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The Trend of Years of Life Lost Caused by 4 Main Non-Communicable Diseases in Fars Province in the Age Group of 30-70 Years. Joinpoint Regression Analysis

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Abstract

Background: This study aimed to investigate the trend of YLL created by four Non-communicable diseases (NCDs) in Fars province.

Materials and Methods: Data on the total number of NCD fatalities in southern Iran from 2004 to 2019 were gathered for this research from the population-based Electronic Death Registry System (EDRS). The JoinPoint Regression method was used to analyze the trends in the crude and age-standardized mortality rate and YLL rate.

Results: During the study period, 54,825 deaths occurred in terms of four NCDs in 30-70 years Fars in the province. The total YLL due to premature death during the sixteen-year study period was 558,316 in males and 401,595 in females. The largest number of YLL was caused by cardiovascular diseases 599,189 (62.7%). The sixteen-year trend of years of YLL owing to CVD was declining for both men and women, according to the joinpoint regression analysis. However, there was a constant tendency for females and a rising trend for men with cancer. Additionally, the YLL rate for diabetes in both boys and females showed steady trends. Furthermore, the trend of YLL rate due to chronic respiratory disease was increasing for males but had a stable trend for females.

Conclusions: The result of this study indicates that the YLL rate because of cardiovascular diseases has been declining. The YLL rates for diabetes, cancers, and chronic respiratory diseases have either increased or remained stable. These results carry important implications for public health policies and educational initiatives aimed at enhancing the prevention, early detection, and treatment of these diseases.

Keywords: Years of Life Lost, Mortality Rate, Regression, Non Communicable Disease, Iran.

Introduction

Non-communicable diseases (NCDs) are the main reason of health problems worldwide, with seven out of ten deaths attributed to these diseases [1]. Worldwide, 74% of total deaths result from NCDs, with 42% occurring before the age of 70 [2]. This rate varied from 28 percent in developed countries to 48 percent in developing countries [3]. Considering World Health Organization (WHO), these deaths are referred to as "premature deaths" [4]. Four categories of non-communicable diseases (NCDs) constitute almost 80% of fatalities attributed to these conditions. Cardiovascular disorders account for the highest number of fatalities attributable to non-communicable diseases, reaching 17.9 million per year. Cancers account for 9.3 million fatalities; chronic respiratory illnesses result in

4.1 million deaths; and diabetes contributes to two million deaths, including those attributable to diabetes-related kidney disease [2]. Therefore, WHO offers programs are presented worldwide, which, if fully implemented, will achieve a 25% reduction in premature deaths from NCDs by 2025 [5].

The WHO estimates that the economic burden from early deaths in low- and intermediate-income countries will rise to approximately US$7 trillion by 2030 [6]. While accidental death is inevitable, we can enhance life expectancy and reduce the risk of premature death [7]. One of the objectives of the United Nations' 2030 Sustainable Development Agenda is to reduce the number of premature deaths [8]. Iran is categorized as a middle-income nation with a high rate of preventable mortality. Iranian men and women had an average life expectancy of 73.2 and 70.5 years, respectively, in 2004. These numbers rose to 74.5 years for women and 76.6 years for men by 2015 [9]. In Iran in 2016, about 15% of deaths in terms of NCDs were between the ages of 30 and 70 [10]. The causes of premature death vary significantly across different regions. It is essential to identify the main reason of premature death and the associated risk factors within any population. This understanding is crucial for enhancing the overall health of society [11].

Based on the results of a study published in 2023, premature death due to four NCDs in Fars province, one of the southern provinces of Iran, was reported as 212.52 per 100,000 populations [12]. Since the possibility of premature death is one of the important indicators in the document of NCDs and considering that the geographical, economic-social conditions and lifestyles are different in the provinces of Iran, to plan and develop appropriate policies to reduce premature death of NCDs, the information of each province can be very valuable, so we conducted this study with the aim of investigating the trend of YLL created by four NCDs in southern Iran.

Materials and Methods

This cross-sectional study was designed and conducted in Fars Province between 2004 and 2019. Based on 2016 national census, Fars province has a population of 4,851,274 and is located in southern Iran. It is the fourth largest province in Iran in terms of both area and population.

We retrieved data on deaths from four major noncommunicable illnesses from the EDRS at Shiraz University of Medical Sciences, which is managed by the Vice Chancellor of Health's Statistics Unit. This data was examined using parameters such as age, gender, year of death, and cause of death from the International Classification of Diseases, 10th version (ICD-10).

The disease codes used in our study include: cancers (C00-D48), Diabetes (E10-E14), Diseases of the Circulatory System (I00-I99), and Chronic Respiratory Diseases (J40-J47). EDRS compiles all deaths in Iran from various sources, including hospitals, health centers, civil registration offices, and forensic organizations, based on international codes for each disease [13]. Duplicates were excluded from the study based on the similarities in the national number and father's name. This study estimated premature mortality due to CVD, diabetes, cancers and chronic respiratory diseases for individuals aged 30 to 70.

To estimate the study population, primary data from health centers and the population and housing census conducted between 1375 and 1395, considering the annual growth rate, was used.

Numbers and percentages were employed to present qualitative analyses. Consequently, the standard life table was employed to determine Years of Life Lost (YLL) and the life expectancy of various age and gender categories. This analysis also included the number of deaths in each age and gender category, and based on following formula: [14]

Formula 1.

$$YLL= N\,Ce^{(ra)} / (\beta+r)^2\,[e^{-(\beta+r)(L+a)}\,[-(\beta+r)(L+a)-1] - e^{-(\beta+r)a}\,[-(\beta+r)a-1]]$$

N = count of deaths.
L = the rest of life expectancy.
r = the discount rate, which is equal to 0.03.
β = the parameter from the age-weighting function, which equals 0.04.
C = the age-weighting correction constant equal to 0.1658.
a = the age at death.
e = a constant and equal to 2.71

The number of YLL in terms of early death was analyzed using the YLL template provided by the WHO in Excel 2016. This analysis utilized WHO life tables and standard life expectancy data. To examine trends in early mortality, we employed joinpoint regression. Using the number of YLL as input, this method determines the years in which trends undergo a change and derives the annual percentage change (APC) in rates between these trend change points. It also provides an estimate of the average annual percentage change over the entire study period [15]. The analysis for the trend was conducted using the Joinpoint Regression Program 4.9.1.0.

Results

During the study period, 54,825 deaths occurred due to CVD, diabetes, cancers and chronic respiratory diseases in 30-70 years Fars province. Of these, 34,715 (63.3%) were caused by cardiovascular diseases, 15,699 (28.6%)

by cancers, 2807 (5.1%) by diabetes and 1604 (2.9%) by chronic respiratory diseases. Of these, 32664 (59.6%) were in men.

The total YLL in terms of early death during the sixteen-year study period were 558,316 (42.1 per 1000 people) in men, 401,595 (30.6 per 1000 people) in women and 959,911 (36.4 per 1000 people) in both sexes (male/female sex ratio = 1.4). The largest number of YLL was caused by cardiovascular diseases 599,189 (62.7%). (Table 1). The average number of years of YLL to cardiovascular diseases was 17.0 in male and 17.6 in female, in terms of cancer was 17.3 in men and 19.2 in women, due to diabetes was 16.6 in men and 17.5 in women and in terms of chronic respiratory diseases was 17.1 in men and 18.3 in women.

Table 1. Number of YLL in terms of cardiovascular disease, cancers, and diabetes and chronic respiratory diseases

Year	CVD (YLL)		Cancer(YLL)		Diabetes(YLL)		Respiratory(YLL)	
	Male	Female	Male	Female	Male	Female	Male	Female
2004	22849	14507	6963	5442	973	1169	633	368
2005	22519	15006	6603	5976	633	968	417	360
2006	23965	16112	7533	6269	1178	1014	941	652
2007	23809	15308	7081	7104	962	1201	754	374
2008	22721	14613	7578	7153	996	1663	817	601
2009	22434	15022	7858	6287	864	1161	879	432
2010	22440	14514	9208	7332	1449	1620	621	461
2011	19279	13921	8510	7733	1718	1964	712	418
2012	24466	14838	7152	5218	1909	1308	835	646
2013	21343	13647	10138	10677	1849	1829	661	500
2014	25473	15749	10638	9267	1183	1602	1643	410
2015	25548	15886	10593	10033	1479	1698	1261	489
2016	22885	12557	11619	10268	1797	2296	902	450
2017	22035	13681	12624	12062	1887	1994	2019	955
2018	22839	14258	12529	12315	1763	1978	2448	1197
2019	23050	11915	13301	11843	1793	1902	2757	1402
Total	367655	231534	149928	134979	22433	25367	18300	9715

Based on the join point regression analysis, the sixteen-year trend of years of life lost rate because of CVD was decreasing: the APC was -3.6% (95% CI -4.3 to -2.8, p<0.001) for males, -4.7% (95% CI -5.4 to -4.0, p<0.001) for females (Fig. 1), but for cancer there were increasing trend for males, APC was 1.0% (95% CI 0.1 to 2.1, p=0.045), but had stable trend for women's APC was 1.5% (95% CI -0.3 to 3.4, p=0.094) (Fig. 2). Moreover, there were stable trends for diabetes YLL rate in males APC was 1.8% (95% CI -0.8 to 4.4, p=0.164) and female APC was 0.7% (95% CI -0.9 to 2.4, p=0.358) (Fig. 3).

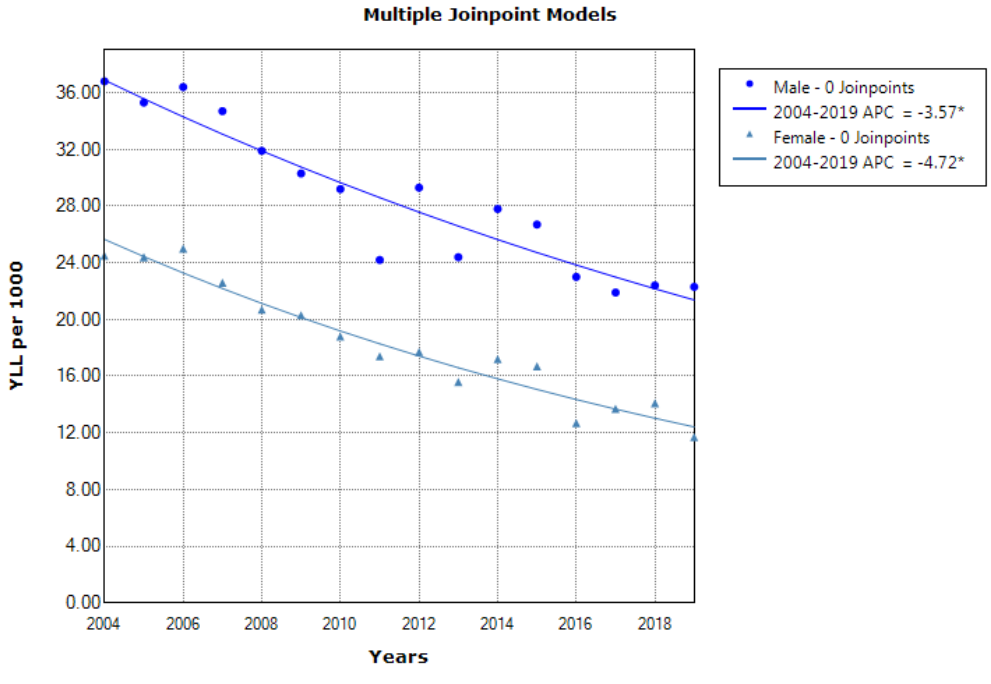

Fig. 1. The trend of YLL in terms of CVD in 30-70 years (2004-2019).

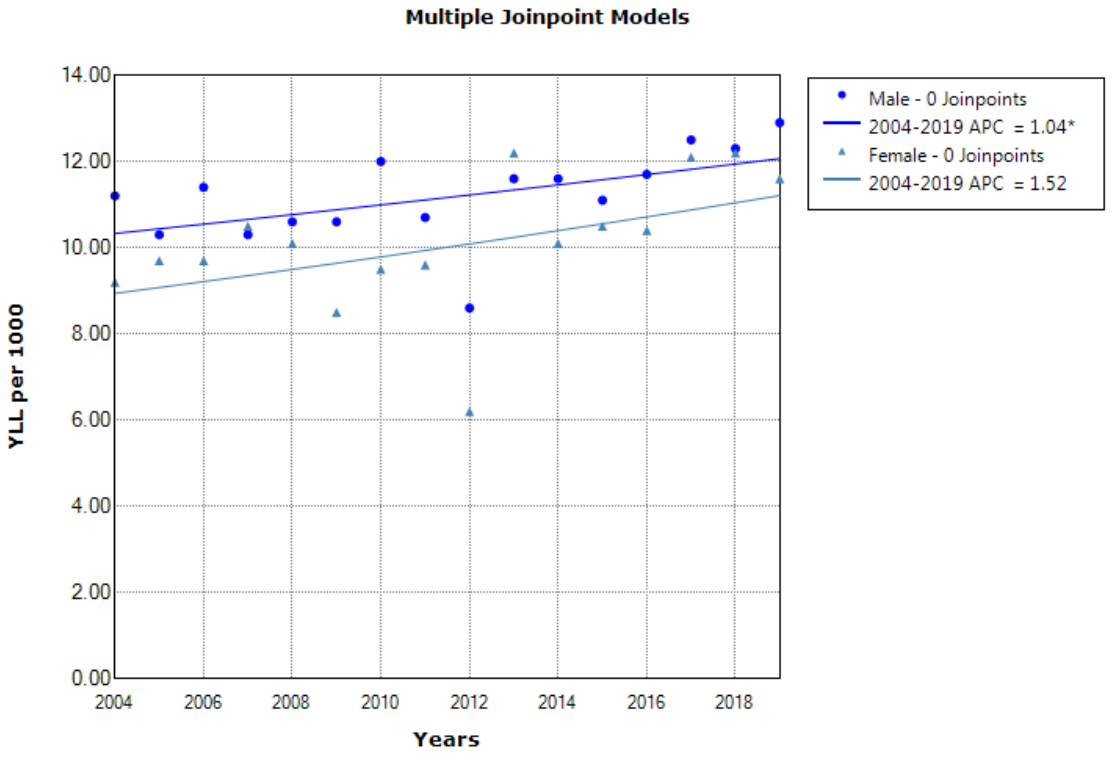

Fig. 2. The trend of YLL in terms of cancer in 30-70 years (2004-2019).

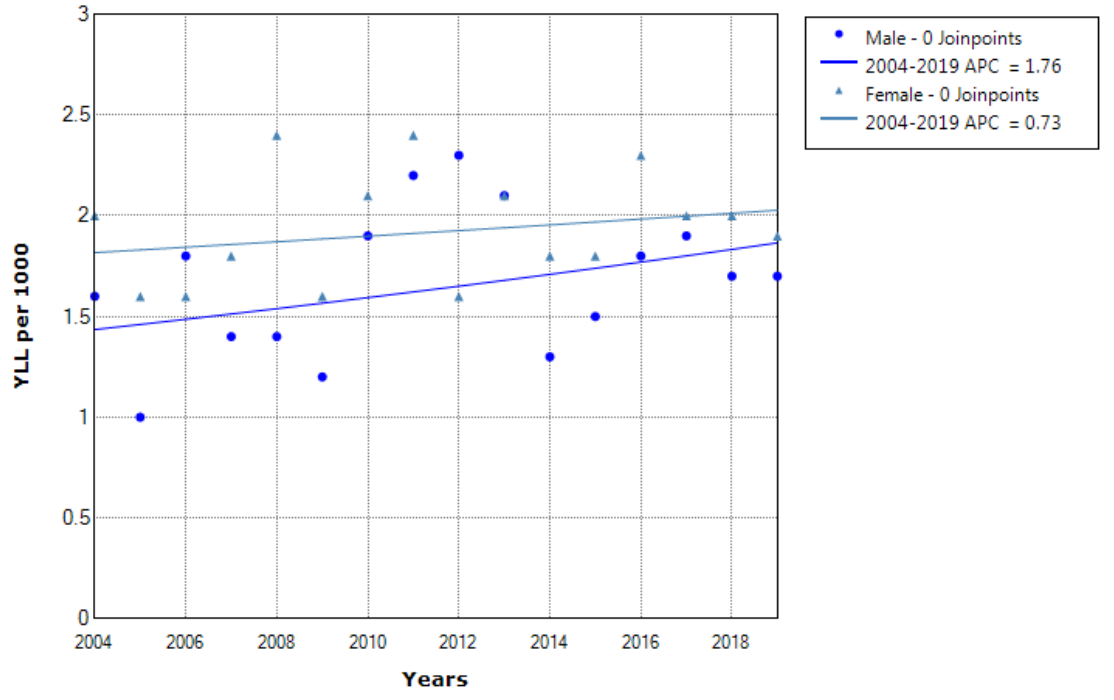

Fig. 3. The trend of YLL in terms of diabetes in 30-70 years (2004-2019)

Moreover, the trend of YLL rate because of chronic respiratory disease was increasing: APC was 5.5% (95% CI 1.6 to 9.6, p=0.009) for males, but had stable trend for women's APC was 2.3% (95% CI -1.8 to 6.5, p=0.253) (Figure 4)

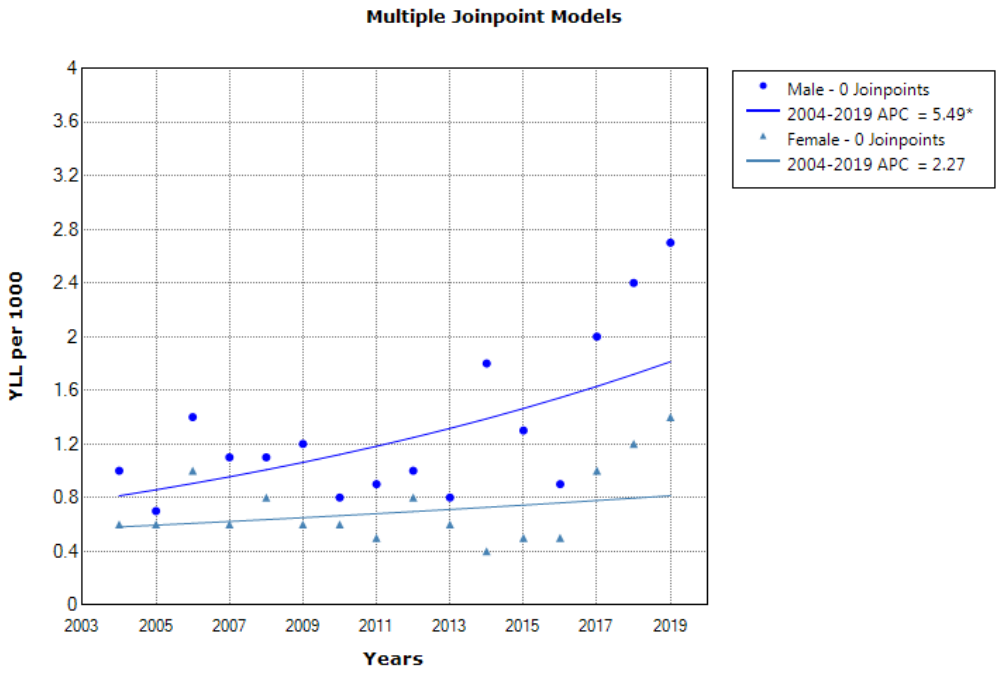

Fig. 4. The trend of YLL in terms of respiratory in 30-70 years from 2004 to 2019

Discussion

This study aimed to examine the mortality rates and YLL due to the main types of NCDs, including CVD, cancers, chronic respiratory diseases, and diabetes, in Fars province from 2004 to 2019. As the results showed, in general, 59.6% of deaths occurred in men. The question of why women survive longer than males is the subject of a variety of hypotheses and explanations. One possible explanation is that women exhibit superior physiological adaptations when confronted with patients [16]. Additionally, the prevalence of healthful behaviors among men is lower than that of women. Tobacco, alcohol, and addictive substances are more prevalent among men than among women. Thus, the probability showing violent behavior, poor nutrition and risky sexual behavior is higher in men. On the other hand, men are generally more exposed to environmental hazards and unsafe working conditions. Besides, several physiological factors can explain gender differences in health [17, 18].

CVD: Our analysis showed that the YLL from CVD was 599189, while the rates were low, in developed countries, such as Switzerland, Belgium, Spain, Slovenia, the United States, and South Korea [19]. Our results confirm the WHO report that low- and middle-income countries (LMICs) account for at least 3/4 of premature cardiovascular disease (CVD)-related deaths [20]. In many areas, a high rate of out-of-hospital mortality caused by inadequate pre-hospital care continues to be a widespread issue that has seen little improvement, particularly in rural regions [21, 22]. Actions are needed to promote the delivery of prehospital care, such as the establishment and chest pain screening centers across the country [23]. In this study, we found that the trend of YLL in terms of CVD decreased, which can be attributed to the improvement of medical treatment [24].

In males, the average number of YLL due to CVDs was higher than in females, as was the case in our study. This was a logical explanation for the increased frequency with which males were exposed to cardiovascular disease risk factors, including a sedentary lifestyle, psychological stress, and inadequate medical treatment and health management [25]. A precise and effective strategy for the prevention and control of cardiovascular disease necessitates an accurate comprehension of gender disparities in early CVD mortality, particularly at the national level. In contrast to our study, Maniecka-Bryła et al. realized the increasing trend in the number of CVD YLL [26]. On the other hand, the reduction in the burden of CVD is consistent with previous findings and may be in terms of implementing life-saving health policies and interventions, rapidly developing essential medical and treatment standards, as well as educating mothers [27-29].

Cancer: From 1990 to 2017, there were 599,099 cancer deaths and 4,280,128 YLLs in the United States, [30], while in our study, these numbers were 15,699 and 17.3 in men and 19.2 in women, respectively, which is in terms of the smaller geographical area under study. In a cohort study in Japan, total YLL because of cancer was 7035.3 years in male and 5627.0 years in female [31]. In 2005, Pham et al. found that the average YLL for women due to cancer was greater than that of males (16.7 years versus 13.9 years). The disparity between men and women can be attributed to two factors: (1) women perish at a younger age than men, and (2) life expectancy is longer in women than in men. Consequently, YLL is higher in women than in men

[32]. In a study in Norway, 148,095 YLLs aged 25–99 years occurred in terms of cancer during 1997–2012, and the trend of YLLs because of cancer was increasing during this time period [33], while in our study the average number of years of life lost in terms of cancer was 17.3 in men and 19.2 in women and the trend were increasing for males and stable for women. This is probably mainly due to advances in treatment, as well as the fact that most incidence occur at an advanced age, where the effect on YLL is limited [34].

Respiratory diseases: We found 1604 deaths in terms of chronic respiratory diseases but in Heidari's study 2,462 deaths [35]. Unlike our study, in Zhou' study the average daily years of life lost rates for males had much higher YLL rates than those for females [36]. In line with our study, Torkashvand et al revealed that YLL in terms of respiratory diseases increased among the elderly from 2011 to 2017 as well [37]. Iran's health system must adjust its policy objectives to accommodate the aging population, given the anticipated rise in the elderly population [38]. The results of a study conducted on MERS-CoV demonstrated that the trend of YLL was initially increasing and subsequently decreasing [39]. Social inequalities exacerbate health problems, and the population over 30 years old continues to face a high burden. Considering these issues and the current lack of progress and investment in the health sector, and considering the progress shown in the estimates since 1990, care should be taken to prevent the burden of chronic respiratory diseases from worsening [40, 41].

Diabetes: In other studies, the results showed that YLL in terms of the diabetes are more in men than in women [42, 43], and the trend is increasing in both genders [43], while in our study, YLL were more in women and the trend was observed in a stable trend. Also, in China, the YLL rate of diabetes in different subgroups decreased between 2005 and 2020 [42]. In response to high mortality and subsequently the number of YLL in terms of diabetes, appropriate measures should be taken. We must enhance the quality of medical care, augment the accessibility of medications, and refine the monitoring and management of patients' prognoses. Primary health care that emphasizes diabetes prevention and control services, together with the creation of population-based interventions, may serve as complementary techniques in both primary and secondary prevention. Besides, a healthy lifestyle such as maintaining a healthy weight, exercising, and quitting smoking, drinking moderate amounts of alcohol, and eating a healthy diet can help prevent diabetes to some extent [44-47].

One of the limitations of this study is that it was conducted in one province of Iran. Still, because Fars province is one of the most populous provinces of Iran, the results of this study can be generalized to other regions of Iran. One of the strengths of this study is the vast time period and high sample size. YLL is also an important measure that should be considered.

Conclusion

Based on the finding of our study, the trend in YLL rate due to cardiovascular diseases has been decreasing, but for diabetes, cancers, and chronic respiratory diseases, it has been increasing or stable. The results of our study have substantial implications for educational interventions and public health policies that are designed to enhance the prevention, early detection, and treatment of these diseases. In an effort to mitigate preventable and premature fatalities from non-communicable diseases (NCDs), policymakers should implement initiatives such as routine adult surveillance for the early detection of cardiovascular diseases and malignancies by family physicians. Diabetes prevention and control strategies should also be planned and implemented by health policymakers. Thus, reducing air pollution and effective treatment measures are necessary to prevent the incidence and mortality of chronic respiratory diseases.

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Conflict of interest

None declared.

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None

Ethical Considerations

In this study, the data of the death registry was used, we did not have access to the names and characteristics of the people, also for this design, the code of ethics was obtained from the Shiraz University of Medical Sciences.

Code of Ethics

The protocol this study was reviewed and confirmed by the Ethics Committee of Shiraz University of Medical Sciences (SUMS) (code: IR.SUMS.REC.1399.772).

Authors' Contributions

Habibollah Azarbakhsh: Responsible for the field work including data collection and management and wrote the discussion. Fatemeh Jafari: Collected. Data and wrote the manuscript. Zahra Jaafari: Wrote the manuscript. Seyed Parsa Dehghani: The analysis of data. Pegah Shoaahaghighi: Wrote the manuscript and edited the English language. Alireza Mirahmadizadeh: Collected

data and edited the final version of the manuscript. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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