

Estimating Years of Life Lost due to COVID-19 over the first two years of the pandemic in Cyprus: comparisons across areas, age, and sex

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Abstract

Knowledge about the extent of the COVID-19 mortality burden is important to inform policy-making decisions. To gain greater insights into the population health impact of COVID-19 mortality, Years of Life Lost (YLL) can be estimated. We aimed to determine YLL linked to COVID-19 over the first two years (March 2020–March 2022) of the pandemic in Cyprus, by areas, and by age and sex. COVID-19 YLL was estimated by multiplying COVID-19 mortality counts by age-conditional life expectancy from the 2019 Global Burden of Disease life table. COVID-19 accounted for 16,704 YLL over the first two years of the pandemic—approximately 18.5 years lost per individual who died due to COVID-19 and 1881 YLL per 100,000 population. YLL per 100,000 was higher among males compared to females (2485 *versus* 1303 per 100,000) and higher among older than younger individuals. COVID-19 deaths and YLL per 100,000 were higher in high population-dense areas of Cyprus, such as Limassol. Continued evaluations of COVID-19 YLL are needed to inform on the proportionate population impact of COVID-19, over time and across areas of Cyprus.

1 Introduction

Knowledge about the extent of the coronavirus disease 2019 (COVID-19) mortality burden is important to inform policy-making decisions, and to ensure that public health interventions and policies are effective, proportionate, and equitable. To gain greater insights into the population health impact of COVID-19 mortality, Years of Life Lost (YLL) can be estimated. YLL measures the years lost to premature mortality, relative to a hypothetical counterfactual situation that could have been aspired to, had the person not died. Hence, YLL gives greater comparative insights into the proportionate population health impact, as YLL recognises that deaths occurring at younger ages have a greater impact on population health compared to those occurring at advanced ages [1, 2].

Since the beginning of the COVID-19 pandemic, a large number of studies have used the YLL method to determine the mortality impact of the COVID-19 [3–7]. However, COVID-19 YLL estimates over the first 2 years of the COVID-19

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pandemic are not yet available for the Republic of Cyprus—a high-income island country with a residential population of less than one million. Two years after the first COVID-19 cases in Cyprus, 904 deaths were reported. The aim of this study was to determine COVID-19 YLL for the first two calendar years of the pandemic in Cyprus, by areas, and by age and sex. The following research questions were addressed:

(i) What age-sex-and-location differences have been observed in COVID-19 YLL during the first 2 years of the pandemic in Cyprus?

(ii) How does COVID-19 YLL compare with the ranking of leading causes of pre-pandemic YLL in Cyprus?

2 Methods

2.1 Data inputs

Individual COVID-19 mortality data during the 21 March 2020–20 March 2022 period were obtained from a publicly available repository provided and updated regularly by the Cypriot Health Monitoring Unit [8]. COVID-19 death counts were identified as those where the underlying cause-of-death was coded according to the emergency International Classification of Diseases-10 (ICD-10) codes U07.1 or U07.2 [9]. Cypriot population demographic data were obtained from the National Statistics 2019 Report [10].

2.2 Computation of COVID-19 YLL estimates

Mortality counts were aggregated by 5-year age-group and sex to calculate COVID-19 YLL absolute numbers and rates per 100,000 population. For the purposes of YLL estimations, the under-5 years age-group was split into under 1 year (i.e., < 1 year) and 1–4 years (i.e., 1–4 years) and the upper age-group was set at 95 years and above (i.e., 95 years plus). COVID-19 YLL were estimated by multiplying the number of death counts in each age-and-sex group by the age-conditional life expectancy from the reference life table of the 2019 Global Burden of Disease (GBD) study [11]. The 2019 GBD study used a relational model life table system which is based on more than 11,100 empirical life tables, and providing life expectancy irrespective of an individual's sex, country of residence, and socio-economic class [12, 13].

2.3 Comparison of COVID-19 YLL estimates

We compared COVID-19 deaths and YLL rates per 100,000 of population by age, sex, areas of Cyprus, as well as by different time-periods of the pandemic (i.e., first calendar year: March 2020–March 2021 and second calendar year: March 2021–March 2022). However, due to the absence of publicly available age-and-sex-specific COVID-19 mortality counts across the areas of Cyprus, we assumed same age-and-sex-specific COVID-19 mortality counts across areas. Thus, COVID-19 YLL by areas were calculated as the summation of the number of deaths in each area multiplied by the YLL per individual COVID-19 death. We also compared our estimated all-ages COVID-19 YLL (second calendar year: March 2021–March 2022) with the most recent pre-pandemic 2019 GBD YLL estimates for Cyprus [13], allowing us to examine whether COVID-19 has replaced the top-ten leading causes of fatal burden among Cypriot males and females.

3 Results

3.1 COVID-19 deaths in Cyprus, March 2020–March 2022

Between March 2020 and March 2022, 904 COVID-19 deaths were recorded in Cyprus. Most deaths occurred in Limassol ($n = 323$ out of 904 deaths), followed by Nicosia ($n = 277$ out of 904 deaths) and Larnaca ($n = 164$ out of 904 deaths). Ammochostos had the lowest number of COVID-19 deaths ($n = 52$ out of 904 deaths) (Supplementary material 1 and 4). During the first two years of the pandemic, male deaths ($n = 550$ out of 904 deaths) were around 1.5 times higher compared to female deaths ($n = 354$ out of 904 deaths). Most deaths occurred in the 80–84 years age-group ($n = 92$ out of 550 deaths; 16.7%) among Cypriot males, and in the 85–89 years age-group ($n = 77$ out of 354 deaths; 21.7%) among Cypriot females (Supplementary material 1). Moreover, the number of COVID-19 deaths was considerably higher during the March 2021–March 2022 period ($n = 663$ deaths) compared to the March 2020 – March 2021 period

($n = 241$ deaths) (Supplementary material 2 and Supplementary material 3). The number of male deaths was around 2.4 times higher during the March 2021–March 2022 period ($n = 390$ out of 663 deaths) compared to the March 2020–March 2021 period ($n = 160$ out of 241 deaths), while the number of female deaths was around 3.4 times higher during the March 2021–March 2022 period ($n = 273$ out of 663 deaths) compared to the March 2020–March 2021 period ($n = 81$ out of 241 deaths) (Supplementary material 2 and Supplementary material 3).

3.2 COVID-19 YLL in Cyprus, March 2020–March 2022

We estimated that COVID-19 accounted for 16,704 YLL over the first 2 years of the pandemic. This translates to an average of 18.5 YLL per individual who died due to COVID-19 and 1881 YLL per 100,000 population (Supplementary material 4). COVID-19 YLL per 100,000 was highest in Limassol (2404 YLL per 100,000), followed by Larnaca (2034 YLL per 100,000) and Ammochostos (1478 YLL per 100,000). The lowest number of COVID-19 YLL rates were seen in Nicosia (1478 YLL per 100,000) (Fig. 1 and Supplementary material 4).

During the March 2020–March 2022 period, a higher number of COVID-19 deaths and YLL were reported among younger male adults aged 15–49 years, compared to younger female adults at the same ages (Supplementary material 1). The distribution of absolute COVID-19 YLL by age-and-sex followed an inverted U-shape that was mainly evident from the 55–59 years (in males) and the 65–69 years (in females) to 95-plus years age-group (Fig. 2). Male YLL rates were almost two-fold higher than female YLL rates (2485 *versus* 1303 per 100,000). The highest COVID-19 YLL rates were in the 90–94 years age-group; males had around 1.5 times higher COVID-19 YLL rates than females (23,679 *versus* 15,750 per 100,000). COVID-19 affected older Cypriots disproportionately. Notably, the absolute YLL among Cypriots aged over 75 years accounted for approximately 50% (in females) and 36% (in males) of total COVID-19 YLL.

The COVID-19 YLL rates among Cypriot males over the March 2021–March 2022 period (1850 YLL per 100,000) exceed those over the March 2020–March 2021 period (635 YLL per 100,000). Similarly, among Cypriot females, the COVID-19 YLL rates increased from 270 (March 2020–March 2021) to 1032 YLL per 100,000 (March 2021–March 2022) (Supplementary material 2 and Supplementary material 3). When comparing the estimated all-ages COVID-19 YLL (March 2021–March 2022; Supplementary material 3) with the top-ten leading pre-pandemic causes of disease and injury in Cyprus [13], COVID-19 was likely the second leading cause of YLL among Cypriot males and the fourth leading cause of YLL among Cypriot females (Fig. 3 and Supplementary material 5).

Fig. 1 Years of Life Lost (YLL) per 100,000 of population in Cyprus, March 2020–March 2022

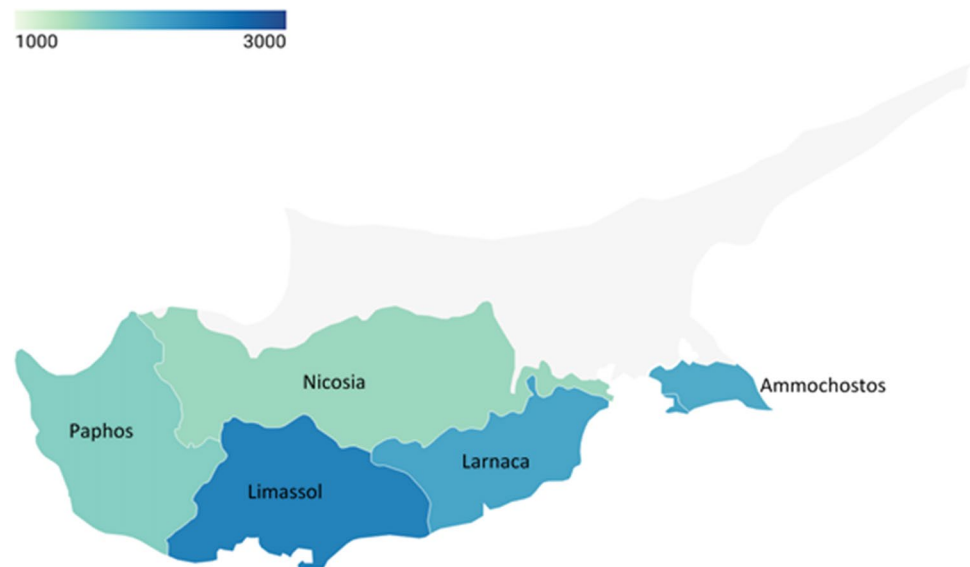


Fig. 2 Absolute numbers of Years of Life Lost (YLL) and YLL rates per 100,000 due to COVID-19 by age-and-sex in Cyprus, March 2020–March 2022

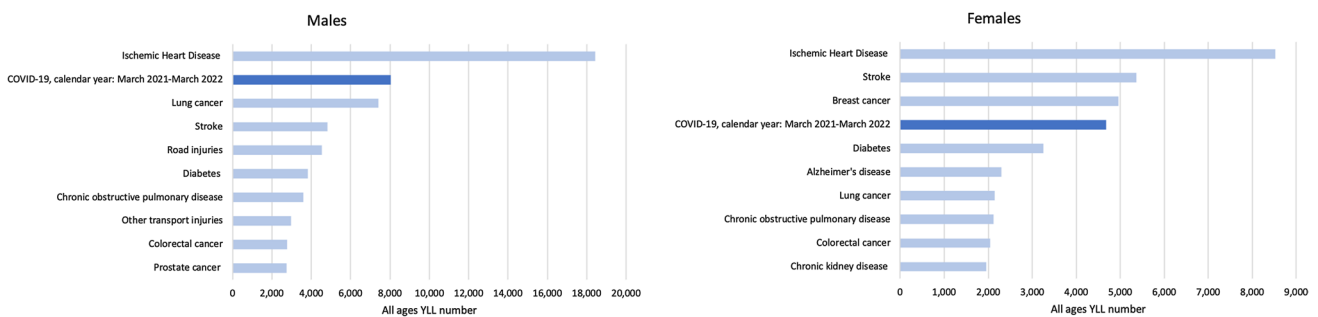
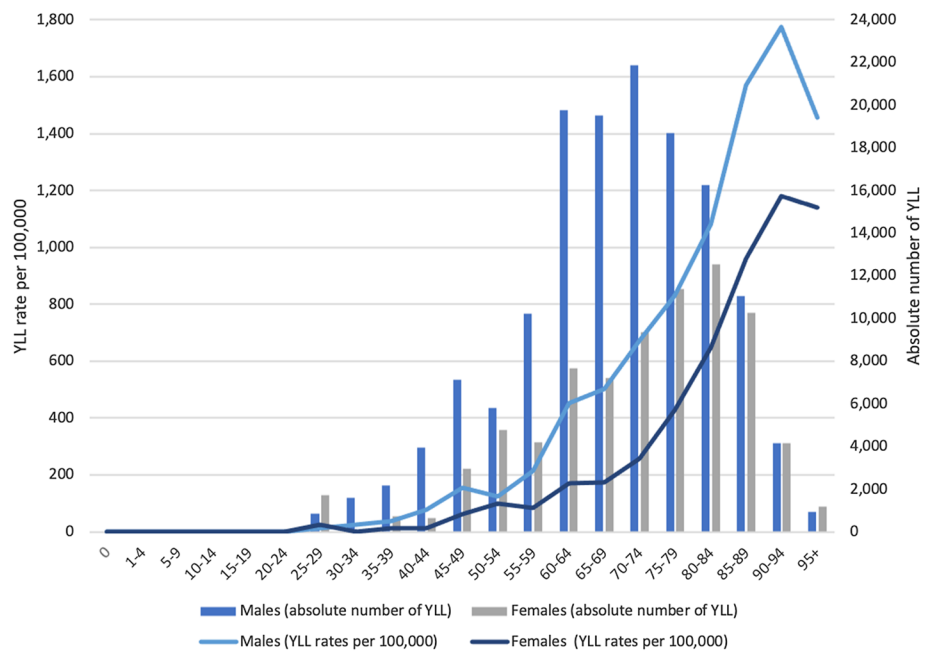


Fig. 3 Comparison of estimated number of all-ages Years of Life Lost (YLL) due to COVID-19 in March 2021–March 2022 with number of all-ages YLL due to the top-ten causes of fatal burden in Cyprus in 2019

4 Discussion

Our findings revealed that there were 1881 COVID-19 YLL per 100,000 during the March 2020–March 2022 period. During the first year of the pandemic, the COVID-19 YLL estimated in Cyprus (448.5 YLL per 100,000; Supplementary material 1) was 2.6 times lower compared to the COVID-19 YLL estimated in Malta (1180 YLL per 100,000) and 2.3 times lower compared to that estimated in Ireland (1013 YLL per 100,000) [14, 15]. COVID-19 deaths and YLL rates per 100,000 were higher in high population-dense areas of Cyprus, such as Limassol.

It has previously become apparent that there are age-and-sex disparities in COVID-19 mortality [3, 16]. We also found age-and-sex disparities in the experience of COVID-19; our finding that YLL was higher for Cypriot males, could in part be explained by the fact that smoking and/or the presence of underlying health conditions, such as diabetes and hypertension, are more prevalent in Cypriot males [17]. Indeed, Cyprus has a higher diabetes prevalence compared to the European region, and its burden has been higher among Cypriot males compared to females [18]. This may indicate that Cypriot males are more vulnerable to COVID-19 and have a greater risk of COVID-19 mortality. Because many individuals, particularly those at older ages, have more than one disease or injury, it is likely that a substantial component of the YLL is attributable to prior exposure to risk factors. Some studies have suggested that hypertension and diabetes mellitus are among the most prevalent conditions in adult COVID-19 patients [19, 20], which might suggest that high systolic blood pressure and high fasting plasma glucose may be important risk factors. Future comparative risk assessments from the GBD study will yield insights into the extent of COVID-19 YLL

which can be attributable to specific risks, in a comprehensive and comparable manner. Continuing to vaccinate vulnerable groups, and tackling the wider environmental and social drivers of health inequalities are important to prevent adverse outcomes from COVID-19, but also to improve overall population health.

When comparing YLL due to COVID-19 in March 2021–March 2022 with the top-ten leading pre-pandemic causes of YLL, COVID-19 YLL were substantial enough to be framed as the second leading cause of YLL among Cypriot males and the fourth leading cause of YLL among Cypriot females. This underlines the extent of the population health impact of COVID-19 in Cyprus and the importance of prevention of COVID-19 with dedicated measures to prevent the spread of COVID-19, such as social distancing and vaccination, and of intervention by adopting a syndemic approach with simultaneous management of priority non-communicable disease and COVID-19 [21].

Our study adopted the same methodological approach as the GBD study, owing to both its comparative and ethical advantages. Therefore, our findings allow not only comparisons with studies adopting the GBD approach, but also inform the GBD future iterations. The use of national and sub-national data used in this study can be useful for informing debates on health policy action. A limitation of this study is the absence of Years Lived with Disability (YLD) data in order to estimate Disability-Adjusted Life Years (DALY), although previous burden of COVID-19 disease studies have indicated that the contribution of COVID-19 YLD to DALYs is low compared to COVID-19 YLL [14, 15, 22–24]. The assumption of estimating COVID-19 YLL across the areas of Cyprus might not fully capture temporal trends in COVID-19 mortality trends and, results should therefore be interpreted with caution. To conclude, continued evaluations of COVID-19 YLL are needed to inform on the proportionate population health impact of COVID-19, over time and across areas of Cyprus. These will be helpful in the assessment of potential health losses averted by the rollout of the national COVID-19 vaccination strategies.

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Data availability Data used in this study are based on an analysis of existing datasets and are publicly available online at: <https://pio.gov.cy/coronavirus/eng>.

Declarations

Competing interests All authors declare no competing interests.

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