relationship between this rate and air pressure as well as rain fall which showed in Fig. 2 and 3. Equation application is forecasting the fertility rate with locating the climate factors specified quantity in it. Whatever Pearson's

Table 1: Relationship between the climatic factors and fertility rate in healthy and infertile women

Climatic factor	Healthy women	Infertile women
Temperature	r = -0.324	r = -0.070
	p = 0.005	p = 0.493
Humidity	r = 0.215	r = 0.008
	p = 0.060	p = 0.944
Air pressure	r = 0.249	r = 0.149
	p = 0.031	p = 0.176
Rainfall	r = 0.415	r = 0.194
	p<0.001	p = 0.077

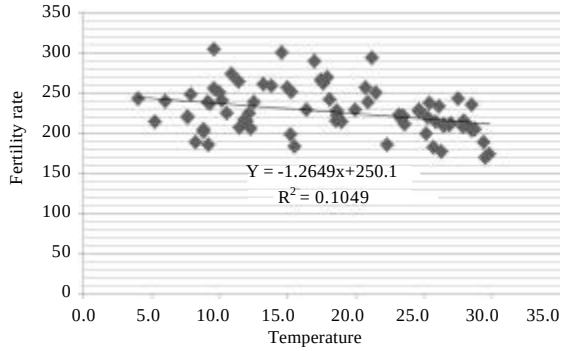

Fig. 1: Linear relationship between the temperature and healthy women's fertility rate with equation

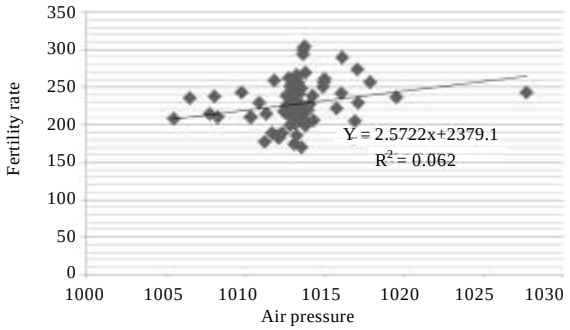

Fig. 2: Linear relationship between the air pressure and healthy women's fertility rate with equation

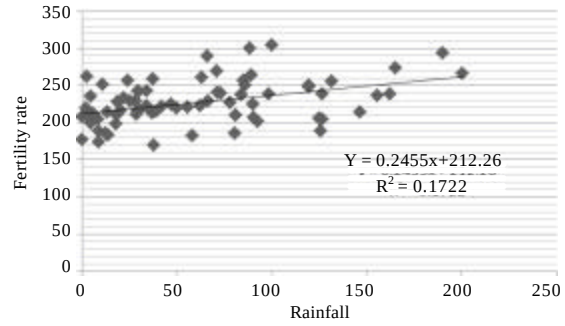

Fig. 3: Linear relationship between the rainfall and healthy women's fertility rate with equation

Solidarity Coefficient is higher, fertility forecasting quantity is closest to regression line and forecasting is more accurate.

Another finding of this study was that the fertility pattern of infertile women was approximately similar to same in the healthy women. it's found that the lowest fertility rate for both groups was during the warm summer months and the highest rate of fertility had shown in the middle of autumn.

DISCUSSION

Climatic factors influence on the fertility rate through different factors including: seasonal, social, economical and physiological. Results of this project about relationship of climatic factors and fertility rate are in accordance to other studies. Lam and Miron (1996) have shown in the European countries and most parts of United States, which like Sari, have a temperate climate; temperature is a significant determinant of birth rate. Although in other regions which have non-temperate climate, this relationship is not probed (Vahidi *et al*., 2012). The reverse relationship between these two variables confirm results of the others that stated the global warming phenomenon due to the greenhouse gases leads to fertility decline in most of the countries all over the world (Basu *et al*., 2010; Potts and Henderson, 2012; Carolan-Olah and Frankowska, 2013). As environmental temperatures have risen by approximately 1-5°C since the middle of the 20th century, now this phenomenon is one of the fastest emerging health concerns for the 21th century (McMichael *et al*., 2006).

Another finding of this project about direct relationship between mean monthly rainfall and fertility rate is in line of the other studies (James, 1990). It seems this relationship may be result of increase of holiday days due to rainfall which consequently increases the leisure time and more intercourse possibility (Ellison, 1991), although, Lam and Miron (1991) in their study can't show any significant relationship between rainfall and fertility rate (Lam and Miron, 1991).

The main finding of this project which was less published before is a positive relationship between air pressure and fertility rate, although the value of Pearson's correlation coefficient of rainfall was more than temperature and air pressure.

Peak of fertility rate in two groups of women in this project during autumn must be in attention. Mazandaran province has Mediterranean temperate climate and in second half of the year two processes of Arctic air advection over the Caspian Sea and pluvial systems which enter this area from the west of country cause relative coldness of the weather and rainfall increase. In other word the average temperature of second half of the year is approximately half of it in the first half of year and rainfalls become three times more than the average of rains during the first half of the year.

These climatic changes in border of two halves of year, together with generating the condition of climatic tranquility for residents lead to growth and fertility of agricultural productions and gardens in this area. Also farmers harvest some of their products such as rice and citrous and patch products are also harvesting. Abundance of agricultural products in these months provides economic condition and energy accessibility for residents in this province. This condition in addition an increasing of rainfalls and people leisure times may be resulted in increasing in fertility rate in normal couples and who underwent ART. At the other hand in the middle of autumn with increase of rainfall and relative decrease of temperature, the effect of social factors on couples, economical factors on women and physiological factors on men, create suitable condition to increase fertility rate that prevail over the seasonal factor in spring and provide the condition of fertility peak in autumn.

The present findings must be interpreted in light of its main limitation in relation to possible incomplete data which gathered based on medical records archives and file profiles in field of study. So, authors emphasized that this study would be considered as a pilot project that will be taken into account for further researches in this area. If more studies in the future will perform in other centers and with more exact statistical basis and more samples in the case of infertile women, perhaps other results would have emerged.

CONCLUSION

In conclusion results of this research indicated that rainfall is the most important climate factor that influences on healthy women fertility rate in North of Iran, although temperature and air pressure have some effects too. In other side, it's documented that the fertility rate of infertile couples has direct relation with numbers of ART cycles. In this way, rainfall increase which subsequently associated with increase in leisure time and infertile couples' referral to ART centers may be resulted in ART successes rate. Finally, considering influences of climate factors on fertility rate could be helpful for developing child birth strategies in this region.

ACKNOWLEDGMENTS

The authors offer our heartfelt thanks to the all staffs that help in data gathering in this project due to their unstinting helps.

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