

Supplementary Table 1 Search strategy detailed in the meta-analysis.

Electronic database	Search strategy	Results(n)
PubMed	(((hepatitis)[Title/Abstract] OR (liver disease))[Title/Abstract] OR (acute Liver Injury))[Title/Abstract] OR ((liver Injury) [Title/Abstract] AND (2019:2022[pdat])) AND (((covid-19) [Title/Abstract] OR (SARS-CoV-2))[Title/Abstract] OR (coronavirus) [Title/Abstract] AND (2019:2022[pdat]))) AND (((Pneumonia)[Title/Abstract] OR (Pulmonary Inflammation))[Title/Abstract] OR (Pneumonitis) [Title/Abstract] AND (2019:2022[pdat]))	3891
Embase	[('coronavirus disease 2019'/exp) OR ('sars-cov-2':ab,ti) OR ('coronavirus':ab,ti)]AND [ ( 'pneumonia'/exp ) OR ( Pneumonitis ) OR ( Pulmonary Inflammation ) ]AND[ ( hepatitis ) OR(liver disease) OR (liver Injury)]	449
Cochrane Library	(((liver Injury) OR (hepatitis)) OR (liver disease)) OR (acute Liver Injury)) AND (((covid-19) OR (SARS-CoV-2)) OR (coronavirus)) AND (((Pneumonia) OR (Pulmonary Inflammation)) OR (Pneumonitis))	122

Supplementary Table 2 Characteristics of the included studies in the meta-analysis.

First author (year)	Country	Study design	Samples (N)	Sex N (%)	Mean (SD) Age (year)	Liver Function Test Mean (SD) or N (%)				Death,N(%)			Study Quality
						Total	Severe Group	Nonsevere Group	Total	Liver injury	Non-injury		
Koichiro Abel (2020)	Japan	RS	Total: 22 Severe:2 Nonsevere: 20	M: 13 (59) F:9 (41)	47.8 (5.3)	NA NA NA	NA NA NA	NA NA NA	NA NA NA	2 (9)	1 (7)	1 (14)	6
Ya-Wen An (2021)	China	PS	Total: 253 Severe:58 Nonsevere: 195	M: 113(44.7) F:140 (55.3)	45.3(17.8)	ALT: AST:	34.6(49.4) 31.1(25.0)	44.2(51.0) 43.6(34.3)	32.0(48.8) 27.8(20.9)	NA	NA	NA	7
Deliang Huang (2020)	China	PS	Total: 318 Severe:85 Nonsevere: 233	M: 198 (62.3) F: 130 (37.7)	NA	ALT: AST: GGT: TBIL:	46(8.2) 38 (4) 47.5(9.2) 20(2.2)	67(8.8) 58(8.7) 92(18) 22(1.7)	41(7) 34(3) 40(6.2) 19(2.2)	NA	NA	NA	8
Ze-yang Din (2021)	China	RS	Total: 2073 Severe:200 Nonsevere: 1873	M:1024 (49.4) F: 1049(50.6)	62(3.3)	Live injury: ALT: AST: TBIL: GGT:	297 (14.3%) 33(6.3) 30(4.5) 11.4(1.3) 37 (7.8)	103 (51.5%) 48(9.5) 68(16.9) 22.05(3.2) 69.5 (13.8)	94 (10.4%) 48(9.5) 68(16.9) 11(1.1) 35 (7.2)	200(9.6)	185 (92.5)	15(7.5)	8
Yu Fu (2020)	China	RS	Total: 482 Severe:188 Nonsevere: 294	M:243 (50.4) F: 239 (49.6)	56.5(4.7)	Live injury:	142(29.5%)	75(39.9%)	67 (22.8%)	64 (13.3)	42 (29.6)	22 (6.5)	6

Supplementary Table 2 (continued)

Kuniyo Gomi (2021)	Japan	RS	Total: 210 Severe:7 Nonsevere:203	M:119(56.7) F: 91(43.3)	49(21)	Live injury: ALT: AST: GGT: ALB:	124(59%) 27(26.8) 30.1(28) 33.3(53.3) 38.6(6)	5 (71.4%) 55.3(17.9) 61.5(18.5) 99.8(84) 28(6.4)	119(58.6%) 26(26.5) 29(27.8) 31(50.7) 39(5.7)	NA	NA	NA	7
Shao-Ru i Hao,MD (2021)	China	RS	Total:788 Severe:78 Nonsevere: 710	M:407(51.6) F: 381 (48.4)	NA	Live injury:	222(28.2%)	20 (25.6%)	202(28.5)	NA	NA	NA	6
Haijun Huang (2021)	China	RS	Total:675 Severe:152 Nonsevere:523	M: 313(46.3) F: 362(53.9)	55(4.8)	Live injury:	305(45.2%)	104 (68.4%)	201(38.4)	NA	NA	NA	6
Wei Huang (2020)	China	RS	Total:2623 Severe:615 Nonsevere:2008	M:1323 (50.4) F:1300 (49.6)	62.3(4.2)	ALT: AST: TBIL: GGT: ALB: PT: APTT:	24.4(4.5) 25.6(5.7) 9(1.9) 31.6(7.8) 34.3(2.5) 13.8(0.8) 38.6(1.4)	25.5(4.9) 31(8.8) 11.7(2.1) 39.9(9.3) 30.4(1.6) 14.9(1.1) 38.7(2.1)	24(4.3) 24(2.7) 8.3(0.9) 29(5) 35.5(1.01) 13.5(0.15) 38.6(1.1)	NA	NA	NA	7
Melanie A. Hundt (2020)	Netwo rk	RS	Total:1827 Severe:652 Nonsevere:1175	M: 969 (53.0) F: 858(47)	64.6(18.2)	ALT: AST: TBIL: ALB:	29(304.3) 42(507.7) 8.6(25.1) 35(7)	28(304.3) 51(507) 8.6(25.1) 33(6)	31(239.2) 38(231.8) 6.8(22.5) 35(6.8)	NA	NA	NA	7

Supplementary Table 2 (continued)

Fang Lei (2020)	China	RS	Total:5771 Severe:1186 Nonsevere:4585	M:2724 (47.2) F: 3047 (52.8)	56.5(3.7)	CLD%: ALT: AST: TBIL: ALB:	81 (1.4%) 24(4.0) 24(3) 10.4(1) 37.5(1.1)	25 (2.1%) 26(4.7) 31(4.2) 10.6(1.2) 35.7(1.1)	56 (1.2%) 23(3.8) 22(2.3) 10.3(1) 38(1.03)	NA	NA	NA	7
M. Lei N. (2021)	China	RS	Total:288 Severe:32 Severe:32	M: 131 (45.5) F: 157 (54.5)	43.9 (8.3)	ALT: AST: TBIL: GGT: ALB: PT: APTT: INR: CLD%:	22.5 (3.4) 18.4(1.8) 9.8(1.7) 17(5.8) 37.1(2.7) 13.5(0.45) 35.1(1.6) 1.01(0.02) 10 (3.5%)	45.8 (8.8) 24.8(5.5) 10.7(1.8) 21(5.7) 34.7(1.5) 13.6(0.5) 36.6(1.9) 1.03(0.5) 2 (6.3%)	21.3 (3) 17.7(1.7) 9.4(0.9) 16(6.8) 39.6(2.6) 13.2(0.5) 34.9(1.7) 0.98(0.3) 8 (3.1%)	NA	NA	NA	8
Shasha Li(2020)	China	PS	Total: 159 Severe:34 Nonsevere:125	M:90 (56.6) F:69 (43.4)	38.5(4.9)	Live injury: ALT: AST: TBIL: ALB: CLD%:	28(17.6%) 27 (7.3) 24.8(3.3) 16.7(3.1) 39(2) 3(1.9%)	11 (32.4%) 57.6(8.2) 39.8(12.7) 19.3(4) 35.5(3.8) 2(5.9%)	17 (13.6%) 22.75(5.2) 23.6(1.9) 16(2.4) 39.7(2.4) 1(0.8%)	NA	NA	NA	7
Liu Chuan (2020)	China	RS	Total: 32 Severe:4 Nonsevere:28	M:20 (62.5) F:12 (37.5)	38.6(5)	ALT: AST: TBIL: ALB:	27 (7.3) 24.75(3.3) 16.5(2.9) 39.5 (2.5)	60.25(7) 37(10.9) 20.5(3.4) 35.75 (3.3)	22.8(5.2) 23.6(1.9) 15.95(2.4) 39.7(2.4)	NA	NA	NA	8

Supplementary Table 2 (continued)

Jianrong Liu (2021)	China	RS	Total:58 Severe:12 Nonsevere:46	M:30 (51.7) F:28 (48.3)	65.1 (14.2)	Live injury: ALT: AST: TBIL: GGT: ALB: PT: APTT: INR:	30 (51.7%) 21.6 (8.9) 22.8 (5) 9.4 (2.6) 32(20.6) 37.1(2.2) 13.4(0.4) 37.8(2.9) 1.03(0.04)	10 (33.3%) 31.8 (11.4) 29.8 (6.7) 12.3 (3.4) 66.3(19) 34.2(2.3) 13.8(0.3) 34.8(4.6) 1.07(0.03)	20 (43.6%) 19 (5.8) 21 (2) 8.6 (1.6 ) 23(7.3) 37.8(1.4) 13.3(0.3) 38.6(1.5) 1.02(0.03)	NA	NA	NA	8
Magdalena Meszaros (2020)	France	RS	Total:234 Severe:114 Nonsevere:120	M:149 (63.7) F:85 (36.3)	67(14)	Live injury	156(66.7%)	89 (78.1%)	67(55.8)	37 (15.8)	31(19.9)	6 (7.7)	6
Fernanda Manhães Pozzobon(2021)	Brazil	PS	Total:406 Severe:149 Nonsevere:257	M:231 (57) F:175 (43)	56(3.3)	ALT: AST:	38(6.2) 37(5)	48(7) 49(7.5)	35(5.3) 34(3.5)	NA	NA	NA	
Z.P. Qian (2020)	China	RS	Total:324 Severe:26 Nonsevere:298	M:167(51.5) F:157(48.5)	51(12.2)	ALT: AST: TBIL: GGT: ALB: CLD%:	21.86(3.14) 23.9(4.13) 8.3(1.1) 24.3(5.18) 40.6(4.13) 20(6.2%)	26(3.9) 34 (6.9) 10.75(1.6) 28(10.6) 35.79(4.75) 2(7.7%)	21.5(2.8) 23(2.2) 8.05(0.7) 24(4.3) 41.07(3.8) 18(6%)	NA	NA	NA	6

Supplementary Table 2 (continued)

Fei Zhou (2020)	China	RS	Total:191 Severe:54 Nonsevere:137	M:119 (62) F:72 (38)	56(3.5)	ALT: ALB: PT:	30(4.8) 32.3(1) 11.6(0.4)	40(0.8) 29.1(1.2) 12.1(0.6)	27(4.2) 33.6(1) 11.4(0.4)	NA	NA	NA	6
Yoshihit o Uchida (2020)	China	RS	Total:35 Severe:8 Nonsevere:27	M:22 (62.9) F:13 (37.1))	52(15.75)	ALT: AST: TBIL: GGT:	38(57.25) 34(51.5) 12(39.8) 37(121)	104.3(64.3) 104.5(56.4) 53.43(48.2) 203(140)	29(52.5) 31(45.5) 10.3(6.4) 30(85)	NA	NA	NA	6
Suxin Wan (2020)	China	PS	Total:135 Severe:40 Nonsevere:95	M:72 (53.3) F: 63 (46.7)	47(3.2)	ALT: AST: TBIL: ALB: PT: APTT: CLD%:	26(3.38) 33.4(2.65) 8.6(1.3) 40.5(1.07) 10.9(0.15) 26.9(0.72) 2 (1.5%)	26.6(4.7) 33.6(4.63) 9.8(1.95) 36(1.38) 11.3(0.28) 29.7(4.2) 1 (2.5%)	21.7(3.68) 22.4(2.3) 8.6(1.4) 49.9(1.03) 10.8(0.15) 26.6(0.72) 1 (1%)	NA	NA	NA	7
Yijin Wang (2020)	China	PS	Total:156 Severe:54 Nonsevere:102	M:82(52.6) F:74(47.4) M:56 (53.3)	51.2(16)	Live injury	64(42%)	30 (55.6%)	34 (33.3%)	4(2.6)	3 (4.7)	1 (1.1)	6
Qi Wang (2020)	China	RS	Total:105 Severe:26 Nonsevere:79	F:49 (46.7)	45(4.3)	ALT: AST: TBIL: ALB:	23.5(3.7) 24.2(3.8) 10.2(1.4) 41.6(1.7)	27.8(4.8) 43.1(8.5) 10.6(1.3) 37.6(2.2)	22(3.4) 22(3.3) 10(1.5) 42(1.7)	NA	NA	NA	8
M. Wen (2020)	China	RS	Total:110 Severe:14 Nonsevere:96	M:59 (53.6) F:51 (46.4)	NA	ALT: AST: TBIL: ALB:	34.15(15.3) 31.89(6.3) 16.7(2.1) 35.8(2.8)	66.04(23) 45.87(5.9) 18.05(2.52) 28.57(0.7)	29.5(4.8) 29.85(2.7) 16.55(2) 36.76(0.94)	NA	NA	NA	8

Supplementary Table 2 (continued)

Hanshen g Xie (2020)	China	RS	Total:79 Severe:28 Nonsevere:51	M:44(55.7) F:35(44.3)	60(3)	ALT: AST: TBIL: GGT:	34(8.2) 30(4.5) 13.6(1.5) 31.5(10.4)	36.5(13.5) 35(7.5) 12.7(1.83) 35.5(14.75)	30(5.63) 28(5) 13.9(2.45) 25.5(19.7)	NA	NA	NA	7
N. Yao (2020)	China	RS	Total:40 Severe:22 Nonsevere:18	M:24(60) F:16(40)	NA	Live injury:	22(55%)	17(77.3%)	4(22.2%)	NA	NA	NA	6
Xiaomei Yu (2021)	China	RS	Total:330 Severe:232 Nonsevere:98	M:163(49.4) F:167(50.6)	68.3(2)	Live injury:	96(29.1%)	76(32.8%)	20(20.4%)	65 (19.7)	23 (24)	42(17.9)	6
Qing-Lei Zeng (2021)	China	RS	Total:70 Severe:40 Nonsevere:30	M:46 (65.7) F:24 (34.3)	56.5(8)	CLD%:	13 (18.6%)	7 (17.5%)	6 (20%)	NA	NA	NA	6
Hu Zhang (2020)	China	RS	Total:218 Severe:38 Nonsevere:180	M:94 (43.1) F:124 (56.9)	50.1(18.3)	Live injury:	79(36.2%)	21 (55.3%)	58(32.2%)	NA	NA	NA	6
Yafei Zhang (2020)	China	RS	Total:115 Severe:31 Nonsevere:84	M:49(42.6) F:66(57.4)	49.5(17.1)	ALT: AST: TBIL: GGT: ALB: INR:	25.7(21.1) 28.3(15.7) 11.3(5.2) 36.1(45) 38.8(4.4) 1.17(0.1)	37.87(32.17) 38.87 (22.55) 14.12(6.37) 56.90(73.28) 34.40(4.11) 1.21(0.13)	21.22(12.67) 24.39(9.79) 10.27 (4.26) 28.47(24.93) 40.41(3.24) 1.15(0.09)	NA	NA	NA	7

Supplementary Table 2 (continued)

Guang Chen (2020)	China	RS	Total:21 Severe:11 Nonsevere:10	M:17 (81.0) F:4(19)	56.75(3.75 )	ALT: AST: TBIL: ALB: PT: APTT:	27.5(6.5) 30.5(6.5) 8.7(0.9) 33.6(1.95) 13.7(0.4) 39(2.7)	41.6(5.1) 49.1(13.5) 9(0.8) 30.2(1.3) 14.2(0.3) 34.5(1.9)	16.8(2.5) 24(1.4) 7.9(0.9) 30.2(1.3) 13.3(0.3) 44.6(1.5)	NA	NA	NA	7
Qingxia n Ca (2020)	China	PS	Total:298 Severe: 58 Nonsevere: 240	M:145 (48.66) F:153(51.34)	47.5(4.7)	Live injury CLD%: ALT: AST: TBIL: GGT:	44 (14.8%) 28 (9.4%) 37(3.2) 34(3.5) 16.2(1.7) 37.8(3.2)	21 (36.2%) 8 (13.79%) 42(12.5) 38(10.6) 20.7(3.2) 47(30.3)	23 (9.1%) 20 (8.33%) 30(2.7) 28(3) 13.5(1.6) 33.6(3.5)	NA	NA	NA	8
Tao Chen (2020)	China	RS	Total:274 Severe113 Nonsevere161	M:171 (62.4) F:103 (37.6)	62(4.3)	CLD%: ALT: AST: TBIL: GGT: ALB: PT: APTT: INR:	11 (4%) 23(3.8) 30(4) 9.6(1.13) 33(5) 33.9(1.2) 14.3(0.3) 30.8(1.3) 1.1(0.03)	6 (5.3%) 28(4.8) 45(6) 12.6(1.2) 42(7.2) 30.1(0.9) 15.5(0.5) 40.6(1.9) 1.2(0.05)	5 (3.1%) 20(2.9) 25(2.3) 8.4(0.9) 28(4.4) 36.3(1) 13.9(0.2) 41(1.2) 1.1(0.02)	NA	NA	NA	8
Chaolin Huang (2020)	China	PS	Total:41 Severe:13 Nonsevere:28	M:30 (73) F:11 (27)	49(4.3)	CLD%: ALT: AST: TBIL: ALB:	1 (2%) 32(7.3) 34(5.5) 11.7(1.1) 31.4(1.8)	0 60.5(25.7) 47(11.7) 18.2(6.5) 28.3(1.3)	1 (4%) 27(5.1) 34(4.1) 10.8(0.7) 34.7(1.6)	6 (15)	5 (38)	1 (4)	8



Supplementary Table 2 (continued)

						PT:	11.1(0.6)	12.3(0.6)	10.7(0.6)				
						APTT:	27(2.5)	27.2(3.3)	27.7(2.3)				
Pingzhe ng Mo (2021)	China	RS	Total:155 Severe:85 Nonsevere:70	M:86 (55.5) F:69(44.5)	54(4)	CLD%:	7 (4.5%)	5 (5.9%)	2 (2.9%)	NA	NA	NA	7
						ALT:	23(3.7)	28(4.2)	20(4.5)				
						AST:	32(4)	37(6.7)	32(3.8)				
						ALB:	38(1.2)	36(1.3)	39(1.5)				
Dawei Wang (2020)	China	RS	Total:138 Severe:36 Nonsevere:102	M:75 (54.3) F:63 (45.7)	56(4.3)	CLD%:	4 (2.9%)	0	4 (3.9%)	NA	NA	NA	7
						ALT:	24(4.0)	35(9.5)	23(3.5)				
						AST:	31(4.5)	52(10)	29(2.8)				
						TBIL:	9.8(0.95)	11.5(2.3)	9.3(0.8)				
						PT:	13(0.2)	13.2(0.55)	12.9(0.2)				
						APTT:	31.4(0.7)	30.4(1.4)	31.7(0.7)				
Xiaobo Yang (2020)	China	RS	Total:52 Severe:20 Nonsevere:32	M:35 (67) F:17 (33)	59.7(13.3)	Live injury	15 (29%)	9 (28%)	6 (30%)	NA	NA	NA	6
						TBIL:	17(10)	12.9(2.9)	13.1(4.3)				
						PT:	12.1(3)		10.9(2.7)				
Maria Effenber ge 2021	Austria	PS	Total: 96 Severe:15 Nonsevere: 81	M:60(62.5) F:36 (37.5)	60.7(18.9)	ALT:	28(12.6)	4.93(24.83)	25(4.2)	NA	NA	NA	7
						AST:	37.2(11.56)	54.7(18.4)	34(5.6)				
						GGT:	40(10)	50.75(16)	38(7)				
Shambel Araya 2022	Ethiopia	PS	Total: 440 Severe:62 Nonsevere: 378	M:270 (61.3) F:170 (38.7)	60.3( 1.3)	ALT:	59(63)	59.9(58.7)	49.26(43.9)	NA	NA	NA	7
						AST:	57(53)	66.5(65)	47.39(35.3)				
Carla Diaz-Lo uzao 2022	United States	RS	Total: 440 Severe:62 Nonsevere: 378	M:120 (56.60) F:97 (43.40)	68.4( 3.43)	CLD%	13(3%)	0	13 (7.4%)	NA	NA	NA	7
						ALT:	35(6.5)	31(11.5)	36(6.75)				
						AST:	30(3.8)	37(8.75)	29(3.3)				
						GGT:	45(10)	59(18.25)	44(9)				

Supplementary Table 2 (continued)

Noha M. Elemam 2022	United States	RS	Total: 440 Severe:62 Nonsevere: 378	M:29 (78.4) F:8 (21.6)	51.95( 14)	ALT: AST: ALB: PT: APTT:	116.45(200.2) 133.7(232.3) 30.9(7.47) 15.04(1.89) 42.38(8.19)	115.1(226.6) 188(308.2) 28.3(9.3) 15.49(2.28) 45.44(9.27)	117.57(180.8) 87.47(131.72) 33.2(4.6) 14.65(1.43) 39.77(6.25)	NA	NA	NA	8
Arunku mar Krishnan 2022	United States	RS	Total: 3830 Severe:1354 Nonsevere: 2476	M:1959 (51.1) F:1871(48.9)	64.2(4.6)	ALT: AST: TBIL: GGT: ALB: PT: APTT:	28(4.8) 36.83(6.3) 8.5(16.53) 126.08(25.36) 38.6(1.2) 11.1(0.2) 26.2(5.2)	30(5) 42(5.8) 8.5(18.8) 144.5(31) 39(1.2) 11.4(0.3) 25.7(5.4)	27(4.5) 34(4.6) 6.8(16.25) 116(13.5) 36(1.3) 10.9(0.2) 25.9(5)	NA	NA	NA	8
Farhad Shaveisi-Zadeh 2022	Iran	RS	Total: 77 Severe:20 Nonsevere: 57	M:35(45.5) F:42(54.5)	61.6( 17.8)	ALT: AST: PT: APTT:	77.7(258.8) 139.5(588.5) 12.77(1.95) 38(24.7)	82.2(146.98) 132.5(261.8) 12.7(0.83) 37.33(7.2)	76.1(289.1) 141.98(668.4) 12.79(2.22) 38.29(28.52)	NA	NA	NA	7
Mehmet Tahir Huyut 2022	Türkiye	RS	Total: 4597 Severe:233 Nonsevere: 4364	M:2371(51.6) F:2226(48.4)	57(6.3)	ALT: AST: TBIL: PT: APTT:	31.6(7.6) 27.7(3.6) 8.5(1) 13.2(0.5) 35.1(1.6)	24(5.17) 32(5.7) 10.6(1.4) 14.83(0.45) 31(0.3)	32(7.5) 27.5(3.3) 8.38(0.88) 13.1(0.25) 35.34(1.31)	NA	NA	NA	8
L. Xu M. 2022	China	RS	Total: 111 Severe:40 Nonsevere: 71	M:61 (55) F:50 (45)	69(3.7)	Live injury CLD%: ALT: AST:	86 (77.5%) 6 (5.4%) 29.6(4.7) 27.7(5.7)	34 (85%) 1 (2.5%) 29(5.9) 32.5(6.4)	52 (73.2%) 5 (7%) 30(3.8) 25(2.7)	NA	NA	NA	8

Supplementary Table 2 (continued)

						TBIL:	12.2(1.9)	13.75(1.98)	11.3(1.2)				
						GGT:	29.6(7.7)	36(8.75)	26(3.8)				
						ALB:	33.7(1.9)	32(2)	34.6(1)				
Wei	China	RS	Total: 157	M:88 (56)	45(18)	Live	20 (1.7%)	8 (5.3%)	12 (8.5%)	NA	NA	NA	8
Zhao						injury							
2022			Severe:15	F:69 (44)		CLD%:	1.27 (5.4%)	0	1.4 (7%)				
			Nonsevere: 142			ALT:	22.4(8)	45.5(6.23)	20(1.9)				
						AST:	23.6(5.5)	38.75(6.1)	22(1.7)				
						TBIL:	7.8(1.6)	9.25(1.45)	7.7(1.5)				
						ALB:	37(4.8)	43.1(5.4)	36.6(4.3)				

Note: CLD: chronic liver disease; ALT: alanine aminotransferase; AST: aspartate aminotransferase; GGT: gamma-glutamyl transferase; TBIL: total bilirubin; ALB: albumin; PT:

prothrombin time; APTT: activated partial thromboplastin time; INR: International Normalized Ratio; RS: retrospective study; PS: prospective study.

Supplementary Table 3 Meta-analysis of liver injury parameters in COVID-19 patients

Parameter	No.	No.	Heterogeneity		Model	Meta-analysis
	studies	patients	P	I <sup>2</sup>		WMD or OR (95%CI)
Live injury (%)	16	6041	0.000	82.3%	Random	3.25(2.19,4.84)
transaminase >3 ULN						
CLD%	17	12138	0.329	10.7%	Random	1.38(1.08,1.77)
ALT level (U/L)	35	25596	0.000	99.2%	Random	12.87(10.52,15.23)
AST level (U/L)	33	25384	0.000	98.2%	Random	13.98(12.13,15.83)
GGT level (U/L)	16	10944	0.000	98.8%	Random	20.67(14.24, 27.10)
TBIL level(μmol/L)	26	23571	0.000	99.4%	Random	2.98(1.98,3.99)
ALB level (g/L)	22	16574	0.000	99.9%	Random	-4.52(-6.28, -2.75)
PT level (s)	13	9739	0.000	99.4%	Random	0.84(0.46,1.23)
APTT level (s)	12	12119	0.000	99.7%	Random	-1.12(-2.95, 0.71)
INR	5	5332	0.000	97.6%	Random	0.09(0.05, 0.13)
mortality	5	3297	0.007	71.6%	Random	2.718(1.179,6.267)
antiviral	7	1538	0.000	78.5%	Random	2.09(1.07,4.08)
antibiotics	5	790	0.000	89.1%	Random	2.46(0.98,6.18)
corticosteroid	7	564	0.014	65%	Random	1.64(1.07, 2.53)

Note: CLD: chronic liver disease; ALT: alanine aminotransferase; AST: aspartate aminotransferase; GGT: gamma-glutamyl

transferase; TBIL: total bilirubin; ALB: albumin; PT: prothrombin time; APTT: activated partial thromboplastin time; INR:

International Normalized Ratio.

Supplementary Table 4 Subgroup analyses and meta-analysis regression of included studies in the meta-analysis.

Outcome	Subgroups	No.of studies	Meta-analysis regression ( $P >  z $ )	Effect size (Odds ratio/mean difference)	I <sup>2</sup> (%)	P	
Liver injury	overall	16	0.548	3.25(2.19,4.84)	82.3%	0.000	
	country	China	14	0.819	3.37(2.17, 5.24)	84.5%	0.000
		Abroad	2		2.70(1.57,4.64)	0.0%	0.666
	Study type	cohort study	11	0.938	3.38(1.90,6.00)	87.0%	0.000
		case-control study	5		2.88(2.11,3.94)	20.6%	0.283
	Sample size	≥175	9	0.420	2.83 (1.65,4.84)	89.5%	0.000
		<175	7		3.88 (2.38,6.32)	31%	0.192
ALT level	overall	35	0.078	12.87(10.52,15.23)	99.2%	0.000	
	country	China	24	0.476	14.73(11.92,17.54)	99.1%	0.000
		Abroad	11		7.34(0.88, 13.79)	99.1%	0.000
	Study type	cross-sectional study	2	0.875	21.13(8.20,34.05)	69.5%	0.070
		case-control study	7		17.71(10.48,24.94)	94.7%	0.000
		cohort study	26		11.38(8.83,13.92)	99.3%	0.000
	Sample size	≥175	17	0.015	9.14(6.21,12.06)	99.5%	0.000
<175		18		18.41(12.75, 24.07)	97.6%	0.000	
AST level	overall	33	0.114	13.98(12.13,15.83)	98.2%	0.000	
	country	China	22	0.992	14.40(11.62, 17.18)	98.6%	0.000
		Abroad	11		17.71(8.33,15.09)	95.7%	0.000
	Study type	cross-sectional study	2	0.596	21.22(13.61,28.83)	65.1%	0.090
		case-control study	7		15.26(10.01,20.50)	87.9%	0.000
		cohort study	24		13.11(11.13,15.09)	98.4%	0.000
	Sample size	≥175	16	0.868	14.17(11.65,16.69)	99.0%	0.000
<175		17		13.96(10.72,17.20)	91.9%	0.000	

Supplementary Table 4 (continued)

GGT level	overall		16	0.025	20.67(14.24, 27.10)	98.8%	0.000
	country	China	11	0.664	19.80(12.47,27.13)	99.0%	0.000
		Abroad	5		23.04(10.62,35.45)	89.8%	0.000
	Study type	cross-sectional study	1	0.022	52.00(48.09,55.91)	.%	-
		cohort study	12		19.32(12.88,25.77)	98.7%	0.000
		case-control study	3		7.96(-1.31,17.24)	65.3%	0.056
	Sample size	≥175	10	0.542	20.46(12.46,28.45)	99.2%	0.000
		<175	6		21.37(9.57,33.16)	88.8%	0.000
	TBIL level	overall		26	0.433	2.98(1.98,3.99)	99.4%
country		China	22	0.427	3.12(1.90,4.33)	99.5%	0.000
		Abroad	4		2.03(0.98, 3.08)	54.4%	0.087
Study type		cross-sectional study	1	0.120	3.00(2.54, 3.46)	.%	-
		cohort study	16		3.40(2.20,4.6)	99.5%	0.000
		case-control study	9		1.31(-0.27, 2.90)	92.6%	0.000
Sample size		≥175	11	0.199	3.56(2.00,5.12)	99.7%	0.000
		<175	15		2.05(1.29,2.81)	84.4%	0.000
ALB level		overall		22	0.113	-4.52(-6.28, -2.75)	99.9%
	country	China	18	0.531	-4.87(-6.16,-3.58)	99.6%	0.000
		Abroad	4		-2.98(-6.95, 1.00)	99.9%	0.000
	Study type	cohort study	17	0.266	-4.00(-5.97,-2.03)	99.9%	0.000
		case-control study	5		-6.28(-8.70,-3.87)	93.9%	0.000
	Sample size	≥175	9	0.864	-4.02(-6.60, -1.45)	100.0%	0.000
		<175	13		-4.83(-7.34,-2.33)	99.2%	0.000

Supplementary Table 4 (continued)

PT level	overall		13	0.288	0.84(0.46,1.23)	99.4%	0.000
	Study type	retrospective study	11	0.447	0.81(0.35,1.27)	99.5%	0.000
		prospective study	2		1.03(-0.04,2.11)	96.5%	0.000
	Sample size	≥175	5	0.311	0.99(0.30,1.67)	99.8%	0.000
		<175	8		0.68(0.42,0.94)	85.8%	0.000
	country	China	9	0.861	0.86(0.46,1.25)	97.9%	0.000
		Abroad	4		0.77(-0.14,1.67)	99.8%	0.000
INR	overall		5	0.000	0.09(0.05, 0.13)	97.6%	0.000
	Sample size	≥175	3	0.000	0.12(0.07,0.17)	97.5%	0.000
		<175	2		0.05(0.03,0.07)	0.0%	0.712
	country	China	4	0.000	0.07(0.03,0.11)	86.7%	0.000
		Abroad	1		0.15(0.14, 0.16)	-	-
Mortality	overall		5	0.989	2.72(1.18,6.27)	71.6%	0.007
	country	China	3	0.727	3.18(0.97,10.44)	83.9%	0.002
		Abroad	2		1.90(0.38, 9.44)	34.6%	0.216
	Study type	cohort study	4	0.322	1.82(1.07, 3.10)	8.4%	0.351
		case-control study	1		6.07(3.46,10.66)	-	-
	Sample size	≥175	3	0.902	2.97(1.14 ,7.70)	83.7%	0.002
		<175	2		1.67(0.17, 16.21)	34.8%	0.215
antiviral	overall		7	0.048	2.09(1.07,4.08)	78.5%	0.000
	country	China	6	0.671	3.59 (1.64, 7.88)	77.9%	0.001
		Abroad	1		1.85 (0.89, 3.87)	.%	-
	Study type	cohort study	4	0.000	1.14 (0.78, 1.67)	18.0%	0.301
		case-control study	3		4.30 (2.50, 7.38)	0%	0.527
	Sample size	≥175	3	0.842	2.75 (0.73, 10.45)	87.7%	0.000

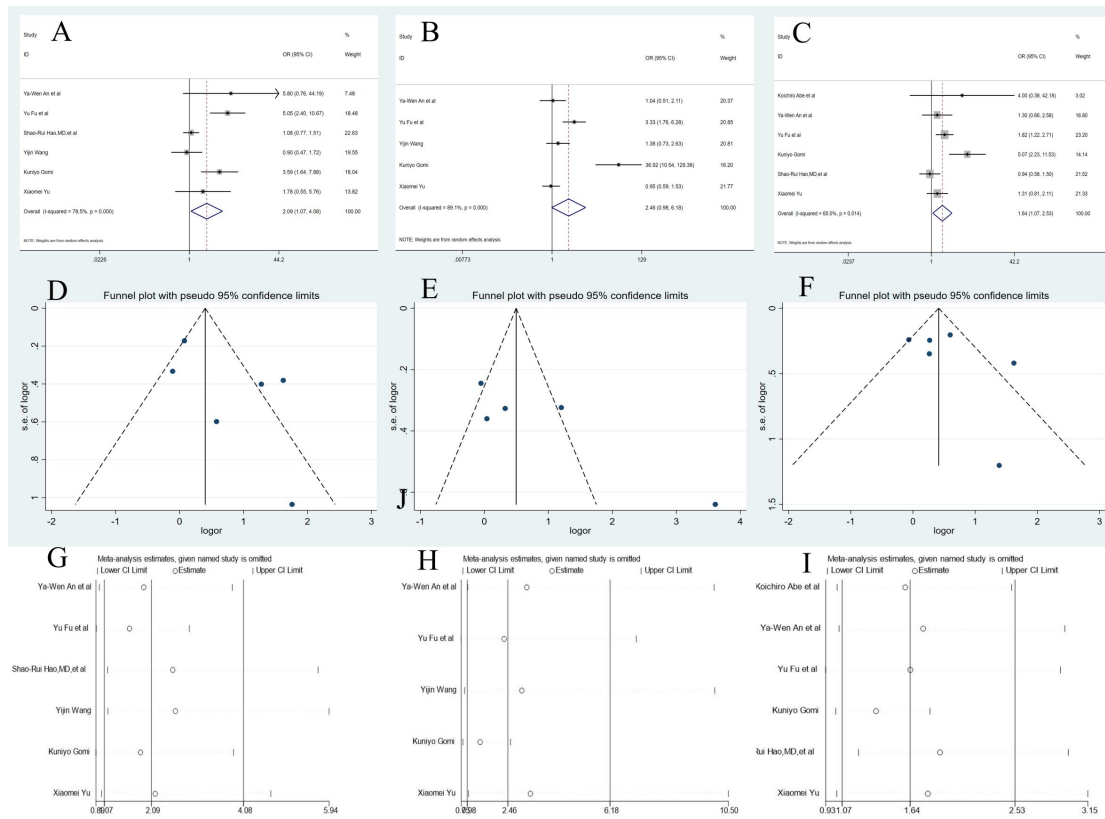
Supplementary Table 4 (continued)

		<175	4		1.75 (0.70, 4.40)	71.9%	0.029
antibiotics	overall		5	0.000	2.46(0.98,6.18)	89.1%	0.000
	country	China	4	-	1.44 (0.82, 2.55)	71.4%,	0.015
		Abroad	1		36.92 (10.54, 129.38)	.%	-
	Study type	cohort study	3	0.000	1.08 (0.77, 1.51)	0%	0.648
		case-control study	2		10.41 (0.98, 110.77)	91.2%	0.001
	Sample size	≥175	1	0.001	3.33 (1.76, 6.28)	.%	-
		<175	4		2.32 (0.75, 7.14)	90.3%	0.000
corticosteroid	overall		6	0.751	1.64(1.07, 2.53)	65%	0.000
	country	China	4	0.145	1.33(0.98, 1.80)	33.2%	0.213
		Abroad	2		4.94(2.27, 10.73)	0%	0.853
	Study type	cohort study	4	0.036	1.16(0.86, 1.57)	0%	0.530
		case-control study	2		2.84(1.05, 7.69)	79.3%	0.028
	Sample size	≥175	4	0.303	1.32(0.69, 2.53)	77.5%	0.035
		<175	2		2.04(1.00, 4.16)	66.7%	0.029

Note: CLD: chronic liver disease; ALT: alanine aminotransferase; AST: aspartate aminotransferase; GGT: gamma-glutamyl transferase; TBIL: total bilirubin; ALB:

albumin; PT: prothrombin time; APTT: activated partial thromboplastin time; INR: International Normalized Ratio.





Supplementary Figure 1 The relationship between drugs and liver injury. (A-C) Forest plots of the included studies evaluating abnormal liver chemistries in patients receiving lopinavir or ritonavir, antibiotics, and corticosteroid treatments, respectively. (D-F) Funnel plot of the included studies evaluating abnormal liver chemistries in patients receiving lopinavir or ritonavir, antibiotics, and corticosteroid treatments, respectively. (G-I) Sensitivity analysis of the serum liver chemistries in patients receiving lopinavir or ritonavir, antibiotics, and corticosteroid treatments, respectively.