Analytical framework

This study employed the value of human life analytical framework developed by Weisbrod [9], Landefeld and Seskin [10], Hall and Jones [11], Chisholm *et al* [12] and WHO [13]; and applied in the past to estimate the productivity losses associated with Ebola Virus Disease (EVD) in the Democratic Republic of the Congo [14]; deaths associated with non-communicable diseases in Africa [15]; deaths due to neglected tropical diseases in Africa [16]; tuberculosis deaths in Africa [17]; maternal deaths in Africa in 2013 [18]; child mortality in Africa [19]; EVD deaths in West Africa [20]; and maternal deaths in Africa in 2010 [21].

Any individual death from COVID-19 constitutes a permanent loss of potential years of life lost (YLL) to society. According to Murray [22], YLL equals potential limit to life minus the age at death. In the current study, YLL was estimated as the difference between the relevant country's average life expectancy at birth and age at death from COVID-19.

In line with past studies [14-21], China's non-health GDP per capita (i.e. the difference between GDP per person and current health expenditure per person) was used as a proxy indicator of the money value of each YLL.

China's fiscal value of YLL ($FVYLL_C$) through COVID-19 deaths is the sum of the potential non-health GDP lost among those aged 25-49 ($FVYLL_{25-49}$), those aged 50-64 ($FVYLL_{50-64}$), and those aged 65 years and above $\left(FVYLL_{\geq 65}\right)$. Each age group's FVYLL was obtained by multiplying the total discounted years of life lost, non-health GDP per person in international dollars (Int$) ($NGDPC_{Int\$}$) and the total number of coronavirus disease deaths (COVID-19D) for age group [9]. China's $FVYLL_C$ associated with COVID-19 deaths was estimated using the equations (1) and (2) below [14]:

$$FVYLL_C = \left(FVYLL_{25-49} + FVYLL_{50-64} + FVYLL_{\geq 65}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\begin{aligned} FVYLL_j = \sum_{t=1}^{T=n} \left\{\left[1/(1+r)^t\right] \times \left[NGDPC_{Int\$}\right] \times \left[COVID-19D_j\right]\right\} = \\ \left\{\left[1/(1+r)^1\right] \times \left[NGDPC_{Int\$}\right] \times \left[COVID-19D_j\right]\right\} + \\ \left\{\left[1/(1+r)^2\right] \times \left[NGDPC_{Int\$}\right] \times \left[COVID-19D_j\right]\right\} + \ldots + \\ \left\{\left[1/(1+r)^n\right] \times \left[NGDPC_{Int\$}\right] \times \left[COVID-19D_j\right]\right\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2) \end{aligned}$$

Where: $1/(1+r)^t$ is the discount factor used to convert future non-health GDP losses into today's dollars; r is an interest rate that measures the opportunity cost of lost earnings, which was 3% in the current study [9]; $\sum_{t=1}^{t=n}$ is the summation from year t =1 to t=n ; t is the first year of life lost, and n is the final year of the total number of YLL per COVID-19 death within an age group; $NGDPC_{Int\$}$ is per capita non-health GDP in Int$ or purchasing power parity (PPP); $COVID-19D_j$ is the number of COVID-19 deaths in j^{th} age group, where j=1 corresponds to the age group 25-49 years, j=2 to the age group 50–64 years, and j=3 to the age group 65 years and above in China [9-16]. Future non-health GDP losses were discounted to their present values using 2020 as the base year. China's mean fiscal value per COVID-19 death was estimated by dividing $FVYLL_C$ by the total number of COVID-19 deaths borne by the country.

Additional File 1 contains an illustration of how the fiscal value of human lives lost from COVID-19 among age groups 25-49 years, 50-64 years, and 65 years and above were calculated.

Data and data sources

Data on the number of COVID-19 associated deaths for China (2595) was extracted from the WHO COVID-19 situation report 35 [2]. The life expectancy at birth data for China (76.4 years) was obtained from the WHO world health statistics report 2019 [5]. The GDP per capita data for China (Int$ 21,083.57) was extracted from the IMF World Economic Outlook Database [1]. The current health expenditure (CHE) per capita for China (Int$ 841) data was gotten from the WHO Global Health Expenditure Database [19].

Sensitivity analysis

As Briggs [24] explains that economic analyses always have some degree of uncertainty, imprecision or methodological controversy. For example: What if discount rates of 5% and 10% had been used, each at a time, instead of 3%? What is the highest life expectancy in the world was used instead of the China average life expectancy? In order to shed light on these two questions, we varied discount rate and life expectancy one at a time to investigate the impact on $FVYLL_C$. First, the economic model was alternately re-estimated using 5% and 10% discount rates [14,25]. Second, the economic model was also re-estimated with the world highest average life expectancy (i.e. the Japanese average female life expectancy) of 87.1 years instead of the national average life expectancy. Thus, the latter was done to gauge the impact of changes in life expectancy on the $FVYLL_C$.