

# Sex differences in COVID-19 fatality rate and risk of death: An analysis in 73 countries, 2020-2021

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## SUMMARY

There is a worrying lack of epidemiological data on the sex differential in COVID-19 fatality rates. We examined the Global Health 50/50 tracks of sex-disaggregated infection and mortality COVID-19 data from 73 countries through May 20, 2021. We compared the infection fatality rate (IFR) in men vs. women and risk of death from COVID-19 by country. Of all cases in 73 countries, 42,933,757 were in women and 40,187,894 in men; 1,274,663 men and 971,899 women died. The IFR was higher in males (3.17%) than in women (2.26%). The IFR in males vs. females varied from country to country, and it was higher in men in Brazil, Yemen,

Mexico, Ecuador, Scotland, Peru, Guatemala, North Macedonia and Afghanistan. Overall, men had a higher odd of death from COVID-19 (OR, 1.22; 95% CI, 1.13–1.32;  $P=0.00001$ ) and in 49 countries, compared to women. Men in Albania and Guatemala had twice the risk of death from COVID-19. Our findings show higher fatality rates among men than among women. These rates vary widely by country, and men have a higher odd of death from COVID-19.

*Keywords:* COVID-19, SARS-CoV-2, fatality rate, sex.

## INTRODUCTION

Although SARS-CoV-2 infection does not discriminate by sex, males/females are more affected and have a higher risk of death from the coronavirus disease (COVID-19) [1-4]. Moreover, a systematic review and meta-analysis recently showed an infection fatality rate (IFR) of 0.68%, and this rate varied with location (from 0.17 to 1.7%) [5]. Despite this, it is unclear whether women or men are more likely to die from COVID-19 and what the differences in IFR are in men vs. women. In this study, we estimated fatality rates

and risk of death from COVID-19 stratified by sex and geographic distribution.

## MATERIALS AND METHODS

We examined the Global Health 50/50 tracks of infection and death COVID-19. This tracker retrieves the sex-disaggregated data being reported in official governments websites in 173 countries. This tracker provides a comprehensive analysis of national COVID-19 health policies from a gender, equity and human rights lens globally [6]. We include data from 73 of 174 countries tracked by the COVID-19 Sex-Disaggregated Data Tracker through May 20, 2021; *i.e.*, countries that had reported data on both cases and deaths at the same time point [6]. Countries that presentation of partial or incomplete data were excluded of

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study. Countries that had stopped reporting data on cases or deaths by sex were also excluded of study. Global Health 50/50 tracks includes cases and deaths sex-disaggregated data (% male and % female).

We compared the IFR in men vs. women and risk of death from COVID-19 by country. Meta-analyses were performed to estimate odds ratios (ORs) with 95% confidence interval (CI) associated with male sex and death, based on pooled average effect measures that were weighted according to the size and precision of each report. The Mantel-Haenszel methods was used to calculate the random effects estimates. P-values of <0.05 were considered statistically significant. The meta-analytic methods were carried out using RevMan 5, Cochrane, available at: <https://revman.cochrane.org/#/myReviews>.

## RESULTS

Of all cases in 73 countries, 42,933,757 were in women and 40,187,894 in men; 1,274,663 men and 971,899 women died. In overall, the IFR was higher in males (3.17%) than in women (2.26%). The IFR in males vs. females varied from country to

country, and it was higher in men in Brazil, Yemen, Mexico, Ecuador, Scotland, Peru, Guatemala, North Macedonia and Afghanistan. The IFR was higher in men and women in Brazil, Yemen, Mexico and Ecuador (Table 1). The IFR was lower in men in Barbados, Bhutan, New Zealand, Norway, Vietnam, Uganda, Maldives and Israel (Table 1). Figure 1 summarizes the number of deaths and total number of confirmed COVID-19 cases for each sex in 72 countries. The forest plot illustrates the estimated OR for the association of death with male sex for each country with 95% CI. The estimated pooled OR was 1.22 (95% CI, 1.13–1.32;  $p=0.00001$ ). Analysis used a random effects model with individual reports weighted using the indicated weights. Overall, men have a higher odd of death from COVID-19 in 49 countries, compared to women. Men in Albania and Guatemala had twice the risk of death from COVID-19 (Figure 1).

## DISCUSSION

This study findings show that although both sexes show the same susceptibility, males have a higher IFR and risk of death from COVID-19. Our findings in 73 countries (as of May 2021) are

**Table 1 - COVID-19 fatality rate in 73 countries, 2020-2021.**

Country	COVID-19 cases		COVID-19 deaths		COVID-19 fatality rate	
	Male, No.	Female, No.	Male, No.	Female, No.	Male, %	Female, %
Overall	40187894	42933757	1274663	971899	3.17	2.26
Afghanistan	38271	19706	1551	609	4.05	3.09
Albania	63375	68657	1631	804	2.57	1.17
Argentina	1640609	1661744	40032	28965	2.44	1.74
Australia	14633	15031	441	469	3.01	3.12
Austria	313269	322294	5454	4806	1.74	1.49
Bangladesh	554408	226449	9379	2802	1.69	1.24
Barbados	2046	1991	8	5	0.39	0.25
Belgium	476628	555929	12444	12280	2.61	2.21
Belize	6664	6078	211	112	3.17	1.84
Bermuda	1115	1362	17	15	1.52	1.10
Bhutan	854	442	1	0	0.12	0.00
Bosnia and Herzegovina	49260	46354	1858	1067	3.77	2.30
Brazil	317396	248069	126614	95205	39.89	38.38
Cambodia	6533	8818	60	46	0.92	0.52
Canada	644355	655534	12268	12451	1.90	1.90

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Country	COVID-19 cases		COVID-19 deaths		COVID-19 fatality rate	
	Male, No.	Female, No.	Male, No.	Female, No.	Male, %	Female, %
Chad	2520	942	90	24	3.57	2.55
Colombia	1504956	1626454	50951	30858	3.39	1.90
Costa Rica	144659	143967	2248	1377	1.55	0.96
Czech Republic	794766	838875	17121	12623	2.15	1.50
Denmark	134034	136523	1358	1145	1.01	0.84
Ecuador	210867	199062	12852	6847	6.09	3.44
England	1791359	2062684	70986	59407	3.96	2.88
Equatorial Guinea	4463	3231	71	32	1.59	0.99
Estonia	59822	68262	641	582	1.07	0.85
Eswatini	8901	9516	346	325	3.89	3.42
Finland	47751	42498	518	462	1.08	1.09
France	2657033	3011908	46503	33911	1.75	1.13
Germany	1732974	1844594	45049	41120	2.60	2.23
Greece	190750	182757	6638	4833	3.48	2.64
Guatemala	128432	111002	5507	2386	4.29	2.15
Guinea-Bissau	2260	1486	46	21	2.04	1.41
Haiti	7574	6024	164	112	2.17	1.86
Hong Kong	5663	6163	123	87	2.17	1.41
Indonesia	853136	895094	27341	21136	3.20	2.36
Iraq	656153	486772	8908	7087	1.36	1.46
Israel	410867	417829	3623	2755	0.88	0.66
Italy	2004903	2100139	68715	53056	3.43	2.53
Jamaica	20883	26503	497	392	2.38	1.48
Jersey	1487	1750	43	26	2.88	1.50
Jordan	343844	330359	5712	3564	1.66	1.08
Kenya	100749	65257	2065	956	2.05	1.47
Latvia	56338	72346	1148	1132	2.04	1.56
Liberia	1415	727	56	29	3.96	3.99
Luxembourg	34620	34620	436	372	1.26	1.07
Maldives	26570	17073	61	34	0.23	0.20
Mexico	1191251	1190298	137670	82814	11.56	6.96
Moldova	105188	148766	2960	3074	2.81	2.07
Netherlands	748885	822422	9493	7890	1.27	0.96
New Zealand	1307	1352	14	12	1.07	0.89
Nigeria	93416	62226	1104	453	1.18	0.73
North Macedonia	78494	76204	3267	1944	4.16	2.55
Northern Ireland	56955	64899	1136	1015	1.99	1.56
Norway	63945	55825	421	360	0.66	0.64
Peru	968116	916479	43442	22469	4.49	2.45

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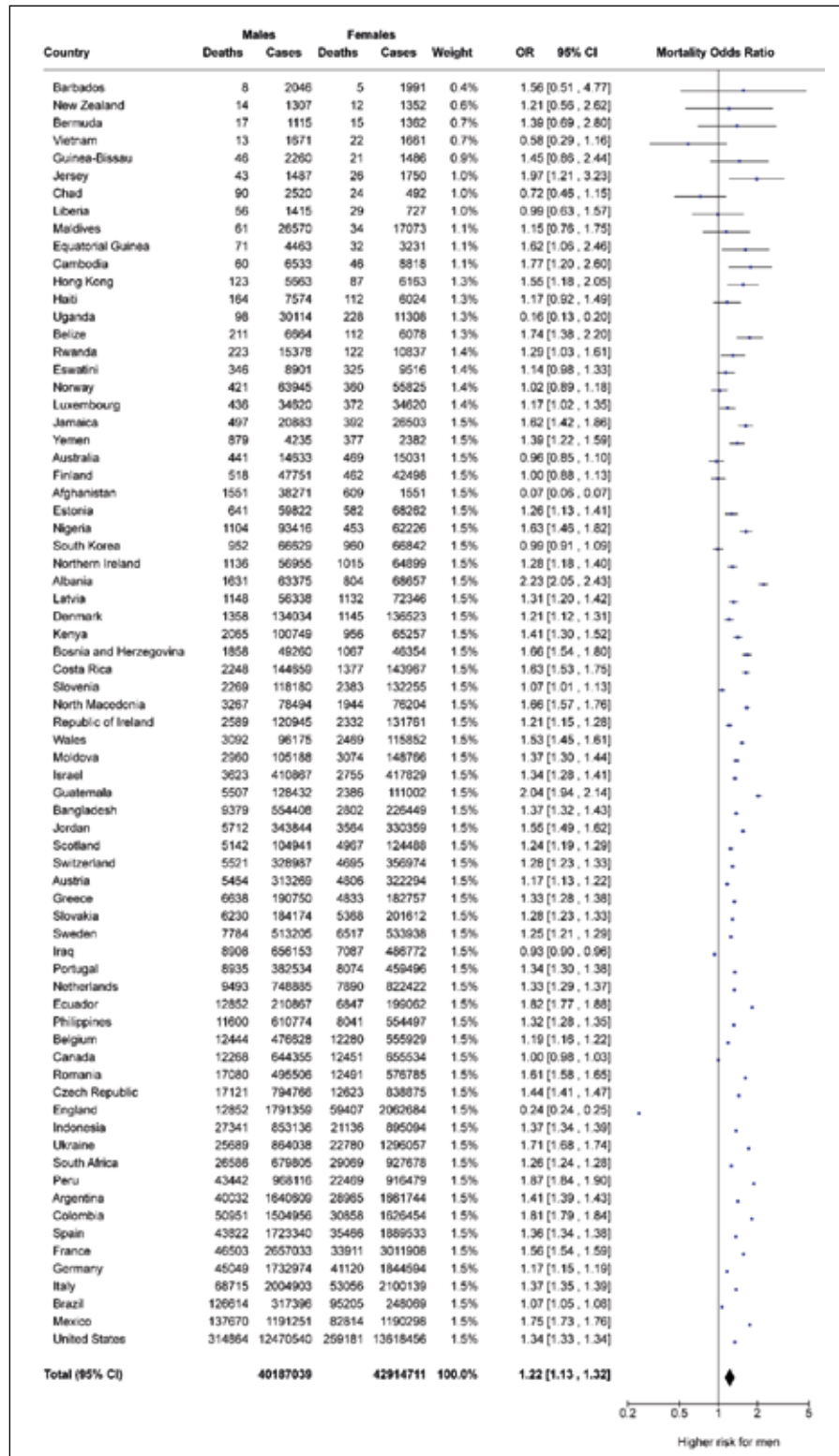
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Country	COVID-19 cases		COVID-19 deaths		COVID-19 fatality rate	
	Male, No.	Female, No.	Male, No.	Female, No.	Male, %	Female, %
Philippines	610774	554497	11600	8041	1.90	1.45
Portugal	382534	459496	8935	8074	2.34	1.76
Republic of Ireland	120945	131761	2589	2332	2.14	1.77
Romania	495506	576785	17080	12491	3.45	2.17
Rwanda	15378	10837	223	122	1.45	1.13
Scotland	104941	124488	5142	4967	4.90	3.99
Slovakia	184174	201612	6230	5368	3.38	2.66
Slovenia	118180	132255	2269	2383	1.92	1.80
South Africa	679805	927678	26586	29069	3.91	3.13
South Korea	66629	66842	952	960	1.43	1.44
Spain	1723340	1889533	43822	35466	2.54	1.88
Sweden	513205	533938	7784	6517	1.52	1.22
Switzerland	328987	356974	5521	4695	1.68	1.32
USA	12470540	13618456	314864	259181	2.52	1.90
Uganda	30114	11308	98	228	0.33	2.02
Ukraine	864038	1296057	25689	22780	2.97	1.76
Vietnam	1671	1661	13	22	0.78	1.32
Wales	96175	115852	3092	2469	3.21	2.13
Yemen	4235	2382	879	377	20.75	15.83

different from those of another study that reported the IFR in 38 countries or regions (as of May 2020) sex-disaggregated [10]. In our study the IFR was higher in men and women in Brazil, Yemen, Mexico, Ecuador, Scotland, Peru, Guatemala, North Macedonia and Afghanistan, whereas the previous study of Scully et al. the IFR was higher in England, Netherlands, Italy, Sweden, and Belgium [10]. These differences can be explained by the small number of cases and deaths of COVID-19 included in the initial period of the pandemic (as of May 2020), while our study included totals of 40,187,894 cases in men and 42,933,757 cases in women, and 1,274,663 deaths in men and 971,899 deaths in women. Subsequently, with more data emerging until May 2021, the trend in fatality rate for COVID-19 has been increased. The differences in IFR and risk of COVID-19 death in males vs. females could be associated with comorbidities such as hypertension and cardiovascular disease, lung disease and cancer although some countries may have a higher burden of these chronic diseases, their prevalence is high-

er in men than women [7-9]. Other factor apart from sex that affect the IFR of COVID-19 and risk of death is age; in this context, previous studies reveal the mortality and fatality rates increased with age and are predominant in men 50 years of age or older [10]. Regardless of the demographics, comorbidities or health systems in each country, there is a consistent biological phenomenon that explains the higher mortality rates in men (immunological mechanisms, genetic factor, inflammation, cancer, etc.) [1, 3, 8]. Experimental and epidemiological evidence suggests that most biomarkers for infection risk and severity of COVID-19 differ by sex. Although women generally have a more robust immune response sustained with age, men are more likely to develop cytokine storm or immunopathological damage associated with adverse clinical outcomes. Further research on sex hormone immunomodulation, age, and X-linked gene expression may help explain poorer survival in men. Although this relationship is complex, and the available data is not uniformly consistent [10,11].

**Figure 1 - Male sex is associated with a significantly increased risk of mortality from COVID-19.**



The IFRs and risk of COVID-19 associated death in males vs. females vary widely by country. The IFR and risk of death could be to health system variations from each country, *i.e.*, infrastructure, overload of the health system, intensive care unit beds, medical staff, medicines, etc. [7]. However, these conditions could vary from country to country, leading to a range of hypotheses. Our findings show that in some countries, the IFR is lower in men or similar to women, which could be due to better living conditions and medical care in the long-lived population of developed countries, compared to underdeveloped countries. These differences can also be explained by control measures or vaccination coverages against COVID-19 implemented in countries as New Zealand or Israel [12, 13].

This report has several limitations. First, detailed information was unavailable in 98 countries; therefore, these findings only provide an approximate estimate of IFR and risk of death from SARS-CoV-2. Second, the data on cases and deaths are not up to date in all countries; consequently, the true IFR may be higher, thus resulting in possible bias. Third, in some countries, asymptomatic cases of COVID-19 and individuals who are misdiagnosed could be left out of the denominator, leading to its underestimation and overestimation of the IFR in 73 countries. Despite these limitations, these findings provide evidence for public health authorities with the aim of mortality prevention for COVID-19. Furthermore, sex-disaggregated data could be of use to ensure better targeting of gender-equitable prevention efforts.

In summary, our findings show higher fatality rates among men than among women. These rates vary widely by country, and men have a higher odd of death from COVID-19. In countries where men having higher fatality rate, public interventions could personalize health messages and implement prevention and surveillance strategies targeting men with recognized risk factors.

### Conflicts of interest

The authors declare no conflict of interest.

### Authors contributions

MCRS designed the study. MCRS and GOC collected all data. MCRS and HAH performed the statistical analysis. All authors were involved in the interpretation of data. MCRS, GOC and HAH drafted the manuscript. All authors were

involved in the critical revision and approved the final manuscript.

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