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Mortality and Years of Life Lost (YLL) Trends in Musculoskeletal Disorders in the South of Iran, 2004-2019

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Abstract

Background: Musculoskeletal Disorders (MSDs) are damage to the tissue of the musculoskeletal system that disrupt the flow and functionality of the human body. The current study evaluated changes in years of life lost (YLL) due to MSDs and mortality rates associated with MSDs in the 16 year-period from 2004 to 2019.

Materials and Methods: In this descriptive study, YLL for MSDs for the years 2004-2019 in Fars province was calculated using the YLL template from World Health Organization (WHO), and the number of total deaths due to MSDs in Fars province was obtained from the electronic population-based death registration system (EDRS).

Results: Between the years 2004 and 2019, 746 deaths due to MSDs occurred in Fars province. The crude mortality rate increased in men from 1.29 (per 100,000 population) in 2004 to 1.47 in 2019 (p-value for trend=0.057) and in women from 1.18 in 2004 to 2.58 in 2019 (p-value for trend <0.001). Total YLL due to MSDs over the same period was 4,690 and 6,852 (0.14 and 0.22 per 1000 population) in men and women, respectively (female/male gender ratio =1.46).

Conclusion: The findings revealed that YLL due to MSDs was higher in females than males. The highest and lowest YLL due to MSDs was seen in the age group of 40-49 and 0-9 years, respectively. To minimize the effects of MSDs, further adjustment in the policies and regulations tailored for appropriate age groups and populations is recommended.

Keywords: Musculoskeletal Disorders, Years of Life Lost, Burden of Disease, Mortality Rate, Iran

Introduction

Over recent decades, rapid population growth, increased aging worldwide, physical inactivity, and changes in lifestyle and nutrition have made societies more vulnerable to non-communicable diseases such as diabetes, cardiovascular disorders, and musculoskeletal complications [1, 2]. Musculoskeletal disorders (MSDs) are tissue injuries within the musculoskeletal system that disrupt the flow and functionality of this system in the human body which, in the long-term, becomes burdensome [3, 4]. MSDs are a wide range of acute and inflammatory conditions in the human body involving musculoskeletal tissues such as muscles, tendons, peripheral nerves, and blood vessels [5, 6]. Although the predominant complication of MSDs is chronic pain that can affect quality of life, end stage MSDs can cause more severe complications and eventually even death [7]. Diseases and injuries such as rheumatoid arthritis, scleroderma, systemic lupus erythematous (SLE), low

back pain, neck pain, and fractures can all be categorized as MSDs, as they show involvement of the musculoskeletal system [5, 6].

The 2010 Global Burden of Diseases study (GBD 2010) evaluated the disability burden of 291 diseases and injuries for 187 countries in 21 regions around the world from 1990 to 2010 and found that MSDs were associated with 21.3% of all years lived with disability (YLD), ranking them second after mental and behavioral disorders (23.2% of YLDs). Most studies have focused majorly on disabilities associated with MSDs, but MSDs can also cause premature death [7]. In GBD 2010, MSDs accounted for 6.8% of total disability adjusted life years (DALY), i.e., the sum of YLL an YLD, which made it the fourth most common contributor to total DALY among all 291 diseases in the study (third in the developing world) [8]. GBD 2019, which evaluated the global burden of 369 diseases in 204 countries from 1990-2019, showed an increase of 30.7% in DALY's contribution to MSDs [9]. MSDs are a major cause of severe chronic pain, inactivity, and loss of mobility, and they lead to decreased quality of life and increased financial burdens on patients and healthcare systems, primarily because of years lost due to unemployment and premature disability [10-12]. In 2011, total direct and indirect costs of MSDs in the United States were estimated to be $874 billion, which was 5.7% of its total annual GDP at the time [13].

Studies have shown a high correlation between MSDs and disability that can add extra strains on healthcare systems [14]. Based on the global burden of disease study (GBD), the incidence of MSK disorders increased globally by 58% from 211.80 million to 334.74 million between 1990 and 2017 [1]. Accordingly, the current study aimed to analyze trends in mortality rate and years of life lost due to MSDs over the sixteen-year period from 2004 to 2019 in Fars province, Iran.

Materials and Methods

This cross-sectional study examined mortality rates and YLLs due to MSDs between the years 2004 and 2019 in cities of Fars province, southern Iran, which has a population of more than 4 million. Mortality data were obtained from the statistics unit of Shiraz University of Medical Sciences, which is responsible for collecting pertinent mortality numbers. In addition, hospitals, local health centers and emergency departments, cemeteries and forensic medicine centers report mortality data monthly to the relevant provincial office. Then, causes of deaths were categorized and classified according to international protocols and guidelines using ICD-10: Arthropathies (M00-M25: infectious arthropathies (M00-M03), inflammatory polyarthropathies (M05-M14) arthrosis (M15-M19), and other joint disorders (M20-M25)), systemic connective tissue disorders (M30-M36), dorsopathies (M40-M54: deforming dorsopathies (M40-M43), spondylopathies (M45-M49), and other dorsopathies (M50-M54)), soft tissue disorders (M60-M79: disorders of muscles (M60-M63)), synovium and tendon disorders (M65-M68), other soft tissue disorders (M70-M79), osteopathies and chondropathies (M80-M94), other disorders of the musculoskeletal system and connective tissue (M95-M99), other acquired deformities of the musculoskeletal system and connective tissue, postprocedural musculoskeletal disorders not elsewhere classified, and biomechanical lesions not elsewhere classified [15]. The total population of Fars province was calculated using data from 1996 to 2016 derived from the Center for Census and Housing while considering an annual population growth of 1.2%.

For standardization, the 2013 population for low- and middle-income countries was used. Compared to this standard population, the standard population of the WHO has a lower proportion of the younger population and a higher proportion of those over 70 years of age. As a result, it is not suitable for low- and intermediate-income countries where the proportion of young people is higher.

Qualitative data in this study were reported as numbers, rates, and percentages. Crude mortality and its age-standardized rates (ASR) for MSDs by sex and for each of the years between 2004 and 2019 were calculated. The chi-square for trend and chi-square goodness of fit were used to examine the trends of mortality rates and ASRs. Statistical significance level was set as p-value = 0.05. Data were analyzed by SPSS version 19 and Microsoft Excel 2016.

The following formula was used to calculate YLL by incorporating data from the standardized life expectancy table for different age groups and genders and mortalities due to MSDs by age and gender [16].

Formula 1.

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

N = number of deaths
L = remaining life expectancy at the age of death
R = discount rate equal to 0.03
B = parameter from the age-weighting function equal to 0.04
C = the age-weighting correction constant equal to 0.1658
A = age of the deceased
e = contractual constant equal to 2.71

The YLL template extracted from the WHO for the year 2015 (standard life table with a life expectancy of 82.5 years for women and 80 years for men) and Microsoft Excel 2016 spreadsheets were used to analyze YLLs caused by MSDs.

Results

Between the years 2004 and 2019, 746 deaths due to MSDs occurred in Fars province, in the south of Iran, 57.64% (430 cases) of which were women. Moreover, 15.28% of all MSD deaths were in the age group of over 85 years.

Crude mortality rate increased in men from 1.29 (per 100,000 population) in 2004 to 1.47 in 2019 (p-value for trend = 0.057) and in women from 1.18 in 2004 to 2.58 in 2019 (p-value for trend <0.001). The age-standardized mortality rate decreased in men from 1.45 (per 100,000 population) in 2004 to 1.29 in 2019 (p-value for trend = 0.908) and increased in women from 1.53 in 2004 to 2.21 in 2019 (p-value for trend = 0.906) (Table 1, Fig.1).

Table 1. Crude mortality rate and age-standardized rate (in 100,000 population) for musculoskeletal disorders in southern Iran, 2004-2019

Year	Total population	Number of deaths		Men		Women		Total	
		Men	Women	Mortality rate	ASR (95%CI)	Mortality rate	ASR (95%CI)	Mortality rate	ASR (95%CI)
2004	3,636,605	24	21	1.29	1.45 (0.94-1.98)	1.18	1.53 (1.03-2.04)	1.23	1.50 (1.14-1.87)
2005	3,639,990	14	19	0.75	0.86 (0.46-1.25)	1.06	1.41 (0.93-1.89)	0.90	1.12 (0.81-1.43)
2006	3,653,434	13	16	0.70	0.94 (0.56-1.33)	0.88	0.91 (0.48-1.35)	0.79	0.91 (0.63-1.20)
2007	3,695,853	20	27	1.07	0.93 (0.46-1.40)	1.47	1.67 (1.11-2.23)	1.27	1.29 (0.92-1.65)
2008	3,738,273	8	24	0.42	0.37 (0.08-0.67)	1.29	1.37 (0.85-1.89)	0.85	0.86 (0.57-1.16)
2009	3,780,692	13	18	0.68	0.68 (0.30-1.05)	0.95	0.88 (0.44-1.33)	0.81	0.77 (0.48-1.06)
2010	3,823,112	25	25	1.29	1.26 (0.75-1.76)	1.31	1.18 (0.67-1.70)	1.30	1.21 (0.84-1.57)
2011	3,865,531	28	24	1.44	1.34 (0.81-1.87)	1.24	1.32 (0.82-1.82)	1.34	1.33 (0.96-1.69)
2012	3,913,270	25	31	1.26	1.20 (0.70-1.70)	1.59	1.61 (1.05-2.17)	1.43	1.41 (1.04-1.79)
2013	3,961,009	11	27	0.55	0.46 (0.14-0.79)	1.37	1.39 (0.87-1.90)	0.95	0.93 (0.62-1.23)
2014	4,008,749	12	26	0.59	0.60 (0.27-0.94)	1.30	1.37 (0.87-1.87)	0.94	0.99 (0.69-1.29)
2015	4,056,488	20	23	0.97	1.01 (0.58-1.44)	1.14	1.10 (0.64-1.57)	1.06	1.05 (0.74-1.37)
2016	4,104,227	21	25	1.01	0.99 (0.56-1.43)	1.23	1.13 (0.64-1.61)	1.12	1.05 (0.72-1.37)
2017	4,106,802	21	36	1.00	0.98 (0.54-1.41)	1.77	1.61 (1.03-2.19)	1.38	1.29 (0.93-1.65)
2018	4,123,177	30	35	1.43	1.42 (0.91-1.94)	1.72	1.55 (0.98-2.12)	1.57	1.47 (1.09-1.86)
2019	4,147,239	31	53	1.47	1.29 (0.77-1.81)	2.59	2.21 (1.51-2.91)	2.02	1.76 (1.33-2.20)
Average (16-year period)	3,890,278	316	430	0.99	0.98 (0.55-1.41)	1.38	1.39 (0.86-1.91)	1.18	1.18 (0.83-1.52)
P-value for trend				0.057	0.908	<0.001	0.906	<0.001	0.999

Total YLL for MSDs over the 16-year study period was 4,690 (0.14 per 1000 population) in males, 6,852 (0.22 per 1000 population) in females, and 11,542 (0.18 per 1000 population) in both genders combined, with a female/male sex ratio = 1.46. Other disorders of the musculoskeletal system (6,920 with 59.9% of YLL) and people aged 40-49 years (740 for men and 1,185 for women) accounted for the largest number of YLL. Children from 0 to 9 years old were associated with the lowest number of YLL (420 for men and 454 for women) (Table 2, Fig. 2).

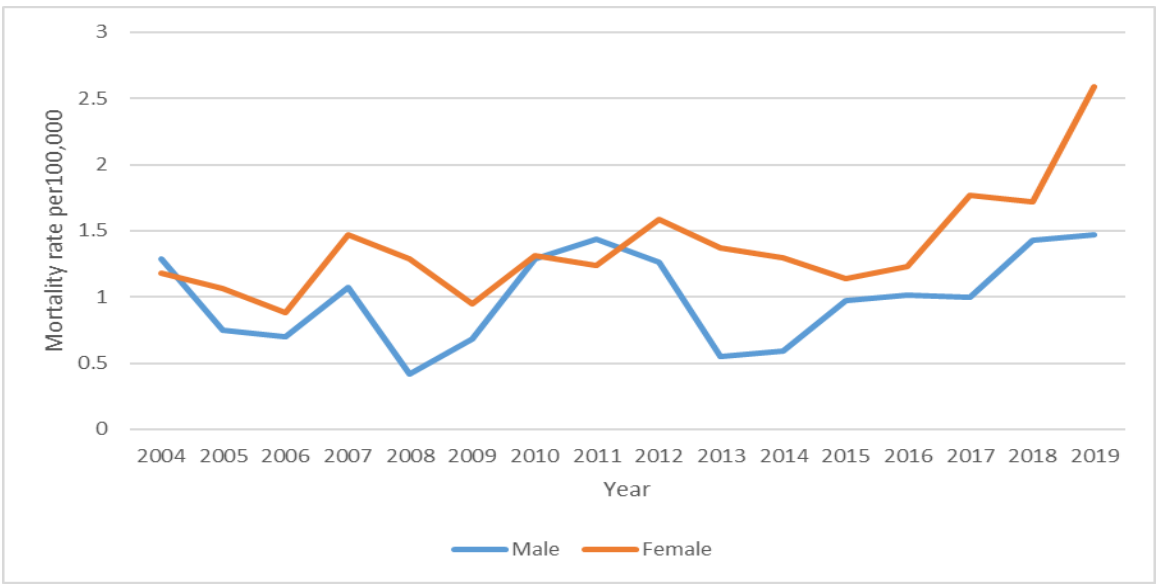

Fig. 1. Mortality rate due to musculoskeletal disorders in Fars province during the years 2004-2019

Table 2. Years of life lost (YLL) by year and mortality caused by MSD in southern Iran, 2004-2019

Year	Systemic lupus erythematosus			Polyarthritis nodosa and related conditions			Systemic sclerosis			Other systemic involvement of connective tissue			Other disorders of the musculoskeletal system			Total
	No. YLL	YLL (%)	Rank	No. YLL	YLL (%)	Rank	No. YLL	Total YLL (%)	Rank	No. YLL	YLL (%)	Rank	No. YLL	YLL (%)	Rank	No. YLL
2004	57	7.2	3	0	0.0	5	80	10.1	2	43	5.4	4	611	77.2	1	791
2005	142	22.2	2	27	4.2	4	26	4.1	5	34	5.3	3	409	64.1	1	638
2006	130	23.3	2	12	2.1	4	35	6.3	3	9	1.6	5	372	66.7	1	558
2007	209	24.8	2	0	0.0	4	0	0.0	4	61	7.2	3	572	68.00	1	842
2008	74	16.2	2	12	2.6	5	16	3.5	4	23	5.00	3	332	72.7	1	457
2009	379	67.4	1	0	0.0	5	10	1.8	3	9	1.6	4	164	29.2	2	562
2010	242	31.1	2	19	2.4	5	93	12.0	3	35	4.5	4	388	50.0	1	777
2011	197	27.1	2	0	0.0	5	78	10.7	3	54	7.4	4	398	54.8	1	727
2012	234	26.0	2	30	3.3	4	80	8.9	3	28	3.1	5	529	58.7	1	901
2013	256	43.5	2	0	0.0	3	0	0.0	3	0	0.0	3	333	56.5	1	589
2014	217	33.1	2	0	0.0	4	0	0.0	4	41	6.2	3	397	60.6	1	655
2015	140	20.9	2	29	4.3	3	23	3.4	4	0	0.0	5	478	71.3	1	670
2016	269	36.3	2	0	0.0	5	50	6.7	3	27	3.6	4	395	53.3	1	741
2017	214	27.6	2	16	2.1	4	16	2.1	4	33	4.2	3	497	64.0	1	776
2018	275	31.8	2	21	2.4	5	33	3.8	3	28	3.2	4	508	58.7	1	865
2019	377	38.0	2	32	3.2	3	22	2.2	5	25	2.5	4	537	54.1	1	993
Total	3412	29.6	2	198	1.7	5	562	4.9	3	450	3.9	4	6920	59.9	1	11542

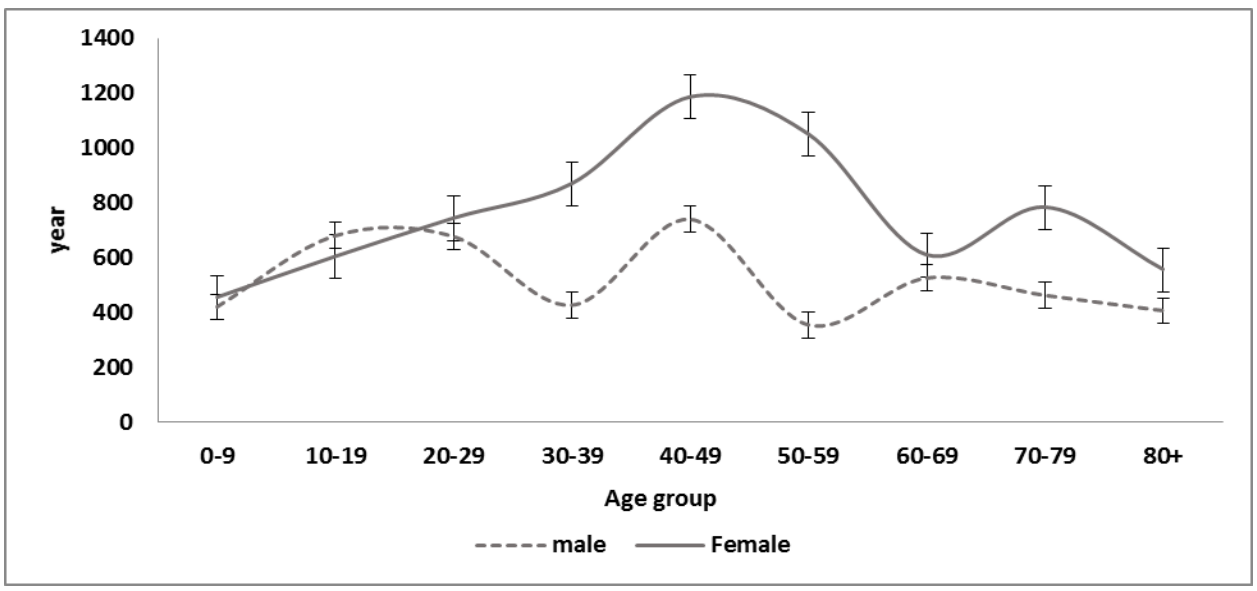

Fig. 2. YLL due to musculoskeletal disorders by sex and age group

Discussion

The current study revealed that YLL from 2004 to 2019 due to premature deaths caused by musculoskeletal diseases in Fars province was 4,690 (0.14 per 1,000 population) in men, 6,852 (0.22 per 1,000 population) in women, and 11,542 (0.18 per 1,000 population) In the total population. Other disorders of the musculoskeletal system (6920 with 59.9% YLL) and 40-49-year-olds (740 for males and 1185 for females) had the highest number of YLL; in the current study, generally significant changes in the number of years lost were observed. Loss of life was not observed due to MSK.

YLL due to MSDs ranked 20th in 1990 and 19th in 2010 and 2019. MSDs ranked first with regards to YLDs for the years 1990-2019 and ranked 12th with regards to DALY for the year 1990, and 7th and 6th in 2010 and 2019, respectively [17]. Shahrezaee et al. showed that the lives of more than 16.5 million people, equivalent to one fifth of Iran's population, are endangered by MSDs [2] because of decreased mortality, aging of the population, and at the same time as rapid urbanization, increased obesity and low physical activity Levels [2-5]. The results suggest that skeletal disorders will have an increasing trend that will continue, especially in low- and middle-income communities [2, 6].

In Mexico in 2019, 4.8 million new cases and 3312 deaths from MSK disorders were reported. MSK disorders, which were ranked second in terms of YLD in 1990, moved to number one in 2019. Among the risk factors, occupational organic factors and high body mass index had the greatest impact on MSK disorders [7]. In Qazvin province, Iran, the rates of death due to MSK for the years 2004-2009 were 0.73, 0.89, 0.89, 1.39, 0.69 per hundred thousand population, respectively [8].

MSKs are responsible for 150 million DALYs or 5.9% of all DALYs and 98.1% of YLDs globally. MSKs in 2019 had a global prevalence of 1516 per million population (869 women, 646 men), incidence rate of 323 per million (182 women, 141 men), YLL of 2.79 per million (1.98 women, 0.815 men), and DALY of 147 per million population (86.7 women, 60.5 men) [9].

Total global YLL progressively decreased from 1990 to 2019 by 1.6% per 100,000 population (0.3% women and 4.5% men), while YLD and DALY increased 0.5% (0.5% women and 0.7% men) and 0.5% (0.4% women and 0.6% men) per 100,000 people, respectively. This result shows that MSDs have a greater impact on disability than on mortality [9]. In a study by Kiadaliri et al., MSDs were listed as the primary reason for death in 0.5% of death certificates, showing fewer mortalities than disabilities due to musculoskeletal disorders [18].

In the current study, the standardized attenuation rate increased from 1.45 per 100,000 males and 1.53 per 100,000 females in 1983 to 1.29 males and 2.21 females in 1998. Moreover, the standardized attenuation rate in the entire population increased from 1.50 per 100,000 people to 1.76 per 100,000 population. Total YLL due to premature death during the 16-year study period was higher in women than men with 4690 (0.14 per 1000 population) men and 6852 (0.22 per 1000 population) women and 11,542 (0.18 per 1000 population) in the overall population. In both sexes, the sex ratio was 1.46 male/female, which was consistent with the results of other studies [10-12]. Kiadaliri et al. in 2016 showed that women suffer a greater burden from MSDs compared to men, with a sex ratio of 1.6 women/men. They also highlighted that ASR was 24.9 in women and 16 in men (per 100,000 people) [18]. A combination of the faster rate of obesity increase, insufficient physical activity, cultural barriers to the active participation of women, and psychological stress in Iranian societies can be put forth as underlying reasons for this result [2, 5, 13]. While the employment rate of the female population has increased in recent years, studies show that most of this increase is attributed to occupations associated with long sedentary hours [2].

The age-standardized evaluation in the current study showed that the age group of 40-49-year-olds followed by the 20-29-year-olds had the highest YLLs due to musculoskeletal disorders, whereas the age group of 0-9-year-olds had the lowest YLL among our study groups. The overall global burden of MSDs is increasing because of the growing number of aging populations [23]. The increase in average age of the world’s population is a major contributing factor that can drive up the numbers of non-communicable diseases such as musculoskeletal disorders; nonetheless, the prevalence of communicable disorders has been decreasing because of better and more advanced healthcare systems and services [23, 24].

In the current study, YLL for other musculoskeletal disorders for the years 2004-2019 ranked 1st across the board among all musculoskeletal disorders. The global prevalence of other musculoskeletal disorders was found to be 453 per 100,000 people (281 women and 172 men). Global YLL due to other musculoskeletal disorders was 1.96 per 100,000 population for both men and women (1.41 for women and 0.550 for men). On the other hand, YLD and DALY for both men and women was higher globally compared to YLL at 38.5 (23.7 in women and 14.8 in men) and 40.4 (25.1 in women and 15.3 in men) per 100,000 population, respectively [16]. Therefore, to reduce the adverse effects of MSDs and their burden on healthcare systems and patients, whether because of disability or mortality, further adjustments in the policies and regulations for vulnerable age groups and populations are recommended.

We carefully checked the data; considering that all death cases are reported to Shiraz University of Medical Sciences Statistics Unit, the possibility of under- or

overcounting is low. Because of the low number of deaths during the study years, a small change in the number of deaths causes a change in the rates. For example, the number of deaths for males was 20 in 2007 and 8 in 2008 and for females was 24 in 2008 and 18 in 2009.

One of the limitations of this study was the use of data from a fluid national registration system, in which the definitions of disorders and their subgroups have changed over the course of the study years. Moreover, the lack of comprehensive research with similar methods and details to the current study made it difficult to compare the current results with those of other relevant studies, thus limiting our ability to extrapolate the results. This is a high-quality study with a strong study design and wide time-period of data analyzed.

Conclusion

Total YLLs between the years 2004-2019 were higher in women than men. The highest YLL due to musculoskeletal disorders occurred in the 40-49 years age group, and the lowest YLL due to MSDs was seen in the 0-9 years age group. Future studies with a focus on global YLLs are recommended.

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Conflict of interest: None declared.

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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 describing this study was reviewed and approved by the ethics committee of Shiraz University of Medical Sciences (reference: IR.SUMS.REC.1399.772).

Authors' Contributions

AH was responsible for the field working including data collection and management and wrote the discussion. AE collected. Data and wrote the manuscript. HJ wrote the manuscript. MA collected data and edited the final version of the manuscript. PE has done the analysis of data and MA wrote the manuscript and edited English language. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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