Original Article: Mini Review Study in Radiologic Findings of Patients with Covid-19-a Systematic

Elham Sadat Motaharian[1] |**Behnam Mahmoodiyeh[2]** |**Hadi Lotfi Ahmad abadi[3]**

|**Saba Lorestani[4]** |**Mohammad Saleh Sadri[5]** |**Maryam Milani Fard[6]** | **Amir**

Mohammad Milani Fard[7] | **Anita Amini*[8]**

[1]Bachelor of Nursing, Iran University of Medical Sciences, Master of Nursing in Kashan University of Medical Sciences, Iran
[2]Anesthesiologist, Critical Care flow ship, assistance Professor of Anesthesiology and critical care medicine department, Arak university of medical sciences, Arak, Iran
[3]Bachelor of Emergency Medicine, Iranshahr University of Medical Sciences, Tehran Emergency. Force, Tehran, Iran
[4]Radiologist, Department of Radiology, Modares Hospital, Saveh University of Medical Sciences, Saveh, Iran
[5]Anesthesiologist, Department of Anesthesiology, Modares Hospital, Saveh University of Medical Sciences, Saveh, Iran
[6]Researcher at the Anesthesia and Pain &Molecular and cell Biology Research cente, Faculty of Medicine Department of Anatomy,Iran university of Medical Sciences, Tehran, Iran
[7]Graduate of nursing, School of nursing and medical emergency, Alborz University of Medical Sciences, Researcher, Tehran, Iran
[8]Master of Industrial Engineering-Management and Productivity, Health Systems Researcher, Firoozgar Hospital Clinical Development and Research Center

ABSTRACT

Covid-19 is a newly emerged viral pandemic with a wide variety of systemic and local manifestations, and radiography is a main diagnostic tool in patients with covid-19. The aim of this review study is to evaluate the radiologic findings of patients with covid-19. In this work, electronic search was conducted on MEDLINE, Google Scholar, Scopus, Web of knowledge and SID. The relevant data were extracted. 22 studies including 1108 patients with main age of 50.1 ± 16.2 were included. The most common finding was ground glass opacification (31.2%) following by consolidation (28.4%). Right lobe involvement was much higher prevalent than left lobe (29% vs 12%) and lower lobe was much higher than upper lobes (33% vs 14%). Chest radiography is a high valuable tool in viral infection detection and according to high prevalence of radiological manifestations, it can be used effectively to encounter this disease.

Corresponding Author: Anita Amini (anitaamini1272@gmail.com)

Introduction

Covid-19 was firstly reported on Wuhan, Habei, China on December 2019 and spread into other territories and became a pandemic according to WHO announcement [1-5]. In Iran the first viral infection was reported on February 2020. High transmission rate of viral infection turned it into a highly-fatal disease with high rates of mortality [6-10]. There are many diagnostic tools for this disease them which among them radiography is the worthiest. Radiographic findings are valuable since they share many information for clinicians and help them to judge about treatment plan [11-14].

SARS-CoV-2 belongs to the beta-coronaviruses genome family, but SARS has milder symptoms [15-18]. The most obvious clinical symptoms after one week from the onset of the disease are fever, cough and sore throat. Other symptoms include; Headache, nausea, diarrhea, and vomiting that in acute cases lead to shortness of breath, hypoxia, and ARDS [19-22].

Considering the initial airway collisions in Covid-19, CT scan will be the first diagnostic tool. Chest radiography has a lower diagnostic value [23-26]. Another diagnostic method with Reverse Transcription is Polymerase Chain Reaction (RT - PCR), which is less sensitive in the detection of Covid-19, thus doubling the importance of CT scan in the diagnosis of Covid-19 [27-31]. Extensive radiological manifestations and CT scans can be seen in Covid-19 patients even before the onset of clinical symptoms [32-36]. Types of findings in CT scan images of patients with Covid-19 are ground glass opacity (GGO) with or without Consolidation, GGO with or without crazy paving pattern, uncertain findings: Multiple GGOs, unilaterally published GGO without clear scatter pattern, small and non-round GGOs Tiny, pleural effusions have been a sign of tree in bud cavitation [37-40].

The most common symptom of COVID-19 clinical tomography is GGO, in which some parts of the lung are seen as faint shades of gray, while normally they should be seen in black with clear lines from the arteries. In GGO, the alveoli are filled with fluid, and in the image fluid instead of air were detected, which is gray. In severe and advanced infections, more fluid collects inside the lung lobes, and GGO becomes Solid White Consolidation, which involves more volume in the lungs [41-45].

There are a wide spectrum of radiologic findings in patients with covid-19 which most of them are ground glass view of lungs and opacities in pulmonary bronchus [46-49]. The aim of the present systematic review study is to evaluate the radiologic manifestations of patients with covid-19.

The study is performed under PRISMA guideline [49]. All processes of study protocol like data inclusion, search, and data extraction were conducted by two separate reviewers and in cases of mismatches, the third reviewer was evaluated and commented [50-55].

Eligibility criteria according to PICO process were as following: Patients: Patients with covid-19 involvement history. Intervention: Radiography assessment. Comparison: Not Applicable. Outcome: Radiographic manifestations of patients with covid-19.

Exclusion Criteria

1. Incomplete Studies.

2. Meta-analysis studies

3. Qualitative studies.

4. duplicates

5. Irrelevant Studies

Search Strategy

In this review, electronic search was conducted on online databases including MEDLINE, Scopus, CINAHL, ISI Web of Knowledge, Google Scholar. With keywords of Radiologic findings AND covid-19 OR coronavirus OR SARS-CoV-2.

The search result papers were reviewed according to their titles and irrelevant studies were excluded. Remaining studies were reviewed according to their abstract and irrelevant studies were excluded. Relevant studies were cited in endnote 8.3 (Clarivate,

Endnote, USA) and duplicate papers were excluded [56-59].

Data were extracted according to study design sample size, type of radiographic manifestations, age, sex, hospital stay. The primary outcomes were radiographic findings.

After considering inclusion criteria 22 studies were selected for review and the relevant data were extracted [60-65].

According to the purpose of the study, in the initial search with keywords, 197 articles were found [66-69]. In the first step of selecting studies, 197 studies were selected to review the abstracts [70-72]. Then, studies that did not meet the inclusion criteria were excluded from the study (n=88) [73-75]. In the second step, the full text of 19109 studies was reviewed. Finally, 22 studies were selected (Figure1) [76-79]. 22 studies have been included in present article. The study results were illustrated in table 1, the sample size a total was 922 with mean of age 43.5 years.

According to our findings, Ground Glass were among most prevalent radiographic findings in patients with Covid-19. Right lowe lobe was the most common finding in our study.

The immediate diagnosis is extremely critical for initiating treatment and containing the disease spread. Currently available diagnostic modalities include laboratory testing with RT-PCR and imaging with chest X-ray and CT scan. Laboratory testing mainly relies on PCR done on samples obtained from the upper and lower respiratory tract and was approved by the Center for Disease Control (CDC) on March 3, 2020. RT-PCR is highly specific (i.e., 95-97%) but has a low sensitivity of 60-70%. There are a number of serology tests available, and on March 27, 2020, the Food and Drug Administration (FDA) approved a five minutes serology test kit.

The radiological perspective used for disease assessment and follow-up is very helpful. It provides a direct insight into the pathophysiology of the disease process. As the coronavirus related respiratory illness presents clinically as pneumonia, predominant imaging findings are that of an atypical or organizing pneumonia. Although chest X-rays are less sensitive than CT scans, the former may be used as a first-line approach because of their availability and ease of decontamination. Chest X-ray findings may be normal earlier in the clinical course and tend to peak 10-12 days after the onset of clinical symptoms.

Eligibility Criteria and Study Selection

To be included in the final review, the articles needed to be published in English, include patients diagnosed with the recent coronavirus outbreak (COVID-19), and report CT findings. Studies pertaining to other coronavirus-related illnesses, such as Middle East respiratory syndrome (MERS) were excluded. Two reviewers independently screened the titles and abstracts according to these eligibility criteria.

The known imaging features of initial CT in COVID-19 cases include bilateral, multi-lobar GGO with a peripheral or posterior distribution (or both), mainly in the lower lobes and less frequently within the right middle lobe. Consolidation superimposed on GGO as the initial imaging presentation is found in a smaller number of cases, mainly in the elderly population. Septal thickening, bronchiectasis, pleural thickening, and subpleural involvement are some of the less common findings, mainly in the later stages of the disease. Pleural effusion, pericardial effusion, lymphadenopathy, cavitation, CT halo sign, and pneumothorax are some of the uncommon but possible findings seen with disease progression. Follow-up CT in the intermediate stages of the disease shows an increase in the number and size of GGOs, progressive transformation of GGO into multifocal consolidation, septal thickening, and development of a crazy paving pattern. The greatest severity of CT findings was visible around day 10 after symptom onset. ARDS is the most common indication for transferring patients with COVID-19 to the ICU and the major cause of ICU death in these patients. The imaging signs associated with clinical improvement usually occur after week 2 of the disease and include gradual resolution of consolidative opacities and decrease in the number of lesions and involved lobes. In the majority of documented COVID-19 cases, the initial chest CT is abnormal. Even some patients without any evident symptoms who were imaged solely on the basis of exposure have abnormal CT findings.

Chest CT findings in confirmed cases of COVID-19 generally resembled those associated with MERS and severe acute respiratory syndrome (SARS), manifesting with viral pneumonia and acute lung injury that may progress to the typical imaging features of ARDS in critically ill patients. According to our findings, chest CT showed similar characteristics in the majority of patients, including predominantly bilateral and multifocal involvement with a peripheral or posterior distribution (or both).

Different findings were reported during various stages of COVID-19 pneumonia. However, there seemed to be a close relation between the pattern of CT findings and disease course. Several studies reported temporal changes in CT findings in follow-up examinations, including a transition from isolated GGO to a superimposition of consolidation on GGO with cavitation over time. Some studies suggested that CT manifestations of COVID-19 may vary across age groups, with a predominance of consolidative opacities in older patients and GGO in younger patients. However, there is a paucity of evidence on the long-term pulmonary effects of this infection. Current studies are limited by their short follow-up periods, and CT findings in recovered patients have yet to be formally documented.

Published clinical guidelines strongly recommend chest CT for patients with suspected COVID-19. RT-PCR screening is now considered the standard laboratory test for diagnosis of COVID-19, but it may yield a false-negative result in some cases. A number of cases with false-negative RT-PCR results were reported in the early stages of the disease, possibly because of inadequate viral material in the sample or technical issues during nucleic acid extraction. In such cases with typical clinical manifestations, chest CT may prove to be an invaluable asset because it may show characteristic features of the disease even when the RT-PCR screening test is negative.

A combination of chest CT and repeat laboratory testing may be beneficial for COVID-19 diagnosis in the setting of strong clinical suspicion, including individuals showing typical clinical manifestations and those with a history of exposure. However, a pretest probability assessment is necessary for accurate interpretation of diagnostic testing and application of these results in the appropriate clinical setting. More specifically, in a patient population with low pretest probability of SARS-CoV-2 infection, the typical imaging features should be interpreted with caution.
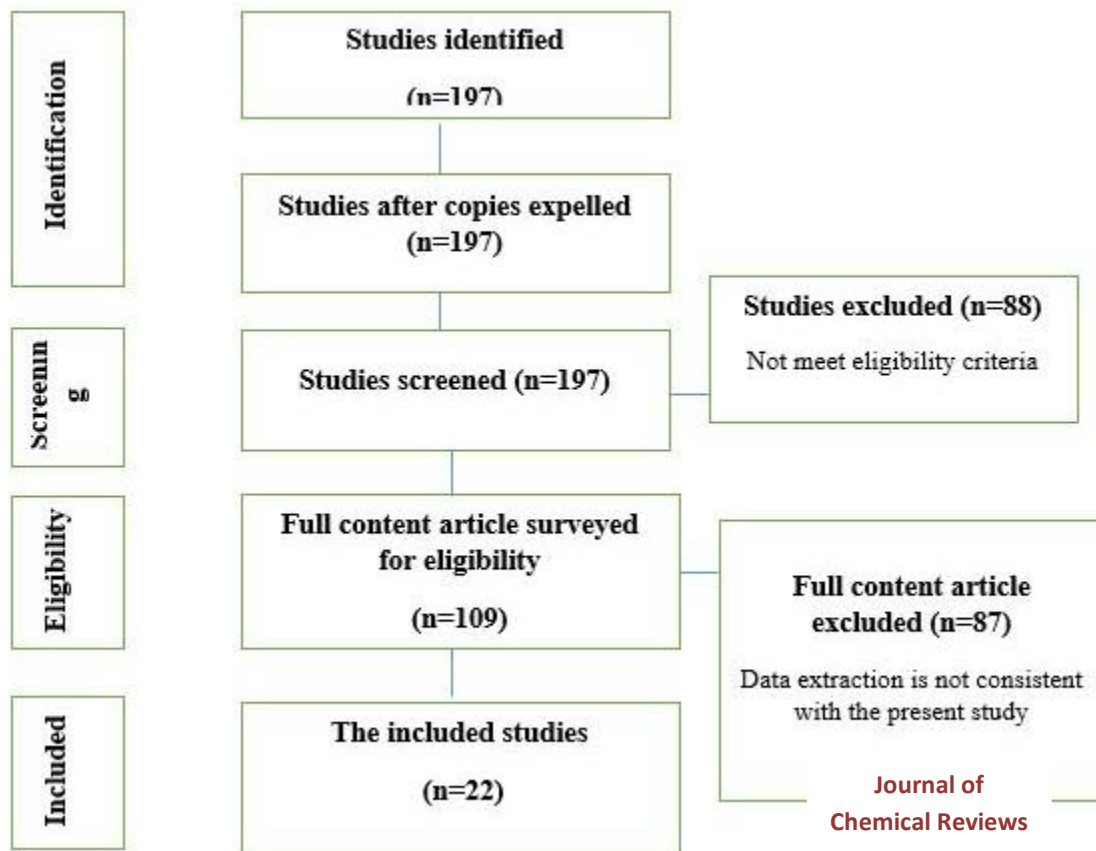
Figure 1. Study Attrition

Table1. Details of selected studies according to inclusion criteria

Study	Sample size	Mean Age	M/F	Travel History	Clinical Outcome (Discharge/ Death)
Mirsadaee et al (12).	163	51 ± 16	116/47	---	122/41
Raiwazi et al (13).	7	53 ± 11.6	4/3	2	5/2
Rousan et al (14)	88	35.2 ± 18.2	50/38	5	87/1
Shi et al (15)	81	49.5	42/39	31	---
Omar et al (16)	124	48.1	37/29		---
Yasin et al (17)	350	41.68	261/89		321/29
Wong et al (18)	64	56 ± 19	26/38	--	---
Xia et al (19)	20	11 ± 8.2	12/8	18/2	---
Zheng et al (18)	25	12.1 ± 1.2	15/10	22/3	---

Table2. Radiographic evaluation

Study	RUL	RML	RLL	LUL	LLL	GG	CD	BWT
Mirsadaree et al (12)	27 (81.9 %)	20 (60%)	30 (91%)	22 (67 %)	30 (91%)	31 (94%)	4 (12 %)	4 (12 %)
Raiwazi et al (13)	1 (14.2%)	--	4 (57.1%)	2 (28.5 %)	4 (57.1%)	3 (42.8 %)	3 (42.8 %)	---
Rousan et al (14)	1 (10%)	1 (10%)	7 (70%)	1 (10%)	2 (20%)	10 (100%)	---	----
Shi et al (15)	5 (32%)	2 (19%)	5 (32 %)	1 (8%)	1 (8%)	14 (93%)	3 (10%)	28 (35%)
Omar et al (16)	2 (20%)	4 (40%)	1 (10%)	3 (30%)	2 (20%)	8 (80%)	----	----
Yasin et al (17)	31 (15.1%)	27 (12.4%)	38(21.6%)	8 (7.1%)	13(10.4%)	87 (32/5%)	218 (81.3%)	107 (39.9%)
Wong et al (18)	0 (0)	32 (50%)	10 (15.62%)	9 (14%)	13 (18.92%)	21 (33%)	30 (47%)	----
Xia et al (22)	1(5%)	3(15%)	2 (10%)	12 (60%)	2(10%)	7 (35%)	9 (45%)	---
Zheng et al (26)	0 (0)	1(4%)	2 (8%)`	1(4%)	3 (12%)	5 (20%)	3 (12%)	----
Diao et al. (39)	6	100	16.7		23.2			
Pon et al. (24)	24	75						
Lu et al (45)	91 (991 lesions)	76.9	19.8	40.7	61.5			
Liu et al. (55)	55 (614 lesions)	78 57	15 19	60 24		36 8		

RUL: Right Upper Lobe. RLL: Right Lower Lobe. LUL: Left Upper lobe LLL: Left Lower Lobe. GG: Ground Glass CD: Consolidation. CP: Crazy Paving. AI: Airway Impaction. BWT: Bronchial Wall Thickening.

Conclusion

Covid-19 is still highly challenging in diagnosis and treatment. Due to high prevalence of radiographic manifestations in patients with covid-19. In our study right bronchi are more predispose to viral involvement than left bronchi, this might be due to straighter and shorter path of right trachea branch. One of the limitations of the present study is difference in radiological interpretations pattern and follow-up periods. Radiographic evaluation is highly sensitive in patients with covid-19 involvement specially in cases with RT-PCR negative which shows its high accuracy. However radiographic evaluation is limited due to similarity in viral pattern to other viral pneumonia, but these situations are few and, in such cases, repeating test or using other tests helps clinicians to overcome uncertainty. The most common finding in chest radiography was ground glass appearance with right lower lobe involvement. Accurate Diagnosis of patients is crucial during covid-19 pandemics but unfortunately it is limited mainly due to technical limitations in screening and diagnosis tools. RT-PCR is gold-standard for covid-19 diagnosis but its sensitivity and specialty are fairly too low (lower than 70 %). Also, this test accuracy is highly dependent on technician skills and viral shedding pattern.

Orcid

Maryam Milani Fard:
https://orcid.org/0000-0002-0888-8847

Amir Mohammad Milani Fard:
https://orcid.org/0000-0003-2635-2728

References

[1] J. N. Chen, M. Zhou, X. Dong, J. Qu, F. Gong, Y. Han, Y. Qiu, J. Wang, Y. Liu, Y. Wei, T. Yu, *Lancet*, **2020**, *395*, 507-513. **[crossref], [Google Scholar], [Publisher]**

[2] T. Ai, Z. Yang, H. Hou, C. Zhan, C. Chen, W. Lv, Q. Tao, Z. Sun, L. Xia, *Radiology*, **2020**, *296*, E32-E40. **[crossref], [Google Scholar], [Publisher]**

[3] V.M. Corman, O. Landt, M. Kaiser, R. Molenkamp, A. Meijer, D.K. Chu, T. Bleicker, S. Brünink, J. Schneider, M.L. Schmidt, D.G. Mulders. *Eurosurveillance*, **2020**, *25*, 2000045. **[crossref], [Google Scholar], [Publisher]**

[4] A. Susanabadi, S. Etemadi, M.S. Sadri, B. Mahmoodiyeh, H. Taleby, M.M. Fard, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2875–2887. **[crossref], [Google Scholar], [Publisher]**

[5] Y. Fang, H. Zhang, J. Xie, M. Lin, L. Ying, P. Pang, W. Ji, *Radiology*, **2020**, *296*, 200432. **[crossref], [Google Scholar], [Publisher]**

[6] M. Wang, Q. Wu, W. Xu, B. Qiao, J. Wang, H. Zheng, S. Jiang, J. Mei, Z. Wu, Y. Deng, F. Zhou, *medRxiv*, **2020**. **[crossref], [Google Scholar], [Publisher]**

[7] A. Bozorgian, *Journal of Engineering in Industrial Research*, **2020**, *1*, 1-8. **[crossref], [Google Scholar], [Publisher]**

[8] F. Rebout, *Journal of Engineering in Industrial Research*, **2020**, *1*, 19-37. **[crossref], [Google Scholar], [Publisher]**

[9] K. Lo Han, Investigation of trivalent cream plating problems, *Journal of Engineering in Industrial Research*, **2020**, *1*, 38-50. **[crossref], [Google Scholar], [Publisher]**

[10] F. Gharekhani Kasa, *Journal of Engineering in Industrial Research*, **2020**, *1*, 51-74. **[crossref], [Google Scholar], [Publisher]**

[11] M. Zbuzant, *Journal of Engineering in Industrial Research*, **2020**, *1*, 75-81. **[crossref], [Google Scholar], [Publisher]**

[12] M. Amirikoshkeki, *Journal of Engineering in Industrial Research*, **2020**, *1*, 82-90. **[crossref], [Google Scholar], [Publisher]**

[13] M. Amini Sadrodin, *Journal of Engineering in Industrial Research*, **2020**, *1*, 91-98. **[crossref], [Google Scholar], [Publisher]**

[14] A. Bozorgian, *Journal of Engineering in Industrial Research*, **2021**, *2*, 194-201. **[crossref], [Google Scholar], [Publisher]**

[15] E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 202-209 **[crossref], [Google Scholar], [Publisher]**

[16] S.M. Shariatmadar, E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 210-217. **[crossref], [Google Scholar], [Publisher]**

[17] S.A. Khalili, K.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 218-227. **[crossref], [Google Scholar], [Publisher]**

[18]   K.A. Mahdiraji, E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 228-233. **[crossref], [Google Scholar], [Publisher]**

[19]   E.A. Mahdiraji, *Journal of Engineering in Industrial Research*, **2021**, *2*, 234-251. **[crossref], [Google Scholar], [Publisher]**

[20]   F. Mohammadkhani Orouji, *Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 1-6. **[crossref], [Google Scholar], [Publisher]**

[21]   F. Momeni, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 7-14. **[crossref], [Google Scholar], [Publisher]**

[22]   S. Zamani, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 15-21. **[crossref], [Google Scholar], [Publisher]**

[23]   Z. Soltani, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 22-32. **[crossref], [Google Scholar], [Publisher]**

[24]   S. Hassan, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 33-38. **[crossref], [Google Scholar], [Publisher]**

[25]   A. Singh, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 39-45. **[crossref], [Google Scholar], [Publisher]**

[26]   M. Aleahmad, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 46-53. **[crossref], [Google Scholar], [Publisher]**

[27]   L. Hosseinzadeh Cham Gordani, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 55-67. **[crossref], [Google Scholar], [Publisher]**

[28]   Z. Torabi, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 68-76. **[crossref], [Google Scholar], [Publisher]**

[29]   M. Rahimirad, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 77-85. **[crossref], [Google Scholar], [Publisher]**

[30]   Z. Rahimi, R. Rashidi, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 86-99. **[crossref], [Google Scholar], [Publisher]**

[31]   H. Asgharpour, R. Emamian, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 100-108. **[crossref], [Google Scholar], [Publisher]**

[32]   F. Jamali, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 109-114. **[crossref], [Google Scholar], [Publisher]**

[33]   G.R. Goodarzi, Q. Bagheri Ragheb, H. Issazadeh, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 115-128. **[crossref], [Google Scholar], [Publisher]**

[34]   A. Mohammadi, D. Comis Bingham, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 134-141. **[crossref], [Google Scholar], [Publisher]**

[35]   F. Mohammadkhani Orouji, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 142-145. **[crossref], [Google Scholar], [Publisher]**

[36]   M. Karimi. *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 146-150. **[crossref], [Google Scholar], [Publisher]**

[37]   Z. Saeid, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 151-155. **[crossref], [Google Scholar], [Publisher]**

[38]   M. Karimi, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 156-160. **[crossref], [Google Scholar], [Publisher]**

[39]   M. Karimi, *International Journal of Advanced Studies in Humanities and Social Science*, **2021**, *10*, 161-170. **[crossref], [Google Scholar], [Publisher]**

[40]   K. Ghajarzadeh, M.M. Fard, M.R. Alebouyeh, H. Alizadeh Otaghvar, A. Dabbagh, M. Mohseni, S.S. Kashani, A.M.M. Fard, S.H.R. Faiz, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2466-2484. **[crossref], [Google Scholar], [Publisher]**

[41]   H. Shi, X. Han, N. Jiang, Y. Cao, O. Alwalid, J. Gu, Y. Fan, C. Zheng, *Lancet Infect. Dis.*, **2020**. **[crossref], [Google Scholar], [Publisher]**

[42]   F. Zhou, T. Yu, R. Du, G. Fan, Y. Liu, Z. Liu, J. Xiang, Y. Wang, B. Song, X. Gu, L. Guan, *Lancet*,

2020, *395*, 1054-1062. **[crossref], [Google Scholar], [Publisher]**

[43] S. Berthier, M.R. Bertrand, F. Ghirenghelli, B. Bonnotte, J.F. Besancenot, B. Lorcerie, *PRESSE MED.*, **2002**, *31*, 107-12. **[crossref], [Google Scholar], [Publisher]**

[44] C. Huang, Y. Wang, X. Li, L. Ren, J. Zhao, Y. Hu, L. Zhang, G. Fan, J. Xu, X. Gu, Z. Cheng, *Lancet*, **2020**, *395*, 497-506. **[crossref], [Google Scholar], [Publisher]**

[45] S. Mirsadraee, M. Pourabdollah Toutkaboni, M. Bakhshayeshkaram, M. Rezaei, E. Askari, S, Haseli, N. Sadraee, *Iranian J. Pathol.*, **2020**, *16*, 137-143. **[crossref], [Google Scholar], [Publisher]**

[46] T. Riawati, W. Indrarto, A.R. Fauzi, W. Widitjiarso, Gunadi, *Ann. Med. Surg.*, **2021**, *62*, 269-273. **[crossref], [Google Scholar], [Publisher]**

[47] L.A. Rousan, E. Elobeid, M. Karrar, Y. Khader, *BMC Pulm. Med.*, **2020**, *20*, 245. **[crossref], [Google Scholar], [Publisher]**

[48] H. Shi, X. Han, H. Jaing, Y. Cao, O. Alwalid, J. Gu, *The Lancet Infec. Dis.*, **2020**, *20*, 425-434. **[crossref], [Google Scholar], [Publisher]**

[49] S.F. Omar, R.M. Habib, A.M. Motawa, *Egypt. J. Radiol. Nuc. Med.*, **2021**, *15*, 27-34. **[crossref], [Google Scholar], [Publisher]**

[50] R. Yasin, W. Gouda, *Egypt. J. Radiol. Nuc. Med.*, **2020**, *51*, 217-32. **[crossref], [Google Scholar], [Publisher]**

[51] H.Y.F. Wong, H.Y.S. Lam, A.H.T. Fong, S.T. Leung, T.W.Y. Chin, C.S.Y. Lo, M.M.S. Lui, J.C.Y. Lee, K.W.H. Chiu, T.W.H. Chung, E.Y.P. Lee, E.Y.F. Wan, I.F.N. Hung, T.P.W. Lam, M.D. Kuo, M.Y. Ng, *Radiology*, **2020**, *296*, E72-E78. **[crossref], [Google Scholar], [Publisher]**

[52] W. Liu, Q. Zhang, J. Chen, R. Xiang, H. Song, S. Shu, L. Chen, L. Liang, J. Zhou, L. You, P. Wu, B. Zhang, Y. Lu, L. Xia, L. Huang, Y. Yang, F. Liu, M.G. Semple, B.J. Cowling, K. Lan, Z. Sun, H. Yu, Y. Liu, *N. Engl. J. Med.*, **2020**, *382*, 1370-1371. **[crossref], [Google Scholar], [Publisher]**

[53] W. Xia, J. Shao, Y. Guo, X. Peng, Z. Li, D. Hu, *Pediatr. Pulmonol.,* **2020**, *55*, 1169-1174. **[crossref], [Google Scholar], [Publisher]**

[54] F. Zheng, C. Liao, Q.H. Fan, H.B. Chen, X.G. Zhao, Z.G. Xie, X.L. Li, C.X. Chen, X.X. Lu, Z.S. Liu, W. Lu, C.B. Chen, R. Jiao, A.M. Zhang, J.T. Wang, X.W. Ding, Y.G. Zeng, L.P. Cheng, Q.F. Huang, J. Wu, X.C. Luo, Z.J. Wang, Y.Y. Zhong, Y.

Bai, X.Y. Wu, R.M. Jin, *Curr. Med. Sci.*, **2020**, *40*, 275-280. **[crossref], [Google Scholar], [Publisher]**

[55] B. Jamalvandi *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 89-96. **[crossref], [Google Scholar], [Publisher]**

[56] H. Bastami, M. Panahi, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 97-111. **[crossref], [Google Scholar], [Publisher]**

[57] L. Hazarika, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 111-124. **[crossref], [Google Scholar], [Publisher]**

[58] H. Jalaeipour, A. Hajizadegan, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 125-140. **[crossref], [Google Scholar], [Publisher]**

[59] M. Heidari, S. Heidari, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 141-149. **[crossref], [Google Scholar], [Publisher]**

[60] M. PourKiani, M. Pourjafari Jozam, M. Pourjafari Jozam, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 150-164. **[crossref], [Google Scholar], [Publisher]**

[61] M. Alikhani, J. Khodayari, M. Dehnavi, J. Verij kazemi, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 165-171. **[crossref], [Google Scholar], [Publisher]**

[62] G. Zaeri, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 310-320. **[crossref], [Google Scholar], [Publisher]**

[63] M. Shafaee, H. Bahramzadeh, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 321-331. **[crossref], [Google Scholar], [Publisher]**

[64] B. Sahranavard, R. Hajhosseini, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 332-349. **[crossref], [Google Scholar], [Publisher]**

[65] S. Abdollahyar, A. Masihpoor, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 350-361. **[crossref], [Google Scholar], [Publisher]**

[66] M. Fathi Rkabdary, *International Journal of Advanced Studies in Humanities and Social*

Science, **2019**, *8*, 362-368. **[crossref], [Google Scholar], [Publisher]**

[67] S.M. Sajjadi, S. Ansari, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 369-382. **[crossref], [Google Scholar], [Publisher]**

[68] M.R. Rahnama, A. Bidkhori, A. Kharazmi, *International Journal of Advanced Studies in Humanities and Social Science*, **2019**, *8*, 383-390. **[crossref], [Google Scholar], [Publisher]**

[69] S. Ketabi, A. Sadeghi, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 1-20. **[crossref], [Google Scholar], [Publisher]**

[70] S. Salehi-Kordabadi, S. Karimi M. Qorbani-Azar, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 21-36. **[crossref], [Google Scholar], [Publisher]**

[71] M.R. Rahnama, M. Ajza Shokouhi, A. Heydari, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 37-49. **[crossref], [Google Scholar], [Publisher]**

[72] Y. Kamyabi, M. Salahinejad, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 50-62. **[crossref], [Google Scholar], [Publisher]**

[73] H. Jenaabadi, B. Ruzrokh, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 63-71. **[crossref], [Google Scholar], [Publisher]**

[74] S. Rahimipour, *International Journal of Advanced Studies in Humanities and Social Science*, **2020**, *9*, 72-83. **[crossref], [Google Scholar], [Publisher]**

[75] F.E. Sadr, Z. Abadi, N.E. Sadr, M.M. Fard, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 6839-6852. **[crossref], [Google Scholar], [Publisher]**

[76] K. Ghajarzadeh, M.M. Fard, H. Alizadeh Otaghvar, S.H.R. Faiz, A. Dabbagh, M. Mohseni, S.S. Kashani, A.M.M. Fard, M.R. Alebouyeh, *Annals of the Romanian Society for Cell Biology*, **2021** *25*, 2449–2456. **[crossref], [Google Scholar], [Publisher]**

[77] K. Ghajarzadeh, M.M. Fard, H. Alizadeh Otaghvar, S.H.R. Faiz, A. Dabbagh, M. Mohseni, S.S. Kashani, A.M.M. Fard, M.R. Alebouyeh, *Annals of the Romanian Society for Cell Biology*, **2021**, *25*, 2457–2465. **[crossref], [Google Scholar], [Publisher]**

Maryam Milani Fard
Researcher at the Anesthesia and Pain &Molecular and cell Biology Research center, Faculty of Medicine Department of Anatomy, Iran university of Medical Sciences, Tehran, Iran.
E-mail: Maryammilani837@yahoo.com, ORCID: 0000-0002-0888-8847

Amir Mohammad Milani Fard,
Graduate of nursing, School of nursing and medical emergency, Alborz University of Medical Sciences, Researcher of Baqiyatallah Hospital Research Center, Tehran, Iran.
E-mail: milanifard.am@gmail.com, ORCID: 0000-0003-2635-2728