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Prostate Cancer in Southern Iran: The 16-year Mortality and Years of Life Lost from 2004 to 2019

Habibollah Azarbakhsh[1], Zahra Maleki[2], Seyed Parsa Dehghani[3], Fatemeh Jafari[2], Shahryar Zeighami[4], Alireza Mirahmadizadeh[5*]

1. Ph.D. in Epidemiology, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran.
2. Ph.D. in Epidemiology, Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran.
3. Medical Doctor, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.
4. Associate Prof., Dept. of Urology, School of Medicine, Shahid Faghihi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran.
5. Associate Prof., Non-Communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

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*** Corresponding author:**
Alireza Mirahmadizadeh,
E-mail:
mirahmadia@sums.ac.ir

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Abstract

Background: As of 2020, prostate cancer is the fifth most common cause of fatalities due to cancer in males and is also the second most common type of cancer overall. The purpose of this study was to look into the patterns of prostate cancer-related mortality and years of life lost (YLL) in the province of Fars.

Materials and Methods: Data on all prostate cancer-related fatalities in the province of Fars were gathered for this cross-sectional investigation via the electronic population-based death registration system (EDRS). We calculated the crude mortality rate, age-standardized mortality rate (ASMR), years of life lost (YLL), and YLL rate. The JoinPoint Regression method was used to analyze the patterns over time.

Results: During the 16-year study period from 2004 to 2019, there were 1,836 deaths from prostate cancer in Fars province. The crude and standardized mortality rates showed an increasing trend over this period. The total number of years of life lost (YLL) due to prostate cancer during these 16 years was 15,785. The highest number of YLL occurred in the age group of 70-79 years, while the lowest was observed in individuals under 30. According to join point regression analysis, the YLL rate due to premature mortality increased over the 16 years, with an annual percent change (APC) of 2.3% (95% CI 0.2 to 4.4, p=0.034).

Conclusion: Prostate cancer-related death and YLL are on the rise, according to the study's findings. Therefore, it is necessary to improve diagnostic and therapeutic measures; more studies in this field are also recommended.

Keywords: Prostate Cancer, Mortality Rate, Years of Life Lost, Regression, Iran.

Introduction

Cancer is a general name for a large group of diseases. The main commonality between them is the uncontrolled growth of cells [1]. Mortality rates and the burden of cancer are rapidly increasing worldwide. The causes of this increase include changes in the incidence and distribution of the primary risk factors for cancer, population aging, and overall population growth. A large number of these risk variables are associated with economic and social growth [2, 3]. According to GLOBOCAN 2020 estimates, overall cancer incidence in post-transition countries was 2- to 3-fold higher for both sexes compared to transition countries, while the death rate for men was less than two times, and for women, it was low. Globally, there will likely be 28.4 million cancer cases by 2040, a 47% increase from 2020. If risk factors rise, the disease may improve [4].

In 2020, prostate cancer was the second most prevalent type of cancer overall and the fifth most common cause of cancer-related deaths among men [4]. Each country

presents different prevalence, incidence, and mortality rates due to several factors, including measuring PSA as a screening test. The latter helps detect prostate cancer even in its early stages [5]. For example, Incidence rates vary by area, ranging from 6.3 to 83.4 per 100,000 men [4]. Prostate cancer mortality rates have declined since the mid-1990s in most high-income countries [6, 7], likely reflecting advances in treatment and early detection through increased screening [8]. Despite progress, the incidence of prostate cancer continues to rise in many developing countries, including Iran [9].

To provide a clearer understanding of mortality trends among young patients, years of life lost (YLL) has emerged as a metric that emphasizes deaths occurring at a younger age more significantly than those in older populations [10]. According to a global study, in 2020, 3.5 million years of life were lost to prostate cancer in men over 50, and 40% of YLL was in people over 75 [11]. Prostate cancer is the fourth most common cause of cancer-related fatalities in men, accounting for 324 deaths, or 10% of all cancer-related deaths in this cohort, according to an Iranian study. Furthermore, from 11.46 cases per 100,000 men in 2005 to 25.67 cases per 100,000 men in 2020, Iran's prostate cancer incidence has increased dramatically over the last ten years [12]. The crude death rate per 100,000 population rose from 4.7 in 2001 to 8.8 in 2010 [13]. Besides, Askari Tajabadi et al. reported that Iran's 5-year prostate cancer survival was equal to 49.3% [14].

There isn't a specific study that examines the number of years of life lost in Fars province as a result of prostate cancer at the moment. Thus, the purpose of this study is to investigate the patterns in the years of life lost (YLL) and mortality rates from prostate cancer in Fars province, Iran, during a 16-year period.

Materials and Methods

This cross-sectional survey was conducted in Fars Province from 2004 to 2019. We obtained data on all prostate cancer fatalities from the population-based Electronic Death Registration System (EDRS) using the ICD-10 coding system, organizing the information by age, sex, and year of death. The specific code used for this study was C61. All accessible sources were used in the population-based EDRS to identify, document, and gather data about deaths [15]. Inclusion criteria include certain deaths due to prostate cancer and being a resident of Fars province, and exclusion criteria include removing repeated deaths based on the similarity in the father's name and national identification number and cases where the age at death was not known or had. Insufficient details Data from health facilities and the population and housing censuses carried out between 1996 and 2016 have been used to estimate the total population of Fars province. This assessment takes into account the annual population growth. The 2013 standard population figures for low- and moderate-income countries were used for standardization. Initially, crude and age-standardized mortality rates (ASMR) for prostate cancer were calculated based on the year of death during the study period.

We then used a standard life table to evaluate life expectancy for different age groups in order to calculate Years of Life Lost (YLL). This required taking into account how many people in each age group died from prostate cancer. The following relationship was used in the computations [16].

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: is the number of deaths in a certain age and sex.
L: is the standard life expectancy of the deceased at the same age and sex.
r: is the Discounting Rate, which is equal to 0.03.
β: is the contractual rate in calculating the age value, which equals 0.04.
C: is an adjusted fixed value equal to 0.1658.
a: is the age at which death occurred, and e is a constant and equal to 2.71

Excel 2016 was used to analyze the years of life lost (YLL) due to early mortality from prostate cancer using the World Health Organization's (2015) YLL template. Next, joinpoint regression was used to look at patterns in YLL and death rates. This technique pinpoints the years when trends shift. It calculates the annual percentage change (APC) in rates between these trend change points and estimates the average annual percentage change (AAPC) throughout the study's period [17]. Unlike linear regression, which focuses on the slope, log-linear regression is based on the concept of Average Percentage Changes (APC). [18]. Trend analysis was performed using the Joinpoint 4.9.1.0 regression program.

Results

Prostate cancer claimed 1,836 lives in Fars province over the course of the 16-year study, which ran from 2004 to 2019. The age group over 80 had the greatest death rate, while the age group under 30 had the lowest (Fig. 1).

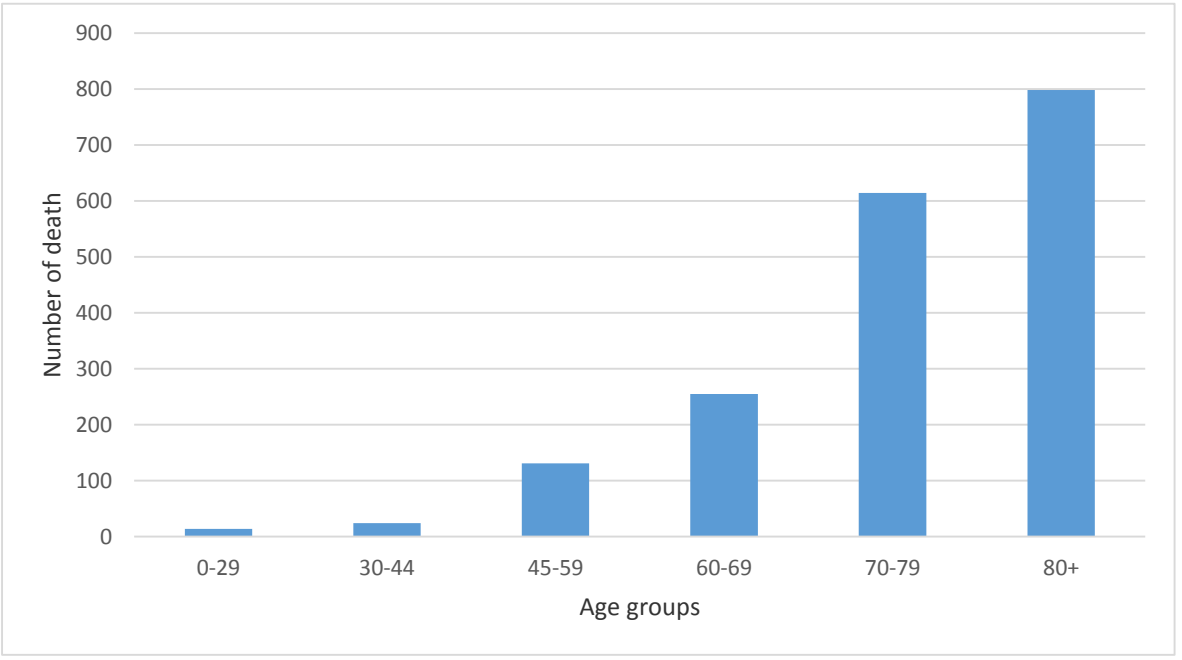

Fig. 1. Number of deaths from prostate cancer by age group

The crude mortality rate from prostate cancer increased from 3.2 per 100,000 population in 2004 to 6.5 per 100,000 in 2019 (p for trend < 0.001), as indicated in Table 1. Comparably, the standardized mortality rate rose from 3.9 per 100,000 in 2004 to 6.1 per 100,000 in 2019 (p for trend = 0.025) (Table 1).

Table 1. Prostate cancer-related years of life lost by year in Fars province from 2004 to 2019 as well as the crude and standardized death rate (per 100,000 people)

Year	No. death	Crude mortality rate	ASR (95%CI)	No.YLL	YLL per 1000
2004	60	3.2	3.9 (3.1-4.8)	549	0.3
2005	68	3.7	5.1 (4.2-6.0)	682	0.4
2006	76	4.1	4.7 (3.8-5.6)	697	0.4
2007	103	5.5	6.0 (4.9-7.0)	874	0.5
2008	105	5.6	6.0 (5.0-7.1)	962	0.5
2009	113	5.9	6.4 (5.3-7.5)	955	0.5
2010	125	6.5	6.2 (5.1-7.3)	1099	0.6
2011	126	6.5	5.7 (4.5-6.8)	979	0.5
2012	113	5.7	5.8 (4.8-6.8)	1364	0.7
2013	108	5.4	4.8 (3.8-5.8)	858	0.4
2014	130	6.4	6.0 (4.9-7.1)	1055	0.5
2015	148	7.2	6.8 (5.7-6.9)	1163	0.6
2016	136	6.6	6.0 (4.9-7.1)	1091	0.5
2017	166	8.0	7.3 (6.1-8.5)	1334	0.6
2018	123	5.9	5.5 (4.4-6.5)	1010	0.5
2019	136	6.5	6.1 (5.0-7.2)	1113	0.5
Total	1836	5.8	5.9 (5.6-6.2)	15785	0.5
P value	-	<0.001	0.025	-	0.034

Temporal trends of prostate cancer mortality by age groups: In the age groups 0–44, 45–59, and 60–74, the prostate cancer mortality rates showed stable trends, with an Annual Average Change in Percentage (AACP) of -2.2% (P = 0.751), 9.5% (P = 0.221), and -0.4% (P = 0.722), respectively. However, there was an increasing trend in the age group of 75 and older, with an AACP of 3.0% (P = 0.017). Prostate cancer was responsible for 15,785 years of life lost (YLL) throughout the course of the 16-year study period, or 0.5 YLL per 1,000 persons. Those aged 70 to 79 had the greatest life loss, while those under 30 had the smallest (Fig. 2).

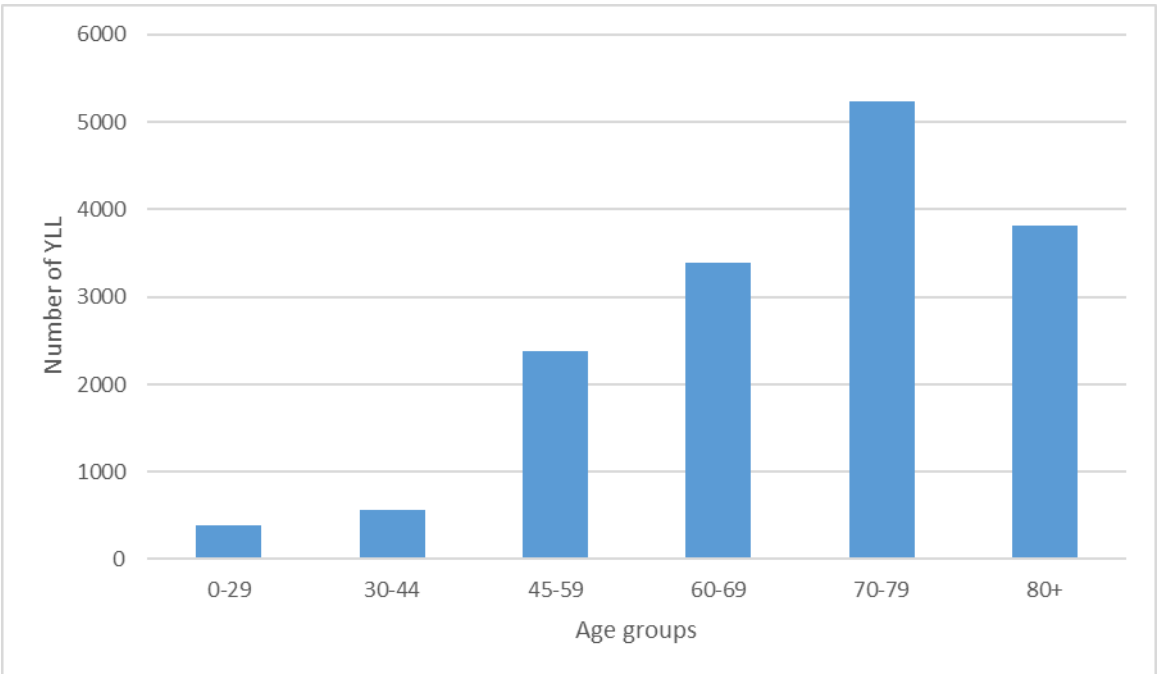

Fig. 2. Years of life lost due to prostate cancer by age group

The annual percent change (APC) was 2.3% (95% CI 0.2 to 4.4, p=0.034), indicating an upward tendency in the 16-year trend of the YLL rate attributable to early mortality, according to the join point regression analysis. The average annual percentage change, or AAPC, is equal to the APC because the model did not display a join point (Fig. 3).

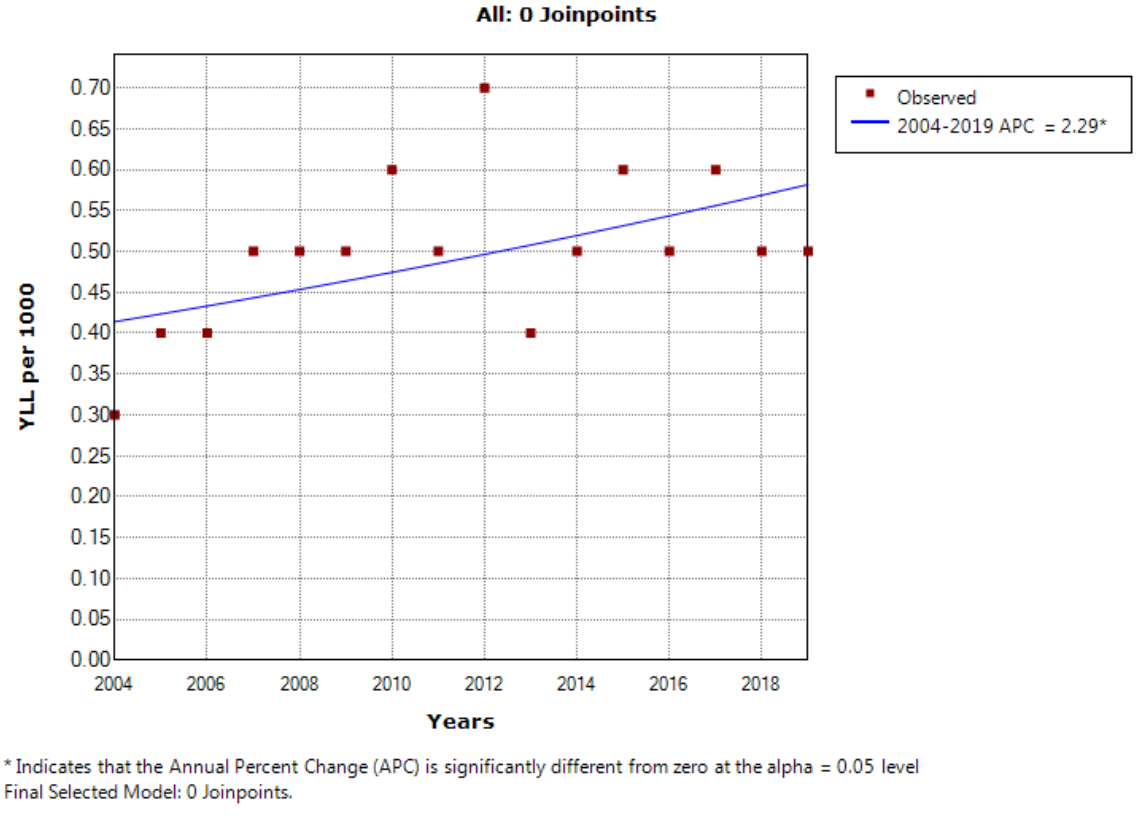

Fig. 3. The trend of the number of years of life lost due to prostate cancer during the years 2004-2019

Discussion

One of the most prevalent cancers in men is prostate cancer, which varies in prevalence depending on the location of Iran. The purpose of this study was to ascertain the prostate cancer death rate and years of life lost in southern Iran during a 16-year period. The findings revealed a rising trend in prostate cancer mortality during the study years. Additionally, the mortality rate for this cancer increased with age, with the highest rate observed in the 80-year age group [19]. Factors contributing to this increase may include an aging population, advancements in diagnostic methods

and screening, changes in diet and lifestyle, and improved access to healthcare. Thus, the rise in cancer cases may reflect enhanced diagnosis rather than an actual increase in incidence [20, 21]. The study by Rafi Menesh and colleagues also concluded that the death rate from prostate cancer had increased from 2.67 per 100,000 people in 2015 to 3.24 per 100,000 people in 2019. The analysis of mortality during the studied years shows that the rate of prostate cancer in men increases significantly with advancing age [22]. Mousavi et al. investigated the incidence and mortality rate of cancers in Iran in 2003-2006 and reported the standardized death rate in men for prostate cancer in 2003-2005 to be 5.70, 7.24, and 9.41, respectively [23]. These studies, like the present study, show an increasing trend of mortality in the past years for prostate cancer. These results are consistent with our study. Furthermore, the study's death rate agrees with comparable worldwide estimates for developing and underdeveloped areas [10]. The study by Ferlay and colleagues estimated the age-standardized death rate for prostate cancer to be 7.5 in the world, and in 1997, the death rate was reported as 15.9 cases per hundred thousand men [24, 25]. In studies conducted around the world, the death rate from prostate cancer is increasing in Asian and African countries (as opposed to Western countries) [25, 26]. The present study also confirms an increasing trend in southern Iran. The studies of Jemal and his colleagues have found prostate cancer death to be the second cause of cancer death in men, and in terms of age groups, the age groups of 60-79 years and above 80 years are among the five main causes of cancer death in men. According to the current study, among men's cancers, prostate cancer has the highest death rate among those aged 70–79 and more than 80 [9, 27]. Therefore, deaths caused by prostate cancer according to age groups in this study are consistent with other studies conducted in Iran and the world. It is possible that increasing age and decreasing the immune system in the elderly may lead to faster disease progression and increased mortality rates. In addition, older adults commonly have other chronic conditions, such as diabetes, heart disease, and lung problems, that can complicate the management and treatment of prostate cancer. Also, physiological and hormonal changes in the body of elderly people may have a negative effect on the progress and severity of prostate cancer [28, 29].

A systematic review conducted in 2018 was also in keeping with the current study's findings. This review study concluded that this cancer is known as the most prevalent cancer in males in Europe and America and the second most common cancer in men globally. An estimated 1.1 million men worldwide have this cancer, with approximately 70% of these cases occurring in developing regions. Nearly 42% of cases of this cancer occur in men over 50 years of age, and it is often seen after the age of 60. The highest death rate associated with prostate cancer was observed in the African-American community, with an ASR of 137 per 1,000,000 and a global incidence of 25.3 per 100,000. This rate is around 60 times higher than the rate recorded in China's Shanghai region, which has the lowest rate globally (2 per 100,000) [30]. This cancer also has a different geographic distribution. The infection rate is lower in Asian nations—including Iran—than in Western nations. In addition to other factors including diet, lifestyle, genetics, environment, race, smoking, physical activity, and cancer registry systems, this disparity may result from variations in access to screening tests like the prostate-specific antigen (PSA) test [31, 32].

Also, a 2018 study by Junior Smith Torres-Roman and colleagues found that in the period from 2005 to 2009, the death rate from prostate cancer was 20.9 per 100,000 men. This rate has increased to 24.1 from 2010 to 2014, representing an increase of 15.2 percent. Also, the analysis shows that from 2005 to 2014, there was an increase in mortality in coastal areas and a decrease in forest and rainy areas. In Peru, the death rate from prostate cancer continues to rise. Consequently, this outcome is in line with our study's findings [33].

Among other results of this study, the highest number of years of life lost due to prostate cancer was related to the age group of 70-79 years. This finding was also consistent with the results of the Diana Withrow and Burnet studies in 2022. This study showed that 40% of years of life lost (YLL) were associated with people over 75. Over the past two decades, YLL rates have increased in many Asian and African countries while decreasing in North American and European countries. By 2040, the number of YLLs is projected to double globally to 7.5 million people, with the largest increase in Africa, Asia, Latin America, and the Caribbean [34, 35].

According to studies conducted based on data from the World Health Organization, the death rate for European and Western countries is higher than in Asian and African countries [36]. Studies have shown that screening by PSA test in men at risk with the diagnosis of prostate cancer in the early stages reduces the mortality caused by this cancer [37]. Therefore, the presence of a screening program in Iran will be able to change the trend of increasing mortality due to prostate cancer by diagnosing and treating cases quickly. The study by Bouchardy et al. found the positive role of PSA testing in reducing prostate cancer mortality in the United States. Although it is mentioned in this study that this reduction in mortality can be due to length bias and detection of low-risk tumors by screening [37]. Other studies have also shown that screening at-risk populations (men over 40 years old) is effective in reducing prostate cancer mortality [38, 39].

One of the limitations of this study is that it was conducted in one of the provinces of Iran. Therefore, the

results of this study cannot be generalized to other regions of Iran. One of the strengths of this study is the wide period and large sample size.

Conclusion

This study indicates a significant increase in the crude and standardized mortality rate due to prostate cancer in the 16 years in Fars province. While mortality rates were stable for younger age groups, a significant increase was observed in the 75+ age group. Total years of life lost due to prostate cancer represent a significant impact of the disease on public health, particularly among older adults. Joinpoint regression analysis further confirms an increasing trend in premature mortality rates. These findings emphasize the need for targeted interventions and improved healthcare strategies to address prostate cancer mortality, particularly among the elderly.

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Conflict of interest

None declared.

Funding

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 Shiraz University of Medical Sciences (SUMS) Ethics Committee examined and approved the study's protocol (code: IR.SUMS.REC.1399.772). The ethical code of SUMS was followed in every stage of this investigation.

Authors' Contributions

Habibollah Azarbakhsh: Was responsible for the field working including data collection and management and wrote the discussion; Zahra Maleki: wrote the manuscript and edited English language; Seyed Parsa Dehghani: has done the analysis of data; Fatemeh Jafari: collected Data and wrote the manuscript; Shahryar Zeigham: wrote the manuscript and edited 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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