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Epidemilogic Study of Death Caused by Endocrine, Nutritional, and Metabolic Diseases in Iran During 2006-2018

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Abstract

Objective: The epidemiological transition and the increase of chronic diseases resulted in the rise of endocrine, nutritional and metabolic (ENM) diseases as causes of death. This study aimed to explore the death rate caused by ENM in Iran 2006-18.

Materials and Methods: Secondary data analysis was done. The demographic data on death were extracted (age, sex and cause of death) at the provincial level from the death records registered by civil registration. The conditions and trends of ENM death were analyzed from 2006 to 2018. The differences were analyzed in terms of age, sex, place of residence, and over time through indicators of death rate, sex ratio, and years of life lost (YLL).

Results: Out of 1708 pregnant women, 244 (14.3%) had GDM, and 1464 (85.7%) did not. There was a statistically significant difference between these two groups in terms of age ($P< 0.001$), weight ($P< 0.001$), number of pregnancies ($P< 0.001$), delivery ($P< 0.001$), previous diseases ($P< 0.001$), and Rh ($P= 0.01$). While in terms of the ABO blood group system ($P= 0.3$) and abortion rate ($P= 0.067$), no statistically significant difference was observed.

Conclusion: 6,906 people were died in Iran between 2006- 2018 due to ENM diseases. The death rate from this disease increased from 3.5 per 100,000 people in 2006 to 8.4 in 2018. More women died, especially in old age, with the peak of death being at the age of 50 and older. ENM death resulted in the loss of 67,041 years of life.

Keywords: Death, Chronic diseases, Diabetes, Endocrine, Nutritional and metabolic

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Introduction

Death is a serious and inevitable event in human life**.** (1). According to the definition by the World Health Organization **(**WHO**)**and the United Nations, death is "the permanent disappearance of all vital functions at any time after birth" (2,3).

Death can occur for different reasons. In the past, infectious and parasitic diseases were the main causes of death but today, the causes of death have changed, and the older diseases have been replaced by non-infectious and non-contagious diseases. This period is known as epidemiological transition.

The epidemiological transition occurs along with changing patterns of population age and demographic features of the population, which means more deaths in old age infirmity and a decrease in the child mortality statistics (4).

The non-communicable diseasesn (NCD), which account for most deaths in the world today, mainly include cardiovascular diseases, cancers, chronic respiratory diseases, and endocrine, nutritional and metabolic (ENM) diseases. According to statistics, annually 63% (about 36 million people) of the world's deaths are caused by NCD with almost 14 million of the dead between 30 and 70 years (5). Among NCD, ENM diseases are on the rise in the world, especially in developing countries, of which diabetes and its related problems account for the majority of deaths (6). According to The International Classification of Diseases (ICD), ENM diseases generally include thyroid gland disorders, types of diabetes, other endocrine disorders, malnutrition and its types, and metabolic disorders (7). As predicted by the WHO, diabetes, which is the main disease of the group of endocrine diseases, will be the fifth cause of death in the world in 2030, accounting for 1.4% of women's deaths and 3% of men's deaths (8). In Iran in 2015, 29.5% of all deaths were due to ENM diseases, mostly diabetes, which was the third cause of death after heart attack and stroke (9). While diabetes is the 8th cause of death in the world and the 9th cause of death in the Eastern Mediterranean (including Iran), the death rate due to these diseases is higher in Iran (8).

Most of the world's population in the future will be elderly, and non-contagious and chronic diseases (including ENM diseases) will be more prevalent than infectious and contagious diseases. Non-contagious chronic diseases are not fatal but involve many years of a person's life and make a person disabled. They are mostly untreatable, or if treated, they are costly (10). Therefore, the best and only way to fight these diseases is to prevent them and receive special attention in the policies made on health systems (11). Bach et al. believed that it is necessary to examine the causes of death to learn how to prevent common causes of death and eliminate risk factors, and, consequently help increase life expectancy (12).

The lifestyle of people today can lead to non-contagious diseases such as heart disease, diabetes, and cancer. The increase of elderly people in societies can also increase the prevalence of these diseases (13) as the aging of the population has increased diabetes (the major disease among ENM diseases). According to statistics, the prevalence of diabetes is 1.4% at the age of 25-44 and rises to 10% at the age of 65 and over. Therefore, the countries where the rate of old age increases, face a high growth of diabetes (14). The increase in unhealthy lifestyle, and the increase in people's survival time as a result of the increase in life expectancy and care measures , have led to an increase in prevalence of chronic diseases and a decrease in contagious and infectious diseases (15).

Most of the studies conducted in Iran have been conducted by health professionals using hospital data and with an emphasis on diabetes**.** Based on Aminorroaya et al. (2020) and jafarvand et al. (2021) and Badariyan et al. (2023) studies, diabetes is one of the main causes of death in Iran. Reports indicate that 20,877 out of 345,478 people of Iran in 2016

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died due to ENM diseases, of whom 18,099 (87%) died of diabetes. In that year in Iran, the death rate due to diabetes was 22.33 per 100,000 people (16), while it was 21 in the world and 16 per 100,000 in the Eastern Mediterranean region (8). Agha Mohammadi (2018) showed that in 2006, the death rate due to ENM diseases was 10.19 per 100,000, but it reached 25.73 per 100,000 in 2016. This indicates the increase in deaths caused by these diseases. It is predicted that in 2037 the death rate will reach 197.71 in the entire population (16). Jafarvand, Ataey and Edalati (2021) concluded that diabetes mortality in Iran has increased over the years 2006 to 2010.The death rate due to diabetes is higher in urban areas, women, and age groups over 70 years old compared to other groups (17). In a recent study and at sub-national level, Bandariyan et al. (2023) showed that aged group rates and numbers of incidence and prevalence of diabetes in most provinces increased in recent ten years(18).

The present study uses the death data registered in the National Organization for Civil Registration, which is more comprehensive than the hospital data**.** The present study was conducted to examine the contribution of ENM diseases to the mortality of the entire population of Iran in the period from 2006 to 2018.

Material and methods

This research employed a quantitative method using secondary data analysis. The data were based on the total number of deaths and the deaths caused by ENM diseases from 2006 to 2018 in Iran. The data on death and death caused by ENM diseases were obtained from death registration which is recorded by age and gender and published annually by the National Organization for Civil Registration. Based on the information obtained from the general population and housing census, the population was divided by age and gender in calculating the death rate. Death data is available for the years 2006 to 2018 by year, and population data is available in the two censuses of 2011 and 2016. Therefore, the analysis of death data has been done annually during the period from 2006 to 2018 and in cases where population data was needed, the analysis was based on the years 2011 and 2016.

Data analysis was done using Excel 2013 software. Percentage of ENM death, death rate per million, difference by rate, sex ratio and index of years of life lost (YLL) due to premature death were used to describe the data.The percentage of death due to ENM was calculated by dividing the death due to ENM by the total number of deaths in each age group. The sex ratio was calculated by dividing the death rate due to ENM in men by the death rate due to ENM in women; this index is a good measure for identifying the gender difference in ENM death between the age groups. The death rate difference index was calculated through the difference in the death rate over two years; This index is a suitable measure for calculating relative changes in death over time (19). And the index of YLL lost due to premature death is a suitable measure to show the power of death caused by diabetes in reducing the population.

Ethical considerations

This study was approved by Yazd University Research Ethics Committee (code: IR.YAZD. REC.1401.0730).

Results

Total population number was 70495782 in 2006 and increased to 82084056 in 2018 (Table 1). The total number of deaths through these years increased from 307,265 to 357,687. What is notable is the increase in the death rate as caused by ENM diseases, which grew from 3.5 per 100 thousand in 2006 to 8.4 per 100 thousand in 2018. Figure 1 shows the increasing trend of the death rate due to ENM diseases.

Table 2 demonstrates the death rate due to ENM diseases by gender.

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Table 1. Changes in population, mortality and death rate due to ENM diseases in Iran from 2006 to 2018

Year	Population	Death	ENM death	ENM death %	Death rate	ENM death rate
2006	70495782	307265	2472	0.8	4.4	3.5
2007	71366189	313308	2835	0.9	4.4	3.4
2008	72266219	325539	2489	0.8	4.5	3.4
2009	73196424	326866	2588	0.8	4.5	3.5
2010	74157377	339280	2770	0.8	4.6	3.7
2011	75103347	340990	2952	0.9	4.5	3.9
2012	76075112	331521	3234	1.0	4.4	4.3
2013	77016011	346936	5060	1.5	4.5	6.6
2014	77970210	338681	5271	1.6	4.3	6.8
2015	78940102	345487	5384	1.6	4.4	6.8
2016	79926270	347987	5537	1.6	4.4	6.9
2017	81070109	353855	5698	1.6	4.4	7.0
2018	82084056	357687	6906	1.9	4.4	8.4

Table 2. Population and death rate due to ENM diseases in 2011 and 2016

Variable		Year		2011 to 2016 difference
		2011	2016	
Population (number)	Total	75149669	79926270	4776601
	Male	37905669	40498442	2592773
	Female	37244121	39427828	2183828
ENM Death (number)	Total	2,950	5,539	2589
	Male	1,397	2,476	1079
	Female	1,558	3,068	1510
ENM Death Rate (Per 100000)	Total	3.9	6.9	3.0
	Male	3.7	6.1	2.4
	Female	4.2	7.8	3.6
	Sex Ratio	113.5	127.3	13.8

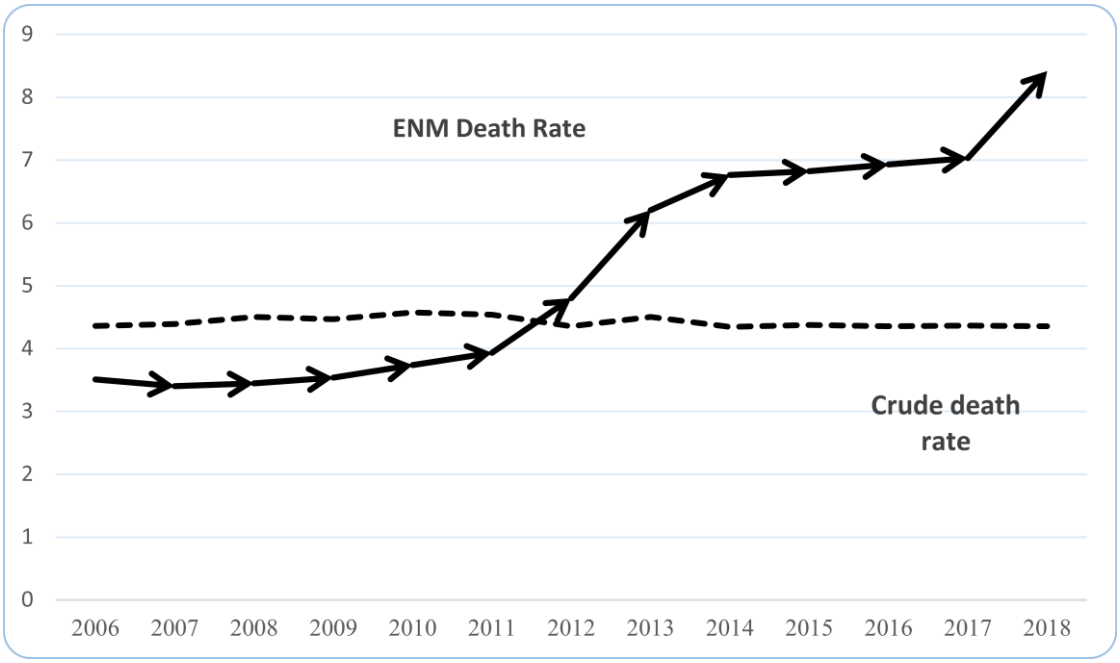

Figure 1. Changes in crude death rate (per thousand) and ENM death rate (per million) in Iran from 2006 to 2018

The population of women and men was 37,244,121 and 37,905,669 in 2011, and, there were 39.427,828 women and 40,498,442 men in 2016. The total number of deaths due to ENM diseases in 2011 was 2950 of whom 1397 were men and 1558 were women. In 2016, 5539 people died due to these diseases, of whom 2476 were men and 3068 were women. In total, in 2016, 2589 people died due to ENM diseases. There were 1510

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women and 1079 men more died in 2016 than in 2011 due to ENM diseases. During these years, there was an increase in the death rate in women more than in men caused by these diseases. The rate increased by 4 per 100,000 in women, while it increased by 2 per 100,000 in men. Figure 2 shows the increase in the death rate caused by ENM diseases. As it is displayed, the death rate in the whole country not only did not increase but also slightly decreased during the years 2011-2016. The point is that although the total death rate is higher in men, the death caused by ENM diseases is more seen in women and the death rate increases more intensely in women.

Figure 3 shows the death rate due to ENM diseases in terms of age. The death rate caused by these diseases is very low before the age of 50 but increases at this age and over. The death rate due to these diseases increased in

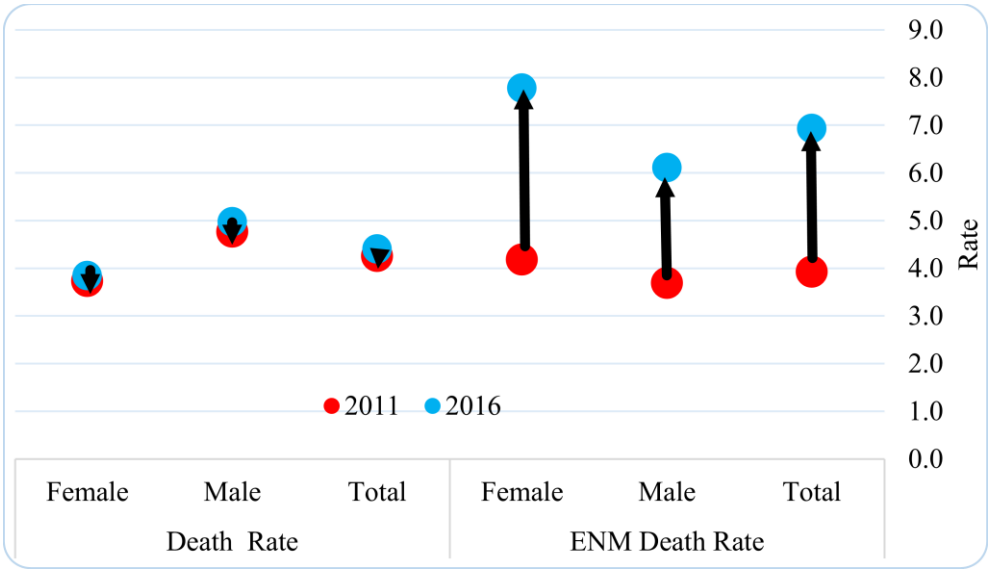

Figure 2. Death Rate (per 1000) and ENM death rate (per 100000) from 2011 to 2016

Figure 3. ENM Death Rate by age and gender in Iran from 2011 to 2016

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2016 compared to 2011, and this increase was higher in women, especially in old ages.

Figure 4 displays the rate of death due to ENM diseases in 2011 and 2018 in terms of the provincial divisions of the country. The total death rate due to these diseases generally increased in all provinces over time. The death rate was high in the provinces of Mazandaran, Semnan, Alborz, Golestan and Gilan but low in the province of Kohgiluyeh and Boyer Ahmad, and even on decrease in the provinces of Ghazvin and Sistan & Baluchistan.

Figure 5 demonstrates the death rate due to endocrine and metabolic diseases in terms of gender in the provinces of the country. In almost all provinces, the death rate in women

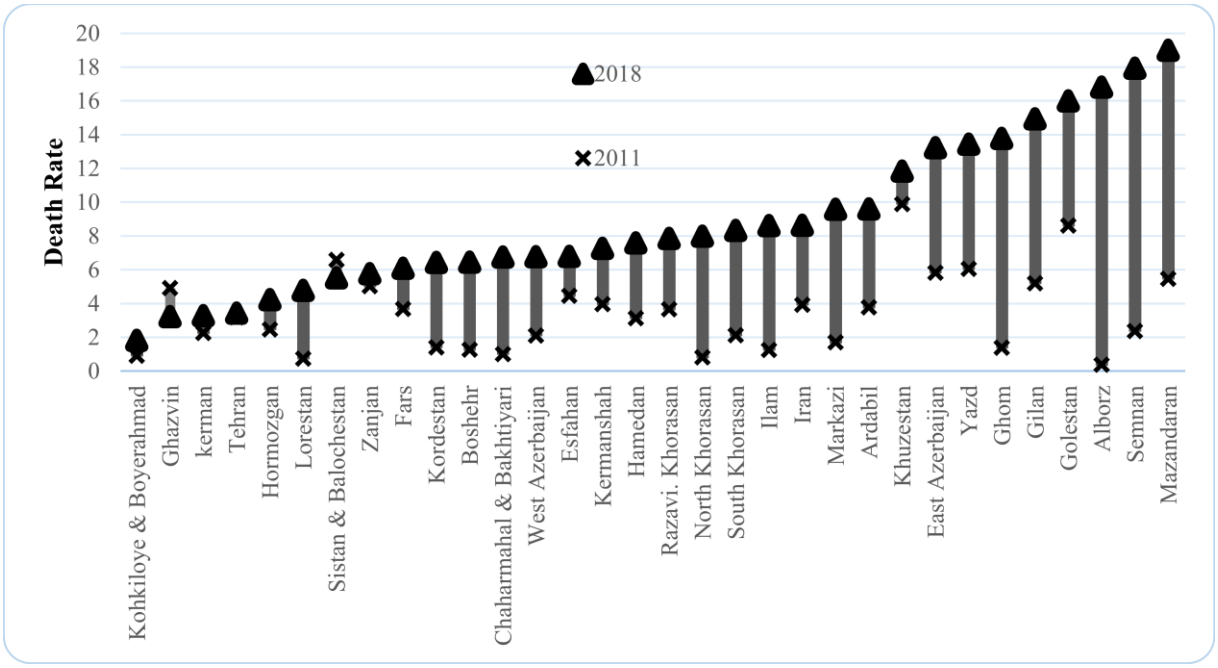

Figure 4. The rate of death caused by ENM diseases in the provinces of Iran from 2011 to 2018

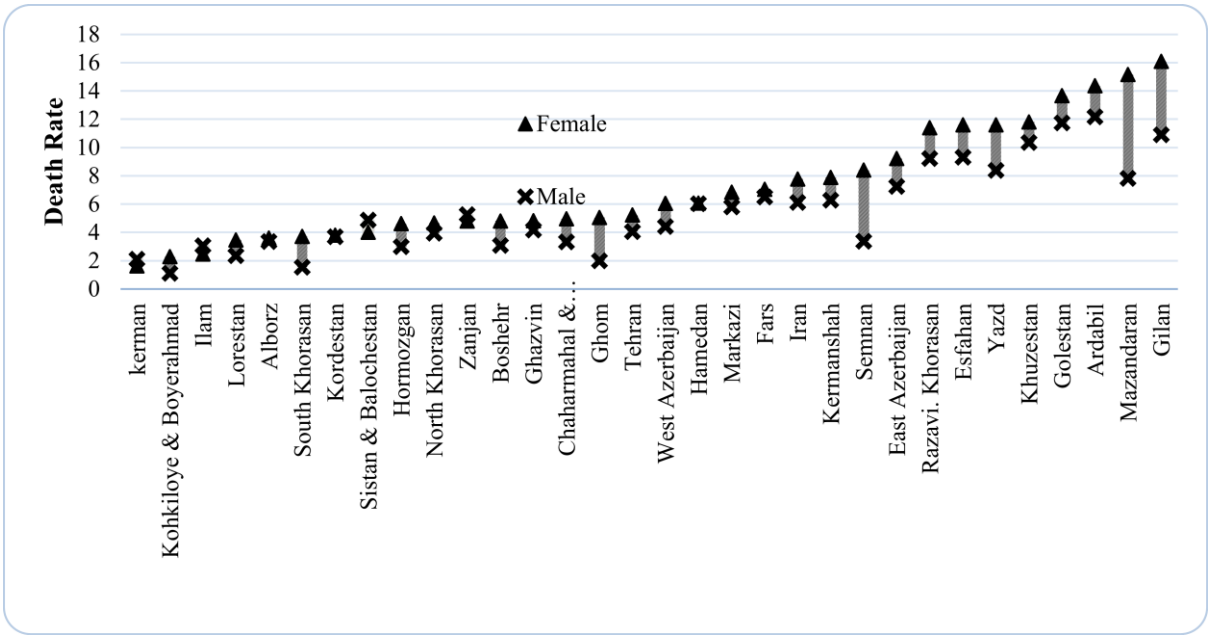

Figure 5. The rate of death ENM diseases in the provinces of Iran by gender in 2016

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was higher than in men, but in the provinces of Gilan, Mazandaran, Semnan, and Yazd, the difference in the death rate due to ENM diseases between women and men was different and higher in women.

Finally, the index of YLL due to premature death was used to measure the number of YLL due to ENM diseases. Totally, 67,041 years of life were lost in 2016 in Iran due to ENM diseases, of which 30,656 years belonged to men and 36,451 years to women. For a better comparison, the YLL by age is given in a logarithmic form (Figure 6). The age group of 75 years and over with 18,252 years and the age group of 10 to 14 years with 231 years have the highest and lowest number of YLL due to these diseases respectively. In general, in most age groups, the YLL are more in women than in men. However, in the two groups of 35 to 39 years and 40 to 44 years, the YLL index is higher in men than in women, yet, this index is higher in women for all age groups above 45. As shown in Figure 6, the death rate due to ENM diseases starts from the age group of 40 to 45 and reaches its peak at the age of 60 and above. On the other hand, the death rate due to ENM diseases is higher and the YLL index is greater for women.

Discussion

As the results of this research indicate, the population of the country increased from 70,495,782 to 82,084,056 people from 2006 to 2018, and the total number of deaths during this period also increased from 307,265 to 357,687 people. The death rate due to ENM diseases also increased from 3.5 per 100,000 people in 2006 to 8.4 per 100,000 people in 2018, indicating a constant increase in the death rate due to ENM diseases. This finding confirms the results obtained by Agha Mohammadi and his associates who predicted the growing trend of mortality due to these diseases (16). Our results are also in line with those in the study conducted in Korea, which predicted the growing trend of death due to diabetes (the major disease among ENM diseases) in that country (20). Furthermore, the findings of the WHO indicate that the death rate due to ENM diseases tripled from 1968 to 2019 (3). The results of a study in the U.S. also show that death due to diabetes is increasing in this country (21). Several studies have also referred to increasing mortality caused by these diseases induced by factors such as obesity (18), sedentary lifestyle (22-24), increased drug use, malnutrition, air-pollution (25), and the aging of populations

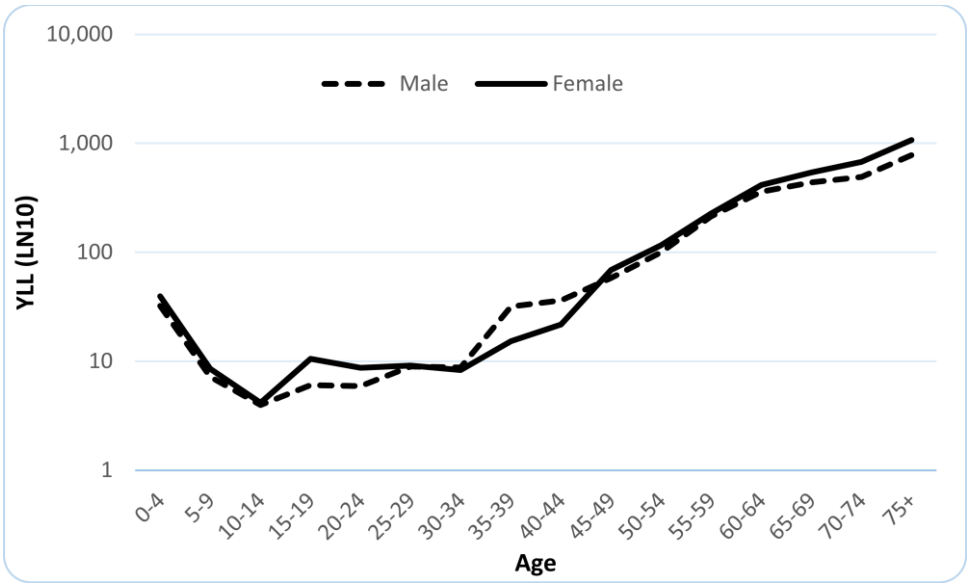

Figure 6. Logarithm of the YLL due to premature death as caused by ENM diseases by sex in Iran in 2016

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(15). Current studies show that this increasing trend of death due to these diseases is more in developing countries that have low or middle income and are mostly struggling with this issue (26).

According to the findings of this study, the total number of deaths caused by ENM diseases in 2013 was 2950 of whom 1397 were men and 1558 were women. The number of deaths rose to 5,539 in 2016, of whom 2,476 were men and 3,068 were women. This means that in 2016, compared to 2011, more people died due to ENM diseases, of whom 1510 were women and 1079 were men. The increase in the death rate due to these diseases occurred more in women with 4 per 100,000 people but 2 per 100,000 people in men. This result is in line with those obtained by Agha Mohammadi et al, who predicted that the death rate would continue to be larger in women (20). However, the result of a study conducted in the U.S. shows that the death rate caused by these diseases is higher in men than in women (21). Further studies are needed to investigate the difference in death rates in men and women due to ENM diseases in Iran.

Another finding in this study is that most of the deaths caused by ENM diseases occurred over 50, and as age increases, the rate of these deaths increases. Agha Mohammadi et al. also reached a similar result in their research, examining the data obtained from the Ministry of Health (16).

Our results indicate that the death rate due to ENM diseases is rising in almost all provinces of the country. While the rate is very high in some provinces such as Mazandaran, Semnan, Gilan and Golestan, it shows a slight increase in Kohgiluyeh and Boyar Ahmad province and even a decreasing trend in Ghazvin and Sistan & Baluchistan province. It needs further research to find out the reasons for these events. In general, the increased rate of death due to ENM diseases is high in women as compared to men in all provinces, and far more significant in provinces such as Gilan, Mazandaran, Semnan, and Yazd. In other words, in these provinces, mortality due to these diseases is increasing in women than in men.

We also examined the YLL due to premature death as caused by ENM diseases. Our findings show that 67,041 years of life were lost in 2016 due to ENM diseases, of whom 30,656 years were for men and 36,451 years were for women. The results of the index of YLL due to premature death clearly show that the death rate due to these diseases increases from age 40 and reaches its peak in old ages.

Conclusions

ENM diseases are among the chronic diseases that rose after the epidemiological transition along with the aging of the population. These types of diseases are agonizing and cause infirmity in the long run and eventually lead to death. Thus, contracting these diseases ruins many years of people's lives due to infirmity. These diseases mostly do not have a specific treatment, and if there is one, it is very expensive for the patient and their family. The only way to deal with such diseases is through prevention. Since a person's lifestyle in youth and middle age has a great effect on their risk of contracting diseases in old age, the most effective solution in reducing such diseases is the promotion of social and cultural programs to improve lifestyle and health-oriented behaviors in youth and middle age. The aging trend of the population in the country can predict the continued increase of such diseases in the future. Therefore, it is suggested that health policy management in the country should design social and cultural programs to improve the lifestyle of young and middle-aged people. In general, the policy system in a society that is approaching old age should not focus only on treatment expenses but part of the health budgets should be spent on social and cultural plans such as organizing sports programs for young and middle-aged people, promoting and teaching healthy eating habits, monitoring food products, teaching health-related behaviors and prohibiting harmful behaviors.

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Conflict of Interest

The authors declare no conflict of interest

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