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The discounted financial worth of human lives lost from COVID-19 in Italy

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Abstract:
Background*:The objective of this study was to estimate the total discounted financial worth of the human lives lost in Italy from Coronavirus Disease (COVID-19).*
Materials and Methods*: This study used the net output approach (or human capital approach) to estimate the total discounted financial worth of the 35,412 human lives lost in Italy from COVID-19 as of 20 August 2020. The main data sources were the Worldometer COVID-19 database, the International Monetary Fund World Economic Outlook Database, the WHO Global Health Expenditure Database, and the Statista database. The economic model was first estimated, assuming Italy's average life expectancy at birth of 84.07 years and a 3% discount rate. Subsequently, the model was recalculated to gauge the impact of changes in (a) discount rate from 3% to 5% and 10%; (b) assumed average life expectancy from 84.07 years to 73.2 years (world's average) and 88.17 (world's highest).*
Results*: The human life losses associated with COVID-19 had a total discounted financial worth of Int$13,070,141,190, and an average of Int$369,088 per human life lost. A sensitivity analysis with 5% and 10% discount rates induced reductions in the total discounted financial worth of 11.8% and 32.8%, respectively. Re-evaluation of the economic model with the world average life expectancy of 73.2 years resulted in an 84.5% reduction in the total discounted financial worth. Whilst, use of the world highest life expectancy of 88.17 years grew the total discounted financial worth by 27.1 %.*
Conclusion*: The results of this study revealed that the human lives lost due to COVID-19 in Italy have a substantive discounted financial worth, which is bound to rise because the pandemic is ongoing.*
Key Words*:Coronavirus; COVID-19; Gross domestic product; Italy;Net output approach; Value of life.*

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I. Introduction

Italy is one of the 53 countries of the World Health Organization [WHO] European Region (EUR) and has a population of 60.45 million persons [1]. In January 2020 the International Monetary Fund [IMF] estimated that Italy would have a total gross domestic product [GDP] of 2,504.63 billion International Dollars [Int$] or Purchasing Power Parity [PPP], and a per capita GDP of Int$41,582.2 [2]. However, following the importation of the Coronavirus Disease (COVID-19) into Italy from China, in April 2020, the IMF predicted that real GDP growth for 2020 would decline by 9.1% in Italy [3].

As of 20 August 2020, worldwide, there were 22,588,815 notified cases of COVID-19; which included 791,090 deaths, 15,309,032 recovered cases, and 6,488,693 active cases [1]. Out of the world burden of COVID-19, a total of 3,250,199 (14.4%) cases accrued to EUR that were made up of 204,224 (25.8%) deaths, 1,942,291 (12.7%) recovered cases, and 1,103,684 (17.0%) active cases. By 20 August 2020, Italy had conducted a total of 7,713,154 COVID-19 tests that revealed a total of 255,278 (7.9%) cases, which consisted of 35,412 (17.3%) deaths, 204,506 (10.5%) recovered cases, and 15,360 (1.4%) active cases. These figures translated to densities of 127,597 COVID-19 tests per million population, 4,223 total COVID-19 cases per million population, and 586 deaths per million population [1].

The rapid spread of COVID-19 and the associated large numbers of deaths might be partially attributed to delayed action to implement preventive measures, and the sub-optimal coverage of essential health services, International Health Regulations (IHR) capacities, and coverage of safely managed water and sanitation services. Table 1 presents a comparison of health system health indicators in Italy with the WHO European Region averages.

Table 1: Comparison of health system and social determinants of health indicators in Italy with the WHO European Region (EUR) averages

Health workforce indicators (2017) [4,5]	**Value in Italy**	**Average value in EUR**
Medical doctors per 10,000 population	39.81	34.1
Nursing and midwifery personnel per 10,000 population	60.61	81.3
Dentists per 10,000 population	8.17	5.7
Pharmacists per 10,000 population	11.69	6.8
Medical devices indicators [4,5]		
Linear accelerators per million population	6.16	N/A
Telecobalt units per million population	0.25	N/A
Radiotherapy units per million population	6.41	3.9
Infrastructure indicators [4,5]		
Hospitals per 100,000 population (2013)	2.08	N/A
Hospital beds per 10,000 population	31.80	N/A
Essential health service coverage indicators [4,5]		
UHC index of service coverage (SCI)	**82**	**77**
UHC SCI components: Reproductive, maternal, newborn and child health	86	86
UHC SCI components: Infectious diseases	82	73
UHC SCI components: Noncommunicable diseases	67	61
UHC SCI components: Service capacity and access	96	94
Catastrophic out-of-pocket health spending (SDG indicator 3.8.2) [4,5]		
Population with household expenditures on health greater than 10% of total household expenditure or income (SDG 3.8.2) (%)	9.29	6.27
Population with household expenditures on health greater than 25% of total household expenditure or income (SDG indicator 3.8.2) (%)	1.08	1.15
Current Health Expenditure (CHE) per Capita in PPP	3619.7	2923
Domestic General Government Health Expenditure as % of CHE	74.0	65.0
Domestic Private Health Expenditure as % of CHE	26.0	35.0
Out-of-Pocket Expenditure (OOPS) as % of CHE	23.0	30.4
Current Health Expenditure (CHE) as % Gross Domestic Product (GDP)	8.84	7.78
Domestic general government health expenditure as percentage of GDP (%)	6.53	4.92
Social Determinants of Health		
Population using safely managed drinking water services (%) [4,5]	95.04	92
Population using safely managed sanitation services (%) [4,5]	96.21	68
Relative poverty rate (%)[6]	20.3	16.9
Unemployment rate (%)[6]	11.2	7.6

Source: WHO [4,5] and European Commission [6]. Note: N/A means not available.

The densities of medical doctors, dentists, and pharmacists per 10,000 population were higher than the EUR averages. Health spending per person of Int$3,620 in Italy was 19.25% above the EUR average of Int$2,923. The domestic general government spending on health accounted for 6.53% of GDP in 2017, which was 1.6 percentage points above the EUR average of 4.92%. The health spending accounted for 8.84% of Italy's GDP in 2017. Almost 74% of health spending was publicly funded, with 23% paid through out-of-pocket payments (OOP). Approximately 5.62 million of Italy's population has household expenditures on health greater than 10% of total household expenditure or income (SDG 3.8.2). Whereas, 652,860 people have household expenditures on health greater than 25% of total household expenditure or income (SDG indicator 3.8.2). These people are at a high risk of catastrophic (impoverishing) health spending.

The universal health coverage (UHC) index for Italy was 82, implying a gap in coverage of essential health services of 18 [4]. The UHC index, which is reported on a unit less scale of 0 (zero coverage) to 100

(target/optimal coverage), is calculated as the geometric mean of 14 tracer indicators of health service coverage which are organized by four components of service coverage: (a) reproductive, maternal, new-born and child health (RMNCH), (b) infectious diseases (IDS), (c) non-communicable diseases (NCD), and (d) service capacity and access (SCA) [7]. The UHC service coverage index (UHCSCI) component of RMNCH had a score of 86, IDS had 82, NCD had 67, and SCA had 96; which were 0.0%, 11.0%, 9.0%, and 2.1% higher than those of the EUR. The overall UHCSCI for Italy of 82 was 6.1 percentage points higher than the EUR average of 77.

As shown in Table 2, in 2018, Italy had an average of 13 International Health Regulations (IHR) core capacity score of 85%, signifying a gap of 15% [8] in disease surveillance and response capabilities.

Table 2: Comparison of the International Health Regulations (IHR) capacity scores for Italy with those of the WHO European Region

IHR capacity	**Italy in 2018**	**WHO European Region average scores in 2019**
Legislation and financing	100	74
Coordination and IHR national focal point functions	100	78
Laboratory	100	73
Surveillance	100	74
Human resources	80	71
National health emergency framework	100	70
Health service provision	100	73
Risk communication	60	66
Points of entry	80	59
Chemical events	60	69
Radiation emergencies	80	77
Food safety	80	77
Zoonotic events and the human-animal interface	100	80
Average of 13 IHR core capacity scores	**85**	**75**

Source: WHO [8].

Italy's average of 13 IHR core capacity score of 85 was ten points higher than the EUR average of 75. The Italy legislation and financing, coordination and IHR national focal point functions, laboratory, surveillance, national health emergency framework, and zoonotic events (and the human-animal interface) each had target score of 100 which was higher than those of the EUR by 26, 22, 27, 26, 30, 27, and 22 points, respectively. Italy's IHR human resources, points of entry, radiation emergencies, food safety, risk communication, and chemical events capacities scores are higher than those of the EUR by 20, 20, 20, 20, 40, and 40, respectively.

The population using safely managed drinking water and sanitation services was 95.04% and 96.21%, respectively (See Table 1) [3]. These percentages imply that 4.96% (2,998,320 persons) and3.79% (2,291,055 persons) of the population was not using safely managed drinking water and sanitation services. The poverty rate in Italy of 20.3% was three percentage points higher than 16.9% in the EUR. Persons living in poverty and those with no access to safely managed drinking water and sanitation services may have significant challenges practising personal hygiene (including handwashing with soap) to reduce the risk of COVID-19 infection.

As cogently explained by Card and Mooney [9] and Rice [10], evidence on monetary valuation of human life is needed for use in advocacy for increased investments into health development. Very recently studies carried out in Brazil [11], Canada [12], China [13], Germany [14], Spain [15], Turkey [16], the United Kingdom (UK) [17]; and the United States of America (USA) [18] estimated monetary value of human lives lost due to COVID-19 for use to advocate for increased multisectoral investments to scale-up coverage of essential health services, IHR capacities, and other services related to social determinants of health. A recent study estimated the macroeconomic impact of the COVID-19-related lockdown strategy on the productivity of the various Italian industries, including automobile, aviation, retail, food and beverage, travel and tourism, manufacturing, banking, finance, and insurance firms [19]. However, that study did not attempt to value the human lives lost to COVID-19 in Italy.

The current study estimates the total discounted financial worth of human lives lost in Italy from COVID-19 as of 20 August 2020.

II. Material and Methods

This cross-sectional study included all persons reported dead from COVID-19 in Italy, i.e. from the time the first case of COVID-19 was reported on 31 January to 20 August 2020. A total of 35,412 persons deceased due to COVID-19 across all ages were included in the study [1]. Since the study covered the entire population of persons whose death was associated with COVID-19, sampling was not necessary.

Analytical framework

The net output approach was employed in estimating the discounted financial worth of the cumulative number of human lives lost from COVID-19 in Italy ($FWHL_{ITALY}$) as of 20 August 2020. Cutler and Richardson [20] reviews the models for valuing human life, including the net output approach. Mooney [21] offers a critique of the approach. One of the variables used in the valuation of human lives lost is the net per capita GDP, which was obtained by subtracting Italy's current health expenditure per capita from the GDP per capita [22,23,24]. The FWHL in Italy was estimated using the analytical framework developed and applied for a similar purpose in in Brazil [11], Canada [12], China [13], Germany [14], Spain [15], Turkey [16], the UK [17], the USA [18], and the Democratic Republic of the Congo (DRC) [25].

Italy's $FWHL_{ITALY}$ from COVID-19 is the total FWHL among eight age groups: 1= 0-9-year-olds ($FWHL_{0-9}$), 2=10-19-year-olds ($FWHL_{10-19}$), 3=20-29-year-olds ($FWHL_{20-29}$), 4=30-39-year-olds ($FWHL_{30-39}$), 5=40-49-year-olds ($FWHL_{40-49}$), 6=50-59-year-olds ($FWHL_{50-59}$), 7=60-69-year-olds ($FWHL_{60-69}$), and 8=70-year-olds and above $\left(FWHL_{\geq 70}\right)$ [13]. The $FWHL_{ITALY}$ was estimated utilizing the following equation [11-18]:

$$FWHL_{ITALY} = \sum_{i=1}^{i=8} FWHL_i \ldots\ldots\ldots\ldots\ldots (1).$$

Each age group's $FWHL_j$ was appraised through the multiplication of discount factor, years of life lost, net GDP per capita, and COVID-19 deaths in the j[th] age group [13]. Formally [11-18]:

$$FWHL_j = \sum_{t=1}^{T} \{(S_1) \times (S_2 - S_3) \times (S_4 - S_5) \times (S_6 \times S_7)\} \ldots\ldots\ldots (2)$$

Where: $S_1 = 1/(1+r)^t$ is the discount factor; r is the discount rate of 3% [11-18,25]; $\sum_{t=1}^{T}$ is the summation from year $t=1$ to $t=n$; $t=1$ is the first year of life lost (YLL) to COVID-19 and T is the final year of the sum of YLL per COVID-19 human life lost within an age group; S_2 is the average life expectancy at birth for Italy; S_3 is the average age at death from COVID-19 for j[th] age group; S_4 is the GDP per capita for Italy in International Dollars (Int$) or purchasing power parity (PPP); S_5 is the current health expenditure per capita in Int$ for Italy; S_6 is the total number of COVID-19 associated deaths reported in Italy as of 20 August 2020; and S_7 is the proportion COVID-19 deaths accruing to the j[th] age group. The current year (2020) was the baseline for the analysis.

Data and data sources

Data on the 35,412 total number of human lives lost due to COVID-19, as of 20 August 2020, was obtained from the Worldometer COVID-19 pandemic database [1]. The International Monetary Fund (IMF) World Economic Outlook Database [2] provided information on Italy GDP per person of Int$41,582.2. The WHO Global Health Expenditure Database yielded data on current health expenditure per person for Italy of Int$3,620 [26]. The distribution of COVID-19 deaths in Italy, as of 11 August 2020, by age group (0-9 years: 4, 10-19 years: 0, 20-29 years: 16, 30-39 years: 67, 40-49 years: 311, 50-59 years: 1225, 60-69 years: 3559, and 70 years and older: 30231) were from the Statista [27]. The data on the COVID-19 deaths in Italy, as of 17 August 2020, by region from the Statista [28] were used to calculate proportions – Lombardy: 0.475988581, Emilia-Romagna: 0.125865627, Piedmont: 0.11701857, Veneto: 0.059244184, Liguria: 0.044348342, Tuscany: 0.03219424, Marche: 0.027897906, Lazio: 0.024590859, Apulia: 0.015687272, Abruzzo: 0.013341248, Campania: 0.012436756, Autonomous Province of Trento: 0.011447469, Friuli-Venezia Giulia: 0.009836344, Autonomous Province of Bolzano: 0.007659911, Sicily: 0.008083892, Sardinia: 0.003787558, Aosta Valley: 0.004126742, Calabria: 0.002741739, Umbria: 0.002261228, Basilicata: 0.00079143, and Molise: 0.000650103. Data on Italy's average life expectancy at birth of 84.07 years, the world average life expectancy of 73.2 years, and the Hong Kong's female life expectancy of 88.17 years (which the world highest) was also from the Worldometer demographics database [29].

Statistical analysis

Equations 1 and 2 were estimated using Excel Software (Microsoft, New York, USA). The analysis entailed the following steps:

Step 1: Search of the literature revealed that the discount rates of 3%, 5%, and 10% had been most frequently used in the valuation of human life losses associated with COVID-19 in some other countries [11-

18,25]. The economic model was estimated at 3% discount rate, and the rates of 5% and 10% were used in the sensitivity analysis.

Step 2: Estimation of the undiscounted YLL for each of the eight age groups through subtraction of the age group average age at onset of death (S_3) from Italy's average life expectancy at birth (ALE) of 84.07 years (S_2). For example, the average age at onset of death for age group 0-9 years = (0+19)/2= 4.5 years. The YLL per human life lost from COVID-19 in the age group 0-9 years = 84.07 years minus 4.5 years = 79.57 years, which rounds up to 80 years. The AAOD for the remaining age groups were: 14.5 for 10-19 years, 24.5 for 20-29 years, 34.5 for 30-39 years, 44.5 for 40-49 years, 54.5 for 50-59 years, 64.5 for 60-69 years, and 74.5 for 70 years and older. The YLL (rounded up to the nearest whole number) for the eight age groups were: 80 for 0-9 years, 70 for 10-19 years, 60 for 20-29 years, 50 for 30-39 years, 40 for 40-49 years, 30 for 50-59 years, 20 for 60-69 years, and 10 for 70 years and older.

Step 3: Calculation of the net GDP per capita through subtraction of the current health expenditure per capita (S_5) from the GDP per capita for Italy (S_4), i.e. Int$41,582.2 - Int$3,620 = Int$37,962.

Step 4: Estimation of the number of COVID-19 deaths accruing to each of the eight age groups. The COVID-19 deaths in Italy as of 11 August 2020 by age group were divided by the total number of deaths to obtain the following proportions: 0-9 years = 0.000112221; 10-19 years = 0; 20-29 years = 0.000448883; 30-39 years= 0.001879699; 40-49 years = 0.008781282; 50-59 years = 0.034592077; 60-69 years = 0.100493772; and 70 years and older = 0.853692066. The multiplication of 35,412 COVID-19 deaths in Italy as of 20 August 2020 (S_6) by respective proportions (S_7) yielded the number of deaths per age group: 0-9 years = 4, 10-19 years = 0, 20-29 years = 16, 30-39 years = 67, 40-49 years = 311, 50-59 years = 1225, 60-69 years = 3559, and 70 years and older = 30231.

Step 5: Calculation of each age group $FWHL_j$ through the multiplication of discounted years of life lost, net GDP per capita, and COVID-19 deaths in the j^{th} age group. For example, FWHL for age group 0-9 years = 30.00459 discounted YLL x Int$37,962 x 4 COVID-19 deaths in age group = Int$4,556,137. The FWHL for the other seven age groups were similarly calculated.

Step 6: Distribution of the total financial worth of human life losses in Italy by the 21 administrative regions through the multiplication of the $FWHL_{ITALY}$ by the proportion of deaths borne by each Region.

Step 7: Sensitivity analysis to gauge the impact of changes in (i) discount rate from 3% to 5% and 10%; and (ii) assumed average life expectancy from 84.07 years to 73.2 years (world's average) and 88.17 (world's highest) on the $FWHL_{ITALY}$. It entailed recalculation of the economic model alternately four times with these parameters:

a) With a 5% discount rate, while holding Italy's life expectancy constant at 84.07 years.
b) With a 10% discount rate, without changing Italy's life expectancy.
c) With the world average life expectancy at birth of 73.2 years, while holding the discount rate constant at 3%.
d) With the world highest life expectancy of 88.17 years, while holding the discount rate constant at 3%.

Ethical approval

Ethical approval was not required because the study exclusively analysed secondary data contained in publicly available databases [1,2,26-29].

III. Result

The financial worth of human life losses assuming Italy's average life expectancy of 84.07 years and a 3% discount rate

As portrayed in Table 3, the human lives losses associated with COVID-19 had a discounted total financial worth ($FWHL_{ITALY}$) of Int$13,070,141,190, and an average of Int$369,088 per life lost.

Table 3: The total and average financial worth of human life losses from COVID-19 in Italy – assuming the national average life expectancy of 84.07 years and a 3% discount rate (in 2020 Int$)

Age group in years	Financial value of human lives lost at 3% discount rate (Int$)	Average financial value per human life lost in an age group (Int$)
0-9	4,556,137	1,146,497
10-19*	0	0
20-29	16,700,724	1,050,634

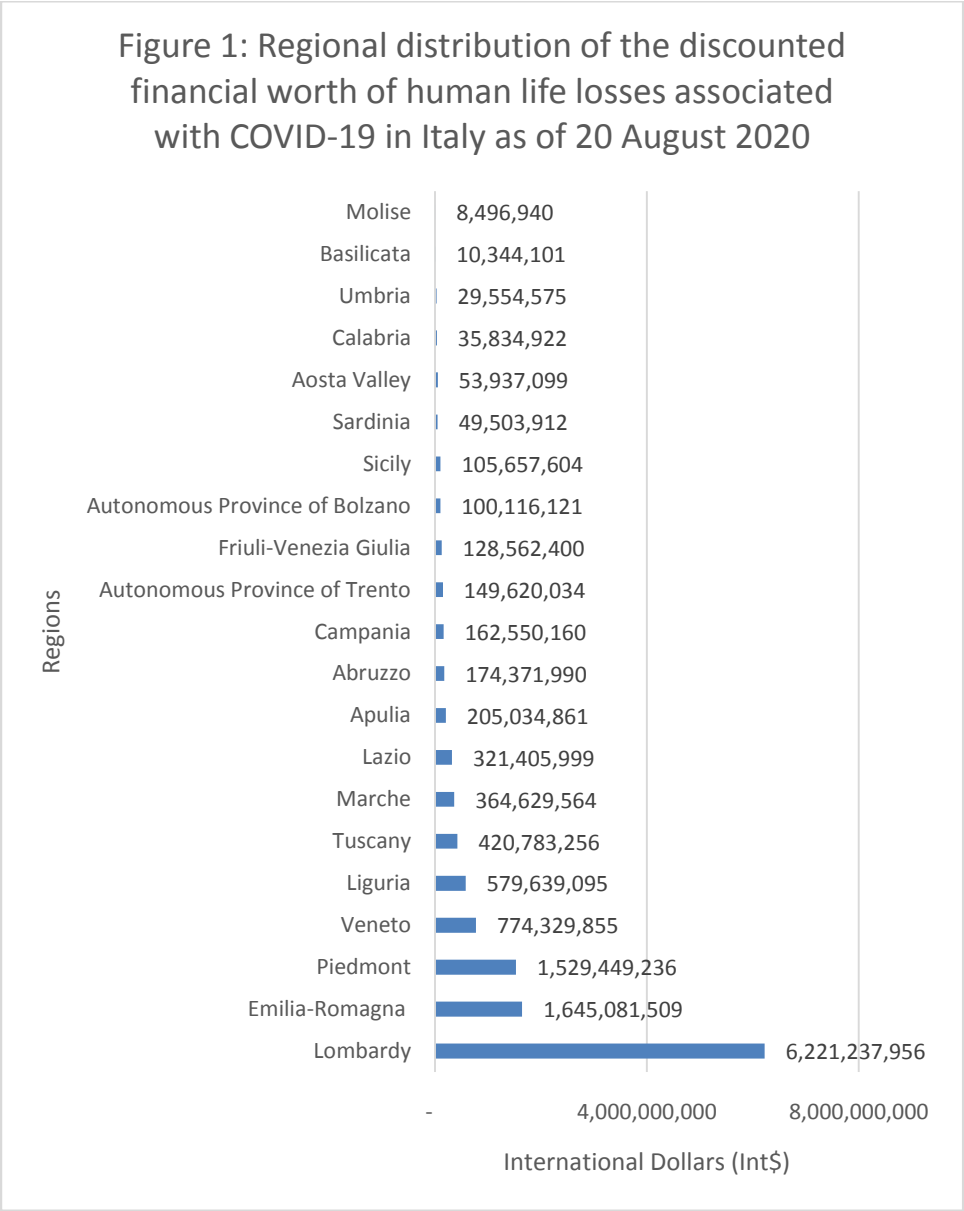
30-39	65,017,378	976,766
40-49	272,868,120	877,495
50-59	911,481,326	744,082
60-69	2,009,896,320	564,786
70 and older	9,789,621,184	323,828
TOTAL	13,070,141,190	369,088

Note: *There were zero deaths in age group, and hence, zero financial value.

About 0.04% was incurred by 0-9-year-olds, 0.0% by 10-19-year-olds, 0.13% by 20-29-year-olds, 0.5% by 30-39-year-olds, 2.1% by 40-49-year-olds, 7.0% by 50-59-year-olds, 15.38% by 60-69-year-olds, and 74.85% by 70-year-olds and above. Approximately 90% of the $FWHL_{ITALY}$ was sustained by those aged 60 years and older. The average financial value per human life lost in the age group 0-9 years was four-fold that of 70 years and older.

***The regional share of*$FWHL_{ITALY}$**

Figure 1 shows the regional distribution of the $FWHL_{ITALY}$ from COVID-19 in Italy as of 20 August 2020.



Lombardy incurred 47.6% of the $FWHL_{ITALY}$, Emilia-Romagna 12.6%, Piedmont 11.7%, Veneto 5.9%, and Liguria 4.4%. Therefore, these five (out of 21) regions incurred 82.2% of the $FWHL_{ITALY}$ associated with COVID-19 in Italy.

Sensitivity analysis of $FWHL_{ITALY}$ assuming 5% and 10% discount rates holding Italy's average life expectancy of 84.07 years' constant

Table 4 compares the $FWHL_{ITALY}$ from COVID-19 in Italy, assuming discount rates 5% and 10%.

Table 4: A comparison of the discounted financial worth of human lives lost from COVID-19 in Italy (in 2020 Int$) – at 5% and 10% discount rates

Age group in years	Financial worth of human lives lost at 5% discount rate (Int$)	Financial worth of human lives lost at 10% discount rate (Int$)
0-9	2,956,354	1,507,880
10-19	0	0
20-29	11,422,815	6,014,647
30-39	46,131,492	25,054,068

40-49	202,561,706	115,440,948
50-59	714,866,660	438,380,766
60-69	1,683,602,287	1,150,153,541
70 & above	8,861,789,255	7,051,764,824
TOTAL	11,523,330,570	8,788,316,674
Average discounted financial worth per human life	325,408	248,173

Employment of a discount rate of 5% led to a reduction in the $FWHL_{ITALY}$ from COVID-19 by Int$1,546,810,620 (11.8%), and the average financial worth per human life by Int$43,680. Whereas, the use of a discount rate of 10% instead, diminished $FWHL_{ITALY}$ from COVID-19 by Int$4,281,824,517 (32.8%), and the average financial worth per human life by Int$120,915.

Sensitivity analysis of $FWHL_{ITALY}$ assuming world average life expectancy and the world highest life expectancy holding discount rate constant at 3%

Table 5 provides a contrast of the $FWHL_{ITALY}$ from COVID-19 in Italy, estimated first assuming Italy's average life expectancy, and subsequently, the average global and the world's highest life expectancies (which is the Hong Kong female life expectancy of 88.17 years).

Table 5: A contrast of the financial worth of human lives lost from COVID-19 in Italy: assuming world's average life expectancy and world's highest life expectancy (in 2020 Int$ or PPP)

Age group in years	**Financial worth of human lives lost at 3% discount rate and assuming the global average life expectancy of 73.2 years (Int$)**	**Financial worth of human lives lost at 3% discount rate and assuming world's highest life expectancy of 88.17 years (Int$)**
0-9	4,374,554	4,608,836
10-19	0	0
20-29	15,388,888	17,081,448
30-39	57,634,821	67,159,956
40-49	226,518,243	286,319,854
50-59	666,101,093	982,695,960
60-69	1,051,876,868	2,287,934,216
70 & above	0	12,963,850,804
TOTAL	**2,021,894,468**	**16,609,651,073**
Average financial worth per human life	**57,096**	**469,040**

Re-evaluation of the economic model with the world average life expectancy of 73.2 years, while holding discount rate constant at 3%, resulted in an Int$11,048,246,723 (84.5%) reduction in the $FWHL_{ITALY}$ from COVID-19. Use of the world's highest life expectancy grew the $FWHL_{ITALY}$ from COVID-19 by Int$3,539,509,883 (27.1 %), and the average financial worth per human life by Int$99,952.

IV. Discussion

Key findings

The 35,412 human lives losses associated with COVID-19 had a $FWHL_{ITALY}$ of Int$13,070,141,190, and an average of Int$369,088 per life lost.Recalculation of the economic model with discount rates of 5% and 10% led to reductions in the $FWHL_{ITALY}$ of 11.8% and 32.8%, respectively. This finding is consistent with similar studies conducted in other countries which found an inverse relationship between changes in the discount rate and the monetary value of human life losses associated with COVID-19 [11-18]. Re-evaluation of the economic model with the world's highest life expectancy grew the $FWHL_{ITALY}$ 27.1 %; which was also consistent with other countries studies that also found a positive relationship between life expectancies above the national averages and the monetary value of human life losses related to COVID-19 [11-18].

Comparison with similar studies

In this subsection, we compare the results from the Italy study with those of eight other countries that employed the human capital approach in the valuation of human life losses associate with COVID-19. The average discounted financial worth per human life in Italy of Int$369,088 was higher than those of Brazil of Int$99,629 [11]; Germany of Int$132,960 [14]; China of Int$356,203 [13]; Canada of Int$237,319 [12]; Turkey of Int$228,514 [16]; the United Kingdom of Int$225,104 [7]; and the United States of America of Int$292,889 [18]. However, Italy's discounted financial value per human life was lesser than that Spain of Int$470,798 [15]. The cross country differences in the financial value of human life have been attributed variations in the total number of years of life lost and GDP per capita [11-18].

Study limitations

First, the study used Italy's GDP per capita in the valuation for all the lives lost. GDP measures the aggregate size of the economy but do not capture inequalities in the distribution of wealth and income in a country [30]. For example, the Gini coefficient for Italy is 35.4; which is noteworthy taking into account that the index varies from 0 (perfect equality) and 100 (maximal inequality) [31]. The share of national income held by the poorest 40% of the population is 18.0%, the wealthiest 10% is 25.7%, and the wealthiest 1% is 7.5% [31].

Second, this study used the net output approach to value human life losses associated with COVID-19. Mooney [21] criticized the approach for valuing the lives of all those outside the labor force (e.g. the retired, full-time home-makers, children) at zero [21,25]. In this study, all lives lost were valued at the net GDP per capita to obviate the discrimination implied in the approach.

Lastly, the study excluded the direct costs associated with prevention (handwashing, physical distancing and lockdowns), diagnosis, contact tracing, isolation and quarantine, and treatment. It also did not include post-mortem and funeral related costs [11,12,14,15].

V. Conclusion

This study bridges a critical knowledge gap in the financial value of human lives lost from COVID-19 in Italy. The results of this study reveal that the 35,412 human lives lost due to COVID-19 in Italy had a substantive discounted financial worth of Int$13.1 billion, which is equivalent to 0.52% of the country's total GDP in 2020. The average discounted financial worth per human life of Int$369,088 is nine-fold the GDP per capita for Italy. The sensitivity analysis reveals that the magnitude of FWHL is partially dependent on the discount rate and life expectancy assumed. Since the pandemic is ongoing, the discounted financial loss from cumulative human lives lost is bound to rise.

The health development policy-makers ought to use such economic evidence in their evidence-based advocacy, with various stakeholders, for increased investments into national and regional health systems, disease surveillance systems (including IHR capacities), and other systems that address social determinants of health to bridge service coverage gaps and ensure resilience in containing and responding to public health emergencies [11,12,14-18]. The case for bridging gaps in health-related services should not be based on economic evidence only but also human rights considerations. For example, the United Nations universal declaration of human rights underscores that every person has right to life (Article 3) and the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services (Article 25) [32].

Besides the kind of evidence presented in this paper, there is a need for studies that weigh the costs and benefits of multi-sectoral preventive, diagnostic, quarantine/isolation, and rehabilitative intervention options to guide decision-making.

Conflict of interest

Authors declare that they have no conflict of interest.

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Contribution of the Authors

JMK, RNDKM, LHKN, and NGM equally contributed in the literature review, study design, extraction of data from secondary sources, development of the economic model, data analysis, interpretation of findings, and drafting of the manuscript. All authors read and approved the final version of this manuscript.

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