The discounted money value of human lives lost due to COVID-19 in Spain

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Abstract

Purpose – To estimate the discounted money value of human lives lost (DMVHL) due to COVID-19 in Spain.
Design/methodology/approach – The study employs the human capital approach to estimate the DMVHL (assuming Spain's life expectancy of 83 years and a 3% discount rate) of the 20,453 human lives lost in Spain from COVID-19 as of 19 April 2020. Sensitivity analysis was conducted alternately assuming (a) 5% and 10% discount rate; and (b) global life expectancy of 72 years, and the world's highest life expectancy of 87.1 years.
Findings – The 20,453 human lives lost due to COVID-19 had a total DMVHL of Int$ 9,629,234,112, and an average of Int$ 470,798 per human life lost. Alternate re-estimation of the economic model with a 5% and 10% discount rates led to 19.8% and 47.4% reductions in the DMVHL, respectively. Re-calculation of the economic model using the global life expectancy of 72 years, while holding the discount rate constant at 3%, diminished the DMVHL by 41%. While the re-run of the same model using the world's highest life expectancy of 87.1 years instead, it increased the DMVHL by 18%.
Research limitations/implications – The study omits the value of health systems inputs used in preventing, diagnosing and treating COVID-19 cases; and the negative impact of COVID-19 on the agriculture, education, finance, manufacturing, travel, tourism, and trade sectors.
Social implications – There is a need to use this kind of evidence to advocate for increased investments into the strengthening of the national health system, IHR capacities, and coverage of safe water and sanitation facilities.
Originality/value – In Spain, no other study had attempted to estimate the net present value of human lives lost from COVID-19.

Keywords COVID-19, Money value of human life, Net gross domestic product, Spain

Paper type Short report

Introduction

Spain is a member state of the WHO European Region (EUR). It has a population of 46.866 million persons and a gross domestic product of Int$ 2,015.6 billion and a GDP per capita of Int$ 43,007.5 [1].

As of 19 April 2020, the world had a total of 2,347,884 coronavirus disease (COVID-19) notified cases, including 161,138 deaths. As of 19 April 2020, the EUR accounted for 1,072,126 (45.7%) of the global COVID-19 cases and 100,143 (62.1%) of the deaths. As of 19 April 2020,

Spain had notified 195,944 cases and 20,453 deaths, that is, 18.3% and 20.4% of cases and deaths in the EUR [2].

The relatively large number of cases and deaths in Spain might be attributed to challenges related to the national health system (NHS), disease surveillance and response system (DSRS) and other systems that address broader social determinants of health (SDHS). Regarding the NHS, the universal health coverage index is 77% [3], which implies a 23% coverage gap in essential health services [4]. Concerning the DSRS, the average of 13 International Health Regulations (IHR) [5] core capacity score was 84% [3], denoting an IHR capacity gap of 16% [6]. As to the SDHS, 98% and 97% of the population in Spain were using safely managed drinking water and sanitation services, respectively [3] denoting that 2% (937,320 persons) and 3% (1,405,980) of the population in Spain did not have access to safely managed drinking water and sanitation services [3].

The current health expenditure per capita for Spain is Int$ 3,469 compared to Int$5,510 in Denmark and Int$5,923 in Germany [7] suggesting a need for Spain to increase its health spending. The economic burden of disease studies could support advocacy for increased health investments. To date, no study in Spain has attempted to estimate the net present value of human lives lost from COVID-19. This study estimates the discounted money value of human lives lost due to COVID-19 as of 19 April 2020.

Methods

Estimating the discounted money value of human lives lost

This study uses a human capital approach (HKA) to monetarily value the human lives lost from COVID-19 as of 19 April 2020 [2]. Kiker [8] provides the historical roots of the concept of HKA. Landefeld and Seskin [9] discuss issues concerning the conceptual basis for valuing human life by applying the human capital approach. Following the WHO [10] and Weisbrod [11] elucidation that human life ought to be valued using a discounted future earnings net of the individual's consumption, we deducted current health expenditure per capita from the GDP per capita to obtain the net GDP per capita (NGDPPC). The net GDP was used in the valuation of human lives lost to COVID-19 because according to WHO [10], the relevant quantity of interest would be the impact of the disease on the "...non-health market consumption possibilities foregone because expenditure on health services and goods reduces opportunities to consume other services and goods, such as food or clothing" (p. 18). Also, demand for health services (or goods) is derived from the demand for health, and thus, as explained by Chisholm *et al.* [12] consumption of "health services (or goods) does not generate utility or welfare per se" (p. 584). The analytic model used in the current study was developed earlier and applied to value human lives lost due to COVID-19 in China [13].

Spain's discounted money value of human lives losses (DMVHL$_{SPAIN}$) associated with COVID-19 is the sum of discounted money values of human lives lost among 0-9-year-olds (DMVHL$_{0-9}$), 10–19-year-olds (DMVHL$_{10-19}$), 20–29-year-olds (DMVHL$_{20-29}$), 30–39-year-olds (DMVHL$_{30-39}$), 40–49-year-olds (DMVHL$_{40-49}$), 50–59-year-olds (DMVHL$_{50-59}$), 60–69-year-olds (DMVHL$_{60-69}$), 70–79-year-olds (DMVHL$_{70-79}$) and 80-year-olds and above (DMVHL$_{\geq 80}$) [13].

The kth age group DMVHL$_k$ was estimated through the multiplication of discount factors, years of life lost (YLL), NGDPPC, and COVID-19 deaths for the age group [13]. In this study, the YLL equals Spain's life expectancy at birth, minus the average age at death for each age group. However, during sensitivity analysis, the highest life expectancy in the world of 87.1 years (i.e. Japan Female average life expectancy) was applied [3].

The DMVHL$_{SPAIN}$ was calculated applying the formula below [13]:

$$\text{DMVHL}_{SPAIN} = \begin{pmatrix} \text{DMVHL}_{0-9} + \text{DMVHL}_{10-19} + \text{DMVHL}_{20-29} + \text{DMVHL}_{30-39} + \\ \text{DMVHL}_{40-49} + \text{DMVHL}_{50-59} + \text{DMVHL}_{60-69} + \text{DMVHL}_{70-79} + \text{DMVHL}_{\geq 80} \end{pmatrix}$$

(1)

$$\begin{aligned}
\text{DMVHL}_k &= \sum_{k=1}^{K=n}\left\{\left[1/(1+r)^k\right]\times[\text{NGDPPC}_{Int}]\times[\text{COVDD}]\right\} \\
&= \left\{\left[1/(1+r)^1\right]\times[\text{NGDPPC}_{Int}]\times[\text{COVDD}_k]\right\} + \left\{\left[1/(1+r)^2\right]\right. \\
&\quad \left.\times[\text{NGDPPC}_{Int}]\times[\text{COVDD}_k]\right\} + \ldots + \left\{\left[1/(1+r)^n\right]\times[\text{NGDPPC}_{Int}]\times[\text{COVDD}_k]\right\}
\end{aligned}$$

(2)

where: $1/(1+r)^k$ is the discount factor; r is the discount rate (3% in this study; $\sum_{k=1}^{K=n}$ is the sum from year $k=1$ to $k=n$; k is the first and n the final year of life lost within an age group from COVID-19; NGDPPC_{Int} is net GDP per capita in International Dollars (Int) or purchasing power parity (PPP); COVDD_k is the number of COVID-19 deaths in the kth age group. Age and level of social engagement (productivity) weighting discriminate against the children and the elderly, which is against the universal declaration of human rights that states every person right to life (Article 3) and right to a standard of living adequate for the health and well-being (Article 25) [14]. Also, it is contrary to the constitution of the World Health Organization [15], that promotes the highest attainable standard of health as a fundamental right of every human being without distinction (p. 1). For this reason, the previous practice of age and productivity weighting of the disability-adjusted life years in the Global Burden of Diseases studies was halted from 2010 [16].

Data and data sources
The GDP per capita (Int$ 43,007.5) data was from the IMF World Economic Outlook Database [1]. The COVID-19 deaths data of 20,453 data was from the Worldometer database [2]. Spain's, global, and the world highest average life expectancies at birth of 83 years, 72 years, and 87.1 years were from the WHO World Statistics Report 2019 [3]. The current health expenditures per capita of Int$ 3,469 was from the WHO Global Health Expenditure Database [7]. Data on the distribution of deaths by age group (0-9 years: 0.2%, 10-19 years: 0.2%, 20-29 years: 1.6%, 30-39 years: 4.2%, 40-49 years: 9.7%, 50-59 years: 15.7%, 60-69 years: 20.2%, 70-79 years: 24.1%, 80-89 years: 19.0%, and 90 years and above: 5.1%) was obtained from Forte [17].

Results
Table 1 portrays the distribution of the discounted money value of human lives lost due to COVID-19 by age group. It also compares the DMVHL estimated at three different discount rates, i.e., 3%, 5%, and 10%. Assuming a 3% discount rate, the 20,453 human lives lost due to COVID-19 in Spain had a total DMVHL of Int$ 9,629,234,112, and an average of Int$ 470,798 per human life lost. The 0–9-year-olds bore about 0.5% of the DMVHLL, 10–19-year-olds bore 0.5%, 20–29-year-olds bore 3.8%, 30–39-year-olds bore 9.2%, 40–49-year-olds bore 19.0%, 50–59-year-olds bore 25.9%, 60–69-year-olds bore 24.9% and 70–79-year-olds bore 16.1%.

Re-estimation of the economic model with a 5% discount rate reduced the DMVHL by Int$ 1,904,706,461, i.e., a 19.8% reduction. Instead, when the model was re-estimated with a 10% discount rate, the DMVHL shrank by Int$ 4,567,402,852, that is, a 47.4% decrease.

Recalculation of the economic model using the global life expectancy of 72 years, while holding the discount rate constant at 3%, diminished the DMVHL by Int$ 3,947,606,561 (41%). Recalculation of the same model using the world's highest life expectancy of 87.1 years instead increased the DMVHL by Int$ 1,708,497,580, i.e. a 18% growth (Table 2). Table 3 shows that the regions of Madrid and Catalonia incurred 55% of the DMVHL.

Discussion
This study estimated the discounted money value of human lives lost from COVID-19 as of 19 April 2020 to be Int$ 9.63 billion, which is 0.48% of Spain's GDP. Our study also established

Age group (yrs.)	Money value of human lives lost at 3% discount rate (Int$)	Money value of human lives lost at 5% discount rate (Int$)	Money value of human lives lost at 10% discount rate (Int$)
0–9	49,879,550	32,433,093	16,558,647
10–19	48,041,112	31,991,613	16,544,467
20–29	364,563,238	250,179,902	132,061,521
30–39	887,249,607	632,123,288	344,658,278
40–49	1,832,699,077	1,367,363,231	783,996,633
50–59	2,495,558,629	1,969,175,613	1,218,566,132
60–69	2,396,832,677	2,022,263,209	1,399,720,400
70–79	1,554,410,222	1,418,997,703	1,149,725,181
80–89	–	–	–
90 and above	–	–	–
Total	9,629,234,112	7,724,527,651	5,061,831,260
Average monetary value per human life lost	470,798	377,672	247,486

Age group (yrs)	Money value of human lives lost at 3% discount rate and assuming Spain's average life expectancy of 83 years (Int$)	Money value of human lives lost at 3% discount rate and assuming the global average life expectancy of 72 years (Int$)	Money value of human lives lost at 3% discount rate and assuming world's highest life expectancy of 87.1 years (Int$)
0–9	49,879,550	47,825,591	50,475,653
10–19	48,041,112	45,280,762	48,842,224
20–29	364,563,238	334,885,811	373,176,267
30–39	887,249,607	782,554,159	917,634,483
40–49	1,832,699,077	1,507,744,628	1,927,007,864
50–59	2,495,558,629	1,788,716,131	2,700,699,559
60–69	2,396,832,677	1,174,620,469	2,751,545,007
70–79	1,554,410,222	–	2,123,150,787
80–89	–	–	445,199,848
90 and above	–	–	–
Total	9,629,234,112	5,681,627,551	11,337,731,691
Average money value per human life lost	470,798	277,789	554,331

that the DMVHL is sensitive to the discount rate and the average life expectancy used in the calculations.

Spain's average discounted money value per human life lost from COVID-19 of Int$ 470,798 was higher than that of China of Int$ 356,203 [13], which could be because the per capita GDP and the life expectancy at birth (and hence YLL) of Spain are higher than that of China.

The value per human life lost from COVID-19 in Spain is almost 11-fold the country's GDP per capita. The high value of human life lost due to COVID-19 underscores the need for increased investments in further strengthening Spain's NHS, DSRS, and SDHS. Thus, the evidence contained in this paper could be used, in conjunction with other forms of evidence and arguments (e.g. human rights), to make a compelling case for such investment to facilitate control of the ongoing pandemic and to prevent and control future public health emergencies.

Region	International dollars (Int$)	Percent
Community of Madrid	3,464,012,908	35.97
Catalonia	1,854,856,063	19.26
Castile Mancha	915,563,280	9.51
Castile and Leon	692,604,836	7.19
Region of Valencia	493,870,258	5.13
Basque country	490,409,705	5.09
Andalusia	464,702,745	4.83
Aragon	277,832,918	2.89
Extremadura	183,903,639	1.91
Calicia	158,196,679	1.64
Navarre	167,095,242	1.74
La Rioja	129,523,531	1.35
Asturias	86,019,444	0.89
Cantabria	71,188,506	0.74
Balearic Islands	66,244,859	0.69
Murcia	55,368,838	0.58
Canary Islands	54,874,473	0.57
Ceuta	1,977,458	0.02
Melila	988,729	0.01
TOTAL	*9,629,234,112*	*100*

Table 3.
Presents the
distribution by regions
of the DMVHL from
COVID-19 deaths
in Spain

Limitations
Our study had some limitations. First, the study did not take into account the value of health systems inputs used in preventing, diagnosing, and treating COVID-19 cases [13]. Also, we did not include costs related to the funerals of those who died from COVID. Also, when the HKA is strictly applied, it would value the human lives lost among children below the working age, the unemployed, the full-time homemakers, the elderly and the disabled (especially those who cannot work due to disability) at zero [9,18]. Since this could potentially lead to discrimination of those groups when it comes to the provision of health services, we decided to value all human lives lost at Spain's net GDP per capita. Lastly, the negative impact of COVID-19 on the education, agriculture, finance, manufacturing, and trade sectors of the Spanish economy was not appraised [19].

Conclusion
The preliminary DMVHL estimates reported in this study indicate that the COVID-19 pandemic continues to harm the Spanish economy. Due to the limitations mentioned above, our estimates are a gross underestimate of the total economic impact of COVID-19 on the Spanish economy. Therefore, there is an urgent need for studies that comprehensively assess the total economic impact of COVID-19; and the costs and consequences of alternative preventive and treatment interventions. The latter would be vital for guiding decision-making.

References

1. International Monetary Fund [IMF]. World economic Outlook database. Washington, DC: IMF; 2020.

2. Worldometer. Reported COVID-19 cases and deaths by country, territories, or conveyance. [cited 2020 April 19]. Available at: https://www.worldometers.info/coronavirus/country/spain/.

3. World Health Organization. [WHO].World Health Statistics 2019: Monitoring health for the SDGs. Geneva: WHO; 2019.

4. World Health Organization [WHO] and The World Bank. Tracking universal health coverage: 2017 global monitoring report. Geneva; Washington DC: WHO; The World Bank; 2017.

5. World Health Organization [WHO]. International health regulations 2005. 3rd ed. Geneva: WHO; 2016.

6. World Health Organization [WHO]. IHR core capacity monitoring framework: checklist and indicators for monitoring progress in the development of IHR core capacities in states parties. Geneva: WHO; 2013.

7. World Health Organization [WHO]. Global health expenditure database. Geneva: WHO; 2020.

8. Kiker BF. The historical roots of the concept of human capital. J Political Econ. 1966; 74(5): 481-499.

9. Landefeld JS, Seskin, EP. The economic value of life: linking theory to practice. Am J Public Health 1982; 72: 555-566.

10. World Health Organization [WHO]. WHO guide to identifying the economic consequences of disease and injury. Geneva: WHO; 2009.

11. Weisbrod BA. The valuation of human capital. J Political Econ. 1961; 69(5): 425-436.

12. Chisholm D, Stanciole AE, Edejer TTT, Evans DB. Economic impact of disease and injury: counting what matters. BMJ. 2010; 340(c924): 583-586. doi: 10.1136/bmj.c924.

13. Kirigia JM, Muthuri RNDK. The fiscal value of human lives lost from coronavirus disease (COVID-19) in China. BMC Res Notes. 2020; 13(1): 198. doi: 10.1186/s13104-020-05044-y.

14. United Nations [UN]. Universal declaration of human rights. New York: UN; 2015.

15. World Health Organization [WHO]. Basic documents. 45th ed. Geneva: WHO; 2006.

16. Salomon JA, Vos T, Hogan DR, Gagnon M, Naghavi M, Mokdad A, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. Lancet. 2012; 380(9859):2129-2143. doi: 10.1016/S0140-6736(12)61680-8.

17. Forte F. COVID-19 hospital case distribution by age group in Spain April 2020. Madrid: Statista; 2020.

18. Mooney GH. The valuation of human life. London: Macmillan; 1977.

19. Schwarzenberg AB, Weiss MA, Nelson LM. Global economic effects of COVID-19. United States: Congressional Research Service (CRS); 2020.

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