Original Article

Burden of Sexually Transmitted Infections in Iran from 1990 to 2010: Results from the Global Burden of Disease study 2010

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Abstract

Background: The present study describes the epidemiological status of sexually transmitted infections (STIs) in Iran based on the Global Burden of Disease study 2010 (the GBD 2010), and compares this with those of other neighboring countries.

Methods: The burden of STIs from 1990 to 2010 in Iran was derived from a systematic study, namely the GBD 2010, which was conducted by the Institute for Health Metrics and Evaluation (IHME). Using a model-based estimation, Disability Adjusted Life Years (DALYs) were calculated on the basis of the prevalence of STIs. The GBD 2010 used disability weights, and a mortality rate that was obtained from the vital registration system of Iran. We review the results of the GBD 2010 estimations for STIs in Iran.

Results: The trend of DALYs attributable to STIs (107.3 and 26.47 per 100,000 people in 1990 and 2010, respectively) and deaths (1.13 and 0.12 per 100,000 people in 1990 and 2010, respectively) decreased dramatically in Iran during the last two decades. The majority of individuals affected by STI DALYs were aged 1 – 4 and 20 – 24 years.

Conclusion: Since the majority of DALYs attributed to STIs were observed among those aged 1 – 4 years and young people, the economic burden of STIs will remain high in Iran. Therefore, effective evidence-based planning is critical to allocate the essential budget for utilizing treatment and prevention approaches.

Keywords: Global burden of disease study 2010 (the GBD 2010), Iran, sexually transmitted infections (STIs)

Introduction

Sexually transmitted infections (STIs) are currently a major worldwide public health problem,[1] and the incidence rate is increasing in developed countries.[2–4] In 2008, approximately, 498.9 million new cases of STIs, including *chlamydia trachomatis*, *neisseria gonorrhea*, *syphilis*, and *trichomonas vaginalis* occurred globally in the reproductive age group. This was 11% higher than the estimations provided for 2005. The Global Burden of Disease study 2010 (the GBD 2010) has reported a growth of 16.9% in the years lived with disability (YLD) due to STIs between 1990 and 2010.[5] Although STI surveillance data usually underestimate the burden of this group of diseases,[6] the World Health Organization has estimated the total global number of new cases in adults to be

approximately 266.1 and 232.8 million in males and females, respectively.[1]

One study showed that the proportion of *chlamydia trachomatis* (CT) infection among women with cervicitis was 12% – 25% in Tehran (the capital city of Iran) in 2006. The majority (49%) of CT-positive samples were in women in the 31 – 40 years age group, followed by those aged 20 – 30 years (33%). This frequency was higher than the previous reported rate in Iran (7%).[7] Also, another study showed that the overall prevalence of STI and its syndromes (even genital ulcer or vaginal discharge) was 7% – 18% and 36%, respectively, in female sex workers aged 18 years or older, in Kerman province.[8] Between 2009 and 2010, the prevalence rate of CT among women with illegal social behaviors (prostitutes) in Isfahan province was 19.8%,[9] and the prevalence of syphilis in female sex workers in Kerman province was 7.2% rates that were far higher than those observed in the general population (less than 1%).[8] In a study of women of reproductive age in Rasht city, the prevalence of gonococci was estimated at 0.6%,[10] while in a separate study that was conducted in Tehran, gonococci, CT and *trichomonas vaginitis* were reported in 2%, 5.3%, and 4% of women, respectively.[11] However, prevalence rates of candidiasis, trichomoniasis, and bacterial vaginitis among women with vaginitis in Hamedan city were 17.2%, 18.1%, and 28.5%, respectively.[12]

Since STIs are the common cause of mortality, and numerous morbidities among people in developing countries,[13,14] determination of the magnitude of their burden appears to be a necessity for health service planning[15] and monitoring, as well

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as supporting prevention programs at a national level.[16] To date, few previous studies have estimated the burden of STIs due to the absence of community-based data on sexual factors,[17,18] technical demands, costs, and administration problems.[19] Therefore, by using the GBD 2010 results, the present investigation described the magnitude of the burden of STIs, including syphilis, gonorrhea, chlamydia and trichomoniasis, and their sequelae, by estimating incidence, mortality, and disability adjusted life years (DALYs) in Iran.

Methods

The general information regarding data, statistical modeling, and metrics for the GBD 2010 have been described elsewhere.[20–26] In summary, the GBD 2010 study listed 291 diseases and injuries in 20 age groups, and both genders for 187 countries, and used several measures to report results, including deaths, YLLs, YLDs, and DALYs rates. YLLs were calculated via multiplying the number of deaths in each age group by a reference life expectancy for that age group.[24] YLDs were calculated according to the prevalence of a disease multiplied by the disability weight for that disease. Disability weights were scaled from 0 to 1, whereby 0 implies full health and 1 means a healthy state that is equivalent to death.[25] The sum of these two indices was used to develop DALYs. Moreover, the uncertainty for each cause-specific DALY was calculated by combining uncertainty at the levels of all-cause mortality, cause-specific mortality, prevalence, and disability weights.[23]

The estimates were prepared on the basis of a database for all age-gender-country-year groups for the majority of diseases, with a Bayesian meta-regression method established for the GBD 2010 (DisMod-MR),[27] in which prevalence, incidence, remission, and excess mortality estimations were calculated for each disease, via a systematic analysis of published and available unpublished data sources.[22] Estimates for causes of deaths were obtained from a comprehensive database of vital registration, verbal autopsy, surveillance, and other sources, covering 187 countries from 1980 to 2010.[23]

Cause of Death Ensemble modeling was used for numerous causes of death[25] but for a few selected causes, including STIs, a combination of methods was designed to derive estimations of STI burden and mortality for the first time. It is worth mentioning that, according to the GBD 2010, the majority of information for estimating STI prevalence and incidence for the countries without original data, such as Iran was gained by multiplication of imputed data from other countries.

However, in the present study, data related to STIs in Iran was extracted using the GBD 2010 (released 2013). Also, data was described using new graphs and tables, and GBD 2010 results were reviewed.

Results

There was an overall decrease in the STI death rate (1.13 to 0.12 per 100,000 people) across all age groups and both genders over the 20-year study period. The syphilis death rate was reduced by approximately 1 per 100,000 in all age groups and both genders, but after standardizing by age, the decrease was even greater (0.70 to 0.12). For chlamydial and gonococcal diseases, age standardized death rates were reduced by around 0.012 – 0.005 and 0.009 – 0.004, respectively, from 1990 to 2010 (Table 1, Figure1).

In 1990 and 2010, total death rates were not remarkable in any age groups except for children aged 1 – 4 years and people aged over 65 years (Figure 2). Death rates were higher in males than females in both 1990 (females: 0.7, males: 0.79 per 100,000 people) and 2010 (females: 0.14, Males: 0.16 per 100,000 people) (Figure 3).

Overall DALY rate (107.3 to 26.47 per 100,000) dramatically decreased during the 20-year study period (Table 1), but was different for each type of disease. For syphilis and trichomoniasis, the age standardized DALYs rate decreased from 54.96 to 9.06 and 2.97 to 1.98 per 100,000, respectively. It increased slightly from 6.69 to 6.77 per 100,000 for chlamydia. The DALYs rate decreased by approximately 0.05 per 100,000 due to gonococcal disease, and slightly increased in those aged 5 – 49 years (Table 2). With regard to age, the total DALYs rate was the highest in those

Table 1. Death & DALY statistics related to sexually transmitted infections by age groups from 1990 to 2010

|	DEATH (#*)						DALY(#)					
	1990	Upper	Lower	2010	Upper	Lower	1990	Upper	Lower	2010	Upper	Lower
Under 5	565.056	920.427	312.57	52.7546	110.007	20.556	48477	78962	26815	4527	9442.2	1764
5–14 years	14.6594	22.9363	8.7604	1.61583	3.03267	0.7465	1468	2204	922.7	380.8	654.59	196.18
15–49 years	11.5147	17.5657	4.9017	8.80507	13.5474	4.2407	7990	15021	3942	13791	26472	6378.5
50–69 years	15.4554	27.7184	5.5393	10.0804	17.4189	4.5327	652.5	1120	289.9	581.4	994.78	291.52
70+ years	13.9261	24.024	4.9163	20.2188	34.189	8.6902	219	370.8	89.23	300.3	479.75	151
All Ages	620.611	975.145	365.54	93.4746	154.306	52.801	58807	89717	35435	19580	32994	10817
	DEATHs (Rate**)						DALY(Rate)					
	1990	Upper	Lower	2010	Upper	Lower	1990	Upper	Lower	2010	Upper	Lower
Under 5	6.1818	10.0698	3.4196	0.8593	1.7919	0.3348	530.4	863.9	293.4	73.74	153.81	28.735
5–14 years	0.0922	0.1443	0.0551	0.0149	0.028	0.0068	9.239	13.87	5.808	3.519	6.0482	1.8127
15–49 years	0.0482	0.0736	0.0205	0.0192	0.0296	0.0092	33.51	63	16.53	30.19	57.949	13.963
50–69 years	0.3085	0.5533	0.1105	0.1161	0.2006	0.0522	13.03	22.37	5.787	6.698	11.46	3.3583
70+ years	1.478	2.5498	0.5218	0.7658	1.295	0.3291	23.24	39.36	9.47	11.38	18.172	5.7198
All Ages	1.132	1.7787	0.6667	0.1263	0.2086	0.0713	107.3	163.7	64.64	26.47	44.609	14.624
*Number of death and DALY; **Rate per 100,000												
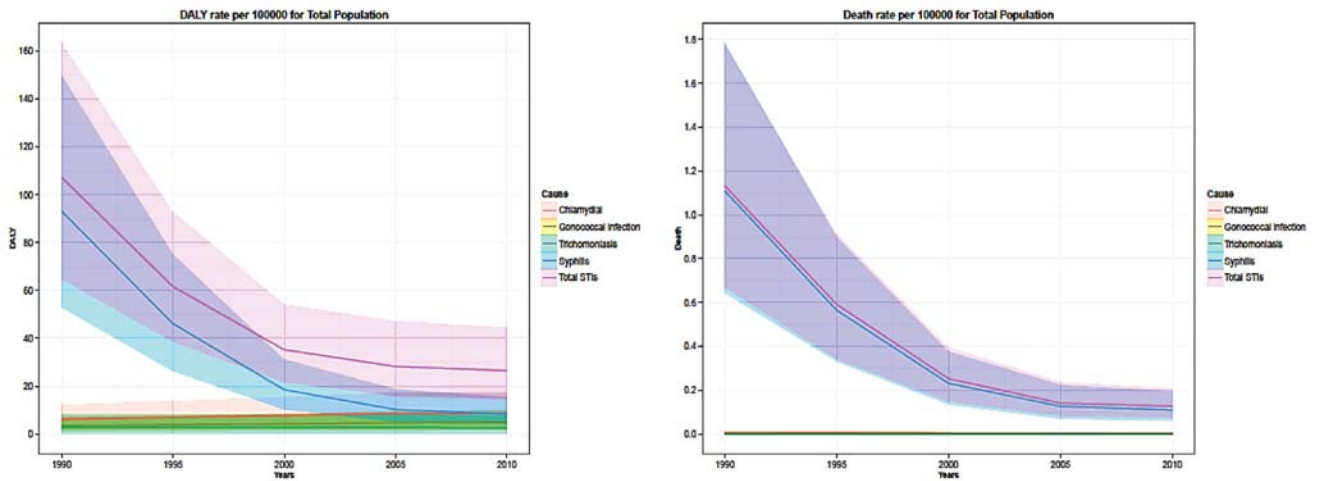
Figure 1. Trends of DALY and death rates of sexually transmitted infections by disease from 1990 to 2010
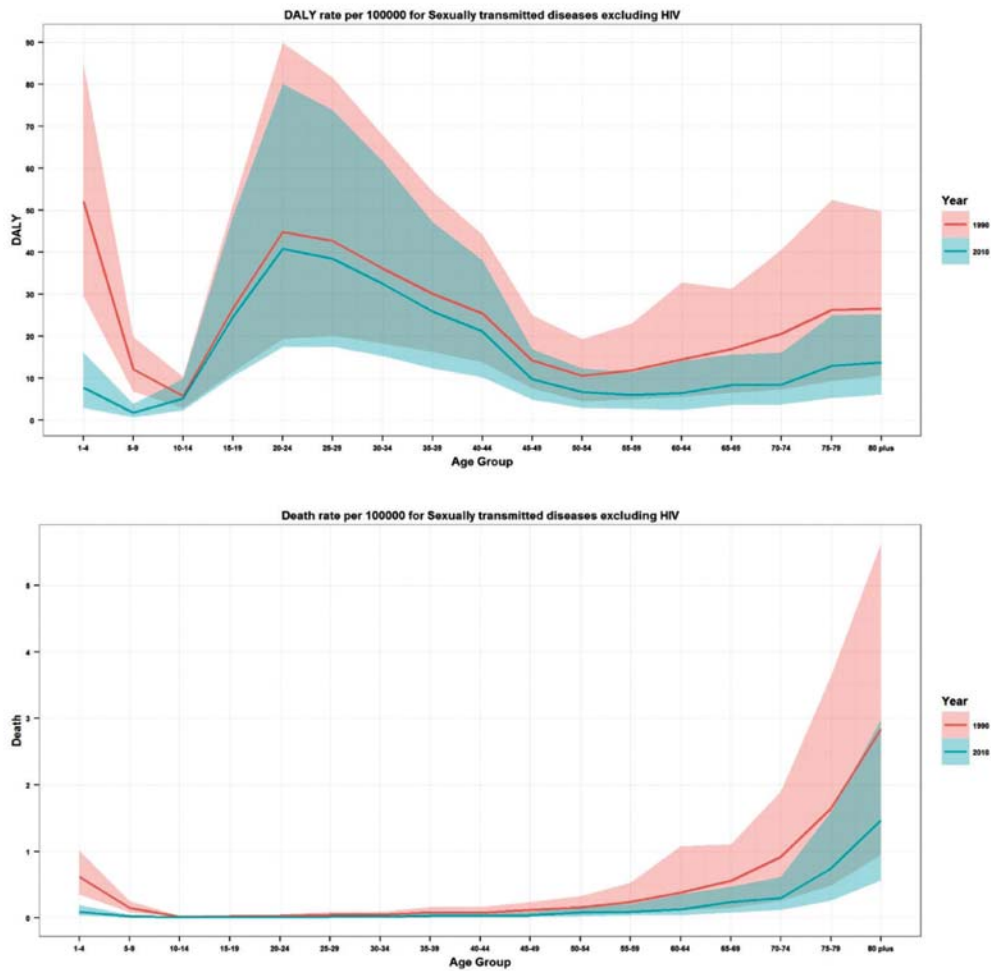

Figure 2. DALY and Death rates for sexually transmitted infections by age groups in 1990 and 2010
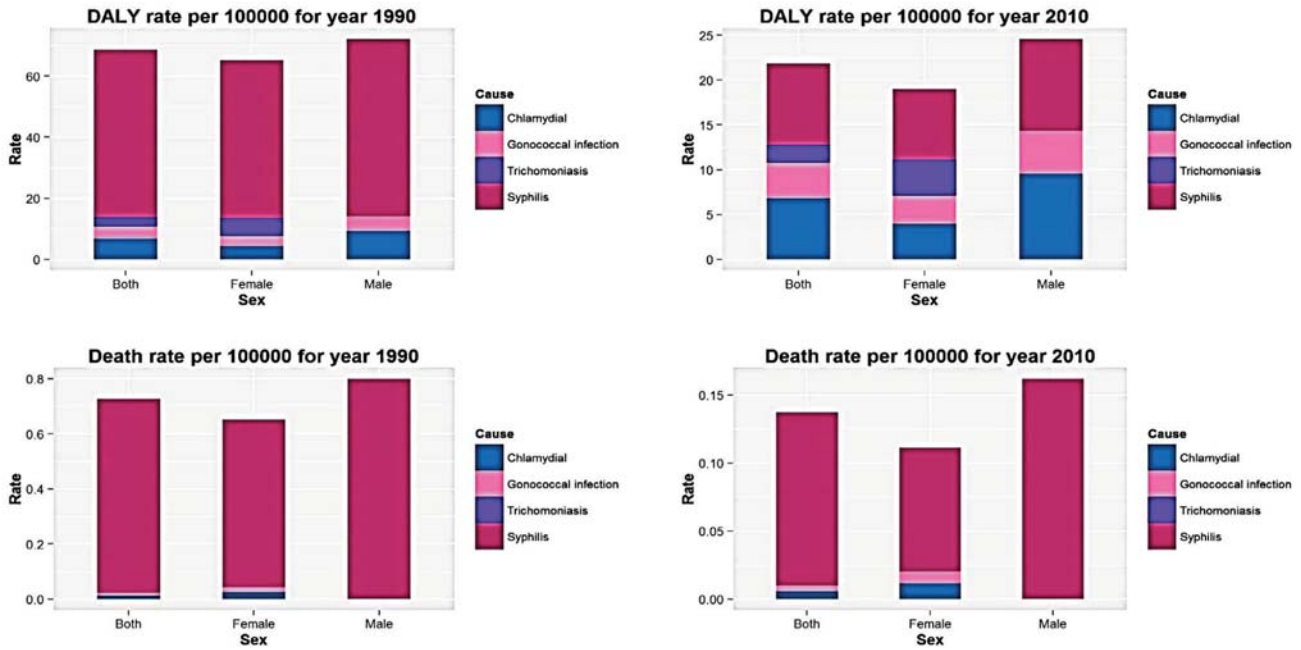
Figure 3. DALY and Death rates of Sexually Transmitted Infections by sex in 1990 and 2010

Table 2. Death & DALY rates (per 100000 population) related to chlamydia, gonorrhea, trichomonasis and syphilis by age groups from 1990 to 2010

	DEATHs			DALY		
	1990	2000	2010	1990	2000	2010
Syphilis						
Under 5	6.1818	1.8734	0.8593	530.358	160.739	73.7377
5–14 years	0.0896	0.0219	0.0135	7.0685	1.7459	1.0798
15–49 years	0.0319	0.0204	0.0128	3.4193	2.4737	1.8923
50–69 years	0.2264	0.1431	0.0793	9.7695	6.7546	4.5729
70+ years	1.0298	0.6775	0.5147	17.4964	11.8525	8.3988
All Ages	1.1089	0.2312	0.1089	93.1565	18.4911	8.2834
Age-standardized	0.7049	0.2585	0.1276	54.9613	18.8912	9.0654
Chlamydial disease						
5–14 years	0.0006	0.0005	0.0003	1.0096	1.2876	1.2544
15–49 years	0.0038	0.0027	0.0015	13.3272	13.6057	13.5823
50–69 years	0.0196	0.0142	0.0087	0.7286	0.6186	0.4887
70+ years	0.1062	0.0750	0.0594	1.3065	0.9200	0.6641
All Ages	0.0054	0.0048	0.0041	6.1781	7.7142	8.6532
Age-standardized	0.0123	0.0087	0.0055	6.6948	6.7932	6.7763
Gonococcal infection						
5–14 years	0.0004	0.0004	0.0002	0.5168	0.6363	0.6140
15–49 years	0.0028	0.0020	0.0011	7.4887	7.4715	7.6361
50–69 years	0.0144	0.0105	0.0064	0.5198	0.4396	0.3522
70+ years	0.0792	0.0560	0.0444	0.9655	0.6779	0.4879
All Ages	0.0040	0.0036	0.0030	3.4710	4.2350	4.8648
Age-standardized	0.0091	0.0064	0.0041	4.0356	4.0080	3.9894
Trichomoniasis						
5–14 years	0	0	0	0.3940	0.4120	0.3263
15–49 years	0	0	0	5.9497	4.8406	3.9356
50-69 years	0	0	0	0.3687	0.3132	0.2655
70+ years	0	0	0	0.2753	0.2157	0.1776
All Ages	0	0	0	2.7404	2.7413	2.5159
Age-standardized	0	0	0	2.9768	2.4241	1.9817

aged 1 – 4 years, then decreased within the age range of 5 – 14 years, and then again increased dramatically, peaking in the 20 – 24 years age group. At this point, the death rate then decreased up to the age of 60 years, and then increased after the age of 65 years. DALYs rates were higher in males than females in both 1990 (females: 69.7, males: 72.1 per 100,000 people) and 2010 (females: 22.8, males: 24.5 per 100,000 people) (Figures 2 and 3).

Discussion

According to our results, the numbers and rates of deaths due to STIs dramatically decreased in all age groups from 1990 to 2010. Surprisingly, the highest rates of deaths were observed among children younger than 5 years and people aged over 60 years. While the maximum DALYs rates were observed in children aged less than 5 years, followed by people aged 15 to 49 years, as the most sexually active group. Since children aged under 5 years are not sexually active, it appears that the high death rates could be related to abortions due to STIs, especially maternal syphilis seroreactivity.[28] Therefore, urgent intervention during pregnancy is required to prevent transmission of the aforementioned infections in children.

In a similar manner to the death rates, trends of rates and numbers of DALYs were also decreasing in nature from 1990 to 2010 in Iran, and the highest rate of DALYs was related to children under the age of 5 years. Despite the trend toward a decrease, higher rates of DALYs and death among these children highlight the need to pay greater attention to this age group as the most vulnerable population in Iran, and to expand proper interventions to reduce the burden of STIs among younger people. It should be noted that, according to the report of the Ministry of Health and Medical Education (MoHME), there was a trend toward increased STI incidence from 1998 to 2005, and this was greater in people aged 20 – 29 years than in those in other age groups.[29] The observed inconsistency between results could be related to the different methodologies used in these two reports.

The comparison between the four most prevalent STIs in terms of deaths and DALYs rates demonstrated higher worldwide values for syphilis followed by chlamydia, gonorrhea, and trichomoniasis. Since syphilis showed a more remarkable decrease than other diseases, it received a great deal of attention among total STIs. Therefore, to control the burden of STIs in Iran, it seems rational to place a greater focus on syphilis than the other STIs. However, the need to address the latter, in terms of preventive and curative activities, should not be overlooked.

Despite the decreasing death rate due to chlamydia, it should be mentioned that the DALYs rate attributed to this infection increased from 1990 to 2010. This demonstrates that although death caused by chlamydia was reduced, this infection made a greater impact on the lives of those affected. This highlights the need for urgent intervention to control the burden of chlamydia in Iran. In addition, although the estimated death rate attributable to trichomoniasis was zero from 1990 to 2010, the observed DALYs rate showed that this infection should still be considered as an active STI in Iran.

When making a comparison with neighboring countries, the burden of STIs in Iran is similar to that found in Turkey (32.14 DALYs per 100,000 people in 2010 vs. 23.73 per 100,000 people in Iran), but is far lower than that observed in Pakistan (99.14 DALYs per 100,000 people in 2010). Overall, compared with developing and developed countries, the age-standardized DALYs rate in Iran is similar to that of developed countries (20.38 per 100,000 people in 2010) and far lower than that of developing countries (170.51 per 100,000 people in 2010).[30] On the basis of these findings, it appears that cultural status and health education in Iran is in a better condition than in other developing countries. However, further studies with a greater number of details, using national and sub-national data, should be conducted to specify burden estimation.

Although the GBD 2010 is important, it has some limitations, and these have been explained elsewhere.[20–26] For example, the IHME did not use the real data, and the results are based on modeling using imputed data. In addition, they did not estimate the measures at the subnational level and the results are not appropriate for planning health interventions and allocating resources in Iran. Therefore, health policy-makers must calculate the information regarding the burden of diseases at sub-national level to monitor the major health risk factors of STIs, determine priorities, fix intervention strategies, and check policy implementation at national and sub-national levels to prevent STIs in Iran.

In this regard, due to the importance of estimating the burden of diseases, injuries, and risk factors, at both national and sub-national levels in Iran, as well as the aforementioned limitations of the GBD 2010, the National and Sub-national Burden of Diseases (NASBOD), which is a systematic comprehensive study,[31] is currently underway in that country. The NASBOD is using a standardized protocol of data collection, statistical methods, and estimation processes to calculate the burden of diseases, injuries, and risk factors at national and sub-national levels from 1990 to 2013. This study is benefiting from two advanced statistical methods for calculation.[32–33] In addition, it provides appropriate information for estimating health status in a single province or across provinces. The details of the NASBOD infectious diseases study protocol have been published elsewhere.[34]

In conclusion, on the basis of the GBD 2010 results, it appears that the deaths and the DALYs rates attributed to STIs are decreasing in Iran, which demonstrates the efficacy of long-term efforts made by the country's healthcare system to reduce the burden of STIs. However, the trend toward an increasing DALYs rate of chlamydia highlights the need for more preventative and curative interventions for STIs in Iran.

Conflict of Interests

The authors declare that they have no competing interests.

Authors' contributions

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Approval

All authors have read and approved the content and the

References

1. World Health Organization. *Global Incidence and Prevalence of Selected Curable Sexually Transmitted Infections-2008*. Geneva: WHO; 2012. Available from: URL: http://www.who.int/iris/bitstream/10665/75181/1/9789241503839_eng.pdf?ua=1 (Accessed Date: May 2016).
2. Martin IM, Ison CA. Rise in gonorrhoea in London, UK. London Gonococcal Working Group. *Lancet*. 2000; 355(9204): 623.
3. Miller M, Meyer L, Boufassa F, Persoz A, Sarr A, Robain M, et al. Sexual behavior changes and protease inhibitor therapy. SEROCO Study Group. *AIDS*. 2000; 14(4): F33 – F39.
4. Van der Heyden JH, Catchpole MA, Paget WJ, Stroobant A. Trends in gonorrhoea in nine western European countries, 1991-1996. European Study Group. *Sex Transm Infect*. 2000; 76(2): 110 – 116.
5. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLD) for 1160 sequelae of 289 diseases and injuries 1990 – 2010: A systematic analysis for the Global Burden of Disease Study. *The Lancet*. 2012; 380(9859): 2163 – 2196.
6. Fenton KA, Mercer CH, Johnson AM, Byron CL, McManus S, Erens B, et al. Reported sexually transmitted disease clinic attendance and sexually transmitted infections in britain: Prevalence, risk factors, and proportionate population burden. *J Infect Dis*. 2005; 191(suppl 1): 127 – 138.
7. Darougar S, Aramesh B, Gibson JA, Treharne JD, Jones BR. Chlamydial genital infection in prostitutes in Iran. *Br J Vener Dis*. 1983; 59(1): 53 – 55.
8. Navadeh S, Mirzazadeh A, Mousavi L, Haghdoost A, Fahimfar N, Sedaghat A. HIV, HSV2 and Syphilis Prevalence in Female Sex Workers in Kerman, South-East Iran; Using Respondent-Driven Sampling. *Iran J Public Health*. 2012; 41(12): 60 – 65.
9. Kassaian N, Ataei B, Yaran M, Babak A, Shoaei P, Ataie M. HIV and other sexually transmitted infections in women with illegal social behavior in Isfahan, Iran. *Adv Biomed Res*. 2012; 1: 5.
10. Abdolahian.P, Shojai-Tehrani.H, Asghari.S, M O. Frequency of gonococcal endocervicitis in child bearing age women and its risk factors. *Journal of Midical Faculty of Gilan University of Medical Sciences and Health Services*. 2005; 14: 63 – 69.
11. Gooya.MM, Nabaee.S. Prevalence of some sexually transmitted infections in a family planning service. *RJMS*. 2007; 14(54): 143 – 150
12. Shobeiri F, Nazari M. A prospective study of genital infections in Hamedan, Iran. *Southeast Asian J Trop Med Public Health*. 2006; 37(suppl 3): 174 – 177.
13. World Health Organization. *Global Prevalence and Incidence of Selected Curable Sexually Transmitted Diseases: Overview and Estimates*. Geneva: WHO; 2001. Available from: URL: http://whqlibdoc.who.int/hq/2001/WHO_HIV_AIDS_2001.02.pdf?ua=1 (Accessed Date: May 2016).
14. Kim AA, Sun LP, Chhorvann C, Lindan C, Van Griensven F, Kilmarx PH, et al. High prevalence of HIV and sexually transmitted infections among indirect sex workers in Cambodia. *Sex Transm Dis*. 2005; 32(12): 745 – 751.
15. Chesson HW, Blandford JM, Gift TL, Tao G, Irwin KL. The estimated direct medical cost of sexually transmitted diseases among American youth, 2000. *Perspect Sex Reprod Health*. 2004; 36(1): 11 – 19.
16. Birch S, Gafni A, O'Brien B. Willingness to pay and the valuation of programmes for the prevention and control of influenza. *Pharmacoeconomics*. 1999; 16(Suppl 1): 55 – 61.
17. Mosha F, Nicoll A, Barongo L, Borgdorff M, Newell J, Senkoro K, et al. A population-based study of syphilis and sexually transmitted disease syndromes in north-western Tanzania. 1. Prevalence and incidence. *Genitourin Med*. 1993; 69(6): 415 – 420.
18. Grosskurth H, Mayaud P, Mosha F, Todd J, Senkoro K, Newell J, et al. Asymptomatic gonorrhoea and chlamydial infection in rural Tanzanian men. *BMJ*. 1996; 312(7026): 277 – 280.
19. Aledort JE, Ronald A, Rafael ME, Girosi F, Vickerman P, Le Blancq SM, et al. Reducing the burden of sexually transmitted infections in resource-limited settings: The role of improved diagnostics. *Nature*. 2006; 444 (Suppl 1): 59 – 72.
20. Wang H, Dwyer-Lindgren L, Lofgren KT, Rajaratnam JK, Marcus JR, Levin-Rector A, et al. Age-specific and sex-specific mortality in 187 countries, 1970 – 2010: A systematic analysis for the Global Burden of Disease Study. *The Lancet*. 2012; 380(9859): 2071 – 2094.
21. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the Global Burden of Disease Study. *The Lancet*. 2012; 380(9859): 2224 – 2260.
22. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: A systematic analysis for the Global Burden of Disease Study. *The Lancet*. 2012; 380(9859): 2095 – 2128.
23. Murray CJL, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALY) for 291 diseases and injuries in 21 regions, 1990 – 2010: A systematic analysis for the Global Burden of Disease Study. *The Lancet*.2012; 380(9859): 2197 – 2223.
24. Murray CJL, Ezzati M, Flaxman AD, Lim S, Lozano R, Michaud C, et al. GBD 2010: design, definitions, and metrics. *The Lancet*. 2012; 380(9859): 2063 – 2066.
25. Salomon JA, Vos T, Hogan DR, Gagnon M, Naghavi M, Mokdad A, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study. *The Lancet*. 2012; 380(9859): 2129 – 2143.
26. Salomon JA, Wang H, Freeman MK, Vos T, Flaxman AD, Lopez AD, et al. Healthy life expectancy for 187 countries, 1990-2010: A systematic analysis for the Global Burden Disease Study. *The Lancet*. 2012; 380(9859): 2144 – 2162.
27. Peterson HM, Flaxman AD. Meta-regression with DisMod-MR: how robust is the model? *The Lancet*. 2013; 381: S110.
28. Temmerman M, Lopita MI, Sanghvi HCG, Sinei SKF, Plummer FA, Piot P. The role of maternal syphilis, gonorrhoea and HIV-1 infections in spontaneous abortion. *Int J STD AIDS*. 1992; 3(6): 418 – 422.
29. Ministry of Health and Medical Education. sexually transmitted infections. Iranian National Center for Addiction Studies (INCAS). report; 2014.
30. Institute for Health Metrics and Evaluation.IHME.GBD compare. 2014. Available from: URL: http://vizhub.healthdata.org/gbd-compare/ (Accessed Date: May 2016).
31. Farzadfar F, Delavari A, Malekzadeh R, Mesdaghinia A, Jamshidi HR, Sayyari A,et al. NASBOD 2013:Design,definitions and metrics. *Arch Iran Med*. 2014; 17(1): 7 – 15.
32. Kasaeian A, Eshraghian MR, Rahimi Foroushani A, Niakan Kalhori SR, Mohammad K, Farzadfar F. Bayesian autoregressive multilevel modeling of burden of diseases, injuries and risk factors in Iran 1990 – 2013. *Arch Iran Med*. 2014; 17(1): 22 – 27.
33. Parsaeian M, Farzadfar F, Zeraati H, Mahmoudi M, Rahimighazikalayeh G, Navidi I, et al. Application of spatio-temporal model to estimate burden of disease, injuries and risk factors in Iran 1990 – 2013. *Arch Iran Med*. 2014; 17(1): 28 – 33.
34. Noori A, Shokoohi M, Moazen B, Moradi Gh, Naderimagham Sh, Hajizadeh Sh, et al. National and sub-national burden of infectious diseases in Iran, 1990 to 2013: The study protocol. *Arch Iran Med*. 2014; 17(3): 169 – 175.