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Systematic Review

Prevalence of Gastrointestinal Problems in Patients with COVID-19: A Systematic Review and Meta-analysis

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ABSTRACT

Background:
Considering the prevalence of COVID-19 worldwide, the present study aimed to determine the prevalence of gastrointestinal problems (anorexia, diarrhea, nausea, and vomiting) in patients with COVID-19.

Materials and Methods:
The purpose of this study was to determine the prevalence of gastrointestinal problems in patients with COVID-19 using Systematic Review and Meta-analysis methodology. The search was conducted independently by two researchers on international databases, including Web of Science (ISI), Scopus, Embase, Science Direct, PubMed/Medline, and Google Scholar Search Engine. Keywords included "Vomiting", "Anorexia", "Diarrhea", "Nausea", "SARS-CoV-2", and "COVID-19". Data were analyzed using STATA statistic software.

Results:
The total sample size was 3602 patients. Initially, 1456 studies were included in the study, which reached 33 articles after the final screening. Regarding the prevalence of gastrointestinal problems in patients, the prevalence rate of diarrhea was 6% (95% CI: 0.06 [0.04, 0.08]), anorexia was13% (95% CI: 0.13 [0.03, 0.24]), nausea and vomiting was 4% (95% CI : 0.04 [0.03, 0.05]), and pharyngalgia was 16% (95% CI : 0.16 [0.02, 0.30]).

Conclusion:
The results of this study can be used as a guideline for clinical professionals.

Keywords: COVID-19, Gastrointestinal problems, Clinical symptoms, Systematic review, meta-analysis

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INTRODUCTION

Gastrointestinal diseases are significantly associated with infectious diseases worldwide (1,2). Common gastrointestinal diseases include diarrhea, nausea and vomiting, and anorexia. Hospital admission of these patients may result in high costs for the health system in all countries (3). Even in some cases, due to gastrointestinal problems, the patient's health may be compromised, and the patient may die (4).

Diarrhea is a common symptom in developing

countries. The causes of diarrhea in patients include functional disorders such as Crohn's disease and Celiac disease, dysfunction of bile acids, or infectious diseases (5,6). Factors such as inadequate hygiene, lack of access to safe drinking water, and other risk factors are contributing to diarrhea (7-9). Another gastrointestinal problem is nausea and vomiting (10).

Constipation can lead to increased intracranial pressure as well as impaired rehabilitation treatments for patients with difficulty in controlling intestine movement (11, 12). Symptoms of constipation affect the patients and their care so that it can decrease the quality of life of such patients and disrupt their daily lives (13). Factors that can contribute to constipation include lifestyle, income status, education, physical activity, hormonal changes, and infectious diseases (14, 15).

COVID-19 is a pandemic infectious disease that has spread worldwide. One of the complications of this disease is gastrointestinal problems. However, studies of these complications have reported different prevalence (4,16,17).

2. Objectives

The purpose of this study was to determine the prevalence of gastrointestinal problems (anorexia, diarrhea, and nausea and vomiting) in patients with COVID-19 using Systematic Review and Meta-analysis methodology.

MATERIALS AND METHODS

3.1. Protocol

According to Systematic Reviews and Meta-Analyses (PRISMA) statement (18).

3.2. Inclusion and exclusion criteria

PICO elements of the study include, P: patients with Covid-19, I: Clinical symptoms, C: Healthy people. O: anorexia, diarrhea, nausea, and vomiting. Case reports, and Systematic Review and Meta-analysis articles were excluded from the study.

3.3. Information sources and search strategy

The search was conducted on the international databases including Web of Science (ISI), Scopus, Embase, Science Direct, PubMed/Medline, and Google Scholar Search Engine. Keywords included "Vomiting" [Mesh], "Anorexia" [Mesh], "Diarrhea" [Mesh], "Nausea" [Mesh], "SARS-CoV-2" [Mesh], and "COVID-19" [Mesh].

3.4. Study selection

The research team consisted of senior expert nurses (master) (FZ & ES) who did the primary search in international databases, and in case of any discrepancies between the two researchers, the final research was reviewed by another researcher with another senior nurse (master) (MB). Also, any questions about the procedure and the data contained in the articles were reviewed and approved by a gastroenterologist (BB).

3.5. Data collection process and data items

The form of findings included the prevalence (percent) of the three main variables associated with gastrointestinal complications such as diarrhea, nausea, and vomiting. The age, sample size for male and female patients, and the name of the published journal were also listed in the checklist (table1).

3.7. Statistical approach

Data analyses were performed inSTATA software, version. 11 (College Station, TX, USA).

RESULTS

The total sample size was 3602 patients. Initially, 1456 studies were included in the study, which yielded 33 articles after the final screening. Regarding the prevalence of gastrointestinal problems in the patients, the prevalence rate of diarrhea was 6% (95% CI: 0.06 [0.04, 0.08]), anorexia was13% (95% CI: 0.13 [0.03, 0.24]), nausea and vomiting 4% (95% CI : 0.04 [0.03, 0.05]), and Pharyngalgia was 16% (95% CI : 0.16 [0.02, 0.30]) (figures 2-5).

DISCUSSION

In this Systematic review and Meta-analysis study, which examines gastrointestinal problems in patients with COVID-19 for the first time in the world, it has been shown that the incidence of diarrhea in patients with COVID-19 is 6% (95% CI: 0.06 [0.04, 0.08]). In a Systematic review and Meta-analysis study by Rodriguez-Morales and colleagues (43), which aimed to assess the clinical symptoms in patients with COVID-19, the prevalence of diarrhea varied

Table 1: Clinical characteristics of the study subjects

-	Author	Age	Country	N (%)	Male N (%)	Female N (%)	Journal	Diarrhea N (%)	Nausea and vomiting N (%)	Anorexia N (%)	Pharyngalgia
1	-Huang et al (2020) (19)	49·0 (41·0–58·0)	China	41	30(73)	11(27)	Lancet	1(3%)	-	-	-
2	Chen et al (2020) (20)	55·5 (13·1)	China	99	67 (68%)	32 (32%)	Lancet	2(2)	1(1)	-	-
3	Chen et al(2020) (21)	29.88	China	9	-	-	Lancet	1(11)	-	-	-
4	Wang et al(2020) (22)	56	China	138	63 (45.7)	75 (54.3)	JAMA	14 (10.1)	5 (3.6)	55 (39.9)	24 (17.4)
5	Guan et al (2020)(5)	47(31-73)	China	18	9 (50)	9 (50)	JAMA	3 (17)	-	-	-
6	Zhang et al (2020) (6)	57 (25-87)	China	140	71 (50.7)	69 (49.3)	Allergy	18(12.9)	7(5)	17(12.2)	-
7	Guan et al (2020)(7)	47.0 (35.0–58.0)	China	1099	640(58.1)	459(41.9)	The New England Journal of Medicine	42 (3.8)	55 (5.0)	-	-
8	Kui et al (2020) (23)	57 (20–83)	China	137	61(44.5)	76(55.5)	Chinese Medical Journal	11(8)	-	-	-
9	Xu et al (2020) (24)	41 (32-52)	China	62	35 (56)	27 (44)	BMJ	3 (8)	-	-	-
10	Chang et al (2020) (25)	34 (34-48)	China	13	-	-		1 (7.7)	-	-	-
11	Henry et al (2020) (26)	0-19	14 Countries	82	43(52.4%)	27(32.9%)	-	1(4)	-	-	-
12	Yang et al (2020) (27)	45.11 ± 13.35	China	85	81	68	Journal of Infection	11(7.38)	2(1.34)	-	-
14	Li et al (2020) (16)	45.1 ± 12.8		17	9 (52.9)	8(47.1)		2 (11.8)	-	-	-
15	Yu et al (2020) (16)	29-34	China	7	-	-	The Lancet Infectious Diseases	1(14.3)	-	-	-
16	Pan et al (2020) (28)	40 ± 9 (25 - 63)	China	21	6 (29%)	15 (74%)	Radiology	-	-	-	-
17	Ng M et al (2020) (29)	56(37-65)	Hong Kong	21	13(62)	8(38)		2(10)	-	-	-
19	Song et al (2020) (30)	49 ± 16		51	25(49)	26(51)		5(10)	3(6)	-	-
20	Chung et al (2020) (31)	51 ± 14	China	21	-	-	Radiology	-	1(5)	-	-

-	Author	Age	Country	N (%)	Male N (%)	Female N (%)	Journal	Diarrhea N (%)	Nausea and vomiting N (%)	Anorexia N (%)	Pharyngalgia
21	Zhou et al (2020) (23)	56·0 (46·0–67·0)	China	191	191	119 (62)	Lancet	9 (5)	7(4)	-	-
22	Shi et al (2020) (32)	49.5(11)	China	81	81	39(48)	The Lancet Infectious Diseases	3(4)	4(5)	1(1)	-
23	Hsih et al (2020) (33)	45.0 (39-51)	China	2	2	1(50)	Journal of Microbiology, Immunology and Infection	1(50)	-	-	-
24	Yang et al (2020) (34)	59·7 (13·3)	China	52	52	17 (33)	Lancet Respir Med	-	2(4)	-	-
25	Ma et al (2020) (35)	-	China	50	50	22(44)	The Lancet	3(6)	-	2(4)	-
26	Qui et al (2019) (36)	8.3	China	36	36	13(36)	The Lancet Infectious Diseases	-	2(6)	-	1 (3%)
27	Du et al (2020) (37)	34.10	China	67	67	35(52.2)	The Lancet Infectious Diseases	2(3)	-	8(11.9)	20(29.9%)
28	Xu et al (2020) (38)	43.9 ± 16.8	China	50	50	21(42)	Journal of Infection	-	-	-	-
29	Zhang et al (2020) (39)		China	28	28			3 (10.7)	-	-	-
30	Chen et al (2020) (46)	51(36–64)	China	249	249	123(49.4)	Journal of Infection	8(3.2)	-	-	-
31	Zhang et al (2020) (40)	46.65±13.82		573	295(51.5)	278(48.5)		45(7.9)	22(3.8)	-	-
32	Sun et al (2020) (41)	-	China	8	6(75)	2(25)	World Journal of Pediatrics	4(50)	4(50)	-	-
33	Zhang et al (2020) (42)	65.0 (56.0-70.0)	China	28	17(60.7)	11(39.3)	Annals of Oncology	3 (10.7)	-	-	-

between 2% and 13.8%. The differences between the results of this study and those of Rodriguez-Morales and colleagues (43) indicate that in this study, the prevalence of diarrhea in patients with COVID-19 were studied in 28 studies, while Rodriguez-Morales and colleagues (43) studied diarrhea in only six articles. Another Systematic Review and Meta-analysis study that investigated the prevalence of diarrhea was done by Nasiri and co-workers (44), with a total prevalence of 5.7 (3.8-8.6) in 13 studies. Anorexia was also reported in five articles with a prevalence of 10.1 (1.0-57.2), which is consistent with Systematic review and Meta-analysis of Nasiri and co-workers (44)

CONCLUSION

The results of this study can be used as a guide for clinical professionals.

Author contributions:

All authors contributed to the initial discussion.

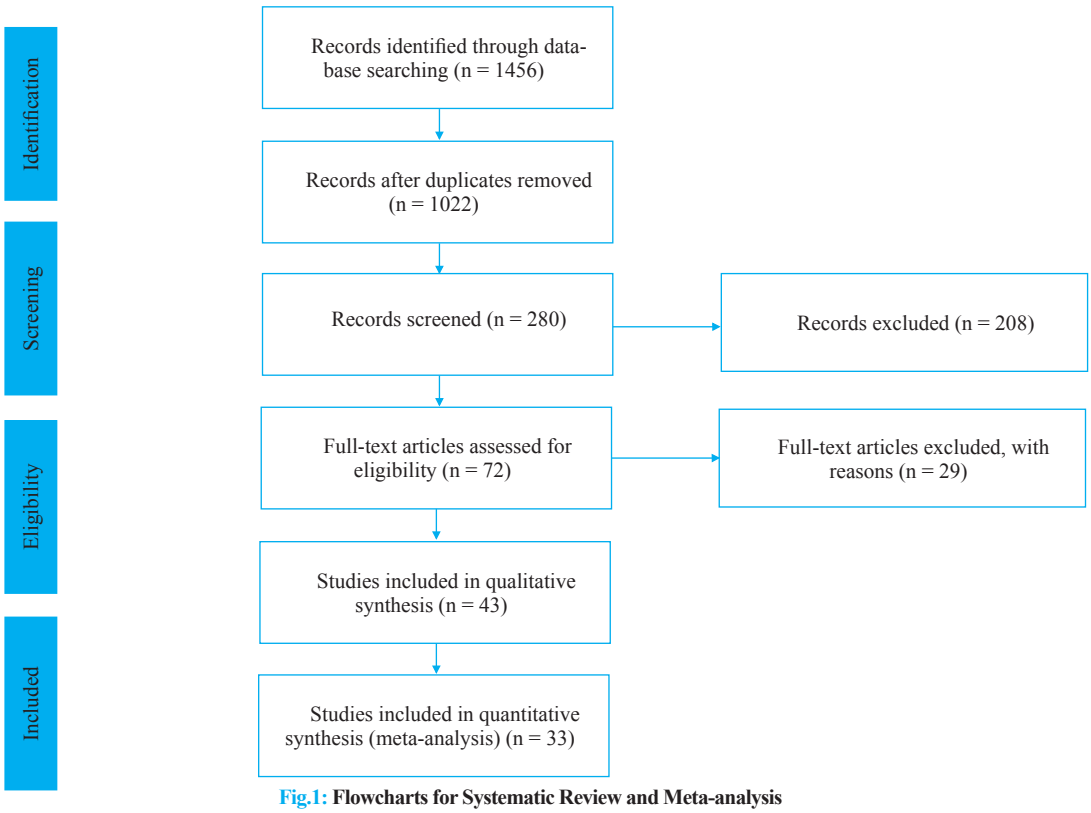

Fig.1: Flowcharts for Systematic Review and Meta-analysis

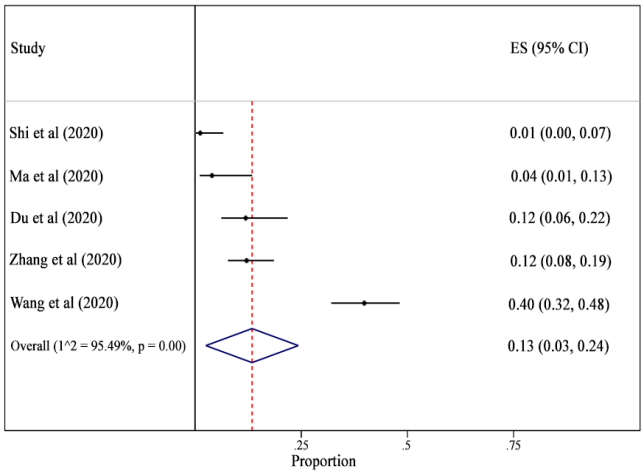

Fig.2: Prevalence of anorexia in studies entered into the Systematic review and Meta-analysis

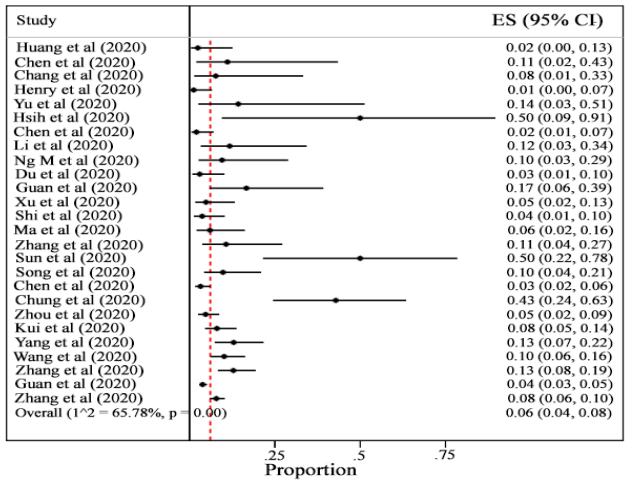

Fig.3: Prevalence of diarrhea in studies entered into the Systematic review and Meta-analysis

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CONFLICT OF INTEREST

The authors declare no conflict of interests related to this work.

Financial disclosure:

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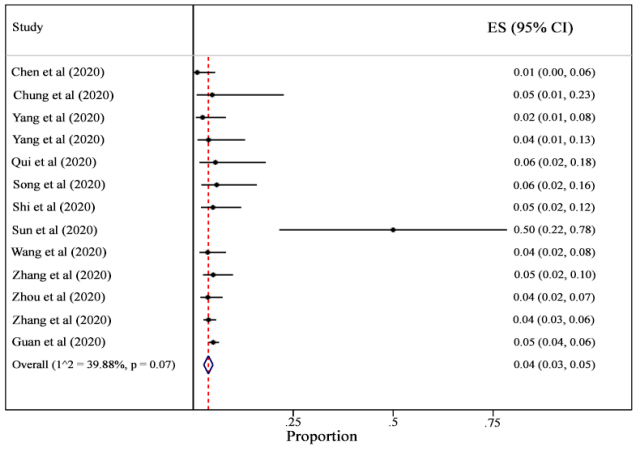

Fig.4: Prevalence of nausea and vomiting in studies entered into the Systematic review and Meta-analysis

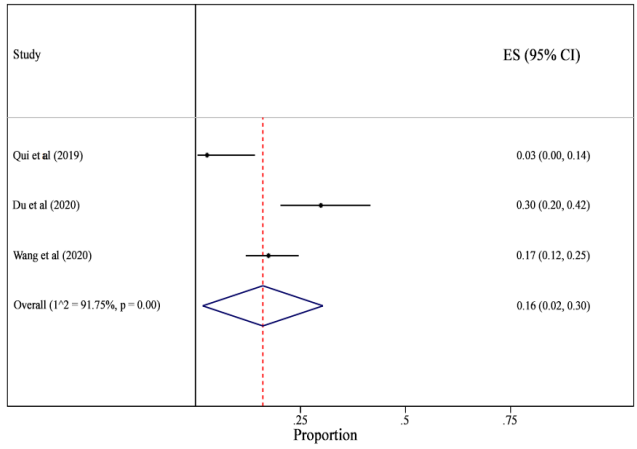

Fig.5: Prevalence of pharyngalgia in studies entered into the Systematic review and Meta-analysis

REFERENCES

1. Mao R, Liang J, Shen J, Ghosh S, Zhu LR, Yang H, et al. Hepatology: Implications of COVID-19 for patients with pre-existing digestive diseases. *Lancet Gastroenterol Hepatol* 2020;5:425-7.
2. Liatsos C, Papaefthymiou A, Tzouvala M, Doulberis M, Petridou E, Kountouras J. Current Aspects on Differentiating Relapses from Over-Infections in Symptomatic Inflammatory Bowel Diseases. *Dig Dis Sci* 2019;64:2686-7.
3. Grenov B, Lanyero B, Nabukeera-Barungi N, Namusoke H, Ritz C, Friis H, Michaelsen KF, et al. Diarrhea, Dehydration, and the Associated Mortality in Children with Complicated Severe Acute Malnutrition: A Prospective Cohort Study in Uganda. *J Pediatr* 2019;210:26-33.
4. Chan JSH, Chao ACW, Cheung VCH, Wong SSK, Tang W, Wu JCY, et al. Gastrointestinal disease burden and mortality: A public hospital-based study from 2005 to 2014. *J Gastroenterol Hepatol* 2019;34:124-31.
5. Sadowski DC, Camilleri M, Chey WD, Leontiadis GI, Marshall JK, Shaffer EA, et al. Hepatology: Canadian Association of Gastroenterology clinical practice guideline on the management of bile acid diarrhea. *Clin Gastroenterol Hepatol* 2020;18:24-41.
6. Newman KL, Gustafson K, Englund JA, Khatry SK, LeClerq SC, Tielsch JM, et al. Risk of Respiratory Infection following Diarrhea among Adult Women and Infants in Nepal. *Am J Trop Med Hyg* 2020;102:28-30.
7. Fletcher SM, McLaws M-L, Ellis JTJJophr: Prevalence of gastrointestinal pathogens in developed and developing countries: systematic review and meta-analysis. *J Public Health Res* 2013;2: 42–53.
8. Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet* 2010;375:1969-87.
9. Wardlaw T, Salama P, Brocklehurst C, Chopra M, Mason EJTl. why children are still dying and what can be done. *Lancet* 2010;375:870-2.
10. Dadkhah B, Anisi E, Mozaffari N, Amani F, Pourghasemian MJJocs. Effect of music therapy with periorbital massage on chemotherapy-induced nausea and vomiting in gastrointestinal cancer: a randomized controlled trail. *J Caring Sci* 2019; 8: 165–71.
11. Su Y, Zhang X, Zeng J, Pei Z, Cheung RTF, Zhou Q,et al. New-onset constipation at acute stage after first stroke: incidence, risk factors, and impact on the stroke outcome. *Stroke* 2009;40:1304-9.
12. Li J, Yuan M, Liu Y, Zhao Y, Wang J, Guo WJM. Incidence of constipation in stroke patients: a systematic review and meta-analysis. *Medicine (Baltimore)* 2017;96: e7225.13.
13. Van Summeren JJ, Holtman GA, Dekker JH, Berger MYJTJoP. Quality of life in children with functional constipation: Are child self-reports and parent proxy-reports interchangeable? *J Pediatr* 2020;217:216.
14. Wald A, Scarpignato C, Kamm M, Mueller-Lissner S, Helfrich I, Schuijt C, et al. The burden of constipation on quality of life: results of a multinational survey. *Aliment Pharmacol Ther* 2007;26:227-36.
15. Novel CPEREJZlxbxzzZlz: The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Zhonghua Liu Xing Bing Xue Za Zhi* 2020;41:145-51.
16. Yu N, Li W, Kang Q, Xiong Z, Wang S, Lin X, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study. *Lancet* 2020;20:559-64.
17. Sun K, Chen J, Viboud CJm. Early epidemiological analysis of the 2019-nCoV outbreak based on a crowdsourced data. *BMJ* 2020.
18. Moher D, Liberati A, Tetzlaff J, Altman DG, Altman D, Antes G, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement (Chinese edition). *BMJ* 2009;339:b2535.

19. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497-506,

20. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China. a descriptive study. *Lancet* 2020;395:507-13,

21. Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet* 2020;395:809-15.

22. Dawei Wang ,Bo Hu, Chang Hu, Fangfang Zhu, Xing Liu, Jing Zhang, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. *JAMA* 2020;323:1061–9.

23. Kui L, Fang Y-Y, Deng Y, Liu W, Wang M-F, Ma J-P, et al. Clinical characteristics of novel coronavirus cases in tertiary hospitals in Hubei Province. *Chin Med J* 2020;133: 1025–31.

24. Xu Xiao-Wei, Wu Xiao-Xin, Jiang Xian-Gao, Xu Kai-Jin, Ying Ling-Jun, Ma Chun-Lian, et al. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-Cov-2) outside of Wuhan, China: retrospective case series. *BMJ* 2020;368: m606

25. De Chang, Minggui Lin, Lai Wei, Lixin Xie, Guangfa Zhu, Charles S Dela Cru, et al. Epidemiologic and Clinical Characteristics of Novel Coronavirus Infections Involving 13 Patients Outside Wuhan, China. *JAMA* 2020;323:1092–3.

26. Henry BM, Oliveira MHSJm. Preliminary epidemiological analysis on children and adolescents with novel coronavirus disease 2019 outside Hubei Province, China: an observational study utilizing crowdsourced data. *BMJ* 2020;1-28.

27. Yang W, Cao Q, Qin L, Wang X, Cheng Z, Pan A, Dai J, Sun Q, Zhao F, Qu JJJoI: Clinical characteristics and imaging manifestations of the 2019 novel coronavirus disease (COVID-19): A multi-center study in Wenzhou city, Zhejiang, China. *J Infect* 2020;80:388-93

28. Pan F, Ye T, Sun P, Gui S, Liang B, Li L, et al. Time course of lung changes on chest CT during recovery from 2019 novel coronavirus (COVID-19) pneumonia. *Radiology* 2020;295:715-21.

29. Ng M-Y, Lee EY, Yang J, Yang F, Li X, Wang H, et al. Imaging profile of the COVID-19 infection: radiologic findings and literature review. *Radiology* 2020;2:e200034.

30. Song F, Shi N, Shan F, Zhang Z, Shen J, Lu H, et al. Emerging 2019 Novel Coronavirus (2019-nCoV) *Pneumonia* 2020:200274.

31. Chung M, Bernheim A, Mei X, Zhang N, Huang M, Zeng X, et al. CT imaging features of 2019 novel coronavirus (2019-nCoV). *Radiology* 2020;295:202-7.

32. Shi H, Han X, Jiang N, Cao Y, Alwalid O, Gu J, et al. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis* 2020;20:425-34.

33. Hsih W-H, Cheng M-Y, Ho M-W, Chou C-H, Lin P-C, Chi C-Y, et al. Featuring COVID-19 cases via screening symptomatic patients with epidemiologic link during flu season in a medical center of central Taiwan. *J Microbiol Immunol Infect* 2020;53:459-66.

34. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *J Microbiol Immunol Infect* 2020;53:459-66.

35. Ma H, Hu J, Tian J, Zhou X, Li H, Laws MT, et al. Visualizing the Novel Coronavirus (COVID-19) in Children: What We Learn from Patients at Wuhan Children's Hospital. *Front Pediatr* 2020;8: 287.

36. Qiu H. Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study. *Lancet Infect Dis* 2020;20:689-96.

37. Du W, Yu J, Wang H, Zhang X, Zhang S, Li Q, et al. Clinical Characteristics of COVID-19 in Children Compared with Adults Outside of Hubei Province in China. *Infection* 2020:1–8.

38. Grant MC, Geoghegan L, Arbyn M, Mohammed Z, McGuinness L, Clarke EL, et al. (2020) The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): A systematic review and meta-analysis of 148 studies from 9 countries. *PLoS One* 15: e0234765.

39. L. Zhang FZ, L. Xie, C. Wang, J. Wang, R. Chen, P. Jia, et al. Clinical characteristics of COVID-19-infected cancer patients: A retrospective case study in three hospitals within Wuhan, China. *Ann Oncol* 2020;31:894-901

40. Xiaoli Zhang, Huan Cai, Jianhua Hu, Jiangshan Lian, Jueqing Gu, Shanyan Zhang et al. Epidemiological, clinical characteristics of cases of SARS-CoV-2 infection with abnormal imaging findings. *Int J Infect Dis* 2020;94:81-7.

41. Sun D, Li H, Lu X-X, Xiao H, Ren J, Zhang F-R, et al. Clinical features of severe pediatric patients with coronavirus disease 2019 in Wuhan: a single center's observational study. *World J Pediatr 2020;16:251-9*

42. L Zhang, F Zhu, L Xie, C Wang, J Wang, R Chen, et al. Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, *China. Ann Oncol* 2020;31:894-901.

43. Rodriguez-Morales AJ, Cardona-Ospina JA, Gutiérrez-Ocampo E, Villamizar-Peña R, Holguin-Rivera Y, Escalera-Antezana JP, et al. Clinical, laboratory and imaging features of COVID-19: A systematic review and meta-analysis. *Travel Med Infect Dis 2020;34:101623.*

44. Nasiri MJ, Haddadi S, Tahvildari A, Farsi Y, Arbabi M, Hasanzadeh S, et al. COVID-19 clinical characteristics, and sex-specific risk of mortality: Systematic Review and Meta-analysis.*Medrxiv* 2020:20042903.