The fiscal value of human lives lost from coronavirus disease (COVID-19) in China

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Abstract

Objective: According to the WHO coronavirus disease (COVID-19) situation report 35, as of 24 th February 2020, there was a total of 77,262 confirmed COVID-19 cases in China. That included 2,595 deaths. The specific objective of this study was to estimate the fiscal value of human lives lost due to COVID-19 in China as of 24 th February 2020. Results: The deaths from COVID-19 had a discounted (at 3%) total fiscal value of Int$ 924,346,795 in China. Out of which, 63.2% was borne by people aged 25-49 years, 27.8% by people aged 50-64 years, and 9.0% by people aged 65 years and above. The average fiscal value per death was Int$ 356,203. Re-estimation of the economic model alternately with 5% and 10 discount rates led to a reduction in the expected total fiscal value by 21.3% and 50.4%, respectively. Furthermore, the re-estimation of the economic model using the world's highest average life expectancy of 87.1 years (which is that of Japanese females), instead of the national life expectancy of 76.4 years, increased the total fiscal value by Int$ 229,456,430 (24.8%).

Introduction

China is a member state of the WHO Western Pacific region. It has a population of 1,409.29 million and a total gross domestic product (GDP) of Int$ 29,712.83 billion [1].

According to WHO, as at 24 February 2020, there was a total of 79,331 confirmed coronavirus disease (COVID-19) cases in the world, which including 2,618 deaths [2]. About 77,262 (97.39%) of those cases and 2,595 (99.12%) were in China. Huang *et al* [3] study entitled "Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China" revealed that 49% of people who died of COVID-19 were aged 25-49 years, 34% were aged 50-64 years, and 17% were aged 65 years and above.

China's capacity to contain the spread of COVID-19 hinges on the strength and resilience of its national health system (NHS), disease surveillance system and other systems that address social determinants of health (SDH). The Universal Health Coverage (UHC) service coverage index [4] for China of 76% implies a gap in coverage of essential health services (reproductive, maternal, newborn and child health; infectious diseases; noncommunicable diseases (NCD); and service capacity and access) of 24% [5]. The average of 13 international health regulations (IHR) core capacities (i.e.

2

legislation and financing, coordination and national focal point, zoonotic events, and the human-animal interface, food safety, laboratory, surveillance, human resources, national health emergency framework, health service provision, risk communication, points of entry, chemical events, and radiation emergencies) scores for China is 94%; implying gaps in IHR core capacities of 6% [6]. Approximately, 92% of China's population uses safely managed drinking water services, implying a gap of 8% [7]. And the population using safely managed sanitation services is 72%, meaning the existence of a coverage gap of 28%. Also, nearly 4.9% of adults (those aged 15 years and above) are not literate [8]. The gaps in NHS (as indicated by coverage of essential health services), disease surveillance (shown in the sub-optimal IHR capacities), and systems that tackle SDH (such as water, sanitation, and education) might hamper China's efforts expand effective coverage of various preventive interventions against COVID-19.

Therefore, there is a need for economic studies that can be used to contribute towards making a case for investing more resources in the strengthening of NHS, IHR capacities and other systems that tackle SDH. To date, no study has attempted to estimate the fiscal value of human lives lost due to COVID-19. The specific objective of this study was to estimate the fiscal value of human lives lost due to COVID-19 in China as of 24th February 2020.

Methods

See Methods in the Supplementary Files.

Results

Table 1 shows fiscal value of human lives lost due to COVID-19 in China by 24th February 2020.

Table 1: Fiscal value of human lives lost due to COVID-19 in China (in 2020 Int$) – assuming different discount rates			
Age group in years	Fiscal value of human lives lost at 3% discount rate (Int$)	Fiscal value of human lives lost at 5% discount rate (Int$)	Fiscal value of human lives lost at 10% discount rate (Int$)
25-49	584,440,699	436,046,884	250,013,516
50-64	256,924,436	216,773,094	150,040,667
=>65	82,981,659	74,495,627	58,250,604
Total	924,346,795	727,315,605	458,304,787
Average fiscal value per death	356,203	280,275.76	176,611
Average fiscal value per person in population	0.655895	0.516087	0.32520

The 2595 deaths from COVID-19 had a potential total fiscal value of Int$ 924,346,795, i.e. assuming a discount rate of 3% and China's average life expectancy. Out of which, 63.2% was borne by people aged 25-49 years, 27.8% by people aged 50-64 years, and 9.0% by people aged 65 years and above. The average fiscal value per COVID death was Int$ 356,203 and per person in population was Int$0.000656.

Re-estimation of the economic model alternately with 5% and 10 discount rates led to a reduction in the expected total fiscal value by Int$ 197,031,189 (21.3%) and Int$ 466,042,007 (50.4%), respectively. This is equivalent to reductions in average fiscal value per death due to COVID-19 of Int$ 75,927and Int$ 179,592.

Table 2 presents a comparison of the fiscal value of human lives lost due to COVID-19 in China assuming the average life expectancy of China and the highest life expectancy in the world.

Table 2: A comparison of fiscal value of human lives lost from COVID-19 in China: assuming China's and world's hi expectancies (in 2020 Int$ or PPP)

Age group	Fiscal value of human lives lost at 3% discount rate and assuming the China's average life expectancy of 76.4 years (Int$)	Fiscal value of human lives lo discount rate and assuming world life expectancy of 87.1 years (Int$
25-49 years	584,440,699	659,302,851
50-64 years	256,924,436	351,570,998
65 years and above	82,981,659	142,929,376
Total	924,346,795	1,153,803,224
Average fiscal value per death	356,203	444,626
Average fiscal value per person in population	0.655895	0.819

Clearly, the re-estimation of the economic model using the highest average life expectancy in the world of 87.1 years, instead of the national life expectancy of 76.4 years, yielded a discounted total fiscal value of Int$ 1,153,803,224 and an average fiscal value per death of Int$ 444,626. The use of this higher life expectancy increased the total fiscal value by Int$ 229,456,430 (24.8%).

Limitations

The study reported in this paper had some limitations. First, the scope of our study was limited to the

potential indirect costs associated with premature mortality from COVID-19. It did not include the direct costs, such as cost of diagnosing and treating COVID-19 cases, transport of patients and family members, post-mortem (autopsy), interment, funeral ceremony, etc. Second, our study did not capture the negative macroeconomic (including effects on industry, trade, commerce, tourism/travel, education, investment, consumption, etc.) impact on both the Chinese and the rest of the world economies. Third, according to WHO world statistics report 2019 [5] completeness of cause-of-death primary data for China was 62% in 2017. This implies that the reported number of deaths from COVID-19 might be underestimate; and should that be the case our estimates could be underestimates of the actual fiscal value deaths from COVID-19.

Abbreviations

CHE: current health expenditure

COVID-19: Coronavirus disease

COVID-19D$_j$: Number of COVID-19 deaths in jth age group

EVD: Ebola Virus Disease

FVYLL: Fiscal value of years of life lost

FVYLL$_C$: China's fiscal value of years of life lost due to COVID-19 deaths

FVYLL$_{25-49}$: Fiscal value of potential years of life lost among those aged 25-49 years

FVYLL$_{50-64}$: Fiscal value of potential years of life lost among those aged 50-64 years

FVYLL$_{=>65}$: Fiscal value of potential years of life lost among those aged 65 years and above

GDP: Gross domestic product

IHR: International health regulations

IMF: International Monetary Fund

Int$: International Dollars or Purchasing Power Parity (PPP)

NCD: Non-communicable disease

NGDPC$_{Int\$}$: Non-health GDP per person in purchasing power parity

NHS: National health system

YLL: Potential Years of Life Lost

r: Discount rate

SDH: Social determinants of health

UHC: Universal health coverage

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable. No ethical clearance was required because the study relied completely on analysis of secondary data publicly available in the IMF World Economic Outlook Database [1], WHO Coronavirus disease (COVID-19) Situation Report – 35 [2], World Health Statistics Report [5], and WHO Global Health Expenditure Database [19].

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

The authors declare that they have no competing interests.

reviewers provided important suggestions that were used to improve our paper. Lenity Honesty

Kainyu Nkanata provided lots of encouragement and moral support. This paper is dedicated to COVID-

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of the authors and should not be attributed to institutions they are affiliated to.

References

1. International Monetary Fund (IMF). World Economic Outlook Database. IMF, Washington, D.C. 2019. https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx. Accessed 4 February 2020.

2. World Health Organization (WHO). Coronavirus disease (COVID-19) Situation Report – 35. Geneva: WHO; 2020.

3. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z, Yu T, Xia J, Wei Y, Wu W, Xie X, Yin W, Li H, Liu M, Xiao Y, Gao H, Guo L, Xie J, Wang G, Jiang R, Gao Z, Jin Q, Wang J, Cao B. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020. URL: https://doi.org/10.1016/S0140-6736(20)30183-5

4. WHO and the World Bank. Tracking universal health coverage: 2017 global monitoring report. Geneva and Washington (DC): WHO and The World Bank; 2017.

5. WHO. World health statistics overview 2019: monitoring health for the SDGs, sustainable development goals. Geneva: WHO; 2019.

6. WHO. State Party Annual Report. Geneva: WHO; 2019.

7. WHO. Global Health Observatory data repository. Water, sanitation and hygiene. WHO, Geneva. 2020. http://apps.who.int/gho/data/node.main.46?lang=en. Accessed 4 February 2020.

8. United Nations Development Programme (UNDP). Human Development Indices and

Indicators: 2018 Statistical Update. New York: UNDP; 2018.

9. Weisbrod BA. The valuation of human capital. The Journal of Political Economy. 1961; 69(5): 425-436.

10. Landefeld JS, Seskin EP. The Economic Value of Life: Linking Theory to Practice. Am J Public Health. 1982; 72:555-566.

11. Hall RE, Jones CI. The Value of Life and the Rise in Health Spending. Q J Econ. 2007; 122(1): 39-72.

12. Chisholm D, Stanciole AE, Edejer TTT, Evans DB. Economic impact of disease and injury: counting what matters. BMJ. 2010; 340(c924): 583-586.

13. WHO. WHO guide to identifying the economic consequences of disease and injury. Geneva: WHO; 2009.

14. Kirigia JM, Muthuri RNDK, Muthuri NG. The monetary value of human lives lost through Ebola Virus Disease in the Democratic Republic of Congo in 2019. BMC Public Health. 2019; 19(1218). URL: https://doi.org/10.1186/s12889-019-7542-2

15. Kirigia JM, Mwabu GM, M'Imunya JM, Muthuri RDKM, Nkanata LHK, Gitonga EB. Indirect cost of non-communicable diseases deaths in the World Health Organization African Region. Int Arch Med. 2017; 10(34). URL: https://doi.org/10.3823/2304

16. Kirigia JM, Mburugu GN. The monetary value of human lives lost due to neglected tropical diseases in Africa. Infect Dis Poverty. 2017; 6(165). URL: https://doi.org/10.1186/s40249-017-0379-y

17. Kirigia JM, Muthuri RDK. Productivity losses associated with tuberculosis deaths in the World Health Organization African Region. Infect Dis Poverty. 2016; 5(43). https://10.1186/s40249-016-0138-5

18. Kirigia JM, Mwabu GM, Orem JN, Muthuri RDK. Indirect cost of maternal deaths in the WHO African Region, 2013. Int J Soc Econ. 2016; 43(5):532-548.

19. Kirigia JM, Muthuri RDK, Nabyonga-Orem J, Kirigia DW. Counting the cost of child mortality in the World Health Organization African region. BMC Public Health. 2015; 15(1103). URL: http://doi.org/10.1186/s12889-015-2465-z

20. Kirigia, J.M.; Masiye, F.; Kirigia, D.W.; Akweongo, P. Indirect costs associated with deaths from the Ebola virus disease in West Africa. Infect Dis Poverty. 2015; 4(45). URL: https://doi.org/10.1186/s40249-015-0079-4

21. Kirigia, J.M.; Mwabu, G.M.; Orem, J.N.; Muthuri, R.D.K. Indirect cost of maternal deaths in the WHO African Region in 2010. BMC Pregnancy Childb. 2014; 14(299). URL: http://www.biomedcentral.com/1471-2393/14/299.

22. Murray CJL. Quantifying the burden of disease: the technical basis for disability-adjusted life years. Bull World Health Organ. 1994; 72(3): 429-445.

23. WHO. Global Health Expenditure Database. WHO, Geneva. 2020. http://apps.who.int/nha/database/Select/Indicators/en. Accessed 4 February 2020.

24. Briggs AH. Handling uncertainty in economic evaluation. In: Drummond MF, McGuire A, editors. Economic evaluation in health care: merging theory with practice. Oxford: Oxford University Press; 2001, p. 172-214.

25. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. 3rd ed. Oxford: Oxford University Press; 2007.

Additional File Legends

Additional File 1: Illustration of calculation of fiscal value of human lives lost due to COVID-19 in China
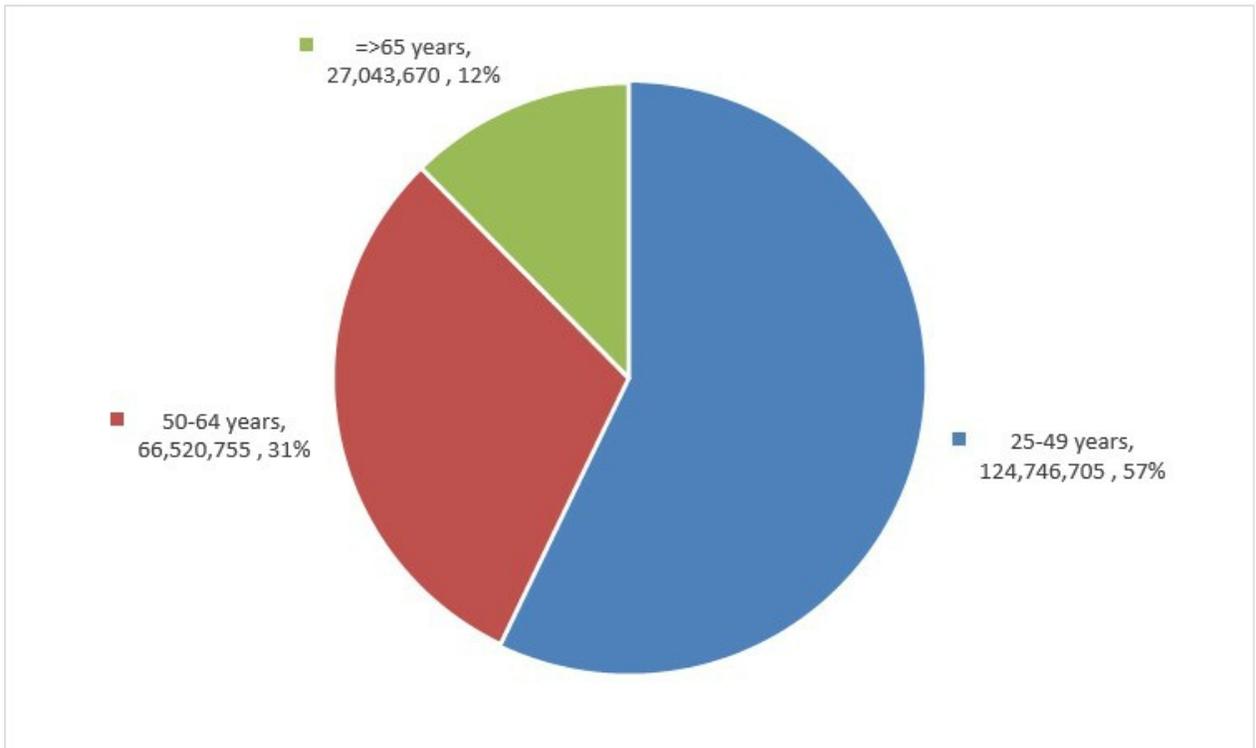
Figures

Figure 1

Discounted fiscal value of years of life lost from 2019-nCoV deaths in China: 261 assuming a

life expectancy of 87.1 years (in 2020 Int$ or PPP)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

Methods.pdf

Additional File 1.docx