Original Article

Identification of Main Patterns in The Incidence of Gynecological Cancers among the Provinces in Iran

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ARTICLE INFO

ABSTRACT

Introduction: Study of cancer incidence trends can provide better insight for decision-making and considering necessary interventions. The current study was focused on investigating the main patterns in the incidence of gynecological cancers among the provinces of Iran during the last decades.

Methods: We carried out an applied longitudinal study through the growth mixture model (GMM), with a concentration on the trajectory of incidence rates. Information about the rate of gynecological cancer incidence (per 100,000) in 31 provinces of Iran during the 1990-2016 period was extracted from the Data Visualization System. Taking into account the p-value of the likelihood ratio test (LRT), the number of main patterns was estimated by Mplus 7.4 software.

Results: Tehran province with the incidence of 2.00 per 100,000 was in the first rank in 1990, while in 2016 the highest rate was observed in Yazd province with 9.38 cases. Five main patterns were determined based on LRT. Tehran and Yazd provinces showed the sharpest rise, while Khuzestan, Fars, Esfahan, Semnan, East Azerbaijan, Razavi Khorasan, and Mazandaran provinces belonged to the pattern with a moderate-to-high-rising trend. 10 provinces including Kerman, Kurdistan, Gilan, Lorestan, Alborz, Hamedan, Kermanshah, Markazi, Ardabil, and West Azerbaijan were on the other hand categorized in the moderate-rising trend. Sistan and Baluchestan and Hormozgan provinces had a slow-rising pattern, and finally, the remaining 10 provinces had the pattern with a slow-to-moderate upward trajectory.

Conclusion: Due to the considerable rising trend in most provinces in Iran, taking urgent and effective preventive actions seems necessary.

Introduction

Gynecological cancers account for 7.6% of total cancer cases worldwide, while breast, cervix, uterine, and ovarian cancers account for 40% of total cancer cases among women. Among the total female cancer mortality, breast, cervix, and ovarian cancers are responsible for more than a quarter (26.1%) of the total deaths.[1] Cervix, uterus, and ovary are organs that are affected by

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cancer all over the world, while in developing countries, after breast cancer, cervical cancer is the most prevalent cancer in women.[2]

Close to the global average, in Iran, gynecologic cancers account for 7.8% of total cancer cases,[1] among which ovarian (55.5%), uterine (24.9%), and cervical cancers (19.6%) are respectively the most prevalent ones.[3] However, cervical cancer, after heart disease and accidents, is the most common cause of death.[4] Reports show that although there is an increasing trend in most gynecologic cancers in Iran, the incidence rate of these cancers is lower than the world average.[5, 6] As noted, the most prevalent gynecologic cancer in Iran is ovarian, however, the ASR of ovarian cancer is lower in Iran, compared to other countries.[6] In the years 2004 and 2008, the ASR of ovarian cancer was respectively 3.07 and 3.1, while it was 2.29 and 1.7 for endometrial cancer, and 1.71 and 2.2 for cervical cancer, respectively.[7]

Cancer registration statistics in Iran indicate that the incidence of cervical cancer has increased from 394 cases per 100,000 in 2003, to 901 cases in 2009, more than a two-fold increase in diagnosed cases. Among them, the highest reported incidence was 7.14 per 100,000 in Yazd province in 2009 and the lowest incidence was reported in Chaharmahal and Bakhtiari, Sistan and Baluchestan, and Kohgiluyeh and Boyer-Ahmad provinces in 2003. In the next years, the lowest rate belonged to Sistan and Baluchestan, and Ilam provinces in 2004, South Khorasan province in 2005, Ilam province in 2007, and Kohgiluyeh and Boyer-Ahmad province in 2009. These statistics showed that the highest incidence rate for uterine cancer was in central provinces and there was a growing trend in this region in the studies period. In contrast, the lowest incidence rate was observed in southern provinces.[5]

ASR of cervical, uterine, and ovarian cancers in Iran during 2005-2006 was 1.9, 2.5, and 3.04 per 100,000, respectively. In Fars province, ASR of gynecologic cancers raised from 3.7 to 12.4 per 100,000 within the 2003 to 2009 period.[2]

Study of cancer incidence trends can clarify the epidemiologic and clinical points to be focused on and studied further and can provide better insight for decision-making and considering necessary interventions. Identifying regions with high and low incidence risk helps to better manage gynecologic cancers. In addition, determining and identifying trend changes of incidence in inexplicable components of the disease risk can allow us to better understand the spatial structure of unmeasured confounding factors. Therefore, the current study was focused on investigating the main patterns in the incidence of gynecological cancers among the provinces of Iran during the last decades.

Methods

We carried out an applied longitudinal study through the growth mixture model (GMM), with a concentration on the trajectory of incidence rates. Information about the rate of gynecological cancer incidence (per 100,000 women) in 31 provinces of Iran during the 1990-2016 period was extracted from the Data Visualization System (https://vizit.report). It is a valid web-based platform that visualizes the published data about non-communicable diseases in Iran. Noteworthy, the moment that we performed this research, the data were available up to 2016.[8]

To investigate the main patterns in the incidence of gynecological cancers, the GMM

was employed, which incorporates both intra-subject and inter-subject variabilities and categorizes observed trends into a few latent patterns.[8,9] In GMM, each of the main k patterns can be estimated as follow:

$$y_{it}^k = \alpha_{i0}^k + \alpha_{i1}^k \lambda_t^k + \varepsilon_{it}^k$$
$$\alpha_{i0}^k = \alpha_{00}^k + \sum_j \beta_{01j}^k x_j + \varepsilon_{i0}^k$$
$$\alpha_{i1}^k = \alpha_{10}^k + \sum_i \beta_{11j}^k x_j + \varepsilon_{i1}^k$$

Where the overall mean of the initial outcome in kth pattern is denoted by α_{00}^k and α_{10}^k is the mean rate of trend changes in outcome variable for kth pattern. Moreover, to estimate the biennial amount of velocity in the main patterns, linear trends were displayed. Taking into account the p-value of the likelihood ratio test (LRT), the number of main patterns was estimated by Mplus 7.4 software and due to the small sample size, p<0.10 was considered as statistically significant.

Results

The trajectory of gynecological cancer incidence in all 31 provinces of Iran was monitored from 1990 to 2016. As it was shown in Figure 1, Tehran province with the incidence of 2.00 per 100,000 was in the first rank in 1990, while in 2016 the highest rate was observed in Yazd province with 9.38 cases. In contrast, Sistan and Baluchestan province had the lowest rate of gynecological cancer incidence both in 1990 and 2016 years (Figure 1).

To estimate an optimum number of the main patterns, results of LRT and other fit indices were summarized (Table 1) and five main
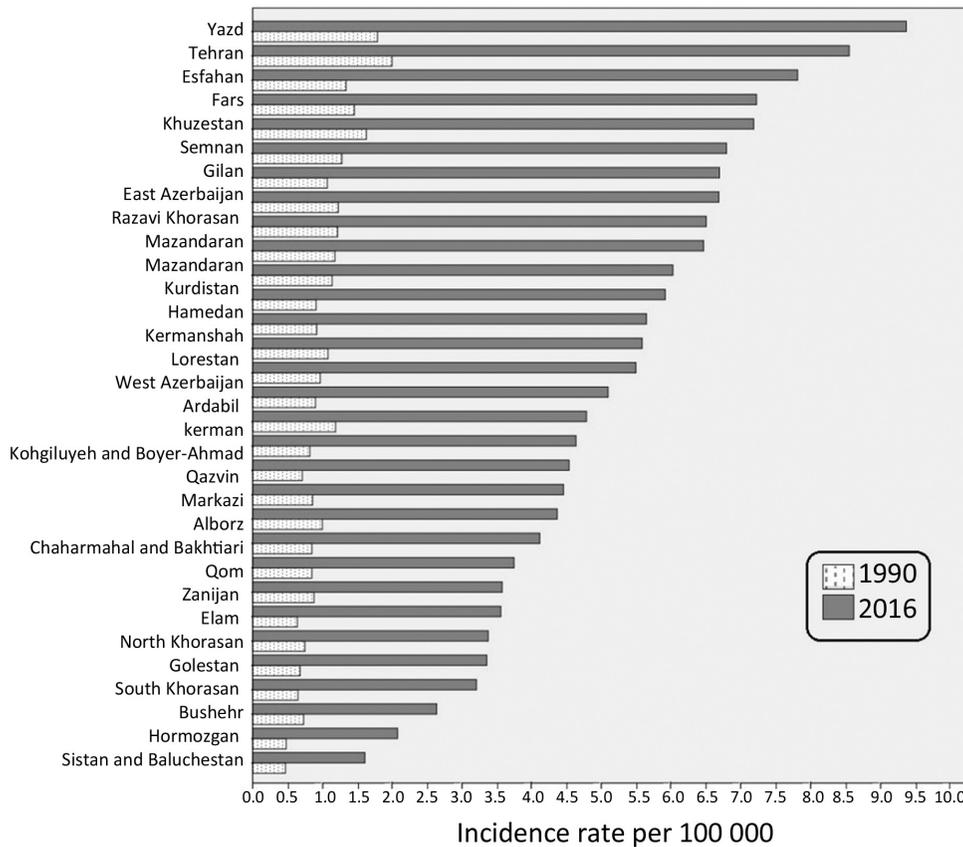
Figure 1. The gynecologic cancers incidence in each province

Table 1. Summary of fit indices in different number of patterns

Fit indices	Number of pattern					
	1	2	3	4	5	6
AIC	1221	838	584	427	201	97
BIC	1244	865	616	463	242	142
SSBIC	1194	806	547	385	154	45
LRT P-value	-	0.36	0.36	0.46	0.08	0.30

Table 2. Intercept and slope of the estimated linear trend for each pattern

Pattern	Number of provinces	Intercept		Biennial velocity	
		Estimate	SE	Estimate	SE
1	7	1.18	0.06	0.47	0.01
2	10	0.69	0.03	0.26	0.01
3	10	0.86	0.06	0.38	0.02
4	2	0.46	0.01	0.11	0.01
5	2	1.78	0.06	0.55	0.02
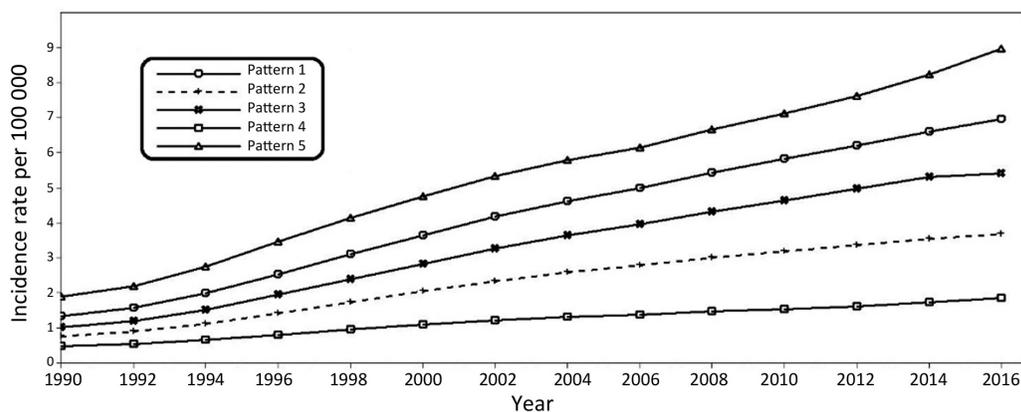
Figure 2. Trend changes of gynecologic cancers incidence in each pattern

patterns were determined according to the reported p-values. More information including the number of provinces and the biennial amount of velocity in each pattern is also presented in Table 2. In this analysis, Tehran and Yazd provinces showed the sharpest rise, while Khuzestan, Fars, Esfahan, Semnan, East Azerbaijan, Razavi Khorasan, and Mazandaran provinces belonged to the pattern with a moderate-to-high-rising trend. 10 provinces including Kerman, Kurdistan, Gilan, Lorestan, Alborz, Hamedan, Kermanshah, Markazi, Ardabil, and West Azerbaijan were on the other hand categorized in the moderate-rising trend. Sistan and Baluchestan and Hormozgan provinces had a slow-rising pattern, and finally, the remaining 10 provinces had the pattern with a slow-to-moderate upward trajectory (Table 2). The trajectory of gynecologic cancers incidence were displayed in Figure 2. In this figure, the intercept of each line shows mean incidence of reported gynecologic cancers among the corresponding provinces in 1990 year. As it was shown, the pattern five (Tehran

and Yazd provinces) had both the highest level of intercept (1.78) and the sharpest upward trend in the study period.

Discussion

Our study aimed to model the trend changes of gynecologic cancer incidence in Iran and identify the main longitudinal patterns during the last decades. Our findings revealed that the incidence of gynecologic cancers in Iran experienced a raising trend from 1990 to 2016. We expect that the incidence of various cancers will keep ascending in the coming years as the age and life expectancy indices in Iran show an increasing pattern.[4] In line with this, Raei et al. (2019) showed that from 2004 to 2009, the incidence rate of breast and cervical cancers had an increasing trend in all parts of Iran. They suggested that the observed rising trend may be due to the growing environmental pollution as well as changes in lifestyles, while extensive access to cancer diagnosis facilities could boost the number of reported cases.[4] Moreover, Almasi et al. (2012) reported a rising trend in the incidence of female genital cancers in Fars province during the 2003-2009 period, which may be due to the population aging, fundamental changes in lifestyle, national pap smear screening of the people at risk, changes in data collection method, possible changes in detection methods, and higher awareness of physicians to report diagnosed cases.[2]

In the present study, GMM proposed five main patterns for the incidence of gynecologic cancers in Iran, which indicated that Tehran and Yazd provinces were in the worst situation. Our findings were then approved by a systematic review study on female gynecologic cancers in Iran. This study revealed that the highest rate of uterine and ovarian cancers between 1996-1999, was reported in Tehran province.[10] This observation can be explained by risk factors such as being sedentary, having an improper diet, and migration that may further induce the incidence of ovarian cancer in Tehran province. Furthermore, air pollution in Tehran, the capital city of Iran, is closely related to ovarian and some other cancers in women, including breast and uterine.[10]

Compared to smaller and less developed provinces, the rate of gynecologic cancers was higher in industrialized and populated provinces like Tehran, Esfahan, Razavi Khorasan, and Fars. Based on these findings, the highest incidence rate of uterine cancer was in Fars province between 1996-2000 and in 2008 and 2009. The low rate of physical activity in larger cities can be another reason for this trend.[10] Studies show that more than half of the patients with ovarian cancer live in cities, among which industrial cities have the highest share. Ovarian tissue is affected by various environmental, occupational, and iatrogenic factors.[1] Besides, the western lifestyle, which influences diet, and leads to obesity and lower parity, may also play a role in the observed rising trend in ovarian cancer incidences.[4]

On the other hand, our employed model proposed five different patterns which reflected a relatively large variation in cancer incidence between studied regions. This variation can be due to the involvement of multiple factors including access to diagnosis facilities, prevalence of HIV infection, average marriage age, decreased physical activation, diet, and BMI.[3, 6] Also, the similarity of many features in Sistan and Baluchestan, Yazd, Mazandaran, and Tehran provinces can differentiate these provinces from their adjacent areas.[4]

Conclusion

In the current study, the main patterns in trend changes of gynecologic cancer incidence were identified using one of the most powerful statistical models. These recognized trajectories and the reported rising trend can help policymakers to better prevent and control the growth of gynecologic cancers in Iran. However, the lack of sufficient longitudinal studies about patterns of these cancers to compare our models with those data was the main challenge in our study. Due to the considerable rising trend in most provinces in Iran, taking urgent and effective preventive actions seems necessary.

Conflicts of Interest

None

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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