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LETTER

Infectious diseases

Prevalence of comorbid tuberculosis amongst COVID-19 patients: A rapid review and meta-analysis

Tuberculosis is reported to be associated with the severity and mortality amongst patients with coronavirus disease 2019 (COVID-19).[1] However, the reported prevalence of comorbid tuberculosis amongst COVID-19 patients varied greatly across the published studies. For example, the low prevalence of comorbid tuberculosis amongst COVID-19 patients was reported in Tian et al's study (0.4%)[2] and Yan et al's study (0.2%)[3] and the relatively high prevalence of comorbid tuberculosis amongst COVID-19 patients was reported in Hu et al's study (4.5%)[4] and Zhang et al's study (9.0%).[5] Therefore, it is needed to quantitatively estimate the pooled prevalence of comorbid tuberculosis amongst COVID-19 patients using a meta-analysis.

A systematic literature search was conducted independently by two investigators in PubMed, Web of Science, EMBASE, Springer, Elsevier-ScienceDirect, Wiley Online Library, Scopus and Cochrane Library databases to select all eligible studies which were published from 1 January 2020 to 31 August 2021. The following keywords

TABLE 1 General information of eligible studies included in this meta-analysis

Author	Country	Study design	Male (%)	Age[a]	Sample size	TB (%)
Hung IF	China	Randomised controlled trial	53.5	48.27	127	2 (1.6%)
Pande D	India	NR	48.1	50	27	1 (3.7%)
Du RH	China	NR	54.2	57.6 ± 13.7	179	8 (4.5%)
Hu Y	China	Retrospective study	47.1	53 (42-62)	308	14 (4.5%)
Mo P	China	Retrospective study	55.5	54 (42-66)	155	3 (1.9%)
Zeng JH	China	Retrospective study	47.6	46.58	416	8 (1.9%)
Sy KTL	Philippines	Cohort study	NR	NR	12 513	113 (0.9%)
Joeng HE	Korea	Cohort study	41.1	48.5	1824	7 (0.4%)
He G	China	Case series	NR	NR	139	3 (2.2%)
Li X	China	Ambispective study	50.9	60 (48-69)	548	9 (1.6%)
Durrani M	Pakistan	Retrospective study	80	44	30	1 (3.3%)
Pachiega J	Brazil	NR	NR	NR	14 737	4 (0.03%)
Souza CDF	Brazil	Observational study	46.7	NR	197	1 (0.5%)
Panthee B	Nepal	NR	72.1	49.7 ± 19.2	79	5 (10.4%)
Chen T	China	Case series	53.2	54 (20-91)	203	4 (2.0%)
Zhang JJ	China	Retrospective study	50.7	57 (25-87)	140	2 (1.4%)
Lee C	Korea	Retrospective study	50	52.0 (37.5-55.5)	10	0 (0%)
Asghar MS	Pakistan	Retrospective study	69	52.58 ± 15.68	100	1 (1%)
Pierrotti LC	Brazil	Retrospective study	49	51.9 (17-78)	51	2 (3.9%)
Song J	China	Retrospective study	52	63 (49-70)	961	20 (2.1%)
Borba MGS	Brazil	Randomised controlled trial	NR	NR	55	2 (3.6%)
Lee JY	Korea	Retrospective study	30.5	55.91	694	2 (0.3%)
Miciel EL	Brazil	Cross-sectional study	NR	NR	416	1 (0.2%)
Tian J	China	Retrospective study	48.1	48.49 ± 14.36	721	3 (0.4%)
Kamal AF	Indonesia	Ambispective study	42.9	32.89 ± 17.42	35	2 (5.7%)
Hong D	China	Retrospective study	54.2	46.7 ± 17.7	168	8 (4.8%)
JeroniMo CMP	Brazil	Randomised controlled trial	NR	NR	362	8 (2.2%)
Yan N	China	Retrospective study	48.9	50 (39-58)	1682	3 (0.2%)

(Continues)

TABLE 1 (Continued)

Author	Country	Study design	Male (%)	Age[a]	Sample size	TB (%)
Panda S	India	Prospective study	70.7	34.96 ± 13.4	225	1 (0.4%)
Wu Q	China	Retrospective study	47.8	48.78	492	4 (0.8%)
Zhang J	China	Retrospective study	48.3	60.0 (49.0-69.0)	901	13 (1.4%)
Liu J	China	Retrospective study	53.4	57 (47-67)	1190	15 (1.3%)
Yu HH	China	Retrospective study	50	62 (50-70)	1561	20 (1.3%)
Boulle A	South Africa	Cohort study	31.6	NR	22 308	2128 (9.5%)
Yang C	China	Retrospective study	61.5	44 (33-55)	104	2 (1.9%)
Barry M	Saudi Arabia	Case series	NR	NR	99	10 (10.1%)
Nachega JB	Congo	Cohort study	65.6	46 (34-58)	766	19 (2.5%)
Al Kuwari HM	Qatar	Case series	88.9	35.8 ± 1.2	5685	13 (0.2%)
Ibrahim OR	Nigeria	Retrospective study	86.7	43 ± 16.0	45	2 (4.4%)
Gupta N	India	Retrospective study	NR	NR	1073	22 (2.1%)
Agarwal N	India	Observational study	83.2	47.6 ± 15.9	95	2 (2.1%)
Dai M	China	Retrospective study	59	51 ± 13	73	3 (4%)
Jin M	China	Retrospective study	33.9	57.52 ± 14.71	121	1 (0.8%)
Zhang X	China	NR	56.4	46.5	78	7 (9.0%)
Parker A	South Africa	Observational study	38.9	48.5	113	13 (11.5%)
Luo Y	China	Retrospective study	52.6	62	78	2 (2.56%)
Zhu J	China	Retrospective study	54	45.04 ± 46.50	50	3 (6%)
Tahtasakal CA	Turkey	Retrospective study	56.4	59 (19-97)	534	2 (0.4%)
Dev N	India	Retrospective study	58	36 ± 13	55	0 (0%)
Li S	China	Retrospective study	50.6	61.9 (49.7-69.5)	2924	52 (1.8%)
Sun C	China	Retrospective study	46	45 (31-56)	129	1 (0.8%)
Feehan AK	USA	Cross-sectional study	NR	NR	311	0 (0%)
Porto LC	Brazil	Retrospective study	NR	40.5 (34-49)	410	0 (0%)
Wang W	China	Retrospective study	61.2	44 (33-50)	147	3 (2.1%)
Thiabaud A	Switzerland	Retrospective study	59.5	68 (54-79)	3645	22 (0.9%)
Jeyaraman P	India	Retrospective study	69.7	60 (18-80)	33	1 (3.0%)
Li C	China	Randomised controlled trial	46.8	54.0 (39.8-63.3)	94	3 (3.2%)
Anaya JM	Colombia	Retrospective study	70.8	57.5 (51.8-66.3)	120	0 (0%)
Yan B	China	Retrospective study	53.7	59.5 (14-86)	190	1 (0.5%)
Patler C	USA	Cross-sectional Study	91.9	37.4 (18.6-68.9)	529	19 (3.6%)
Zheng B	China	Retrospective study	40.4	49.5	198	1 (0.5%)
Fisman DN	Canada	Cohort study	43	55	21 922	52 (0.2%)
Lee SG	Korea	Retrospective study	40.1	47.1 ± 19.0	7339	28 (0.4%)
Lu Y	China	Retrospective study	65	59 (54-63)	77	1 (1.3%)
Bepouka BI	Congo	Retrospective study	67.4	49.6 ± 16.5	141	1 (0.7%)
Zhou S	China	Retrospective study	56	56.0 (45.3-64.8)	62	0 (0%)
Yitao Z	China	Retrospective study	54	46 ± 17	257	3 (1.2%)
Li G	Multi-country	NR	54	66 (58-74)	399	6 (1.5%)
Zhang W	China	Retrospective study	53.6	40.6	500	3 (0.6%)
Abraha HE	Ethiopia	Retrospective study	63.3	29 (24-38)	2617	8 (0.3%)
Kumar S	India	Retrospective study	87.1	64.5 (53.7-70)	31	0 (0%)
Sun J	China	Prospective clinical trial	61.29	60.39 ± 10.20	31	1 (3.23%)
Hafiz M	Indonesia	Case series	62.8	55.9 ± 15.7	42	5 (11.9%)
Riou C	South Africa	Cohort study	57.9	52 (43-57)	95	15 (15.8)
Meng M	China	Retrospective study	58.8	62.63 ± 13.49	415	8 (1.9%)
RECOVERY Collaborative Group	UK	Randomised controlled trial	64.3	63.5	11 558	46 (0.4%)

(Continues)

TABLE 1 (Continued)

Author	Country	Study design	Male (%)	Age[a]	Sample size	TB (%)
African COVID-19 Critical Care Outcomes Study (ACCCOS) Investigators	Ten African countries	Prospective study	60.6	56 ± 16.11	3140	51 (1.7%)
Sahin B	Turkey	Prospective study	55.2	63.2 ± 13.8	58	10 (18.2%)
Marimuthu Y	India	Longitudinal study	56.6	45.3 ± 17.2	854	10 (1.2%)
Venturas J	South Africa	Retrospective study	53	50 (39-60)	384	14 (4%)
Tsuchihashi Y	Japan	Retrospective study	55	60	516	1 (0.3%)
Kridin K	Israel	Case–control study	47.4	46.0 ± 19.3	6151	9 (0.29%)
Chanda D	Zambia	Retrospective study	57.3	48.2	443	21 (4.74%)
Xu J	China	Retrospective study	45.9	46.5 (34.3-62.0)	98	2 (2%)
Zhang Q	China	Retrospective study	51.6	51.49 ± 17.39	157	1 (0.6%)
Dilogo IH	Indonesia	Randomised controlled trial	75	NR	40	2 (5%)
Pakdel F	Iran	Cross-sectional study	66	52	15	1 (6.7%)
Agrupis KA	Philippines	Retrospective study	55.8	48 ± 17	500	41 (8.2%)
Prasetya IB	Indonesia	Retrospective study	62	43 (32-54)	391	4 (1.2%)
Dave JA	South Africa	Retrospective study	38.3	40.0 (30.0-52.0)	64 476	4736 (7.3%)
Zhou K	China	Retrospective study	53.5	47	144	4 (2.8%)
Meenakumari R	India	Retrospective study	76.9	39.53 ± 13.4	204	1 (0.5%)
Sharif N	Bangladesh	Retrospective study	65.8	39.8 ± 12.6	966	9 (0.9%)
Giubelan LI	Romania	Retrospective study	NR	NR	100	1 (1%)
Ali MR	Bangladesh	Cross-sectional study	60.12	35 ± 14.90	326	27 (8.28%)
Kumar G	India	Prospective study	64.8	50	18 961	138 (0.7%)
Aggarwal R	India	Retrospective study	65.9	56 (41.5-65)	247	21 (8.5%)
Kirenga B	Uganda	Randomised clinical trial	71.3	50 (38.5-62.0)	136	4 (2.9%)
Sang L	China	Retrospective study	67.4	62.7 ± 13.3	190	1 (0.5%)
Bakamutumaho B	Uganda	Prospective study	NR	NR	11	0 (0%)
Suryananda TD	Indonesia	Prospective study	61.3	48.04 ± 11.66	75	5 (6.7%)
Fleitas PE	Argentina	Cross-sectional study	49.7	37 (26-51)	7968	84 (1.1%)
Ren P	China	Retrospective study	62.3	57 (48-66)	80	1 (1.25%)
Badr OI	Saudi Arabia	Retrospective study	69.8	52.8	159	2 (1.26%)
Lee SW	Korea	Cohort study	37.3	NR	3882	51 (1.31%)
Maximiano Sousa F	Switzerland	Prospective study	59.5	68 (55-80)	3590	21 (0.58%)
Sandoval M	USA	Retrospective study	38	24 (21-27)	1853	1 (0.05%)
Munblit D	Russia	Cohort study	48.9	56 (46-66)	2649	2 (0.08%)
Jassat W	South Africa	Cohort study	45.5	NR	151 779	5173 (3.41%)
Bushman D	USA	Case–control study	65.5	56 (23-64)	1029	1 (0.1%)
Wang J	China	Retrospective study	59.2	57.0 (43.0-66.0)	436	6 (1.38%)
Wolday D	Ethiopia	Prospective study	63.9	37 (28-50)	751	1 (0.13%)
El-Battrawy I	Italy-Spain-Germany	NR	58.6	NR	5810	15 (0.26%)
Arenas Jimenez MD	Spain	Retrospective study	70.8	72.4 ± 12.6	288	5 (1.7%)

Abbreviations: NR, Not clearly reported; TB, tuberculosis; UK, United Kingdom; USA, the United States of America.

[a]Indicates age (years) was presented as mean ± standard deviation (SD) or median (interquartile range, IQR).

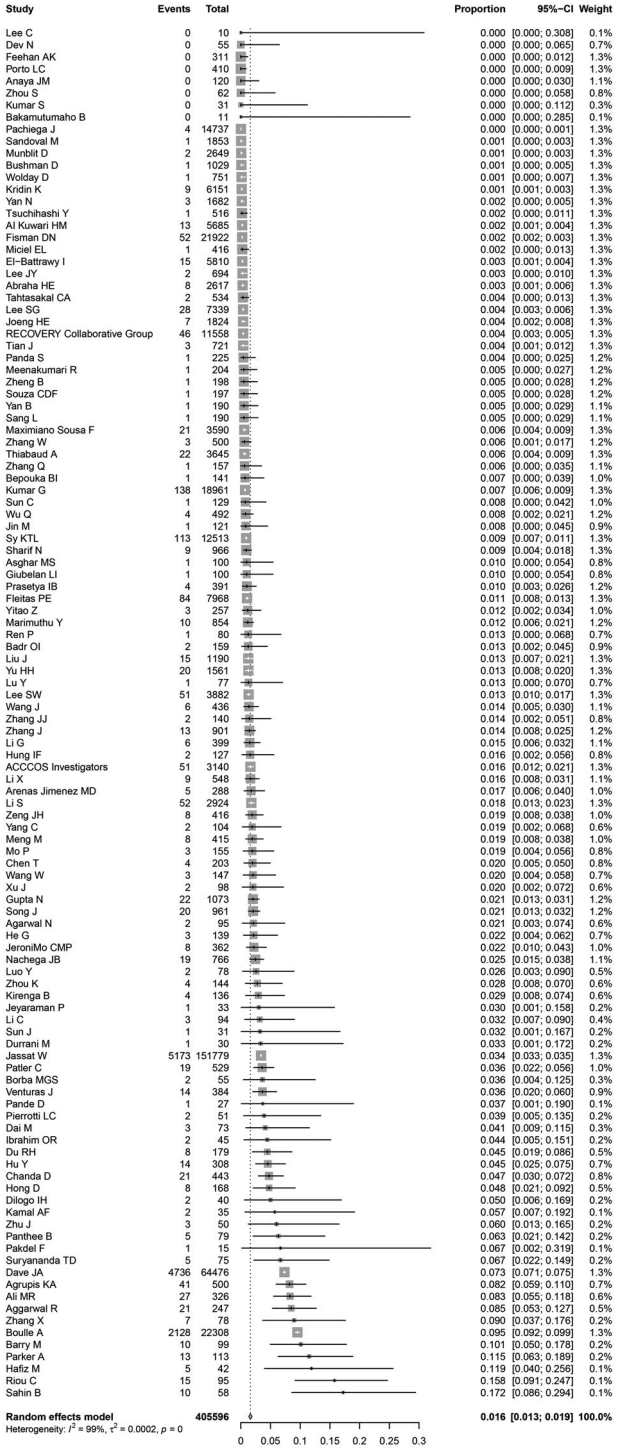

FIGURE 1 The forest plot demonstrating the prevalence of comorbid tuberculosis amongst coronavirus disease 2019 (COVID-19) patients on the basis of 114 studies with 405 596 cases

were used: "prevalence" or "incidence" or "rate" or "characteristics" and "tuberculosis" and "COVID-19" or "SARS-CoV-2" or "2019-nCoV" or "severe acute respiratory syndrome coronavirus 2" or "coronavirus disease 2019" or "2019 novel coronavirus". All peer-reviewed papers which were published in the English language were eligibly included if they provided the incidence rate of comorbid tuberculosis amongst COVID-19 patients. Accordingly, we excluded case reports, review articles, duplicate publications, errata, comments and preprints. Reference lists of the retrieved articles were also screened to identify additional studies. This rapid systematic review and meta-analysis was performed following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA).[6]

The pooled prevalence of comorbid tuberculosis amongst COVID-19 patients was estimated using a random effects meta-analysis model.[7,8] The statistical heterogeneity across studies was assessed by I^2 statistic and Cochrane Q test.[9,10] The risk of publication bias was evaluated by Begg's rank correlation test.[11,12] All statistical analyses were carried out using the package "meta" on R version 3.6.3 (R Foundation for Statistical Computing). A two-tailed P value <.05 was regarded statistically significant.

A total of 114 eligible studies[2-5,13-122] with 405 596 COVID-19 patients were included in this meta-analysis. Amongst the included studies, 77 studies[2-5,13-85] were reported in Asia, 15 studies[90-100] were conducted in Africa, nine studies[101-109] were conducted in South America, five studies[110-114] were performed in North America, seven studies[115-121] were conducted in Europe and one study[122] was from multicountries. The baseline characteristics of the included studies are summarised in Table 1. Overall, our findings demonstrated that the prevalence of comorbid tuberculosis amongst COVID-19 patients in this pooled meta-analysis was 1.6% with 95% confidence interval (CI): 1.3%–1.9% (Figure 1). The regional tuberculosis prevalence in COVID-19 patients was estimated as follows: Africa (4.1%, 95% CI: 0.0%–5.8%), Asia (1.1%, 95% CI: 0.9%–1.3%), South America (0.5%, 95% CI: 0.0%–1.0%), Europe (0.4%, 95% CI: 0.0%–0.6%) and North America (0.2%, 95% CI: 0.0%–0.4%), which revealed great variability in the prevalence of comorbid tuberculosis amongst COVID-19 patients in different regions. Begg's test revealed that there was potential publication bias (P = .0017).

In conclusion, our findings demonstrated that the prevalence of comorbid tuberculosis amongst COVID-19 patients was 1.6%, which varied greatly in different regions.

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DISCLOSURES

The authors declare that they have no any potential conflict of interest regarding this submitted manuscript.

AUTHOR CONTRIBUTIONS

Yadong Wang and Haiyan Yang designed the study. Jie Xu, Ying Wang, Hongjie Hou and Li Shi performed literature search and data extraction. Jie Xu and Yadong Wang performed data analysis. Yadong Wang and Haiyan Yang wrote and reviewed the manuscript. All the authors approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are included in this article and available from the corresponding author upon reasonable request.

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