

Covid-19 disability-adjusted life years in maharashtra state of india

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Abstract

Background and objective: The world is experiencing a pandemic of corona virus disease. In India maximum cases and deaths are seen in the state of Maharashtra. Objective of the study was to calculate disability adjusted life years (DALY) of COVID-19 to quantify burden of COVID-19 in Maharashtra state of India. **Material & methodology:** In this observational study, using the methodology given by WHO, DALY is composed of years lived with disability (YLDs) and years of life lost due to premature mortality/death (YLLs). We used data of confirmed cases and deaths due to covid19 between March to August 2020, taken from Government of Maharashtra. **Results:** The total DALY for COVID-19 was 549468.62 (490.74 of DALYs per 100000 population). YLDs and YLLs constituted 19.75% and 80.25% of the DALYs, respectively. The relative contribution of YLDs and YLLs varied by age. Maximum DALYs was seen in the age group of 51-60 years of age. There were 108510 YLDs and 440958 YLLs attributed to COVID 19 in the state of Maharashtra. Maximum burden of YLDs of 22798 was seen in the age group 31-40years which constitutes 21 % of total YLDs. Maximum burden of YLL of 129975.2 is contributed by age group 51- 60 years of age which is 29% of the total YLL. **Interpretation and conclusion:** Most of the disease burden from COVID-19 in Maharashtra is derived from YLL; this indicates the state needs to focus on reducing the mortality due to covid19 especially in the older age group.

Key words: COVID-19, DALY, YLL, YLD

Introduction

Severe Acute Respiratory Syndrome Coronavirus -2 (SARS-CoV-2) belongs to a family known as *Coronavirus*, and is closely related to 2 other viruses namely Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV). SARS-CoV-2 was reported, for the first time, in Wuhan, China, at the end of December 2019⁽¹⁾. World Health Organization (WHO) announced the disease as a pandemic on March 11, 2020⁽²⁾. As on 1st August 2020,

there were 18,449,773 cases worldwide, and 697,255 deaths⁽³⁾. The COVID-19 virus entered Indian boundaries through various international travels and it then spread to rest of the population. The first laboratory-confirmed case of COVID-19 was a student returning from Wuhan, China, on 30 January 2020. Since then, the disease has rapidly spread to the rest of the country accounting for high morbidity and mortality. India is witnessing different rate of cases in different states, with a huge difference. Maximum cases and deaths are reported from the state of Maharashtra.

For better understanding the enormous influence of this pandemic on Public Health, it is worthwhile to quantify the burden of the disease. There could be several ways to express the burden of an illness. Although prevalence and incidence reflect the magnitude and gravity of the problem for a given health state, there is strong need to adopt summary measures which examine health outcomes. The Disability adjusted life years (DALY) is a summary measure which combines time lost through premature death and time lived in states of sub-optimal health, referred to as “disability”. It gives comprehensive information than conventional incidence or prevalence or mortality rates. DALYs for a specific cause are calculated as the sum of the years of life lost (YLLs) from that cause and the years lived with disability (YLDs) by the people living in states of less than good health resulting from that specific cause⁽⁴⁾.

Objective: To calculate disability adjusted life years (DALY) due to COVID-19 in terms of YLL and YLD by age group in Maharashtra State, India.

* Disability weight

YLL = Number of deaths * life expectancy at the age of death

Estimation of YLD

Cases: For the calculation of the YLDs, we used the numbers of confirmed cases obtained from Directorate of Medical Education and Research, Government of Maharashtra⁽⁵⁾. This is the only accessible, valid Government data source but there are some limitations in this data source like it does not consider comorbidities and confounding factors. As the severity of COVID-19 varies from asymptomatic infection to a severe and sometimes fatal disease, Directorate of Medical Education and Research, Government of Maharashtra categorized the severity of COVID-19 into 4 categories (asymptomatic/mild, moderate, critical and recovered). In Maharashtra the cumulative cases of COVID-19 on 18th August 2020 were 584,774. Out of that, 19800 patients expired. The statistics used for calculation is given in Table 1.

Table 1. Parameters used to calculate the years lived with disability (YLD)

Category	Active cases on 18th August		Recovered cases divided in category	Total cases	Mean DW	Adjusted duration	Adjusted DW
	Cases	%					
Asym./mild	150,206	96.04	392,131	542,337	0.006	14	3254.0247
Moderate	2,074	1.33	5,414	7,488	0.051	14	381.91019
Severe	4,114	2.63	10,740	14,854	0.133	28	1975.5965
Total/Overall	156,394	100	408,286	564,680*	0.01	18.7	5611.5314

* Details of 294 patients not available

Material and methods

This study was analysis of available data. Authors have used the methodology given by WHO, asserting that DALY (disability adjusted life years) is composed of years lived with disability (YLDs) and years of life lost due to premature mortality/death (YLLs)⁽⁴⁾.

YLDs, the morbidity component of the DALYs, have been calculated as follows:

YLD = Number of cases

* Duration till remission or death

We adopted DWs of acute infectious disease of lower respiratory tract as COVID-19 is an infectious disease. COVID-19 specific disease weightage is not yet available. Disability weight scale of infectious disease used in Global burden of disease 2013 study was used⁽⁶⁾. For duration till remission or death, using available preliminary data, the median time from onset to clinical recovery for mild cases is approximately 2 weeks and is 4 weeks for patients with severe disease⁽⁷⁾.

Estimation of YLL

Age group wise number of deaths was taken from data acquired from Government of Maharashtra. The standard reference life table is intended to represent the potential maximum life span of an individual in good health at a given age. Although, alternatively local life tables can also be used instead of standard life tables. Population of Maharashtra according to age groups and life expectancy were taken from Sample Registry System based abridged life tables 2013-17 and census⁽⁸⁾.

19 calculated by using age wise expectation of life in Maharashtra State are given in Table 4.

Between 9th March, 2020, and 18th August, 2020 a total of 19800 deaths due to COVID-19 were reported in the state of Maharashtra. The deaths from COVID-19 occurred in individuals over 31 years old. During the study period, there were 440,958 YLLs attributable to COVID-19 in Maharashtra. Maximum deaths of 5,641 in the age group of 61 to 70 years were reported but maximum burden of YLL of 129,975.2 is contributed

Table 2: Age group wise population, cases and deaths due to COVID-19 in the state of Maharashtra, March-August 2020

Age group	Population	Cases	Cases/ million	Deaths	Deaths/ million	CFR
0-10	2,15,00,019	23,508	1,093	54	2.51	0.23
11-20	2,16,36,988	41,629	1,924	90	4.16	0.22
21-30	2,14,02,618	1,02,866	4,806	397	18.55	0.39
31-40	1,68,46,535	1,22,903	7,295	1,122	66.60	0.91
41-50	1,25,96,232	1,03,891	8,248	2,655	210.78	2.56
51-60	84,60,379	94,106	11,123	5,168	610.85	5.49
61-70	62,80,351	60,046	9,561	5,641	898.20	9.39
71-80	24,28,498	27,282	11,234	3,422	1409.10	12.54
81-90	6,01,113	7,621	12,678	1,147	1908.13	15.05
91-100	2,13,904	922	4,310	104	486.20	11.28
Grand Total	11,19,66,637	5,84,774	5,223	19,800	176.84	3.39

Results

Compiled information about morbidity and mortality in Maharashtra State is given in Table 2.

Age group wise calculation of years lost due to COVID-19 is given in Table 3. Age group wise deaths from table 2 were used for calculation.

The details of age wise years of life lost due to COVID-

by age group 51- 60 years of age which is 29% of the total YLL. Comorbidities are also one of the determinants for mortality of covid19 but we couldn't consider that because of the limitation of data source. The burden of YLL is lowest in the older age group 91 to 100 years which contributes 509.6 YLL and the younger age group 0 to 10 years contributes 3857.22 of YLL. Final calculation of DALYs is given in Table 5.

Table 3: Years lost due to disability (YLD) attributable to COVID-19 Stratified by age, in the state of Maharashtra, 2020

Age group	YLD	percent of YLD
0-10	4360.753	4.02
11-20	7722.212	7.12
21-30	19081.72	17.59
31-40	22798.6	21.01
41-50	19306.28	17.79
51-60	17456.74	16.09
61-70	11138.58	10.26
71-80	5060.833	4.66
81-90	1413.702	1.30
91-100	171.0317	0.16
Total	108510.5	100.00

Table 4: Years of life lost (YLL) attributable to COVID-19 stratified by age, in the state of Maharashtra, 2020

Age group	YLL	Percentage of YLL
0-10	3857.22	0.87
11-20	5557.5	1.26
21-30	20703.55	4.69
31-40	48021.6	10.89
41-50	89606.25	20.32
51-60	129975.2	29.47
61-70	98717.5	22.38
71-80	37299.8	8.45
81-90	6709.95	1.52
91-100	509.6	0.11
Total	440958	100

Table 5: Disability - adjusted life years (DALY) attributable to COVID-19 stratified by age in the state of Maharashtra, 2020

Age group	YLL	%	YLD	%	DALY	% of DALY
0-10	3857.22	46.9	4360.752589	53.06	8217.973	1.49
11-20	5557.5	41.85	7722.212418	58.15	13279.71	2.41
21-30	20703.55	52.04	19081.72434	47.96	39785.27	7.24
31-40	48021.6	67.81	22798.60368	32.19	70820.2	12.88
41-50	89606.25	82.27	19306.27669	17.73	108912.5	19.82
51-60	129975.2	88.16	17456.73741	11.84	147431.9	26.83
61-70	98717.5	89.86	11138.58048	10.14	109856.1	19.99
71-80	37299.8	88.05	5060.832573	11.95	42360.63	7.70
81-90	6709.95	82.60	1413.701526	17.40	8123.652	1.47
91-100	509.6	74.87	171.0317291	25.13	680.6317	0.12
Total	440,958.2	80.25	108,510.45	19.75	549,469	100

The total DALY for COVID-19 was 5,49,468.62 (490.74 of DALYs per 100,000 populations). YLDs and YLLs constituted 19.75% and 80.25% of the DALYs, respectively. The relative contribution of YLDs and YLLs varied by age. The contribution of the YLL increased with age. Maximum DALYs of 147,478.92 was seen in the age group of 51-60 years of

age. Age group 51 to 60 years contribute 26.8 % in total DALYs. The lowest DALYs of 680 were seen in 91-100 years of age. Age above 81 years contribute just 1.5 % in total DALY. Burden in the age group of 61-70 years is 109,856 i.e. 19.9% of total DALY. The total DALYs were highest in the 51-60 years age group (147,431), followed by the 61-70 years age group

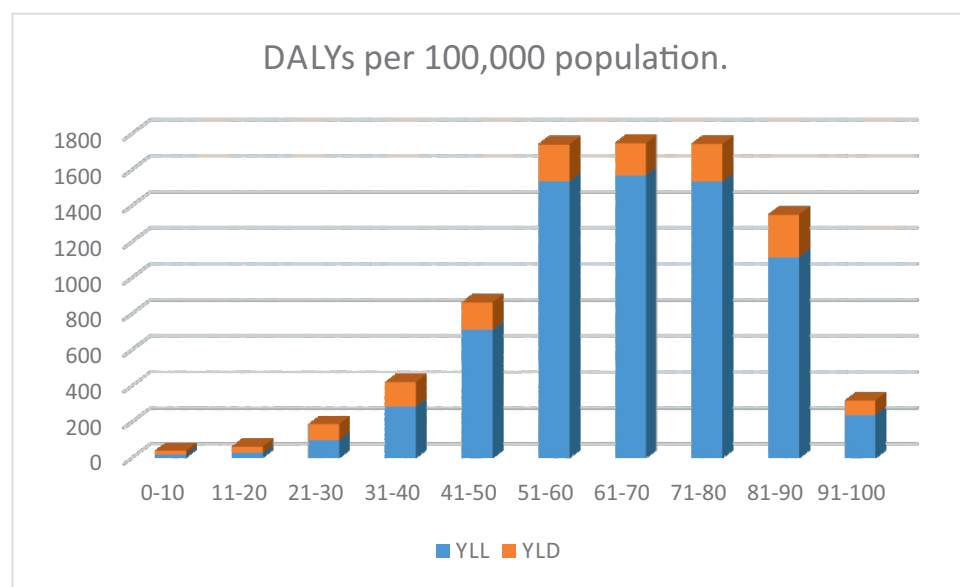


Figure 1: DALYs per 100,000 population for coronavirus disease by age group in the state of Maharashtra, 2020. The DALYs per 100,000 population were highest in 61-70 years age group (1749.20), followed by 71-80 years (1744.31), and 51-60 years (1742.62) where it is lowest in age groups below 41 years of age.

(1,09,856), 41-50 years age group (1,08,912), 31-40 years age group (70820), and 21-30 years age group (39,785) (Table 4, Table 5).

Discussion

The disability weights (DWs) are a crucial component of the DALY calculation, as they translate morbidity into healthy life years lost, thus enabling comparison of morbidity and mortality. The disability weights, scaled from zero (perfect health) to one (worst possible health state), can be interpreted as the proportional reduction in good health due to an adverse health state⁽⁹⁾. However, as there is no published Disability weight for COVID-19, a multiplicative approach is used to combine DWs. We calculated the burden of COVID-19 in the first wave of pandemic from 9th March 2020 to 18th August 2020 in Maharashtra. By August 2020, there were a total number of 549468.62 DALYs attributable to COVID-19, comprising 108510.45 YLDs and 440958.17 YLLs at an end of the first wave of COVID-19 in Maharashtra. The data we used may have some limitations about completeness, but it is the only large source -available in the public domain.

All age DALYs of leading 30 Major diseases (Ischemic heart disease, COPD, Diarrheal disease, Lower

respiratory infections, CVD etc.) in Maharashtra is 23,668 per one lakh population and, all age DALY of Respiratory infections in Maharashtra is 937 per one lakh population published in the Indian state-specific estimates in a recent GBD study⁽¹⁰⁾. However all age DALY due to COVID-19 in Maharashtra found in our study is 490.74 per 100,000 populations. Our estimate of DALYs due to COVID-19 per 100,000 population was almost 50% of the total burden of respiratory infectious diseases and 2 % of total all age DALY of major diseases in Maharashtra. When we match all-age DALY rates of the leading 30 causes of DALYs in the states of Maharashtra, 2016 with COVID-19, the all age DALY per one lakh population of COVID-19 attains 18th position. We found a very high burden of DALYs lost due to COVID-19 in Maharashtra, India. Importantly, the majority of DALYs lost occurred at ages between 31 and 70 years, revealing a large premature burden of COVID-19.

We found that the absolute numbers of DALYs were the highest in 51-60 years age group followed by 61-70 years age group, however, the population adjusted value, representing the DALYs per 100,000 populations, showed the highest in 61-70 years followed by 71-80 years of age. This shows that the

higher the age group, the higher is the risk of developing COVID-19 disease and death due to COVID-19, which is similar to the findings of previous studies reporting age-specific mortality in other countries⁽¹¹⁾. Contribution of all disease YLL and YLD in Maharashtra is 64.2% and 35.8% respectively⁽¹⁰⁾. However, our study reveals that YLL due to COVID-19 in Maharashtra is 80% which is quite high then the average YLL of diseases in Maharashtra. The care for those at high-risk, who are older adults or have serious underlying medical conditions is now a higher priority.

Adults with underlying conditions such as obesity, diabetes and hypertension are at high risk of mortality due to COVID-19⁽¹²⁾ and prevalence of hypertension in Maharashtra is 25 percent and that of obesity is 23 percent which is quite high^(13,14). Less production of oxygen as compared to the demand and high cost of the available oxygen is a major concern in the state of Maharashtra, which can be a reason among many other reasons for a high YLL. Longer wait for access to medical care was observed in severe cases of COVID-19 and its high mortality⁽¹⁵⁾ which may be a cause of high mortality in Maharashtra too. Considering the burden of COVID-19, the most important strategy to reduce DALYs of COVID-19 is to focus on reducing case fatality because the portion of YLL is very high. It can be achieved through improving the healthcare resources like hospitals, ICU services, oxygen supplies, drugs, healthcare professionals and beds. In addition, preventive approach to reduce the incidence of COVID-19 is also important which includes Physical distancing of at least 6 feet, mandatory use of face mask, frequent hand washing with soap, use of alcohol hand rubs, respiratory etiquettes. If the cases exceed than the capacity of healthcare resource, we expect a higher mortality. Lastly, early detections of cases could also reduce the spread of the disease and it might reduce incidence of COVID-19. There are some limitations to this study. First, as COVID-19 is an emerging disease and COVID-19 specific DWs have not yet been determined so DWs of similar infectious disease were adopted. However, we recommend to estimate specific DWs for COVID-19 to reflect the exact level of disability in the near future. Second, as it is a secondary

data minor variation in number of cases and deaths can be there, but surely that will not affect the results.

The Maharashtra government only reports the number of cases and deaths by age groups; we could not get the data on sex-based groups. So we cannot comment on any difference in DALY of COVID-19 on sex based. Comorbidities are also one of the determinants for mortality of covid19 but we couldn't consider that because of the limitation of data source. Third, ideally, we should calculate DALY for a year, we have done it on the basis of few months but our study can act as a model for future study on DALY estimation of COVID-19. We calculated the DALYs of COVID-19 even though the epidemic is ongoing because it is necessary to know the exact burden of COVID-19 to make informed decisions. Once the COVID-19 pandemic ends, we can estimate the final burden of disease due to COVID-19.

The authors have no mechanism to assess the quality of data collected under IDSP. DALY being a summary index we didn't analyze separately for sex or place for residence. We did not include complete one-year data.

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Conflict of interest: Nil

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