Int J Mol Epidemiol Genet 2021;12(6):120-125
www.ijmeg.org /ISSN:1948-1756/IJMEG0139857

Original Article

Burden of severe COVID-19 in center of Iran: results of disability-adjusted life years (DALYs)

Moslem Taheri Soodejani[1], Leili Abedi Gheshlaghi[2], Vali Bahrevar[3], Saeed Hosseini[1], Mohammad Hassan Lotfi[1]

[1]*Center for Healthcare Data Modeling, Department of Biostatistics and Epidemiology, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran;* [2]*Assistant Professor of Epidemiology, Bam University of Medical Sciences, Bam, Iran;* [3]*Msc of Health Education & Promotion MSc of Health Education & Promotion, Department of Health Education & Health Promotion, Shahid Sadoughi University of Medical Sciences, Yazd, Iran*

Received October 16, 2021; Accepted December 6, 2021; Epub December 15, 2021; Published December 30, 2021

Abstract: The outbreak of COVID-19 disease is an international public health concern. Therefore, the analysis of information related to mortality and disability due to COVID-19 is considered important, so the present study was designed and conducted with the aim of assessing COVID-19 Disability-Adjusted Life Years (DALYs) in Yazd. In Yazd province, all suspected cases of COVID-19 that would be referred to central hospitals in order to get confirmed through PCR or CT scan test, were recruited to our study. The fatality data of COVID-19 was gathered from the forensic medicine organization. The Disability-Adjusted Life Years (DALYs) combines in one measure years of life lost (YLL), the loss of healthy life due to premature mortality and years of life lived with disability (YLD), the loss of healthy life because of disease and disability. The total burden of COVID-19 was 23,472 years. The number of years lost due to premature death was 23385 and the number of years of life with disability due to COVID-19 was estimated to be 87 years. The disease burden was 12992 years for men and 10480 years for women. The overall incidence of COVID-19 was 1411 per 100,000, of which 1419 in men and 1402 in women per 100,000. The outbreak of COVID-19 pandemic affected a large population and the residents of Yazd Province lost many years of their lives due to this disease.

Keywords: DALY, COVID-19, Yazd, Iran

Introduction

In December 2019, cases of an unknown infectious disease were reported to the WHO [1]. Research into the new known disease has shown that it is caused by the Coronavirus family [2]. Since the old times, these viruses have been able to cause colds and mild respiratory infections [3], but in recent decades these have been responsible for several major epidemics, including Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), and Ebola [4].

On January 30, 2020, the Head of the WHO announced that the outbreak of the disease is an international public health concern. In February, new pneumonia was named by the WHO as COVID-19 [5].

Common symptoms of COVID-19 include fever, chills, fatigue, dry cough, and shortness of breath, which in some cases can lead to death [2, 6]. The prevalence of this disease in the world is reported to be between 31% and 1.8% [7] and the mortality rate due to COVID-19 varies in different countries of the world and is estimated between 1 to 7% [8]. Higher mortality occurs in people with underlying diseases such as diabetes, hypertension, etc. but due to the high prevalence of this disease [8], the mortality rate is very significant as so far more than three million people have died of COVID-19 in the world [9].

According to studies, these complications becomes more severe one or two months after COVID-19, so that in some cases a person is

forced to multiple leaves from work and rest at home [10, 11].

One of the most important indexes for assessing the extent of damage to a health's disease is the "disability-adjusted life years" (DALY). This index calculates the number of years lost due to premature death or non-fatal diseases. It is used to calculate the "disease burden". To calculate the DALY, two indexes called "years of life lost" (YLL) and "years lost to disability" (YLD) were calculated and add together [12, 13].

Assessing the disability and mortality rate of a disease is very important for the executive planning and policy interventions in the field of country's health. In one study, the YLL index for COVID-19 mortality was calculated in 81 countries, and the results showed that more than 20.5 million years of life were lost worldwide due to COVID-19 and this result was more in the age of less than 75 years [14]. In another article in India, the DALY index for men and women were estimated 15,924.24 and 8,699.32, respectively [10].

Assessments have shown that so far few studies have been conducted to estimate the burden indices of COVID-19 in Iran and the COVID-19 DALY in Iran from January 2020 to January 2021 is estimated 973 per 100,000 [16] and yet there are still new cases of the disease every day. In addition, available information on mortality and population health in all parts of the world is scattered and inconsistent. Given that more than 2 million people in Iran have been infected with the disease and 70,000 people have died from the disease [9], study of disease burden indexes such as DALY, YLL, and YLD and a comparative description of the COVID-19 burden and its damages and risk factors provide important information for health policymakers. Therefore, the analysis of information related to mortality and disability due to COVID-19 is considered important, so the present study was designed and conducted with the aim of assessing COVID-19 DALY in Yazd.

Materials and methods

Data source and data extraction

All suspected cases of COVID-19 would be referred to central hospitals in order to get confirmed through PCR or CT scan test. The data have been recorded in the data registry. After making the necessary arrangements, all data included suspected and confirmed, recovered cases and deaths due to COVID-19 became available.

DALY (disability adjusted life years)

The DALYs (Disability Adjusted Life Years) are a gap measure; they measure the gap between a current situation and an ideal situation where everyone lives up to the age of the standard life expectancy, free from disease and disability [15]. The DALY combines in one measure years of life lost (YLL), the loss of healthy life due to premature mortality and years of life lived with disability (YLD), the loss of healthy life because of disease and disability the following formula is used to calculate it:

DALY = YLL + YLD.

Years of life lost (YLL)

To calculate the YLL indicator of DALY, the standard life table proposed by GBD 2010 was used, and life expectancy at birth was considered to be 86.02. This table is applicable to both women and men. One YLL is calculated as follows:

$YLL = \sum_x N_x Ce^{(ra)}/(\beta+r)^2 [e^{-(\beta+r)(Lx+a)} [-(\beta+r)(L_x+a)-1] - e^{-(\beta+r)a} [-(\beta+r)a-1]]$

- N_x = Number of deaths of COVID-19
- *C* = Age-weighting correction constant, C= 0.165
- *r* = Discount rate, *r*=0.03
- *a* = Age at death
- L_x = Standard life expectancy at age *a*
- β = Age-weighting parameter, β=0.04

Age weights give less weight to years lived at young and older ages. In other word, age weight give the most value to life lived as a young adult. In this study, the number of deaths of COVID-19 obtained from forensic medicine organization.

Years lived with disability (YLD)

The YLD component equals the number of incident cases of COVID-19 multiplied by the aver-

age duration of COVID-19 disease multiplied by disability weight of this disease (DW).

YLD = number of cases ($\sum I_x$) * duration of the disability (L_x) * disability weight (DW_x) (x is the age and gender category).

In Yazd province, each suspicious or definite person that was hospitalized due to acute lower respiratory tract disease (pneumonia), was recruited in this study.

Based on Mirzaee and et al study, the duration of COVID-19 disease was considered 14 days; (it is from infection to remission or death based on 85% of patients experiencing signs and symptoms for 14 days).

Disability weight (DW) is a key variable for YLD estimation. In this study, the DW was considered 0.14 based on Mirzaee and et al study [11].

Total YLDs are the sum of the YLDs for each sequel associated with the COVID-19.

We used the number of the population by age and sex in Yazd province based on the reports from the Statistical Center of Iran for 2016.

Result

The total burden of COVID-19 was 23,472 years (20.6 years per 1,000 people). The number of years lost due to premature death was 23385 (99.6% of the total burden) and the number of years of life with disability due to COVID-19 was estimated to be 87 years (0.4% of the total burden).

Burdon of COVID-19 by age subgroup

The overall burden of COVID-19 increased by age after age 15. The disease burden was 12992 years for men (22.2 years per 1000 people) and 10480 years for women (19 years per 1000 people). Between the ages of 5 and 70, the overall burden was higher in men than in women.

The number of years of life with disability was estimated to be higher in men (45 years) than women (42 years). In all age groups except the age group of 30-44 years, both sexes had the same number of years of life with the same disability.

Burdon of COVID-19 by sex

The number of years lost due to premature death from COVID-19 was reported to be 12947 years in men and 10438 years in women. In both sexes, after 15 years of age, the amount of YLL increased with age, and in all age groups except the age group of 0-4 years, the amount of YLL was estimated to be higher in men than women.

The death cases from COVID-19 were 1,585, of which 863 were men and 722 were women.

In both sexes, in the age group under 15, the number of deaths was lower, but with increasing age in both sexes, the number of cases has increased. In both sexes the number of deaths was lowest in the age group under 15, but it raised by age increment.

The overall incidence of COVID-19 was 1411 per 100,000 (1419 in men and 1402 in women). In both sexes, the highest number of cases of COVID-19 disease was reported in the age group of 59-45 years, and in the age groups of 14-5, 59-45 and 79-79 years, the incidence was slightly higher in women than men.

In both sexes, the highest number of cases of COVID-19 was reported in 45-59 years. Meanwhile, the incidence rate was slightly higher in women than men in 5-14; 45-59 and 70-79 age groups. More detail is showed in **Table 1** and **Figure 1**.

Discussion

The results showed more than 48,000 people were diagnosed with COVID-19, indicating these people lost 23,000 years of their lives, i.e., every 1,000 people lost 20 years of their lives due to COVID-19. Various studies have been conducted to estimate the COVID-19 burden in different countries, the results of which indicated different statistics. In Uganda, Iceland, Italy, Spain, the United States, and China, years of life lost (YLLs) due to COVID-19 were estimated to be 9, 38, 53, 47, 40, and 33 years per 1,000 population, respectively [16]. These figures showed this virus could significantly impact on human life. However, these estimates are updated daily and the current figures are increasing. Considering different

Table 1. Sex- and age-specific Incidence rate, YLLs, YLDs, and DALYs for COVID-19 patients in 2020

Age Groups	sex	Total cases of COVID-19	Incidence rate per 100000 Population	Case leading to Death	Total YLDs	Total YLLs	Total DALYs	DALYs/1000 population
Total	Male	8314	1419	863	45	12947	12992	22.2
	Female	7747	1402	722	42	10438	10480	19
	Both sexes	16061	1411	1585	87	23385	23472	20.6
0-4	Male	78	129	4	0.4	123	123.4	2
	Female	72	124	7	0.4	215	215.4	3.7
5-14	Male	29	30	2	0.2	60	60.2	0.6
	Female	35	38	1	0.2	30	30.2	0.3
15-29	Male	517	362	9	2.8	258	260.8	1.8
	Female	449	332	6	2.4	172	174.4	1.3
30-44	Male	1871	1209	45	10.1	1162	1172.1	7.6
	Female	1391	981	30	7.4	780	787.4	5.5
45-59	Male	1968	2391	144	10.5	3173	3183.5	38.7
	Female	1941	2609	92	10.4	1999	2009.4	27
60-69	Male	1558	5678	177	8.4	3124	3132.4	114.2
	Female	1428	5349	147	7.6	2600	2607.6	97.6
70-79	Male	1137	8173	199	6.1	2601	2607.1	187.4
	Female	1279	8716	190	6.8	2491	2497.8	170.2
>80	Male	1156	13703	283	6.2	2445	2451.2	290.6
	Female	1152	12958	249	6.2	2151	2157.2	242.6

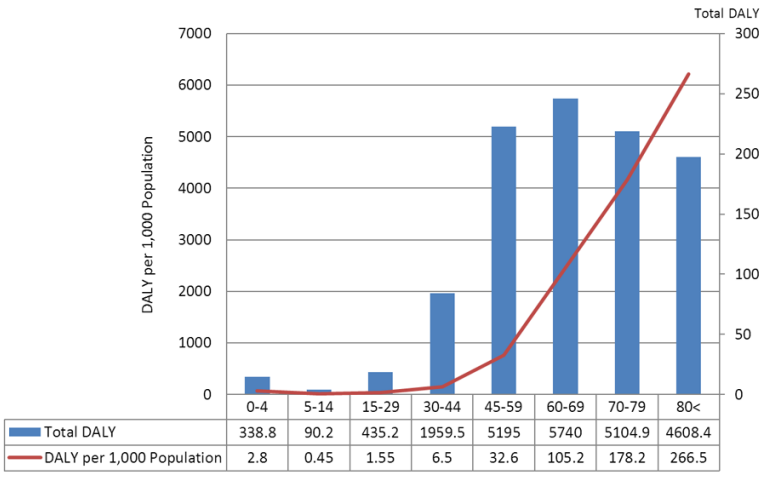

Figure 1. Total DALYs and DALYs per 100,000 individuals for COVID-19 according to age groups, Iran.

conditions such as healthcare infrastructure, prevalence of chronic diseases, and age distribution in different countries, discrepancies in the reported COVID-19 burden are inevitable.

Italy, as one of the European countries involved in the COVID-19 pandemic, estimated YLLs as 2 years per 1,000 people by May 21, 2020. More than 99% of the YLLs was due to premature death, particularly among the elderly [17]. These results were similar to those of the present study and revealed that COVID-19 deaths could significantly affect the YLLs due to this disease.

A study conducted on the YLLs and premature death due to COVID-19 in Fars Province, Iran, indicated the highest number of YLLs due to COVID-19 occurred in the age group of 60-70 years old [18]. Most of the COVID-19 deaths occurring in older age groups could be attributed to physiological changes and comorbidity with other underlying diseases.

Considering that elder people constitute a large portion of the population of countries such as Italy, Greece, Germany, and Finland, these countries highly suffered the pandemic, with the highest number of YLLs due to this disease [19].

Following the 2009 H1N1 pandemic, a report published on the burden of this pandemic in the Netherlands revealed that 5,800 years of life were lost due to this disease (0.35 year per

1,000 people), which was less than the statistics reported for the COVID-19 pandemic [20]. A study on the burden of infectious diseases in South Korea indicated respiratory diseases caused a loss of 1.43 years of life per 1,000 people. Therefore, COVID-19 pandemic was among the most influential diseases that affected many years of life of different populations in the world [21].

Conclusion

The outbreak of COVID-19 pandemic affected a large population and the residents of Yazd Province lost many years of their lives due to this disease. The highest number of YLLs due to COVID-19 in the population aged over 60 years old could be due to comorbidity with other chronic diseases such as diabetes.

Acknowledgements

This research has been ethically approved by the ethic committee of the Shahid Sadoughi University of Medical Sciences, Yazd, Iran (Ethical Code: IR.SSU.SPH.REC.1400.021).

Disclosure of conflict of interest

None.

Address correspondence to: Mohammad Hassan Lotfi, Center for Healthcare Data Modeling, Department of Biostatistics and Epidemiology, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. E-mail: mhlotfi56359@gmail.com

References

[1] Liu YC, Liao CH, Chang CF, Chou CC and Lin YR. A locally transmitted case of SARS-CoV-2 infection in Taiwan. N Engl J Med 2020; 382: 1070-1072.

[2] Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, Si HR, Zhu Y, Li B, Huang CL, Chen HD, Chen J, Luo Y, Guo H, Jiang RD, Liu MQ, Chen Y, Shen XR, Wang X, Zheng XS, Zhao K, Chen QJ, Deng F, Liu LL, Yan B, Zhan FX, Wang YY, Xiao GF and Shi ZL. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature 2020; 579: 270-273.

[3] Fehr AR and Perlman S. Coronaviruses: an overview of their replication and pathogenesis. Methods Mol Biol 2015; 1282: 1-23.

[4] Suwantarat N and Apisarnthanarak A. Risks to healthcare workers with emerging diseases: lessons from MERS-CoV, Ebola, SARS, and avian flu. Curr Opin Infect Dis 2015; 28: 349-361.

[5] Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C and Agha R. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int J Surg 2020; 76: 71-76.

[6] Bajema KL, Oster AM, McGovern OL, Lindstrom S, Stenger MR, Anderson TC, Isenhour C, Clarke KR, Evans ME, Chu VT, Biggs HM, Kirking HL, Gerber SI, Hall AJ, Fry AM and Oliver SE; 2019-nCoV Persons Under Investigation Team; 2019-CoV Persons Under Investigation Team. Persons evaluated for 2019 novel coronavirus-United States, January 2020. MMWR Morb Mortal Wkly Rep 2020; 69: 166-170.

[7] Louca S. COVID-19 prevalence in 161 countries and over time. MedRxiv 2020.

[8] Nikpouraghdam M, Jalali Farahani A, Alishiri G, Heydari S, Ebrahimnia M, Samadinia H, Sepandi M, Jafari NJ, Izadi M, Qazvini A, Dorostkar R, Tat M, Shahriary A, Farnoosh G, Hosseini Zijoud SR, Taghdir M, Alimohamadi Y, Abbaszadeh S, Gouvarchin Ghaleh HE and Bagheri M. Epidemiological characteristics of coronavirus disease 2019 (COVID-19) patients in IRAN: a single center study. J Clin Virol 2020; 127: 104378.

[9] Taheri Soodejani M, Tabatabaei SM, Dehghani A, McFarland W and Sharifi H. Impact of mass screening on the number of confirmed cases, recovered cases, and deaths due to COVID-19 in Iran: an interrupted time series analysis. archives of Iranian medicine. Arch Iran Med 2020; 23: 776-81.

[10] John D, Narassima MS, Menon J, Rajesh JG and Banerjee A. Estimation of economic burden of COVID-19 using disability-adjusted life years (DALYs) and productivity losses in Kerala state, India : a model-based analysis. BMJ Open 2021; 11: e049619.

[11] Mirzaee N, Barouni M, Goudarzi R, Jahani Y, Haghdoost A, Gohari MA, Nakhaeizadeh M, McFarland W and Sharifi H. Prediction the burden of COVID-19 in Iran: application of disability-adjusted life years (DALYs). 2020.

[12] World Health Organization. WHO coronavirus (COVID-19) dashboard: world health organization: World Health Organization; 2021 [Available from: https://www.who.int/healthinfo/global_burden_disease/about/en/].

[13] Saxena N and Sethia D. Decomposition of years of life lost due to premature death (YLL): a method for spatial and temporal comparative assessment. Arch Public Health 2020; 78: 91.

[14] Pifarré I Arolas H, Acosta E, López-Casasnovas G, Lo A, Nicodemo C, Riffe T and Myrskylä M.

Years of life lost to COVID-19 in 81 countries. Sci Rep 2021; 11: 3504.
[15] Hyder AA, Puvanachandra P and Morrow RH. Measuring the health of populations: explaining composite indicators. J Public Health Res 2012; 1: 222-8.
[16] Bell D, Hansen KS, Kiragga AN, Kambugu A, Kissa J and Mbonye AK. Predicting the impact of COVID-19 and the potential impact of the public health response on disease burden in Uganda. Am J Trop Med Hyg 2020; 103: 1191-1197.
[17] Nurchis MC, Pascucci D, Sapienza M, Villani L, D'ambrosio F, Castrini F, Specchia ML, Laurenti P and Damiani G. Impact of the burden of COVID-19 in Italy: results of disability-adjusted life years (DALYs) and productivity loss. Int J Environ Res Public Health 2020; 17: 4233.
[18] Azarbakhsh H, Mirahmadizadeh A, Ghaem H, Amiri S, Mokhtari AM, Lotfi M and Hemmati A. Mortality rate and years of life lost due to COVID-19 in Iran, Fars Province. 2021.
[19] Wyper GMA, Assunção R, Cuschieri S, Devleesschauwer B, Fletcher E, Haagsma JA, Hilderink HB, Idavain J, Lesnik T, Von der Lippe E, Majdan M, Milicevic MS, Pallari E, Peñalvo JL, Pires SM, Plaß D, Santos JV, Stockton DL, Thomsen ST and Grant I. Population vulnerability to COVID-19 in Europe: a burden of disease analysis. Arch Public Health 2020; 78: 47.
[20] Wielders C, van Lier EA, Van't Klooster TM, van Gageldonk-Lafeber AB, van den Wijngaard CC, Haagsma JA, Donker GA, Meijer A, van der Hoek W, Lugnér AK, Kretzschmar ME and van der Sande MA. The burden of 2009 pandemic influenza A (H1N1) in the Netherlands. Eur J Public Health 2012; 22: 150-157.
[21] Lee YR, Moon K, Kim Y, Park SY, Oh CM, Lee KS and Oh IH. Disability-adjusted life years for communicable disease in the Korean burden of disease study 2012. J Korean Med Sci 2016; 31 Suppl 2: S178-S183.