A study of fertility trend in the urban and rural areas of Sabzevar during 2002 to 2014: Joinpoint Regression Analysis

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Abstract

Background: Fertility in Iran has declined dramatically over the last three decades. The rapid decline in fertility in Iran has taken place in all geographical areas and in all social and demographic subgroups. This study aims to evaluate the fertility trend in Sabzevar’s towns and villages during a 13 year period.

Methods: The present study is a descriptive-analytic one. The information about fertility was obtained from Sabzevar Health Department according to the age groups and the proportion of married women on an annual basis for urban and rural areas separately. The indexes of fertility rate and age-specific fertility were calculated by using Excel software. The data were analyzed using joinpoint regression 3.4 software at a significance level of P < 0.05.

Results: The results of the study showed that in all of the years of the study the total fertility rate in urban areas was higher than in rural areas. The total fertility rate in rural areas has risen from 1.97 in 2002 by 1.5% annual growth to 2.28 in 2014. In urban areas, the fertility rate has reached 2.31 in 2002, with a mean annual increase of 1.7%, to 2.63 in the year 2014. The highest percentage of annual increase in urban and rural areas has occurred in the age group of 15 to 19 years. Furthermore, family planning policies in Iran have had a significant impact on increasing fertility in the age group of 20 to 24 years.

Conclusions: Although the overall fertility rate in Sabzevar is almost at the replacement rate, due to the demographic policies of the country – which is aimed at increasing the fertility rate –, it is recommended that, along with the implementation and the continuous monitoring of these comprehensive health policies in this city, health care policymakers perform some programs to reduce pregnancy in high-risk age groups.

Keywords: Total fertility; Joinpoint regression; Age-specific fertility

1. Introduction

One of the most important issues that most countries in the world are facing is the continuous decline in fertility, as fertility plays a decisive role in population growth or in the reduction of population growth rate (1). Worldwide, the total fertility rate or the expected number of the children born per woman in the child bearing years has reached from an average of 5 children in 1960 to 2.5 children in the year 2012. Therefore, reducing fertility is a global phenomenon. Different countries have had different degrees of fertility reduction. In Africa, fertility reduction is lower than that in other areas, so that the total fertility rate (TFR) in 2012 was 5 children per woman in the child bearing years, which is the highest fertility rate in the world (2).

On the other hand, over the past three decades, Iran, astonishingly, has had one of the fastest declines in fertility in the world. The total fertility rate, has reached by a 70% decrease from 6.8 children in 1360 to 1.8 children in the year 90, which is lower than replacement rate. It should also be noted that currently Iran has the lowest fertility rate in the Eastern Mediterranean (3).
Fertility trends in the last three decades indicate that the fertility level has been different in different provinces of the country. Provinces located at border regions have had a higher fertility level than other provinces. However, along with other provinces, these provinces have experienced fertility decline. For example, in Sistan and Baluchestan province, the total fertility rate has decreased from 9.3 children in the 1360's to 3.5 children in 2011 (4).

Fertility together with population growth could have a significant impact on society, including the impact on socio-economic development, natural resources, household welfare, and even the political conditions of the country (5). One of the consequences of population decline is the change in the age structure, that is, the increase in the population of the elderly in the country (6). At present, the ratio of the elderly in the country is 8.2% of the population. It is expected to reach 30 million people in 30 years (7). Of the main challenges of this increase are problems related to the system of retirement pensions and to the increasing social burden of the elderly, which means that the government must pay more for the health care and pensions of this group. Therefore, it is necessary for the government to prepare for this sudden increase in the population of the elderly.

Moral and educational damages are also among other negative consequences of population reduction and control, which should be given more attention. Most demographic discussions have not paid attention to the moral and educational damages that affect small families, especially single-parent families, as well as to the benefits of large families. They have dealt mostly with the issue of poverty and population density of the family. John Ryan, the American Catholic theologian, argues that the provision of large families requires a variety of disciplines, the result of which are successful lives – a kind of life that happens only through affording the expense of the continuation of life, namely, sacrifice, self-revival to withdraw the resources, in anticipation of the future. In his view, experts who believe in birth control have not thought of the kind of personality that needs to be built up in order for society to grow balanced and continue to survive (8).

Several studies have been conducted in the country regarding the process of fertility development and its related factors. These studies have dealt with identifying economic factors (female employment status, monthly cost of household, effect of the subsidy), socio-cultural factors (husband and wife education, inclination to have children, type of family, type of marriage, place of birth), and demographic factors (age of marriage, the use of contraception, and duration of marriage). Among these factors, maternal age and marital years have had the most increasing effect and mother’s education the most decreasing effect on fertility (9-12).

Considering the dramatic decline in fertility in recent decades, researchers have paid more attention to this issue, since they are concerned that fertility may reach below the replacement level and that this decline may continue in the years ahead (13). Since no study has been performed in this regard in Sabzevar, it was deemed necessary that the changes and annual fluctuations of fertility should be investigated in the time period 2002-2014 in this city. With respect to the fact that rural areas have different economic and social conditions, and considering that 34% of the country’s population is located in rural areas (14), the present study, therefore aimed to examine and compare the pattern and rate of fertility in cities and villages separately so that the direction of future studies in this regard could be clarified, and that health care providers could put appropriate demographic policies on the agenda.

2. Methods

Sabzevar is one of the major cities of Khorasan-e Razavi province, which is located west of Khorasan, in northeastern Iran. The population of the city of Sabzevar in 2011 was 231,557, which is, after Mashhad and Neyshabur, the third most populous city of Khorasan Razavi Province (as well as in the Great Khorasan). The present study was carried out to investigate the annual variation in the fertility rate and pattern in urban and rural population of Sabzevar. The study is a descriptive-analytical one, and the population of the study includes the total population of married women aged 15 to 49 years who are covered by health and treatment centers of Sabzevar University of Medical Sciences. The demographic data of villages were collected at the beginning of each year – via the direct departure of caregivers to villagers’ houses with special forms – and their total sum were summarized in life table. Then, at the level of health and care centers, after reviewing and implementing the necessary reforms, the life table of all health houses of a certain health center was provided. This summary was done once more at the city level. For this purpose, the demographic data required to calculate the age
specific fertility and total fertility, such as the population of
marrried women aged 15-49 by age groups and live births in
each age group of the mothers, were obtained from the data
recorded in the life table of the years 2002 to 2014, with the
separation of cities and villages from the Health
Department of Sabzevar University of Medical Sciences. In
the data of 2010 and 2011 – due to the fact that some rural
areas were added to urban areas – the fertility of these points
was considered as rural fertility just like in the past years –
the data were incomplete and inefficient. Therefore, these
years were left out from the analysis. In this study, age-
specific fertility rate and total fertility rate were calculated
using EXCEL software. The age-specific fertility rate
(ASFR) represents live births per 1000 women in five-year
age groups in one year. Total fertility rate (TFR) calculates
the average number of children a woman can give birth to
during the period of her child bearing years if the fertility
pattern persists. To calculate the total fertility rate, the sum
of specific fertility of 5 year age groups is multiplied by 5
which is the interval of the age groups, and the result is
divided into one thousand.

Joinpoint regression is known as piecewise regression,
continuous two-or-more-state regression, minimum two-
stage square, and broken line regression. For the analysis of
multi-year trend, the joinpoint regression model is preferred
because it can identify the points in which the course of
data changes significantly (15). Joinpoint regression model for the observations

\[
(x_1, y_1, \ldots, x_N, y_N)
\]

in which \(x_1 < \cdots < x_N\) is the time and \(y_i\) is response variables (for example, the
standardized annual amount) are as follows:

\[
E(y_i|x_i) = \beta_0 + \beta_1 x_i + \gamma_1 (x_i - \tau_1)^+ + \ldots + \gamma_n (x_i - \tau_n)^+
\]

Where \(\beta_0, \beta_1, \ldots, \gamma_n\) are regression variables and
\(\tau_k\) where \(k = 1, 2, \ldots, n, n < N\), the \(k\) is the known
piece (points of refraction) (16).

\[
(x_i - \tau_k)^+ = (x_i - \tau_k) \text{ if } (x_i - \tau_k) > 0
\]

=0, otherwise

Where it is assumed that \(y_i\) \((i = 1, \ldots, n)\) are
independent and have a constant variance \(\sigma^2\), the method
of minimum weighted squares is used to calculate and
deduce the linear-piece regression model (17).

For the data analysis, JOINPOINT REGRESSION
software designed specifically for joinpoint regression
analysis was used. National Cancer Institute publications
also analyze the trends (incidence and mortality) of the
cancer by using this software. This software matches the
most simplified model of the joinpoint regression to the
data, but the user can change the minimum and maximum
number of joinpoints at will and test whether more number
of joinpoints are significant in the model, or should be
added to it or not. In this software, the meaningful test is
performed by using the Monte Carlo permutation method.
The software also has the ability to perform a joinpoint
regression for the dependent variable in the format of
Poisson, linear, and logarithmic.

Annual Percent Age (APC) and Average Annual
Percent Age (AAPC) for the fertility trend were calculated
in urban and rural areas, which were annual percent change
and average annual percentage change, respectively. In fact,
the APC shows how much the fertility has increased or
decreased per year, and AAPC is the average change. If
there are no change points in the trend, APCs and AAPCs
will be the same.

3. Results

To determine the changes in the fertility rate in urban
and rural areas by age group, joinpoint regression was used.
The results showed that the age-specific fertility rate in
rural areas in the years 2012 to 2014 in the age groups of 15
to 19 years, 20 to 24 years, 25 to 29 years, 30 to 34 years,
35 to 39 years has increased in each year by 4.5 Percentage,
3.1%, 0.5%, 0.6% and 2% respectively. In the age group of
40 to 44 years, before the year 2009, the fertility trend has
increased by 2.1 % per year and after the year 2009 it has
dropped by 3.9 percent. In the age group of 45 to 49 years,
fertility has declined by 6.9% per year. In the age-specific
fertility trend of each of the age groups of 15 to 19 years, 20
to 24 years and 40 to 44 years, there was a trend change
point in the years 2005, 2012 and 2009, respectively. In the
age group of 15 to 19 years before 2005, the trend
declined by 3.7% per year and after 2005 it has decreased
by 8.6 % per year. For the age group of 20 to 24 years,
before the year 2012, the fertility trend rose by 1.6 percent
per year, and from 2012 to 2014, it has increased by 11
percent per year. In the age group of 40 to 44 years, before
the year 2009, fertility increased by 2.1% per year, and then
dropped by 3.9% each year (Figure 1, Table 1).

The age-specific fertility rate in urban areas during the
years 2002 to 2014 in the age groups of 15 to 19, 20 to 24,
25 to 29, 30 to 34, 35 to 39, 40 to 44, and 45 to 49 years has
increased in each year by 4%, 2%, 2.5%, 0.5%, 2.1% and

Table 1: The summary of the results of joinpoint regression analysis for assessing the trend of age-specific fertility rates and overall fertility in the urban and rural areas of Sabzevar

<table>
<thead>
<tr>
<th>Age group</th>
<th>Urban Fertility Rate</th>
<th>Rural Fertility Rate</th>
<th>Trend</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trend</td>
<td>Fertility Rate</td>
<td>Trend</td>
<td>Fertility Rate</td>
</tr>
<tr>
<td></td>
<td>Period Time</td>
<td>AAPC 2014</td>
<td>95% CI</td>
<td>APC 2014</td>
</tr>
<tr>
<td>15-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.8,7.2 4’ 2002-2014</td>
<td>4’ 37.4 4</td>
<td>-14.7,8.7 6.2,11</td>
<td>-3.7 8.6</td>
</tr>
<tr>
<td>20-24</td>
<td>-0.4,3.4 1.5 2002-2014</td>
<td>1.5 126.23</td>
<td>0.3,2.9 -1.5,25.1</td>
<td>1.6’ 11’</td>
</tr>
<tr>
<td>25-29</td>
<td>-19.9,4.1 8.7 2002-2004</td>
<td>3.2,5.4 2004-2014</td>
<td>2’ 148.87</td>
<td>-0.6,1.6 0.5</td>
</tr>
<tr>
<td>20-34</td>
<td>0.7,4.4 2.5’ 2002-2014</td>
<td>2.5’ 115.92 4</td>
<td>-0.2,1.4 0.6</td>
<td>2002-2014 0.6</td>
</tr>
<tr>
<td>35-39</td>
<td>-38.2,18.3 14.5 2002-2004</td>
<td>11.6,5 3.8’ 2004-2014</td>
<td>0.5 71.7 7</td>
<td>1.2,9 2’</td>
</tr>
<tr>
<td>40-44</td>
<td>-0.7,5 2.1 2002-2014</td>
<td>2.1 25.2 3</td>
<td>-0.6,4.9 -13.2,6.3</td>
<td>2.1 2002-2014 2’</td>
</tr>
<tr>
<td>45-49</td>
<td>-44.5,115.4 9.4 2002-2014</td>
<td>4.2 32</td>
<td>-11.4,2.1 2.1</td>
<td>2002-2014 -6.9’</td>
</tr>
<tr>
<td>TFR</td>
<td>-18.5,9.4 3.2’ 2002-2004</td>
<td>2.4 1.7 2004-2014</td>
<td>1.7 2.63 2.31</td>
<td>1.5’ 2002-2014 1.5’</td>
</tr>
</tbody>
</table>

*: P<0.05

9.4%, respectively. In urban areas, in the age groups of 25 to 29 years and 35 to 39 years, there has been a trend change point in 2004, and fertility decreased before this year and then increased significantly (Fig. 2, Table 1).

The highest and lowest fertility rates in all years of the study in rural and urban areas were observed in the age groups of 25 to 29 years and 45 to 49 years, respectively. The total fertility rate in rural areas has risen from 1.97 in 2002, by 1.5% annual increase, to 2.63 in 2014. In urban areas, the fertility rate reached from 2.31 in 2002, with a mean increase of 1.7% in each year, to 2.63 in the year 2014. There was a change point in the fertility trend in urban areas in 2004, so that before this year fertility decreased by 5.6% per year and after this year, it has increased by 3.2% each year.

The ratio of married women in rural areas reached from 0.49 in 2005 to 0.61 in 2014, and in urban areas from 0.54 in 2005 to 0.65 in 2014, and in all study years, this ratio were higher in urban areas than in rural areas (Fig. 4).
Figure 2: The trend of age-specific fertility rate in urban areas

Figure 3: Comparison of the trend of the overall fertility rate in the urban and rural areas of Sabzevar

Figure 4: Comparison of the trend of the ratio of married women in the urban and rural areas of Sabzevar
Population size is affected by three factors: fertility, mortality and migration, among which fertility is of more importance. The results of this study showed that the overall fertility rate in all years of the study in urban areas was higher than rural areas. This finding is not consistent with those of the study by Ziaei Bigdeli et al. (18) and Mahmudiani et al. (14) who showed that fertility level in rural areas was higher than urban areas. The reason for the difference of our results with those of previous studies is probably due to the high percentage of the ratio of married women in urban areas. In rural areas, a higher percentage of women of childbearing age are single and even a percentage of them never marry. Furthermore, in the recent years, the system of health and rural networks has been developed. On the other hand, in relation to the changes in family and fertility, two basic factors can be distinguished: structural changes and factors related to ideas. Along with structural changes that have had an impact on reducing fertility, such as decreasing the mortality of children and infants, increasing the use of family planning tools, education, etc. the ideals of individuals have also changed, so that the ideals of individuals are close to their behavior in terms of fertility (19). Economic disadvantages such as inflation and increased living costs affect women's fertility ideals, and thus influence the fertility behaviors of individuals. The studies conducted in this regard show that economic events and economic insecurity affect the couples' demand for childbirth (2, 20). This issue has been theoretically explained by the theory of propagation, according to which, the tendency towards low fertility begins first from urban areas and gradually shifts to rural areas. On the other hand, on average, more than 273,000 villagers annually migrate out of their villages (mostly to cities) (21), and this partly account for the decline in young force in villages – for the aging population in villages and for the decline in fertility in these areas.

According to Caldwell Theory, the fertility system is divided into two sections: fertility before transfer and fertility after it. In his opinion, in fertility before transfer, children are considered to be among pure resources of the parents, while in the stage after the transfer, children are among the net costs to the parents. In economies that impose a severe inflation on poor and middle-income people, the inability to feed children, the cost of providing clothing and other facilities are a heavy burden to the parents, and inflationary pressures are a barrier to fertility (22).

According to the results of this study, fertility in urban areas, during 2002 to 2014, has been decreasing by a rate of 0.9% per year. The study of Shapiro (2013) in sub-Saharan Africa revealed that one-third of sub-Saharan African countries have prevented fertility decline. However, the increase in women's education, the reduction of infant and child mortality, and the economic growth are related with delayed fertility and reduced fertility (23). Mirskila et al., 2013) predicted the fertility trend in 37 developed countries. The results showed that in 1970, only 10 countries experienced a fertility below the 1.5. They predicted that in 2008, 19 countries experienced a fertility below 1.3 (24).

The results of this study showed that in the cities of Sabzevar the age group of 25 to 29 years had the highest age-specific fertility rate in all years, and the age groups of 24 to 24 years and 30 to 34 years, in competition with each other, had the next grades. However, in Sabzevar villages, the age specific fertility rate was highest in the age group of 20 to 24 years and the age group of 30 to 34 had the next grade. In the age group of 40 to 44 years, fertility decreased significantly in 2011. In general, in Sabzevar, between 2002 and 2015, the overall fertility rate and age-specific fertility are increasing. The results of this study showed that the specific fertility of the age group of 20 to 24 years in rural areas has increased by 11 percent since 2012. The authors believe that this was due to changes in family planning policies towards increasing the population, which only affected the age group of 20 to 24 years in rural areas. The highest percentage of annual increase in urban and rural areas has occurred in the age group of 15 to 19 years, which is a high-risk group for pregnancy. No similar study was found to compare the results. This finding shows that high risk pregnancies are rising in Sabzevar women. A high-risk pregnancy not only affects the woman but also causes changes in family function (25).

In the study of Kaboudi et al. in Kermanshah, there was an inverse relationship between the age of marriage and the number of children born to the age of 40 years. According to the findings of this study, it is expected that in the future the decline in fertility rate will be decreased (26).

One of the most successful programs after the Islamic Revolution has been the family planning program. The program, aimed to promote the health of the mother and the child, allowed for the planning and reduction of

4. Discussion

Population size is affected by three factors: fertility, mortality and migration, among which fertility is of more importance. The results of this study showed that the overall fertility rate in all years of the study in urban areas was higher than rural areas. This finding is not consistent with those of the study by Ziaei Bigdeli et al. (18) and Mahmudiani et al. (14) who showed that fertility level in rural areas was higher than urban areas. The reason for the difference of our results with those of previous studies is probably due to the high percentage of the ratio of married women in urban areas. In rural areas, a higher percentage of women of childbearing age are single and even a percentage of them never marry. Furthermore, in the recent years, the system of health and rural networks has been developed. On the other hand, in relation to the changes in family and fertility, two basic factors can be distinguished: structural changes and factors related to ideas. Along with structural changes that have had an impact on reducing fertility, such as decreasing the mortality of children and infants, increasing the use of family planning tools, education, etc. the ideals of individuals have also changed, so that the ideals of individuals are close to their behavior in terms of fertility (19). Economic disadvantages such as inflation and increased living costs affect women's fertility ideals, and thus influence the fertility behaviors of individuals. The studies conducted in this regard show that economic events and economic insecurity affect the couples' demand for childbirth (2, 20). This issue has been theoretically explained by the theory of propagation, according to which, the tendency towards low fertility begins first from urban areas and gradually shifts to rural areas. On the other hand, on average, more than 273,000 villagers annually migrate out of their villages (mostly to cities) (21), and this partly account for the decline in young force in villages – for the aging population in villages and for the decline in fertility in these areas.

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One of the most successful programs after the Islamic Revolution has been the family planning program. The program, aimed to promote the health of the mother and the child, allowed for the planning and reduction of
childbearing in the last two decades. Regarding the population changes in Iran and the experiencing of a fertility under the replacement level, the overall population policies were revised with the aim of achieving the overall fertility rate at the replacement level. On the other hand, the purpose of the family planning program has been to empower families and society to make informed and free decisions about the choice of the number of children, the interval between pregnancies, the choice of the time of pregnancy, the prevention of unwanted pregnancies and minimizing high-risk pregnancies with the aim to promote the health of mothers and children, the family and, ultimately, society. According to the results of this study, in the urban and rural areas of Sabzevar, fertility is higher than replacement level, but in urban and rural areas of Sabzevar, the highest increase in fertility rates has taken place in the high risk age groups. Thus, policymakers should pay serious attention to this issue.

5. Conclusion

With regard to the component 14 of demographic policies – on the continuous observation of demographic policies in quantitative and qualitative dimensions by creating the appropriate mechanism and formulating indigenous indices of human development – it is required that in each region demographic policies tailored to demographic conditions, overall fertility rate, economic, social and cultural status of the region are arranged. Through demographic research and human development, the necessary planning to realize the goals of demographic policies could be established. To intervene in fertility trends and to adjust it, a safe economy for families should be provided. Improving youth employment and family income and reducing inflation, in addition to reducing the age of marriage, and creating relaxation, will strengthen the foundation of the family and increase the level of fertility.

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References


