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Original Article

Incidence, Mortality, and Burden of HIV/AIDS and Its Geographical Distribution in Iran during 2008-2016

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Abstract

Background: This study aimed at estimating the incidence, mortality, burden, and geographical distribution of HIV/AIDS in Iran at national and provincial level during 2008-2016.

Methods: We applied the Disability Adjusted Life Years (DALYs) index to assess the burden of HIV/AIDS on the basis of Years of Life Lost (YLLs) and Years Lived with Disability (YLDs). We used the Iranian life table of 2016 for treated and a fixed figure of 8 years as remaining length of life in untreated patients, 0.03 as discount rate, and 0.504 as disability weigh in both treated and untreated cases. The primary data was obtained from HIV/AIDS surveillance system.

Results: The incidence of HIV/AIDS increased from 4440 cases in 2008 to 4928 cases in 2016. The mortality rate was 259 and 288 cases in 2008 and 2016, respectively, which was always higher among males than females. The burden of HIV/AIDS increased from 26231 DALYs in 2008 to 29114 DALYs in 2016. In addition, the population-adjusted burden of HIV/AIDS was not equally distributed among different provinces of Iran, and it was more concentrated in western regions of the country during the studied period.

Conclusion: Although the trend of the national burden of HIV/AIDS did not change significantly over the past decade, it was alarming especially among males and among people living in some provinces such as Kermanshah, Lorestan, Hormozgan, and Tehran.

Keywords: AIDS; HIV; Disability-adjusted life years; Burden of disease, Iran

Introduction

HIV/AIDS epidemic continues to be one of the most important public health problems in the world. The disease changed from a relatively small threat in the 1980s to a major cause of mortality in the last decade (1, 2). In 2016, the population of patients living with HIV was about 37 million worldwide, and more than a million people died in the mentioned year due to HIV/AIDS-related causes (3). Now, with the improvements in people's access to health ser-

vices and treatments, the rate of global mortality due to HIV-related factors is declining; for instance, it decreased by about 43% between 2003 and 2015 (4). Moreover, the number of new cases of HIV infection dropped by about 39% between 2000 and 2016. These achievements are largely due to increased coverage of services, improved access to antiretroviral drugs, reduced incidence, increased coverage of the prevention of mother-to-child transmission(PMTCT) program, extensive nation-wide efforts supported by the civil society, and a wide range of international collaborations to tackle HIV/AIDS (3,5).

Based on UNAIDS-recommended models, there were 75700 people infected with HIV in Iran in 2014 (Mar 2014-Mar 2015), of which 55,000 were male and 20,700 were female. The new HIV-infected cases were estimated to be 8190 cases in 2014 (5570 males, 2620 females). The trend of new cases was ascending in female population and descending in male population (6).

Despite the increasing contribution of non-communicable diseases to the global burden of diseases and injuries, the share of HIV/AIDS in the global burden of diseases has decreased over recent years. In spite of a decline in HIV/AIDS mortality rate in recent years, DALYs caused by HIV/AIDS ranked fifth among the leading causes of the burden of diseases worldwide (5, 7).

The international agencies are committed to tackleHIV/AIDS epidemic as a global threat by 2030. The Sixty-ninth World Health Assembly approved the "Global Health Sector Strategy on HIV" for 2012-2016. The strategy includes five strategic goals that introduce the priority measures to be adopted by countries and the WHO over the next 6 years. These five strategic goals include: strengthening and focusing on national HIV programs and plans through sound strategic information and good governance; designing a package of effective interventions; equity in providing services to cover different areas and populations (to cover populations in need); providing sustainable funding (service cost coverage) and innovation to accelerate progress. The vision of this strategy is zeroing new HIV infections and mortality and its goal is to end HIV/AIDS epidemic as a global threat by 2030. The targets of this strategy by 2020 is to reduce new HIV-infected cases to less than 500,000, zeroing new HIV-infected cases in infants, reducing HIV-related mortality to less than 500,000 individuals and raising the awareness of 90% of HIV-infected people about their disease (3,4).

Measuring the burden of diseases is now a basis for prioritizing diseases and interventions in health systems. Therefore, measuring the burden of HIV/AIDS provides an opportunity to set the disease as an agenda for policy makers in the health system to attract their attention and elicit an appropriate response (5). Measuring the burden of HIV/AIDS at the national and local levels will help to understand the importance of the epidemic and change its time trend. It helps into locate areas in which the disease acts as a health threat to people. It also makes interventions more targeted. In addition, measuring the burden of the disease can help to assess the interventions over time (8-12).

Therefore, we aimed at using the data on HIV/AIDS obtained from national HIV/AIDS surveillance system and the UNAIDS reports to calculate the burden of HIV/AIDS at the national and provincial levels and track the changes between 2008 and 2016 in order to better understand the epidemiology of the epidemic. The surveillance system is administrated by the universities of medical sciences across the country, however, the results of case finding activities performed by various universities are not of the same quality.

Methods

We applied the WHO's methodology to calculate the burden of HIV/AIDS using the DALYs index, as described elsewhere. DALYs is calculated by adding the years of life lost (YLLs) due to premature death to the years lived with disability (YLDs) (13). YLDs value was obtained by multiplying the annual incidence of HIV/AIDS by the mean duration and the disease disability weight. In addition, to measure YLLs, we multiplied the

number of occurred premature death in discounted lost years calculated as difference of standard life expectancy from age of death. YLD and YLL indices were measured separately for both sexes and different age groups. The only exception was the first age group divided into two groups of <1 and 1-4 yr (13). The average age of each age group was calculated as the age of death for patients who died of AIDS; however, based on the WHO's recommendation, the average age of death was considered to be 0.1 and 2.6 yr for 0-1 and 1-5 age groups, respectively.

HIV/AIDS patients were classified into the two groups of treated and untreated patients. Those with a positive response in one of the antibody, antigen, and/or measurement tests were diagnosed as HIV/AIDS patients. The sources of data were different. The epidemiological data such as incidence, prevalence, and mortality of HIV/AIDS was obtained from unpublished national surveys and an unpublished report conducted by the AIDS office in the Ministry of Health and Medical Education in 2016. The data collected by the HIV/AIDS surveillance system was used to determine the age, sex, geographical, and time variations in the distribution of the disease over the studied time. The HIV/AIDS surveillance system electronically records the data on positive cases detected by the healthcare centers in all provinces of the country, but it does not have acceptable coverage, yet. For treated patients, we used the Iranian life table of 2016 and for untreated cases, we considered 8 yr as the remaining length of life. The data on natural course of the HIV infection was obtained from Porter et al.'s study (14).Based on a study (15), the disability weight for both treated and untreated cases during the disease was set at 0.504. Finally, the data on the population of the country (as a whole and in each age group) was obtained from the Statistical Centre of Iran. A discount rate of 0.03 was used over the future years to consider the time preferences (5).

As compared with the data reported by the UNAIDS, the HIV/AIDS surveillance system has only recorded 28% of all cases (16). Hence, to correct the data collected by this national information system, the data was multiplied by 3.57. This method of correction enabled us to determine the HIV/AIDS incidence and mortality rates over the studied years in all the provinces.

The distribution of the burden of HIV/AIDS was calculated and presented by sex, age, time, and place (all provinces). To present the geographical distribution of the disease burden, we used the GIS software package of ArcGIS (ver. 9.1). All the collected data was analyzed by Excel software (Microsoft Windows 10; Microsoft Corporation). Given the significant uncertainty about the incidence of the disease, a sensitivity analysis was carried out for lower and upper limits of 95% confidence interval, which provided different DALYs values.

Results

The total burden of HIV/AIDS increased from 26231 DALYs in 2008 to 29114 DALYs in 2016; of all, about 69% is related to untreated cases and the remaining is related to treated cases. The burden of HIV/AIDS among males is higher than among females. The incidence of the disease during the same period of time changed from 4440 to 4928 cases annually. The rate of mortality from HIV/AIDS was higher among males than females, with an average value of 82.5% (Table 1).

In general, the incidence of HIV/AIDS increased during the studied years. This increase was very moderate and stable among the female population. The trend of the disease among the male population was ascending by 2013, however, it became descending in the following years (Fig. 1).

Figure 2 indicates the higher rate of HIV/AIDS-related adjusted mortality among males. However, unlike females who had almost the same mortality rate over the studied years, male mortality rate had raised slightly in the early years, but it started declining since 2012. The overall adjusted mortality rate also changed with a similar trend. All the deaths were attributed to untreated HIV/AIDS. The average burden of HIV/AIDS disease did not change significantly. The changes in the burden of the disease in both sexes were quite symmetrical (Fig. 3).

Table 1: Incidence, mortality, and burden of HIV/AIDS by sex during 2008-2016

Year	*Incidence in males*	*Incidence in females*	*Mortality in males*	*Mortality in females*	*DALY - males*	*DALY - males*	*Overall DALY*	*DALY per 1000 individ-uals*	*Overall DALY for lower limit of 95% CI*	*Overall DALY for upper limit of 95% CI*
2016	3771	1157	234	54	19506.1	9607.5	29113.6	0.36	27942.1	30285.2
2015	3864	1154	239	55	18676.6	10968.8	29645.4	0.37	28473.8	30816.9
2014	3965	1153	243	56	21770	8466.1	30236.1	0.38	29064.6	31407.6
2013	4064	1149	248	57	21250.2	9547.2	30797.4	0.40	29625.6	31968.9
2012	4175	1146	253	58	22319.1	9116.3	31435.4	0.41	30263.9	32606.9
2011	4049	1076	244	56	21497	8780.5	30277.5	0.40	29106	31449
2010	3779	975	226	52	20502.5	7583.2	28085.7	0.39	26914.2	29257.2
2009	3649	890	216	49	17966.4	8849.1	26230.6	0.38	25644	27987
2008	3605	835	211	48	16525.3	9705.3	26230.6	037	25059.1	27402

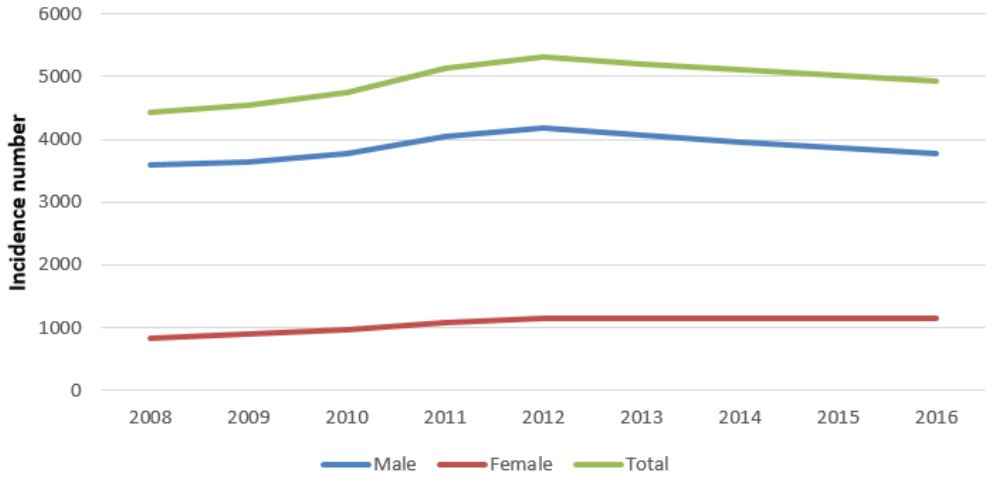

Fig. 1: Time trend of changes in the incidence of HIV/AIDS by sex during 2008-2016

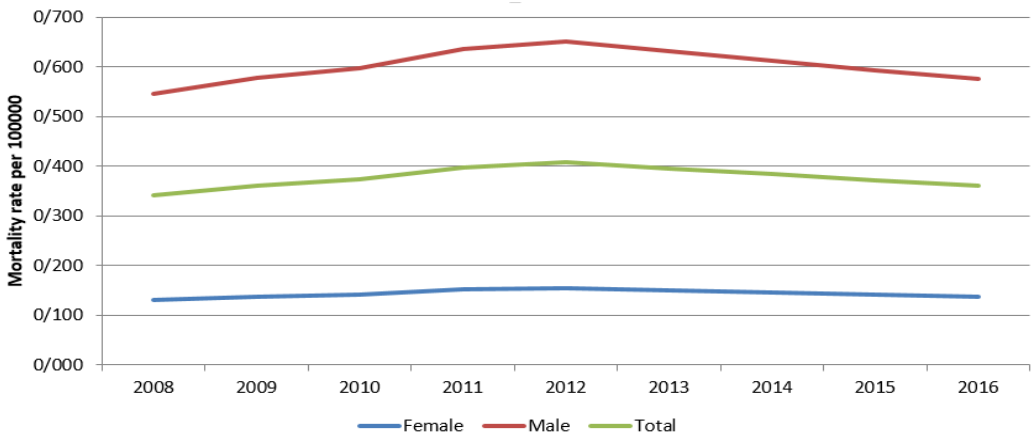

Fig. 2: Time trend of HIV/AIDS mortality by sex during 2008-2016

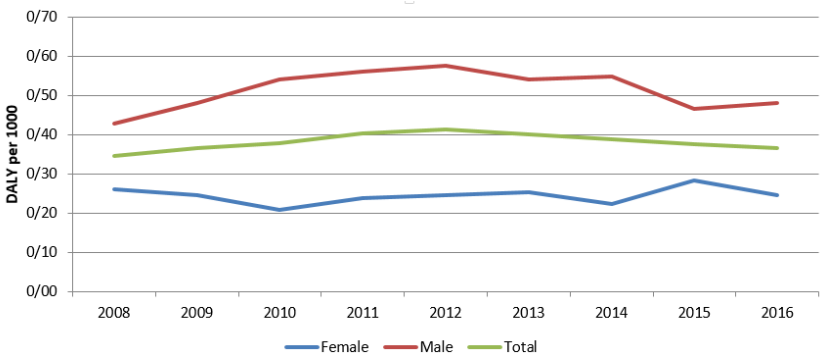

Fig. 3: Time trend of changes in the burden of HIV/AIDS (DALY) by sex during 2008-2016

The largest share of HIV/AIDS burden was attributed to YLLs due to premature death caused by the disease that decreased from 67% to 60% during the studied time. The highest level was observed at 70% in 2013 (Fig. 4).

The highest burden of HIV/AIDS in 2016 was observed in 30-45 age group, and the lowest burden was observed in 0-14 and >60 yr age groups. This was true for both components of the burden of the disease, i.e. YLLs and YLDs (Fig. 5).

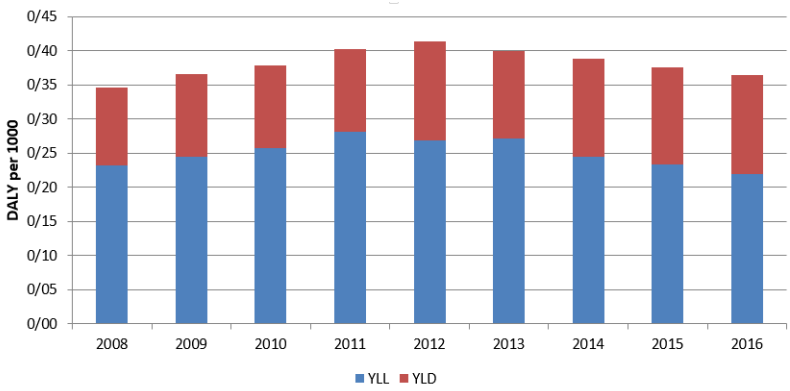

Fig. 4: Share of YLL and YLD in the burden of HIV/AIDS during 2008-2016

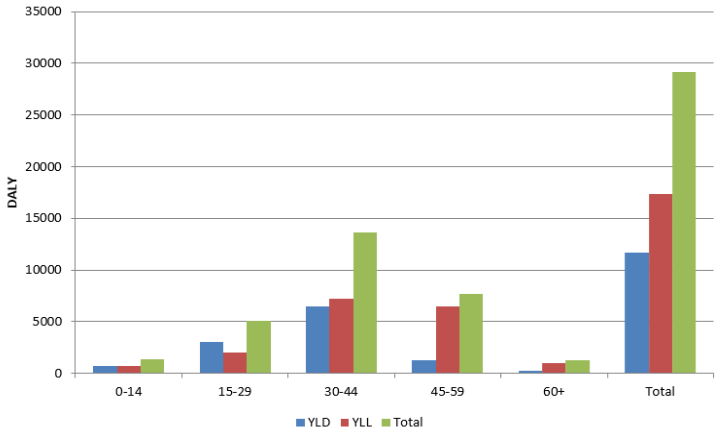

Fig. 5: Share of YLL and YLD in the burden of HIV/AIDS by different age groups in 2016

In 2008, the lowest burden of the disease was reported in Golestan (0.07 DALY per 1000 population), Ilam, and Kerman provinces (0.15 DALY per 1000 population), and the highest burden was reported in Tehran (0.63 DALY per 1000 people), Kermanshah (0.57 DALY per 1,000 people), and Lorestan (0.91 DALY per 1,000 people) (Fig. 6).

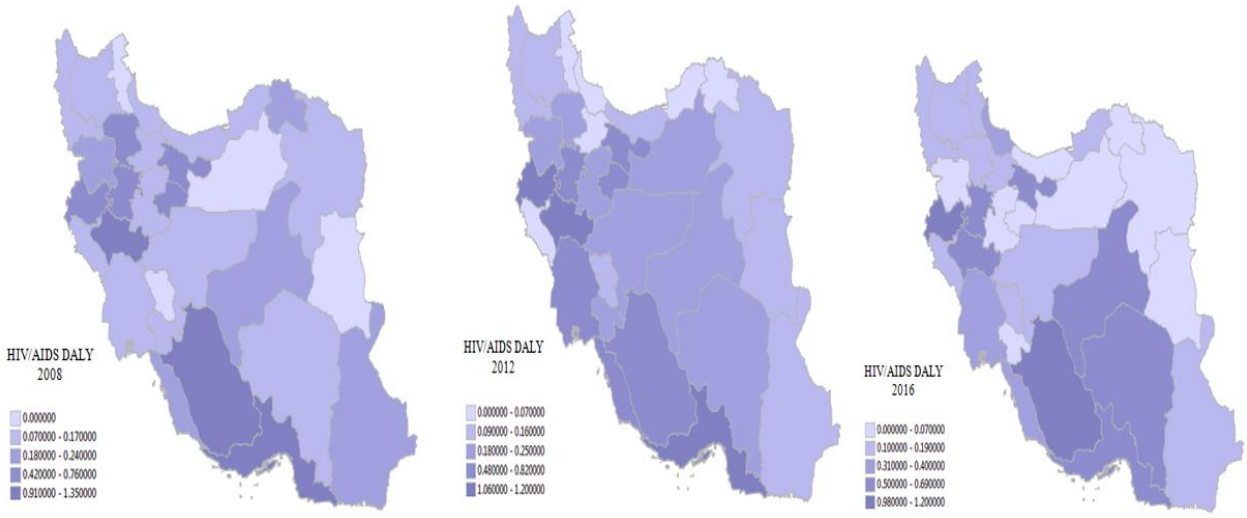

Fig. 6: Geographical distribution of the adjusted burden of HIV/AIDS per 1000 population in 2008, 2012, and 2016

In 2016, the highest burden of the disease was observed in Kermanshah (1.2 DALY per 1000 people), Lorestan (1.07 DALY per 1000), and Hormozgan (1.06 DALY per 1000). In 2016, the lowest burden of the disease was in observed in Kohgiluyeh and Boyer-Ahmad, Southern and Northern Khorasan, Markazi, Semnan, and Qom, and the highest burden of the disease was observed in Fars (1.2 per 1000), Tehran (0.69 per 1000), and Kermanshah (0.98 per 1000 population).

Discussion

The present study investigated the data collected over a 9-year period to determine the trend of HIV/AIDS burden, identify its geographical distribution, and evaluate the performance of the HIV/AIDS surveillance system in Iran. Although the raw number of mortality, incidence, and burden of HIV/AIDS increased during 2008-2016, the population-adjusted rates of mortality and burden of the disease remained relatively constant over the studied years. The increase in raw values of the HIV/AIDS incidence and mortality over the studied years can be attributed to the improvements in data registry and diagnosis system, changes in the pattern of HIV/AIDS transmission (from shared-injection among addicted people to unprotected sexual behaviors), social issue such as increased age of marriage, unemployment, and inadequate training on the prevention of HIV/AIDS, especially among 15-45 yr age group who are more at risk of the disease than others (17-19). This increase in HIV/AIDS incidence and mortality resulted in an increase in the economic burden of the disease among Iranian people.

Males always had a larger share of mortality and disease burden associated with HIV/AIDS. Although the majority of patients with HIV/AIDS were males in the past, nowadays the rate of HIV/AIDS incidence is rising more rapidly among females and young women are more at risk. In other words, the change in the pattern of the disease transmission in recent years (from shared-injection in drug-addicts to sexual behaviors) can justify the increase in the incidence and the burden of the dis-

ease among women (20). As another strong reason, many HIV-positive women without a history of high-risk behaviors are infected by their husbands (21); it highlights the importance of training for HIV-positive people about the routes of HIV/AIDS transmission and about the importance of the condom use. Over 60% of Iranian youth did not have enough knowledge about the diseases; thus, there is a need for a comprehensive training program to be implemented in high schools and universities (22, 23).

Although YLL has the highest share in HIV/AIDS burden (except for 15-29 yr age group), its share has dropped by 7% since 2011. However, the incidence of the disease increased during the studied time. The decrease in the trend of HIV/AIDS mortality and YLL can indicate the relative effectiveness of the case finding activities and the free treatment policies of the Ministry of Health and Medical Education implemented for tackling HIV/AIDS disease. The Global Burden of Diseases (GBD) study showed that only 5.3% of the HIV/AIDS's DALYs worldwide were due to YLDs and the remaining 94.7% were attributed to YLLs (5).

The data collected from 2012 to 2016 revealed that antiretroviral treatments increased from 13% to 16.7% for males and from 19.7% to 25.1% for females; however, most of patients suffering from HIV/AIDS disease still do not have timely access to the needed treatments.

The provinces of Kermanshah, Tehran, Fars, Hormozgan, and Lorestan have the highest population-adjusted burden of HIV/AIDS, which seems to be due to a high number of drug abusers in these provinces; there is always a high positive correlation between these two variables (24, 25).

To the best of our knowledge, very few studies in the world have specifically and independently measured the burden of HIV/AIDS and almost all of what we know about the burden of this disease in different countries is coming from the Global Burden of Diseases (GBD) studies. The burden of the disease in this study is more than two times higher than the burden of the disease in Iran reported by the GBD Study in 2016; it may be attributed to differences in data sources and methods of estimations. This study used vital registration data to correct the values for the incidence of the disease, while the GBD study for Iran used the data collected by UNAIDS and published demographic studies. Moreover, the use of a similar method of modeling for different countries in the GBD study can lead to a bias in estimations. Because of the difference in data sources, the mortality and incidence reported by the GBD study in 2016 were 217 and 1726 cases, respectively, while they are far lower than those reported in the present study. Moreover, as compared with a study in Brazil, the rate of HIV/AIDS burden in Iran (36 DALYs per 100,000 people) is much lower than its burden in Brazil (309.7 DALYs per 100,000 inhabitants) (26).

One of the main obstacles facing the Iranian health system to deal with HIV/AIDS is the shortage of manpower and equipment in training and medical centers that hinder the prevention or reduction of high-risk behaviors in Iran, especially in provinces with the largest burden of the disease (27). It is recommended to provide HIV/AIDS-related training in junior and senior high schools to make them ready before reaching a high-risk age for HIV/AIDS. Furthermore, due to the change in the pattern of HIV/AIDS transmission in Iran and the concentration of the disease in youth, it is recommended to pay more attention to training on safe sex. Such training require more political commitment and more human and financial resource, especially in areas with a higher burden of the disease. The policy-makers' focus on AIDS control must shift from resource allocation to investment because several studies have shown that controlling the epidemiological burden of the disease indirectly reduces the health system resources in the future (28, 29). Political commitment and effective technical strategies are needed to prevent the incidence of the disease and provide timely, effective, and continuous care services and tools such as syringes, needles, and condom for high-risk groups including female sex-workers to control drug use and sexually transmitted diseases.

The major strength of this study was the use of individual data registered in the Ministry of Health's AIDS/HIV Control Center for a 9-year period. Nevertheless, this study had some limitations too, including incomplete coverage of AIDS/HIV patients by the surveillance system and the absence of local disability weights for different levels of disease stages. The comparison of the number of patients registered in the AIDS/HIV surveillance system with the results of demographic surveys conducted by the Ministry of Health showed that the surveillance system only covers about 28% of the patients, which indicates the need for improving and expanding the coverage of the diagnosis and registry system.

Conclusion

HIV/AIDS leads to about 30000 DALYs in Iran annually, which indicates the need for a response from health system policy-makers. Over the studied years, males always had a larger share of the HIV/AIDS mortality and burden. However, there has been a decrease in the sex proportion of the burden of HIV/AIDS among males (as compared with females) since 2012. Moreover, over the studied years, there was an increase in the burden of HIV/AIDS among the female population. In addition, the burden of HIV/AIDS was not equally distributed among all provinces of Iran, and it was more concentrated in some provinces. Therefore, special attention must be paid to these provinces when allocating resource and designing interventions.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interests.

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