RESEARCH ARTICLE / ARAŞTIRMA

DOI: 10.4274/mjima.galenos.2021.2020.18
Mediterr J Infect Microb Antimicrob 2021;10:18
Erişim: http://dx.doi.org/10.4274/mjima.galenos.2021.2020.18

Mortality Rate and Years of Life Lost, Due to Premature Death Caused by COVID-19 In Iran, Ahvaz Jundishapur University of Medical Sciences

İran, Ahvaz, Jundishapur Tıp Bilimleri Üniversitesi'nde COVID-19'un Neden Olduğu Erken Ölümlere Bağlı Ölüm Oranı ve Kaybedilen Yaşam Yılları

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Abstract

Introduction: The emerging and evolving situation of Coronavirus disaese-2019 (COVID-19) threatens the health of all human beings. This study aims to measure the mortality rate and years of life lost (YLL) due to premature death caused by COVID-19 in Iran, Ahvaz Jundishapur University of Medical Sciences.

Materials and Methods: In this study, all definite deaths due to COVID-19 were used. First, descriptive analysis, including mean and standard deviation and the number, was performed. Then, raw and age-standardized mortality rates were calculated. The analysis of the number of YLL due to premature death caused by COVID-19 was performed using the YLL template of 2015, from the World Health Organization, in the Excel spreadsheet software version 2007.

Results: During the study period (from March 2020 to June 2020), 629 definite deaths due to COVID-19 occurred (men 59.14% and women 40.86%). The mortality rate due to COVID-19 in men and women was 16.24 and 17.17 per 100,000 persons, respectively. The total YLL during the study period was 4,722 (3.06 per thousand persons) in men, 3,691 (2.46 per thousand persons) in women, and 8,413 (2.77 per thousand persons) in both sexes.

Conclusion: This study is one of the first studies to measure YLL due to COVID-19 in Iran. The results of this study show that due to the high mortality of this disease, decision-makers should focus on reducing mortality to stop the potential next waves of COVID-19.

Keywords: COVID-19, burden of disease, years of life lost, Iran

Öz

Giriş: Ortaya çıktıktan sonra ilerlemeye devam eden Koronavirüs hastalığı-2019 (COVID-19), tüm insanların sağlığını tehdit etmektedir. Bu çalışmanın amacı; İran, Ahvaz Jundishapur Tıp Bilimleri Üniversitesi'nde COVID-19'un neden olduğu erken ölümlere bağlı ölüm oranını ve kaybedilen yaşam yıllarını (YLL) ölçmektir.

Gereç ve Yöntemler: Bu çalışmada, COVID-19'a bağlı tüm kesin ölümler kullanıldı. İlk olarak, ortalama, standart sapma ve sayıları içeren tanımlayıcı analizler yapıldı, ardından ham ve yaşa göre standartlaştırılmış ölüm oranları hesaplandı. Koronavirüs hastalığı-2019'a bağlı erken ölüm nedeniyle YLL sayısının analizi, Excel elektronik tablo yazılımı 2007 sürümünde Dünya Sağlık Örgütü'nün 2015 YLL şablonu kullanılarak gerçekleştirildi.

Cite this article as: Azarbakhsh H, Mirahmadizadeh A, Rostami M, Vali M. Mortality Rate and Years of Life Lost, Due to Premature Death Caused by COVID-19 In Iran, Ahvaz Jundishapur University of Medical Sciences. Mediterr J Infect Microb Antimicrob. 2021;10:18.

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Received/Geliş Tarihi: 26.11.2020 **Accepted/Kabul Tarihi:** 15.03.2021 **ORCID ID:** orcid.org/0000-0001-7733-2116

Published: 25 March 2021

Bulgular: Çalışma döneminde (Mart 2020'den Haziran 2020'ye kadar), COVID-19 nedeniyle 629 kesin ölüm meydana geldi (erkek %59,14 ve kadın %40,86). Erkeklerde ve kadınlarda COVID-19'a bağlı ölüm oranı sırasıyla 100.000 kişi başına 16,24 ve 17,17 idi. Çalışma süresi boyunca toplam YLL sayısı erkeklerde 4.722 (bin kişide 3,06), kadınlarda 3.691 (bin kişide 2,46) ve her iki cinsiyette 8.413 (bin kişide 2,77) idi.
Sonuç: Bu çalışma, İran'da COVID-19 nedeniyle YLL'yi ölçen ilk çalışmalardan biridir. Bu çalışmanın sonuçları, bu hastalığın ölüm oranının yüksek olması nedeniyle, karar vericilerin olası bir sonraki COVID-19 dalgalarını durdurmak için ölüm oranlarını azaltmaya odaklanmaları gerektiğini göstermektedir.
Anahtar Kelimeler: COVID-19, hastalık yükü, kayıp yıllar, İran

Introduction

Coronavirus is one of the main pathogens that primarily target the human respiratory system. In late December 2019, several patients were admitted to the hospital with an initial diagnosis of pneumonia of unknown cause. The patients were epidemiologically linked to a marine animal wholesale market in Wuhan, Hubei Province, China[1,2]. This emerging and evolving situation threatened the health of all human beings, and the World Health Organization (WHO) described the risk of Coronavirus disease-2019 (COVID-19) as "very high" globally[3-5]. The first reported case of COVID-19 was in Wuhan, China. By the end of 2019, it had rapidly spread across China, and despite global efforts to prevent its spread, it is causing other cases[6-8]. According to the WHO's latest report on August 17, 2020, the number of cases and deaths worldwide are 21,900,054 and 774,394, respectively, and in Iran, 345,450 and 19,804, respectively[8].

In a study in 2020 titled The Burden of COVID-19 in South Korea, the total burden of COVID-19 related disease was 2531 years, of which 89.7% was the years of life lost (YLL), and 10.3% was the years lived with disability (YLD). The highest disability-adjusted life years (DALY) per 100,000 population was in the age group over 80 years[9].

The current COVID-19 pandemic remains severe and worrisome. It has become a clinical threat to the general population and healthcare professionals worldwide[10]. As a result, considering that this disease has caused many cases and deaths in all regions of Iran, it is vital to take the necessary disease control and preventive measures and prioritize control measures. Therefore, summary measures such as premature mortality can help identify priorities. Thus, this study aims to measure the rate of mortality and YLL due to premature death from COVID-19 in areas covered by Ahvaz Jundishapur University of Medical Sciences.,

Materials and Methods

Study Design and Data Collection

This study includes all definite deaths due to COVID-19 that occurred from March 2020 to the end of June 2020 in Khuzestan province and the cities covered by Ahvaz Jundishapur University of Medical Sciences. Mortality data are taken from the statistics unit of the provincial health deputy. Trained physicians in different organizations in Iran, first reported deaths, and then codified the causes of death according to the national protocol and the international classification of diseases. Hospitals, local health centers, and cemeteries then report the data to the death registration committee monthly. These reports are then matched and compared with the country's forensic medicine organization data. The population of the cities covered by Ahvaz Jundishapur University of Medical Sciences using the health centers' databases and national census data in 2020 is 3,035,827 people (Figure 1).

Statistical Analysis

First, a descriptive analysis, including the number of deaths, the sex ratio of deaths, and then the age-specific mortality rates were calculated. Raw rates were calculated first, then for comparison, standardized age rates were used, using the 2013 standard population for low- and middle-income countries[11].

The WHO has introduced three YLL calculation methods in the second edition of its Practical Disease Burden Calculation Handbook, published in 2001[12]. In this study, the third method was used to calculate the YLL. The formula is given below.

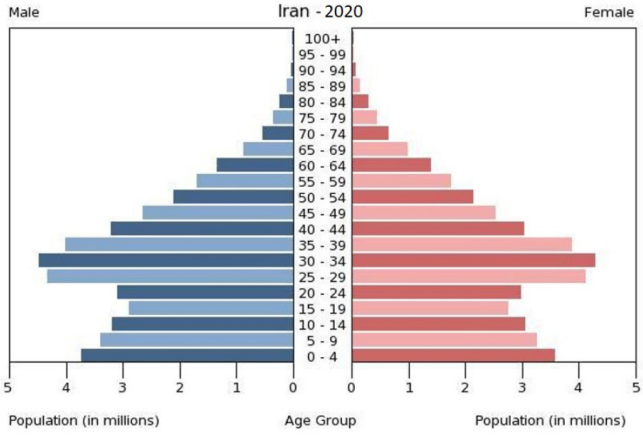

Figure 1. A population pyramid of the 2020 national census data (based on the site: https://www.amar.org.ir/english)

YLL: Years of life lost

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

N= the number of deaths at a certain age and gender

L= the standard living of the deceased in the same age and gender

r= the discount rate and is considered 0.03

β= the age weight and is considered equal to 0.04

C= the age weight correction factor and is 0.165

a= the age of death

e= a constant value equals to 2.71828

First, the lost years of life are calculated separately for the five sex and age groups, and then the age groups are merged as 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and over 80 years old.

The analysis of the number of YLL due to premature death due to COVID-19 was performed using the YLL template of 2015, from the WHO, in the Excel spreadsheet software version 2007. Descriptive analyses were performed using the Statistical Package for Social Science version 19.0 software.

This study protocol was reviewed and approved by the Ahvaz University of Medical Sciences' Ethics Committee with the ethics code IR.AJUMS.REC.1399.207. All aspects of the study have been done according to the code of ethics of the university.

Results

During the study period (March 2020 to the end of June 2020), 629 definite deaths due to COVID-19 occurred in Khuzestan province (59.14% men and 40.86% women). The sex ratio was 1.44 (male to female). The mean age at death was 65.96±14.75 in men, 65.19±15.32 in women, and 65.60±15.01 in both sexes.

Mortality Rate due to COVID-19

The COVID-19 mortality rate in men and women was 24.16 and 17.17 percent per thousand, respectively. The highest death rate in men and women was in the age group over 80 years, and the lowest was in both sexes in the age group of 0-9 years (Table 1).

YLL Caused by COVID-19

The total YLL during the study period was 4,722 (3.06 per thousand persons) in men, 3,691 (2.46 per thousand persons) in women, and 8,413 (2.77 per thousand persons) for both sexes. The sex ratio (male to female) was 1.27. The highest YLL was in both sexes in the age group of 69-60 years, and the lowest in both sexes was in the age group of 0-9 years (Table 1 and Figure 2).

Discussion

It is essential to appreciate the full health influence of the COVID-19 pandemic to evaluate potential policy measures. The present study analyzed the COVID-19 mortality effect by obtaining Iranian YLLs. We used the third method to calculate the YLL considering the discount rate, age weight, and age correction factor. YLL is essential from a public health perspective as it

Table 1. Mortality rate and YLL due to premature death caused by COVID-19 by age and sex groups from March 2020 to the end of June 2020

Age group/sex		Number of deaths	Mortality rate (per 100,000)	Number of YLL	YLL (per 1000)
Male	0-9	0	0	0	0
	10-19	1	0.45	29	0.13
	20-29	7	2.52	188	0.67
	30-39	12	3.88	296	0.95
	40-49	37	19.72	802	4.27
	50-59	48	40.03	847	7.06
	60-69	107	150.60	1437	20.76
	70-79	90	373.64	786	32.63
	+80	70	438.67	337	21.11
	Total	372	24.16	4722	3.06
	ASR	33.34		4.03	
Female	0-9	0	0	0	0
	10-19	2	095	57	0.27
	20-29	2	0.71	55	0.19
	30-39	9	2.95	230	0.75
	40-49	27	14.97	611	3.38
	50-59	49	42.27	934	8.05
	60-69	63	88.68	954	13.43
	70-79	57	223.27	592	23.18
	+80	48	353.95	258	19.02
	Total	257	17.17	3691	2.46
	ASR	22.68		3.12	
All	0-9	0	0	0	0
	10-19	3	0.69	86	0.19
	20-29	9	1.61	243	0.43
	30-39	21	3.42	526	0.85
	40-49	64	17.40	1413	3.84
	50-59	97	41.13	1781	7.55
	60-69	170	121.21	2391	17.04
	70-79	147	296.27	1378	27.77
	+80	118	399.75	595	20.15
	Total	629	20.71	8413	2.77
	ASR	27.95		3.57	

ASR: Standardized age rates, YLL: Years of life lost, COVID-19: Coronavirus disease-2019

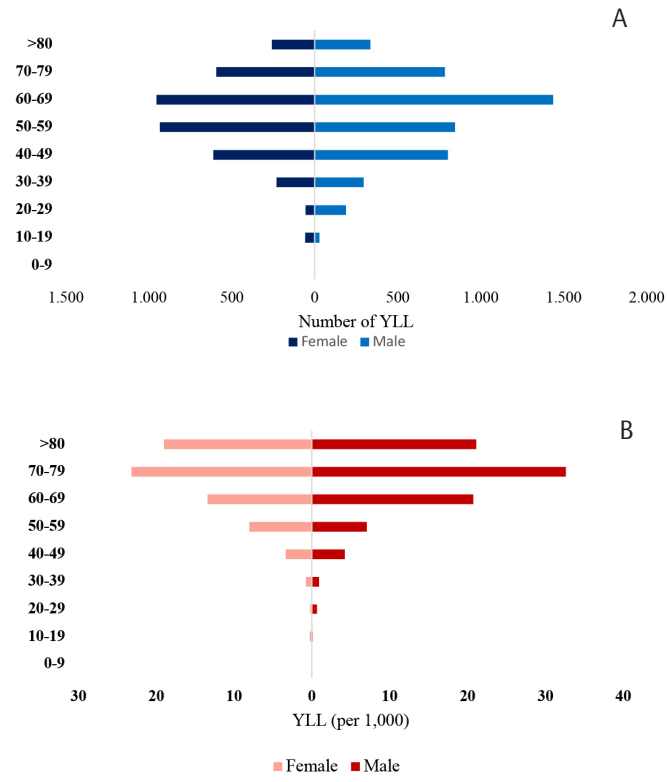

Figure 2. The years of life lost (YLL) for coronavirus disease 2019 by sex and age group. (A) YLL; (B) YLL per 100,000 population

YLL: Years of life lost

evaluates the life cut by the disease-affected individuals. The COVID-19 burden was measured through the initial COVID-19 outbreak wave from March to June in Khuzestan Province via YLL. During this period, a total of 8,413 COVID-19 attributable YLLs were identified. The COVID-19 YLL per 100,000 in the initial wave accounted for a total of 2.77 (3.06 for males and 2.46 for females).

It is essential to understand these findings for the continuing pandemic and after implementing unheard policy measures. The available estimations of the counterfactual of zero policy responses indicate significantly greater death tolls and YLL. Among the 243 diseases, COVID-19 was found ranked 85 in the YLLs and 172 in the YLDs. The COVID-19 burden had a greater YLL percentage (i.e., 89.7%) and a smaller YLD percentage (i.e., 10.3%). YLLs had a greater proportion than the mean of communicable diseases (i.e., 72.0%), suggesting the more considerable impact of COVID-19 on premature death[11,12].

Regarding age and sex, males had a higher YLL than females, which enhanced with age. Also, the maximum absolute YLL count occurred at the age of 60-69. However, the YLL per 100,000 population indicated the largest value at 70-79 in the development group. This suggests that older individuals are at higher risk of COVID-19 exposure and dying from it. This is in line with earlier studies investigating age-specific mortality within other countries[13-16].

Compared with other communicable diseases in the Korean National Burden of Disease 2016 investigation, the burden of COVID-19 from January 20 to April 24 was 1.39 times higher than influenza, 1.16 times lower than pneumococcal pneumonia, and 5.18 times lower than upper respiratory infections. The COVID-19 YLDs, however, were less than influenza and upper respiratory infections and larger than influenza type B *Pneumonia*, *Haemophilus*, and *Pneumococcal pneumonia*. Furthermore, the YLLs were less than those attributed to pneumococcal pneumonia and were higher than those attributed to the three other diseases. Despite the limitations compared with diseases of similar symptoms instead of similar epidemiological characteristics, the COVID-19 incidence rate and cases were relatively low. The DALY contribution, on the other hand, was rather high due to the greater fatality rate.

The present work has several limitations. This study's findings cannot be considered the final results since the pandemic continues. The COVID-19 YLLs were calculated. Despite the pandemic's continuance, it is vital to realize the exact COVID-19 burden for informed decision-making. After the end of the COVID-19 pandemic, the final COVID-19 disease burden could be estimated. It might be beneficial in the future to make annual estimations of the COVID-19 burden.

Furthermore, COVID-19 victims are probably a population at risk since their remaining life expectancy is shorter than the average. This methodological concern is probably valid. As a result, the presented total COVID-19 YLL estimate can be considered an overestimation.

Conclusion

In summary, the present study is the first to examine the COVID-19 burden in Iran through YLL. Determining the COVID-19-attributable YLLs in other countries may lay the groundwork for making international comparisons and prioritizing healthcare resources for controlling the pandemic. Most of the COVID-19 disease burden was extracted from YLL. This suggests that decision-makers need to make a concerted effort to decrease fatalities in preparation for the next COVID-19 wave.

Acknowledgments

We would like to acknowledge Ahvaz Jundishapur University of Medical Sciences for assistance in the collection of participants' demographic data and financial support.

Ethics

Ethics Committee Approval: This study was conducted under the approval of the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The study were approved by the Ahvaz Jundishapur University of Medical Sciences of Local Ethics Committee (Protocol number: IR.A.JUMS.REC.1399.207).

Informed Consent: All participants gave consent and signed the form.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: H.A., A.M., M.V., Design: H.A., A.M., Data Collection or Processing: M.R., M.V., Analysis or Interpretation: M.V., H.A., Literature Search: H.A., M.R., Writing: H.A., A.M., M.R., M.V.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: This study was funded by Ahvaz Jundishapur University of Medical Sciences (grant No. 330097286).

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