Journal of Advances in Medicine and Medical Research

34(20): 432-443, 2022; Article no.JAMMR.90155
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Population Growth Rates and Pattern of COVID-19 Deaths Per Million

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JAMMR/2022/v34i2031514

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/90155

Original Research Article

Received 11 July 2022
Accepted 01 August 2022
Published 05 August 2022

ABSTRACT

Background: Population growth rate (PGR)can reflect the age group structure of the community because low PGR usually indicates low birth rate and old age structure of the community. As PGR is a single easily recalled from public sources (unlike the age distribution), we designed this study to look for any relation between PGR's impact on COVID-19 mortality and looking for a new indicator for COVID-19 mortality risk assessment. The importance of this study is to study the relation between COVID -19 pandemic and the universal trend in decreasing PGRs and continual change in population structure.
Methods: Ninety-two countries with a total population of more than ten million people were chosen as a sample for this study. We used publically available data for PGRs and COVID-19 deaths per one million populations. These countries were classified into three groups according to COVID-19 death rate per million people as follows: < 1000 / (62 Countries), COVID-19 death rate 1000-2000 (11 Countries), and > 2000 (19 Countries).
Analysis of variance (ANOVA) was used as a statistical method to provide information about levels of variability within a regression model and form a basis for testing the fitted logarithmic model for significance.
Results: PGR was inversely related to COVID-19 mortality in a too highly significant association (p-value 0.000).
Conclusion: We described a novel method to predict countries at increased risk for COVID-19 death through PGR estimation. Low PGR is correlated with the increased COVID-19 mortality rate for COVID-19 and vice versa.

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Keywords: COVID-19; population growth rate; COVID-19 deaths per million.

ABBREVIATIONS

ANOVA : Analysis of Variance;
COVID-19 : Corona Virus Disease 2019;
PGR : Population Growth Rate;
SARS-COV 2 : Severe Acute Respiratory Syndrome Coronavirus 2;
SPSS : Statistical Package for the Social Sciences;

1. INTRODUCTION

The global population has grown from 1 billion in 1800 to 7.9 billion in 2020 [1,2].

The absolute increase of the population per year peaked in 1988 with almost 93 million, while it was 80 million in last year (2021). Annual additions are projected to continue declining by around 1 million every year, reaching 48 million by 2050 and 3 million by 2100 [2]. The world population growth rate (PGR) declined from 2.2% per year 50 years ago to 1.05% per year.

Demographic transition refers to the shift from high birth rates and high death rates to low birth rates and low death rates, as well as the stages between these two scenarios [3]. Contemporary societies are now at very different stages of their demographic transitions. Most regions and countries in the world are experiencing unprecedentedly rapid demographic change. Extraordinary change is women's fertility which dropped rapidly and life expectancy has risen to new highs in the developed countries. This leads to an increase in older populations in these countries [4]. Fertility and mortality trends in developing countries have led to very young populations in these countries [4].

Population growth is determined by births and deaths and every country has seen very substantial changes in both. Universally, a dramatic decline in child mortality has been achieved throughout the world.

Soon after 2019 (COVID-19) was first reported in December 2019 in the Wuhan city of China, the disease Corona Virus Disease got spread to the entire world and the world starts to suffer a current COVID-19 pandemic. As of 30 January 2022 over 370 million COVID-19 confirmed cases and over 5.6 million deaths have been reported globally [5]. Since early times in this pandemic, COVID-19 has been examined according to age groups contexts. High incidence was recognized among older adults [6]. Furthermore, it is known that the distribution of the cases varied widely between countries.

Evidence indicates that children seldom develop a severe clinical presentation of severe acute respiratory syndrome coronavirus 2(SARS-COV 2) infection and are less prone to transmit it than adults [7-10].

The age structure of the cases dramatically impacts the differences in the fatality rates between countries. Adjusting for age reduces the variances. After an age-adjustments variance still exists [11]. Adjustments are specifically difficult when the data about age structure and age distribution of cases are not easily accessible or lacking or scarce [12,13] especially in middle-income countries and low-income countries [13].

COVID-19 has been examined in the context of age structure, but has not been examined in contexts of PGR.

We look through this study to find a correlation of the PGR to the COVID-19 deaths per one million populations as crude mortality rate which is a ratio of the number of people that die from a disease divided by the total number of individuals in a population [14].

This study can look for age structure and age distribution of the disease by other prospective i.e. the growth rate. This methodology does not require data concerning the age distribution of the disease.

2. METHODS

Patient and public were not involved. This study analyzed data from a public database, so no informed consent was required for this type of study and there was no need for ethics committee approval.

2.1 Study Design

We chose all countries with a total population of more than ten million people as a sample for this study. As North Korea did not register any COVID-19 case till the time of the study, it was excluded. We used publically available data for 2016-2021 PGRs and COVID-19 deaths per one million people as they were on February 6, 2022 to perform the study.

The selected countries were ninety-two countries furtherly classified into three groups according to COVID-19 death rate /Million people into < 1000 / (62 Countries), COVID-19 death rate 1000-2000 (11 Countries), and > 2000 (19 Countries). We used publically available data through:

1. Countries by population growth rate 2021 - StatisticsTimes.com https://www.statisticstimes.com/demographics/countries-by-population-growth-rate.
2. UN (World Population Prospects 2019) https://population.un.org/wpp/
3. World Population Prospects - Population Division - United Nations https://population.un.org/wpp/
4. COVID Live - Coronavirus Statistics - Worldometer (worldometers.info)

2.2 Statistical Methods

The statistical data analysis approaches were used under the application of the Statistical Package for the Social Sciences (SPSS) ver. (22.0). Descriptive data analyses predicted equation estimates for high fitted regression, and analysis of variance (ANOVA) were used.

An optimum model of high fitted regression was checked among several assumed linear and non-linear equations (Table 1).

3. RESULTS

The most fitted model was the logarithmic model (Table 1).

Table (2) shows a summary statistic for studied selected countries who were classified in three groups according to their numbers of COVID-19 death per million people.

Results showed the mean population growth rates were 9.398, 4.767, and 2.287 among countries with the following COVID-19 death/ million categories < 1000, 1000-2000, and >2000 respectively. There was no overlap in 95% confidence interval (C.I.) for the mean between first and second group categories (7.949- 10.8 vs 2.532-7.002) ,while the third group category C.I. (0.619- 3.954) overlapped the lower border of the second group whose C.I. was (2.532-4.767) (Table 3). This was also illustrated in (Fig. 2).

Fig. 1 represents the selected studied countries who were classified in three groups according to their numbers of COVID-19 deaths per one million people.

Table 4 shows a meaningful logarithmic model tested in a two-tailed alternative statistical hypothesis. Testing the nonlinear regression of the best fitted (logarithmic) model by ANOVA was very highly sig. at P<0.001.

Table 1. Predicated Equations for fitness with shaded predicated equation with an optimal model

Predicated equations	Models
Model whose equation is Y = b0 + (b1 * x).	Linear
Model whose equation is Y = b0 + (b1 * Ln (x)).	Logarithmic
Model whose equation is Y = b0 + (b1 / x).	Inverse
Model whose equation is Y = b0 + (b1 * x) + (b2 * x**2).	Quadratic
Model defined by the equation Y = b0 + (b1 * x) + (b2 * x**2) + (b3 * x**3).	Cubic

Table 2. Descriptive statistics for studied countries

COVID-19 deaths / million				
Statistics		< 1000	1000 - 2000	> 2000
Mean		231.68	1535.17	2716.72
95% C.I. for mean	L.b.	165.97	1316.48	2247.98
	U.b.	297.39	1753.86	3185.47
Standerd. deviation		258.75	344.19	942.6
Minimum		3	1034	2014
Maximum		970	2014	6138

Table 3. Descriptive statistics for 2016-2021 population growth rate (%) classified in three groups according to COVID-19 deaths per one million people

Pop. Growth Rate (%) 2016-2021 in light of COVID-19 death/ million				
Statistics		**COVID-19 deaths/ million**		
		< 1000	**1000 - 2000**	**> 2000**
Mean		9.398	4.767	2.287
95% C.I. for Mean	L.b.	7.949	2.532	0.619
	U.b.	10.847	7.002	3.954
Std. Deviation		5.707	3.517	3.353
Minimum		-3.840	-1.530	-3.380
Maximum		20.89	8.55	7.87

Table 4. Regression analysis for the influence of COVID-19 death per one million people on 2016-2021 PGR

Dependent variable: " 2016-2021 Pop. Growth Rate (%)"					
List wise Deletion of Missing Data					
Correlation Coefficient	-0.63030 (THS)	Meaningful non-linear regression (Logarithmic) tested in two tailed alternative statistical hypothesis			
R- Squared	0.39728				
Adjusted R squared	0.39059				
F statistic of reg. ANOVA	59.32398	Sign. F =	0.0000 (VHS) (*)		
Variables in the Equation					
Variable	B	SE.B	Beta	t-test	Sig. level (*)
COVID-19 death per one million	-2.026032	0.263046	-0.630304	-7.702	0.0000
(Constant)	18.873429	1.563576	-	12.071	0.0000
Predicted equation - logarithmic model					

$$\widehat{(\text{Pop. Growth Rate\%})} = (18.873429) + \text{Ln}(-2.026032 * \text{Covid} - 19\ \text{Death/ Million})$$

(*) *VHS: very highly Sig. at P<0.001 testing non linear regression (logarithmic model): whose equation is Y = b0 + (b1 * Ln (x)*

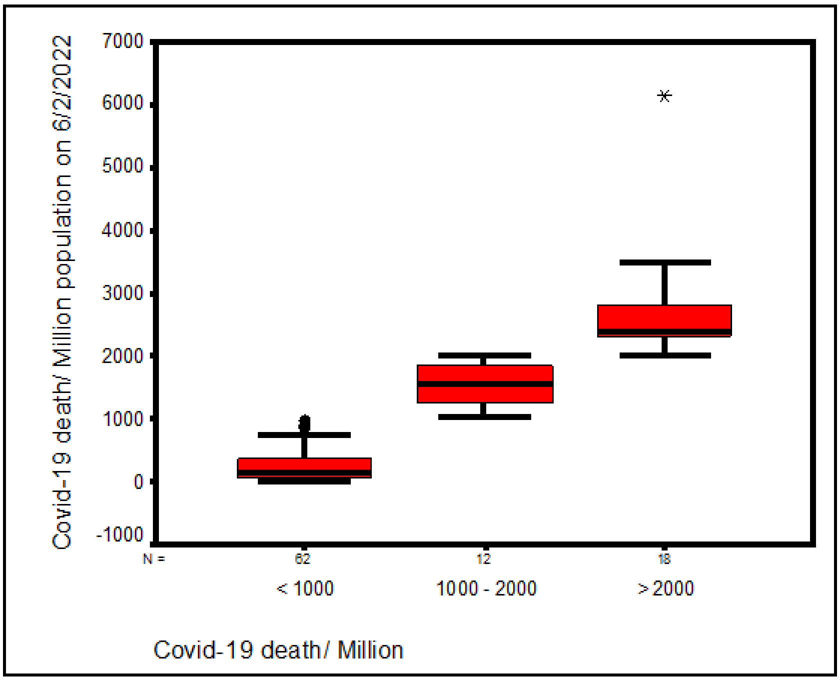

Fig. 1. Stem-leaf plot for COVID-19 death/million

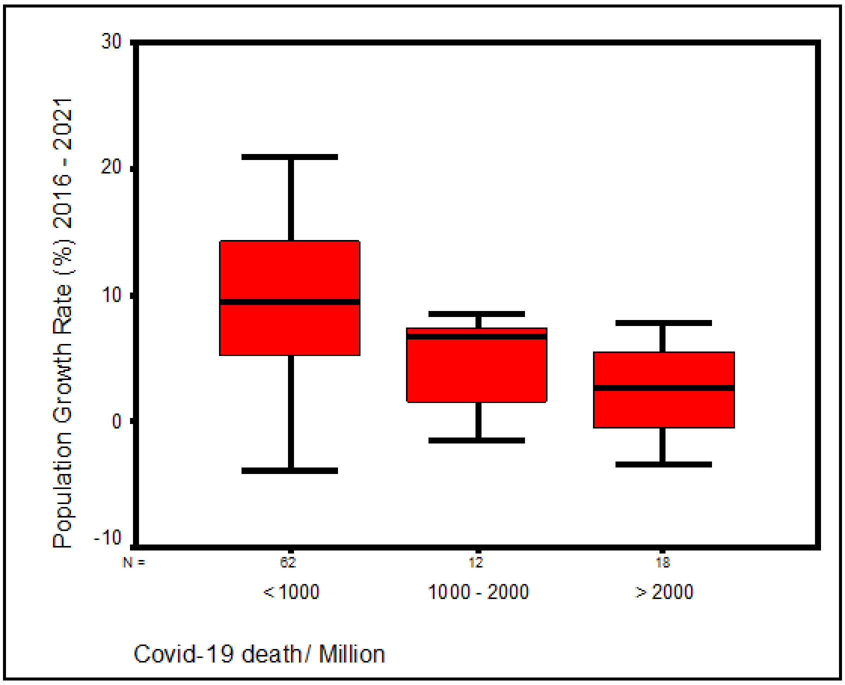

Fig. 2. Stem-leaf plot for 2016-2021 population growth rate (%) according to COVID-19 death per one million population groups

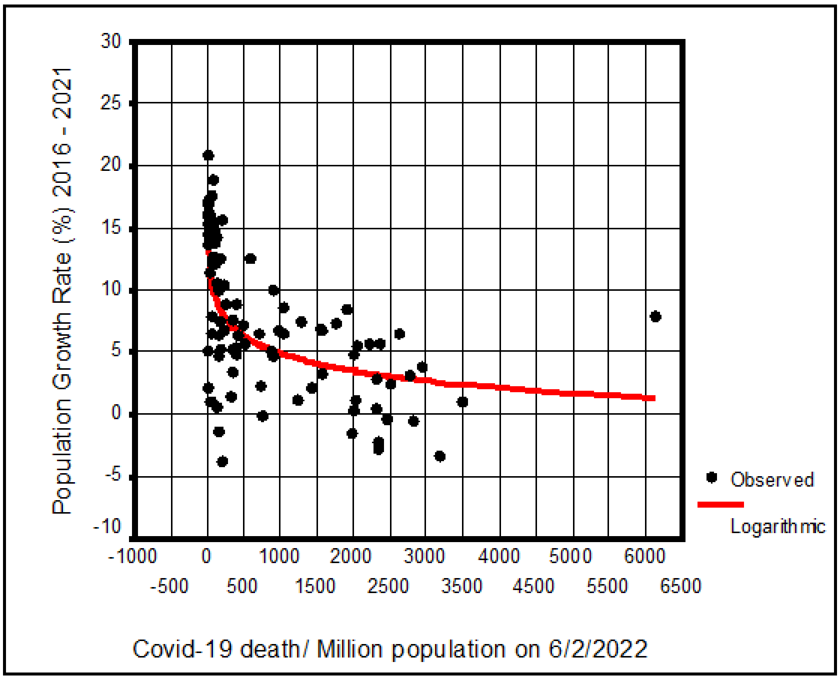

Fig. 3. logarithmic model of long term trend of the scatter diagram concerning influence of PGR in COVID-19 deaths per one million

Slope value indicates that with increasing one unit of the COVID-19 death per million, there is a negative impact on the unit of (2016-2021 PGR), and was estimated as (-2.026032). This records too highly significant impact at <0.001 P-value, as well as the correlation coefficient which accounts a figure of (0.63030). The determination coefficient R^2 (r-squared) is meaningful and significant (39.728%). The corrected coefficient of determination coefficient also confirms a large convergence of the estimated value of the coefficient, which reflects the strength of the fitted logarithmic model. Another source of variations that were not included in model (intercept) shows a too highly significant level at P<0.001 are accounted, and indicating that there are other sources of variations that have an actual effect explaining the variations that have been observed in the studied function. Fig. 3 illustrates logarithmic model of long term trend of the scatter diagram concerning influence of PGR in COVID-19 deaths per one million.

4. DISCUSSION

Population growth is calculated by subtracting the death rate from the birth rate. Over the last two decades, we have seen declining PGRs in nearly all countries. PGRs are lowest in the most developed regions. In contrast, less developed regions have a higher growth rate which declined more slowly. High birth rate is a contributing factor for high GR in developing countries while birth rates are characteristically low in developed countries.

There is a dramatic decline in child mortality that has been achieved in all parts of the world [1] but there is no universal decline in adult deaths in this stage of global demographic transition. For this reason, adult mortality contributes to a substantial portion of death rates varies among countries. Since older people are the most-at-risk group in many developed countries, the high COVID-19 mortality rate was attributed to a higher rate of elderly people (a characteristic age structure of the developed countries). The largest increase in mortality risk for COVID-19 was observed in patients aged >50 years especially patients aged 60 to 69 years [15]. Findings of low COVID-19 deaths per one million people and high adult death rates in certain countries with high birth rates (high growth rates countries) is partly attributed to substantial low proportions of the older age group.

Although we found a very high significant negative association between COVID-19 deaths per one million people and PGR, outliers were identified among three COVID-19 category groups as follows (Appendix 1 and Table 3):

1. Low COVID-19 deaths per million (<1000) was found in China, Japan , South Korea, Taiwan, Cuba, Venezuela , and Mauritius. These countries had PGR values 1-2 SD below the mean value except Venezuela which recorded a PGR value < 2 SD. The death rates for these countries in 2020 was equal to 8.20, 10.2,8.2,7.90, 9.10, 7.50 ,7.3 respectively [16]. The death rates for these countries were relatively high and were above 7 (the whole world's death rate was 7.7 in 2020) [16]. This reflects a community structure which is consistent with a high adult death in these communities. This leads to a decrease in old age proportion.

2. Medium COVID-19 deaths per one million (1000-2000): In this group we found Portugal which had a PGR value of -1.53 (just below 1SD). Relatively high death rate which was 10.80 in 2020 [16] might explain relatively low COVID-19 deaths. High elderly deaths in Portugal minimize elderly proportion again.

3. High COVID-19 deaths per one million >2000: Countries with outliers in this group have relatively low death rates and were below the whole world death rate (7.7 in 2020). This group includes Colombia with a death rate of 5.60 and Peru with a death rate of 6.20 [16]. PGR was just > 1 SD for both of these countries. Low adult deaths increase elderly proportions among these countries. This might explain the increase in COVID-19 deaths per one million people among these relatively high PGR countries.

In the context of scarce of COVID-19 age distribution data, we think that this observational data analyses provide the best available source for public health and decision making.

Our results confirm (in this large representative sample) that COVID-19 deaths per one million people is negatively correlated to PGR in a very high significant association with a p-value of 0.000. PGR reflects the age structure of a community in one way or another. As far as we know, this is the first to study in this aspect. This study might consolidate findings of the high COVID-19 mortality rates among countries structurally characterized by high old age people and vice versa [12,13].

Demographic adjustments do not necessarily explain COVID-19 indices variances across regions [12].

Despite the demographic adjustments in Italy (2016-2020 PGR value of -0.49), the distribution of both cases and fatalities across ages shows a striking anomaly which has a high case fatality rate for ages above 60 years in respect to other countries [17].

We can conclude that COVID-19 mortality rates among low PGR countries can be driven to levels beyond usual adjustment levels. Possibly, countries with high predominant young age people have lower risk for infection increasing herd immunity level acting as a barrier for the spread of disease thus, slowing or preventing the transmission of disease to others.

On the other hand, high infection rates among adults leads to higher infection rates among countries characterized by high older age demographics. High rate of infection is simply a contributing factor to increased mortality rate per million and may furtherly increase the mortality rate through increasing the case fatality rate [18-21].

As COVID-19 mortality decreases when herd immunity is relatively increased by the presence of a high proportion of children within the community, it was also noticed that mortality rate have been decreased by increased vaccination level through a similar mechanism i.e. increased heard immunity [22-25].

Some limitations might include the accuracy of data estimates and the potential of ecological bias due to confounding by country-level estimates. Of special importance, countries already used different methods to count mortalities, and they sometimes changed these methods [26].

5. CONCLUSIONS

This is study showed that PGR is negatively correlated to COVID-19 mortality. There is a very high significant negative association between PGR and COVID-19 mortality rate. Low PGR is correlated with the increased COVID-19 mortality rate for COVID-19 and vice versa.

This is the first study that addresses such correlation. This novel finding can help to identify countries at increased risk for COVID-19 death. Furthermore. PGR might be added as factor during risk factors assessments for future epidemics.

6. RECOMMENDATION

PGR can be considered as an indicator for any disease risk assessment specially for infections with various predilections among different age groups especially when disease –age distribution data are missing or scarce. This novel finding can help policy makers to tight or loose restrictions during epidemic.

DISCLAIMER

This paper is an extended version of a preprint document of the same author.
The preprint document is available in this link: https://www.researchsquare.com/article/rs-1449842/v1
[As per journal policy, pre-print article can be published as a journal article, provided it is not published in any other journal].

AVAILABILITY OF DATA AND MATERIALS

All the data are in the manuscript’s tables and supplement.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENT

I am very grateful to Bio-Statistician Prof. Abdulkhaleq Al-Naqeeb, College of Health and Medical Technology, Baghdad – Iraq for reviewing the statistical analysis and results.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Roser M, Ritchie H, Ortiz-Ospina E. World population growth; 2013. Ourworld. InData.org. [Online Resource] [cited Feb 12, 2022]; 2022.
Available: https://ourworldindata.org/world-population-growth.
2. UN. Department of economic and social affairs population division. World population prospects. [Online Resource]. (Accessed: February 10, 2022); 2022
3. Models of demographic transition [biz/ed virtual developing country] [web]. Available

from: csulb.edu. [Online Resource] [cited Feb 12, 2022]; 2022.
Available:https://home.csulb.edu/~gossette/classes/g460/DemTrans4.html.

4. Bongaarts J. Human population growth and the demographic transition. Philos Trans R Soc Lond B Biol Sci. 2009;364(1532):2985-90.
DOI: 10.1098/rstb.2009.0137, PMID 19770150.
5. World Health Organization Weekly epidemiological update on COVID-19-February 1 2022. [accessed Feb 12 2022].
6. Stokes EK, Zambrano LD, Anderson KN, Marder EP, Raz KM, El Burai Felix S, et al. Coronavirus disease 2019 case surveillance - United States, January 22-May 30, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(24):759-65.
DOI: 10.15585/mmwr.mm6924e2, PMID 32555134, PMCID PMC7302472.
7. Viner RM, Mytton OT, Bonell C, Melendez-Torres GJ, Ward J, Hudson L, et al. Susceptibility to SARS-CoV-2 infection among children and adolescents compared with adults: A systematic review and meta-analysis. JAMA Pediatr. 2021;175(2):143-56.
DOI: 10.1001/jamapediatrics.2020.4573. (PMC Free article). PMID [CrossRef].
8. González-García N, Castilla-Peón MF, Solórzano Santos F, Jiménez-Juárez RN, Martínez Bustamante ME, Minero Hibert MA et al. COVID-19 incidence and mortality by age strata and comorbidities in Mexico City: A focus in the pediatric population. Front Public Health. 2021;9:738423.
DOI: 10.3389/fpubh.2021.738423, PMID 34568267.
9. Galow L, Haag L, Kahre E, Blankenburg J, Dalpke AH, Lück C, et al. Lower household transmission rates of SARS-CoV-2 from children compared to adults. J Infectol. 2021;83(1):e34-6.
DOI: 10.1016/j.jinf.2021.04.022. (PMC Free article).
10. Zurl C, Eber E, Siegl A, Loeffler S, Stelzl E, Kessler HH, et al. Low rate of SARS-CoV-2 infections in symptomatic patients attending a pediatric emergency department. Front Pediatr. 2021;9:637167.
DOI: 10.3389/fped.2021.637167. (PMC Free article). PMID
11. Green MS, Peer V, Swartz N, Nitzan D. The confounded crude case-fatality rates (CFR) for COVID-19 hide more than they reveal – a comparison of age-specific and age-adjusted CFRs between six countries medRxiv 2020.05.09.20096503. Plos One; 2020.
DOI: 10.1371/journal.pone.0241031.
12. Omori R, Matsuyama R, Nakata Y. The age distribution of mortality from novel coronavirus disease (COVID-19) suggests no large difference of susceptibility by age. Sci Rep. 2020;10(1):16642.
DOI: 10.1038/s41598-020-73777-8, PMID 33024235.
13. Ioannidis JPA, Axfors C, Contopoulos-Ioannidis DG. Second versus first wave of COVID-19 deaths: Shifts in age distribution and in nursing home fatalities. Environ Res. 2021 April;195:110856.
DOI: 10.1016/j.envres.2021.110856. PMID 33581086, PMCID PMC7875012.
14. Focacci CN, Lam PH, Bai Y. Choosing the right COVID-19 indicator: crude mortality, case fatality, and infection fatality rates influence policy preferences, behaviour, and understanding. Humanit Soc Sci Commun. 2022;9(1):19.
DOI: 10.1057/s41599-021-01032-0.
15. Bonanad C, García-Blas S, Tarazona-Santabalbina F, Sanchis J, Bertomeu-González V, Fácila L, et al. The effect of age on mortality in patients with COVID-19: A meta-analysis with 611,583 subjects. J Am Med Dir Assoc. 2020;21(7):915-8.
DOI: 10.1016/j.jamda.2020.05.045. PMID 32674819, PMCID PMC7247470.
16. Death rate; 2020. Country ranks, by rank. SOURCE: CIA world Factbook. [cited Feb 10, 2022]; 2020
Available:https://photius.com/rankings/2020/population/death_rate_2020_0.html.
17. Goujon A, Natale F, Ghio D, Conte A. Demographic and territorial characteristics of COVID-19 cases and excess mortality in the European Union during the first wave. J Popul Res (Canberra). 2021;29:1-24.
DOI: 10.1007/s12546-021-09263-3 [Epub ahead of print]. PMID 34093083, PMCID PMC8164406.
18. Raham TF. Epidemiological philosophy of pandemics. Int J Community Med Public Health (IJCMPH). 2021;8(7):3255-61.
DOI: 10.18203/2394-6040.ijcmph20212574.
19. Raham TF. COVID-19 high attack rate can lead to high case fatality rate. Am J Epidemiol Public Health. 2021;5(2):045-9.
20. Al-Naqeeb AAA, Raham TF. Case fatality rate components based scenarios for

COVID-19 lockdown. J Community Med Public. 2021;5(3):1-10.
21. Svensson G, Rodriguez R, Padin C. Predictability of COVID-19-related morbidity and mortality based on model estimations to establish proactive protocols of countermeasures. Sci Rep. 2021;11(1):14523. DOI: 10.1038/s41598-021-93932-z, PMID 34267295.
22. Raham TF. COVID-19 vaccination: Early estimates of a relative post interventional case fatality risk. JAMMR. 2022;34(15):54-64. DOI: 10.9734/jammr/2022/v34i1531398.
23. Raham TF. Influence of COVID-19 vaccination coverage on case fatality risk. Asian J Res Infect Dis. 2022;9(2):21-31. DOI: 10.9734/ajrid/2022/v9i230265.
24. Liang LL, Kuo HS, Ho HJ, Wu CY. COVID19 vaccinations are associated with reduced fatality rates: Evidence from cross-county quasi-experiments. J Glob Health. 2021;11:05019. DOI: 10.7189/jogh.11.05019, PMID 34326999.
25. Moghadas SM, Vilches TN, Zhang K, Zhang K, Wells CR, Shoukat A, et al. The impact of vaccination on COVID-19 outbreaks in the United States. Version 2. medRxiv [preprint]. November 30 [Accessed : 2021 Jan 2]; 2020. DOI: 10.1101/2020.11.27.20240051.
26. Statistica.coronavirus (COVID-19) deaths worldwide per one million population as of February 17, 2022, by country; 2022. Available:https://www.statista.com/statistics/1104709/coronavirus-deaths-worldwide-per-million-inhabitants/.

APPENDIX

Appendix 1.

COVID-19 death rate /Million people As it is in 6/2/2022	Country	Pop. Growth rate 2016-2021 (%)
COVID-19 death rate < 1000 (62 Countries)		
3	Burundi	16.85
3	China	2.13
11	Chad	16.16
12	Niger	20.89
12	South Sudan	5.07
13	Tanzania	15.93
13	Benin	14.52
14	Congo, Democratic Republic Of The	17.25
15	Nigeria	13.68
17	Burkina Faso	15.29
31	Guinea	14.98
34	Mali	16.09
36	Taiwan	1.00
44	Ghana	11.41
45	Madagascar	14.19
46	Uzbekistan	7.93
55	Angola	17.65
62	Ethiopia	13.78
66	Yemen	12.23
67	Mozambique	15.57
68	Cameroon	13.78
69	Haiti	6.47
69	Mauritius	0.92
74	Uganda	18.85
79	Sudan	12.70
80	Somalia	15.32
101	Kenya	12.10
107	Rwanda	13.78
112	Senegal	14.69
129	Malawi	14.20
129	Pakistan	10.59
134	Korea, South	0.63
147	Algeria	10.02
153	Japan	-1.34
162	Australia	6.29
165	Syria	4.64
171	Bangladesh	5.27
176	Cambodia	7.49
184	Afghanistan	12.58
194	Venezuela	-3.84
205	Zambia	15.63
217	Egypt	10.39
225	United Arab Emirates	6.73
251	Saudi Arabia	8.93

COVID-19 death rate /Million people As it is in 6/2/2022	Country	Pop. Growth rate 2016-2021 (%)
318	Thailand	1.42
351	Burma (Myanmar)	3.32
353	Zimbabwe	7.57
358	India	5.20
388	Vietnam	4.84
392	Dominican Republic	5.35
394	Nepal	8.85
415	Morocco	6.32
487	Philippines	7.12
520	Indonesia	5.66
588	Iraq	12.48
697	Kazakhstan	6.53
723	Sri Lanka	2.26
746	Cuba	-0.16
863	Azerbaijan	5.01
894	Guatemala	10.05
907	Canada	4.63
970	Malaysia	6.8
COVID-19 death rate 1000-2000 (11 Countries)		
1,034	Turkey	6.53
1,039	Honduras	8.55
1,241	Netherlands	1.13
1,283	Jordan	7.48
1,417	Germany	2.08
1,550	Iran	6.87
1,583	Sweden	3.30
1,584	South Africa	6.82
1,772	Bolivia	7.26
1,913	Ecuador	8.47
1992	Portugal	-1.53
COVID-19 death / million > 2000 (19 Countries)		
2,014	Spain	0.24
2,014	Argentina	4.82
2,021	France	1.17
2,064	Chile	5.51
2,215	Tunisia	5.59
2,313	United Kingdom	2.88
2,313	Russia	0.44
2330	Greece	-2.30
2,338	Ukraine	-2.79
2,360	Mexico	5.62
2,466	Italy	-0.49
2504	Belgium	2.45
2,619	Colombia	6.42
2,771	United States	3.06
2,821	Poland	-0.51
2,939	Brazil	3.80
3,186	Romania	-3.38
3,489	Czechia	1.00
6,138	Peru	7.87

Appendix 2 Data References:

1. Countries by population growth rate 2021 - StatisticsTimes.com
2. UN (World Population Prospects 2019)
3. World Population Prospects - Population Division - United Nations
4. COVID Live - Coronavirus Statistics - Worldometer (worldometers.info)

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/90155