

# Investigating Factors Affecting Mortality from Mucormycosis after COVID-19 Infection: A Systematic Review

Hamid Owaysee Osquee  Ali Reza Lotfi\*

Associate Professor of Infectious Disease, Department of Infectious Disease, School of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

Associate Professor of Otorhinolaryngology, Head and Neck Surgery, Tuberculosis and Lung Disease Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

\*Corresponding Author E-mail: [Alireza.Lotfi@yahoo.com](mailto:Alireza.Lotfi@yahoo.com)

Received: 2023-01-19, Revised: 2023-02-10, Accepted: 2023-04-01

## ABSTRACT

**Introduction:** Examining laboratory parameters to determine acute or less severe cases of mucormycosis after contracting Covid-19, identifying patients who are at higher risk of mortality, and increasing awareness for proper practice will be useful in improving the clinical situation. Therefore, we decided to investigate factors affecting mortality from mucormycosis After Covid-19 infection.

**Methods:** This study was a systematic review (Conducted by PRISMA guideline). This study was conducted in Tabriz University of Medical Sciences in 2022.

**Results:** From examining the results of these studies (15 studies), it was found that mortality was higher in patients hospitalized in ICU and general wards, and a significant difference was observed between the average age of recovered and deceased patients. Having high blood pressure as well as diabetes mellitus also significantly led to an increase in mortality.

**Conclusion:** Hospitalization in the intensive care unit, advanced age, high severity of Covid-19, high blood sugar, and underlying diseases significantly increase the risk of death due to mucormycosis following Covid-19.

**Keywords:** Mucormycosis, Mortality, Risk factor, Systematic review.

## 1. Introduction

Symptoms of sore throat, headache, and runny nose have also been reported. Gastrointestinal symptoms such as nausea, diarrhea, and abdominal pain with these symptoms may occur before respiratory symptoms in about 10% of patients [1-3]. Asymptomatic patients may test positive for Covid-19 (in 30% of

cases) [4-6]. However, most patients present with mild to moderate symptoms (55%). About 30% of patients show symptoms of dyspnea after 5 days from the onset of the disease. The aggravation of symptoms in the second week of the disease is a typical phenomenon in patients with more severe involvement (Figure 1) [7-9].

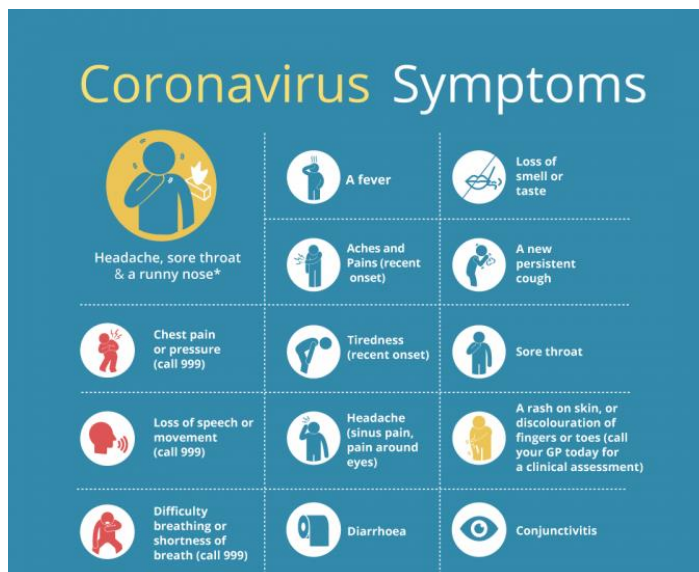


Figure 1. COVID-19 symptoms.

These patients usually require hospitalization for 7-8 days and have low blood oxygen levels and may have bilateral pneumonia (75%) (Figure 2) [10-13]. One of the common complications of this disease is acute respiratory distress syndrome (ARDS), which occurs especially in people with multiple organ failure [14-17]. In these

cases, respiratory support is unavoidable and may range from non-invasive high-flow oxygen to invasive mechanical ventilation [18-20]. A group of patients may have acute inflammatory conditions with fever and an increase in inflammatory markers such as cytokines. Several laboratory findings have been observed in Covid-19 disease [21-23].

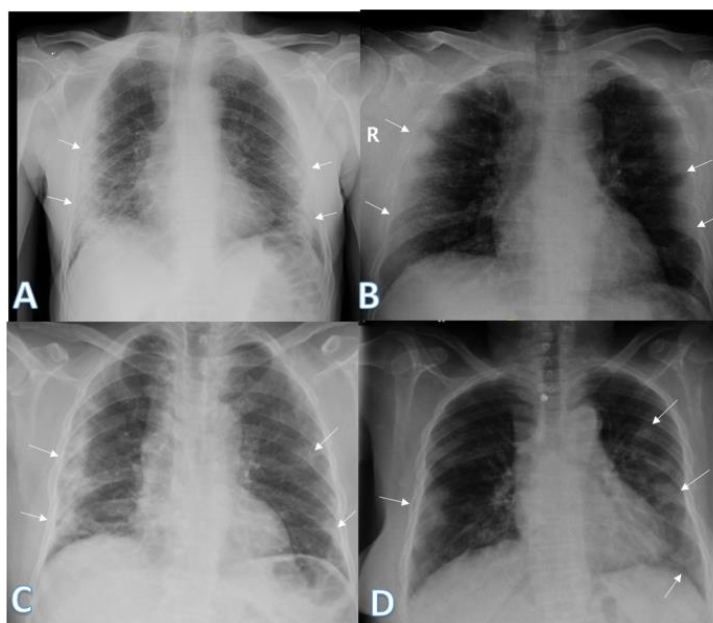


Figure 2. bilateral pneumonia in COVID-19.

Although the complete blood cell count (CBC) test in these patients may be completely normal, the most common positive findings in this test include lymphopenia (63%), leukopenia (25-9%), leukocytosis (24-30%), and thrombocytopenia (is 36%). Liver enzymes are increased in 37% of cases of this disease. Other inflammatory factors including ESR, CRP, D-dimer, ferritin, and IL-6 are also commonly elevated. Procalcitonin is usually normal. However, there is a possibility that it may be positive, especially in the case of bacterial infections [24-26].

In a study conducted on patients with MERS-CoV, Hin Chu *et al.* reported that MERS-CoV virus, but not SARS-CoV virus, effectively engages patients' T cells and induces apoptosis in these cells. These findings show that viremia in SARS patients may have different clinical significance than the viremia in MERS patients, in such a way that patients with MERS usually have a worse outcome due to the destructive nature of T cells in this disease [27-29].

Alfonso *et al.* conducted a systematic review with meta-analysis of 19 articles in the field of the disease of Covid-19 to obtain information about the clinical, laboratory, and imaging characteristics of the disease. In this study, the most common laboratory changes included decreased albumin level (75.8%), increased CRP (58.3%), increased lactate dehydrogenase level (57.0%), lymphopenia (43.1%), and high ESR (41.8%). According to these findings, it can be concluded that nearly half of the people with Covid-19 have lymphopenia [30-32].

Despite the previous study that showed a decrease in the number of leukocytes and lymphocytes in patients

with Covid-19, Nanshan *et al.* in a study conducted on 99 patients with Covid-19 reported that the rate of leukopenia in these patients was only about 9%. Other findings in the CBC test of these patients included leukocytosis (24%), increased number of neutrophils (38%), leukopenia and anemia in 33% and 50% of patients, respectively. According to the results of this study, it can be mentioned that leukopenia and lymphopenia do not necessarily exist together in Covid-19 patients and the lymphopenia incidence in these patients is higher than leukopenia [33-35]. Ali Mohammadi *et al.* also state in their research results that the rate of spread of infection caused by Covid-19 in Iran can be reduced by interfering with effective factors such as health education, preventing the formation of human gatherings, active disease detection, contact tracing, and isolation of sick people [36-38]. During the period of disease transmission from the rest of the community and quarantine, it reduced to a great extent [39-41].

However, the researchers' information about the different aspects of this disease as well as the diseases resulting from this disease such as mucormycosis are being updated (Figure 1), and accurate information is limited due to the global geographical features. Therefore, for a more detailed analysis of such data, attention should be paid to the available data related to patients with mucormycosis after contracting Covid-19. Hence, systematic review studies can be mentioned among the methods that can be effective in this field. Therefore, the current study was conducted as a review with the aim of investigating the mortality rate due to mucocormycosis after contracting Covid-19 (Figure 3) [42-44].

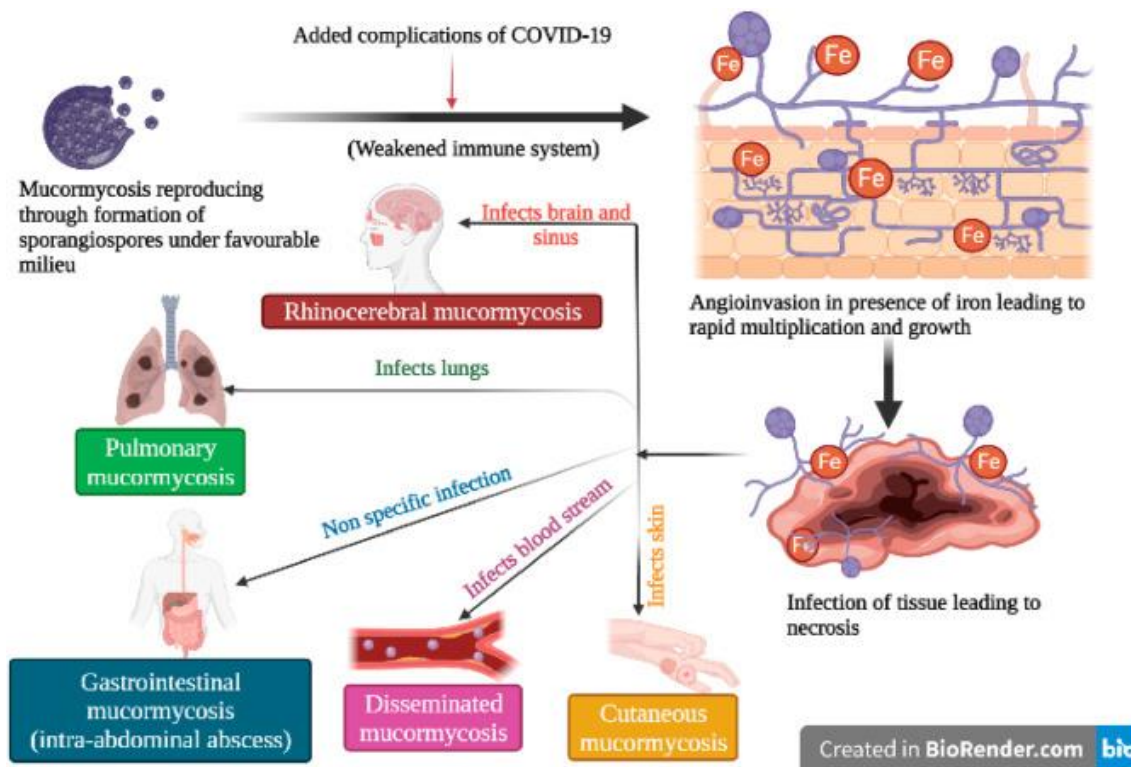


Figure 3. Mucormycosis associated COVID-19.

**Method**

This study was a systematic review (Conducted by PRISMA guideline). This study was conducted in Tabriz University of medical sciences in 2022. Inclusion criteria included definitive diagnosis of Covid-19 through lung CT scan or polymerase chain reaction (PCR) test or doctor's diagnosis. Furthermore, the exclusion criteria included patients for whom more than half of the examined variables were unclear before or after contracting the corona virus. To find articles, use the keywords "2019-nCoV", "COVID-19", "SARS-CoV-2", "Coronaviruses", "mortality", "risk factor", and "Mucormycosis", all possible combinations.

To obtain the texts of the articles published in the field of Covid-19 and mucormycosis, the research team of the present study tried their best to find all the articles. At first, a meeting consisting of both researchers was held in an academic place, and in this meeting, the

keywords were determined based on the mesh system. This system can provide us with keywords that are related to medicine. After the keywords were confirmed, a database search was initiated by both authors. This search was done without time limit and separately by the researchers of this study. Among the articles that were found in the search, those that had a good quality entered the final stage. In the final stage, the most important parts of each article were extracted to be used for the purposes of this study.

**Results**

From examining the results of these studies (15 studies), it was found that mortality was higher in patients hospitalized in ICU and general wards, and a significant difference was observed between the average age of recovered and deceased patients. Having high blood pressure and diabetes mellitus also significantly led to an increase in

mortality [45-47]. A mean age of 54.2 years, 73.7 of whom were male and infected with Covid-19 were reviewed (14 articles included). The most reported symptoms in these patients were respectively fever (82.3%), cough (58%), shortness of breath (33.2%), and fatigue (30.7%) (6). Acute kidney injury was observed in 34.1% of patients. Mucormycosis patients with Covid-19 were treated with prednisone (77%). Overall, 20% of patients required intensive care unit (ICU) admission and 24.6% of patients required mechanical ventilation. Totally, 18.8% of patients with mucormycosis had died, which was much higher than the overall mortality due to COVID-19, which was reported at 3.4%. Clinical manifestations of Covid-19 in patients with mucormycosis may differ from the general population in terms of disease severity, complications including renal failure, and mortality [48-50].

### Discussion

About 20% of the patients in the study had died. The mortality rate is different in different studies. In different studies, percentages between 9 and 21 percent have been reported [51-53].

The results of multiple Cox regression showed that increasing one year of age increases the chance of death by 5%. Based on the single Cox regression test, it further showed that increasing one year of age raises the chance of death by 6% . The results of a study in America showed that 80% of the deaths of Covid-19 patients were in people over 65 years old. These findings are similar to Chinese data, which show that 80% of deaths occurred among people over 60 years old (Figure 4).

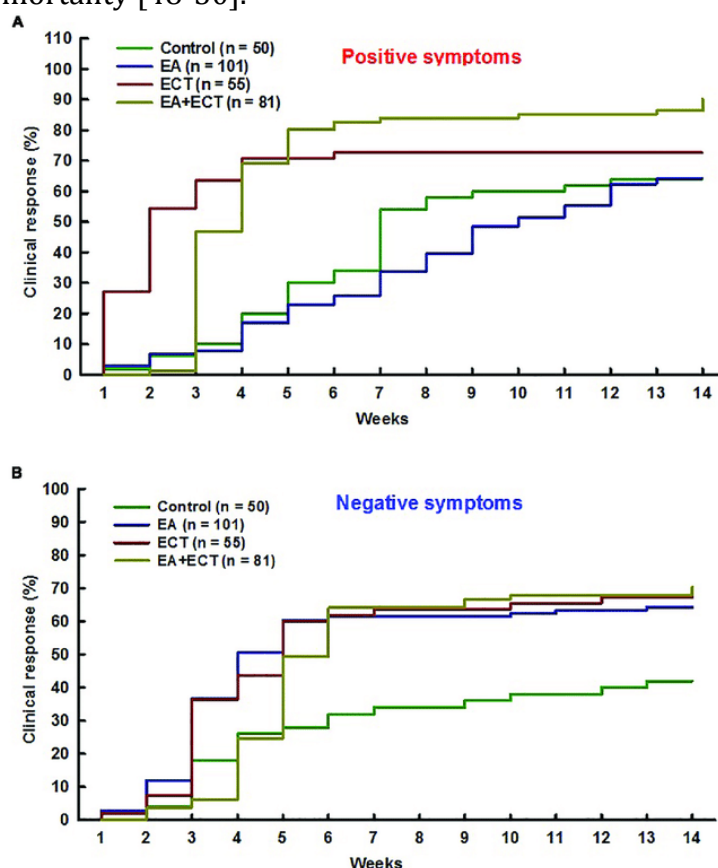


Figure 4. Cox regression results.

In studies conducted in America and European countries, the average length of stay of the examined patients was between 16 and 25 days [54-56]. The difference in the results of the studies can be related to the difference in the strategies used by different countries in the prevention and treatment of the disease, the time of occurrence, and peak of the disease in the countries and the treatment facilities in the hospitals [57-59].

The results of hospitalization in the special care department also show that 30% of patients have used special care services. The results of meta-analysis study by Taylor *et al.* showed that the mortality rate of patients under mechanical ventilation was 72%. In similar studies, mortality and length of stay of patients under mechanical ventilation were higher than other patients. Patients who need mechanical ventilation are admitted to special care units, which are usually associated with acute respiratory problems, and therefore need more care than other patients. In these people, the length of stay and the percentage of death are higher [60-62].

In another study by Goffin *et al.*, the mortality rate and outcome of COVID-19 disease in dialysis patients as well as patients with mucormycosis were investigated. Among the patients studied in this study, which was equal to 1670 patients, 16.9% of kidney transplant patients and 23.9% of hemodialysis patients died within 28 days of the onset of the disease. The risk of mortality in mucormycosis patients was significantly higher in the first year after the disease. Mortality risk in mucormycosis patients was 78% higher than hemodialysis patients after adjustment for multiple factors. The numbers obtained for mortality were also true for other characteristics examined, such as the need for hospitalization or ICU admission [63-65].

In a case report study by Qiu *et al.*, the clinical status of a 30-year-old male patient with mucormycosis after developing severe COVID-19 disease in Wuhan, China, was investigated. This patient suffered from an acute lung and kidney injury, and therefore required systemic treatment, including readjustment of the immunosuppressive drug regimen. In this study, the patient was followed up for 1 year after discharge from the hospital [66-68]. There was no evidence for pulmonary fibrosis or lung dysfunction in this individual. Unlike the damage caused by the Covid -19 disease to the person's kidney, transplant rejection did not occur. The immunological profile of this patient showed the activity of cellular and humoral immunity against this virus. This issue shows that transplant patients who are treated with immunosuppressive drugs, benefit from the injection of this disease vaccine [69-71].

In Elhadedy's study, which was conducted on the outcome of Covid-19 in 8 kidney transplant patients, 4 of whom were women and the other 4 were men, it was reported that high blood pressure is the most important factor predicting the severity of the disease in these people [72]. Likewise, the most common clinical symptoms in these patients were fever and cough. The most common radiological method used in these patients was portable chest radiology. Other common findings in these patients include lymphopenia, high CRP, and very high ferritin levels. In general, among these 8 patients, 1 patient was treated on an outpatient basis, but the other patients required hospitalization, one of them was admitted to the ICU [73]. All 7 patients studied in this study were discharged from the hospital and recovered [74-76].

## Conclusion

One of the patients required mechanical ventilation. In addition to

these findings, this study showed that a short stay in the hospital and home quarantine after leave reduces the burden on health services and the transmission of disease to the surrounding people. Hospitalizations in the intensive care unit, advanced age, high severity of Covid-19, high blood sugar and underlying diseases significantly increase the risk of death due to mucormycosis following Covid-19.

## References

1. Eskandar S, Jalali P. (2020). Relationship between patent foramen ovale and COVID-19 in patients admitted to an intensive care unit. *Revista espanola de cardiologia* (English ed.); 74(8): 725-726. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
2. Azhough R, Jalali P, Golzari E J, et al. (2020). Pilonidal Sinus Surgery with Mechanical Drilling Technique. *Indian J Surg.*, 82: 824-827. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
3. Forghani N, Jalali Z, Ayramlou H, Jalali P. (2022) Fulminant Guillain-Barre syndrome associated with SARS-CoV-2: A case series. *J Clin Images Med Case Rep.*, 3(1): 1626. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
4. Azhough R, Azari Y, Taher S, Jalali P. (2021) Endoscopic pilonidal sinus treatment: a minimally invasive surgical technique. *Asian Journal of Endoscopic Surgery.*; 14(3): 458-63. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
5. Shahsavarinia K, Gharekhani A, Mousavi Z, Aminzadeh S, Jalali P. (2022). Diagnostic value of red blood cell distribution width in patients with organophosphate poisoning in emergency department of Sina hospital in 2019. *J Clin Images Med Case Rep.*; 3(2): 1634. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
6. Gol M K, Dorosti A, Montazer M. (2019). Design and psychometrics cultural competence questionnaire for health promotion of Iranian nurses. *Journal of education and health promotion.*, 8: 155. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
7. Shahidi N, Mahdavi F, Gol M K. (2020). Comparison of emotional intelligence, body image, and quality of life between rhinoplasty candidates and control group. *Journal of Education and Health Promotion.*, 9: 153. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
8. Mobaraki-Asl N, Ghavami Z, Gol M K. (2019). Development and validation of a cultural competence questionnaire for health promotion of Iranian midwives. *Journal of Education and Health Promotion.*; 8: 179. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
9. Gol M K, Davoud A. (2020). Checklist for Determining Severity of Pain and Type and Dosage of Analgesics Administered to Women s Patient Undergoing Breast Surgeries. *International Journal of Women's Health and Reproduction Sciences.*, 8(2): 227-31. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
10. Rostami F, Osquee H O, Mahdavi F, Dousti S. (2020). Development of a new psychometric assessment tool for predicting hepatitis b virus infection in pregnant women. *International Journal of Women's Health and Reproduction Sciences.*, 8(3): 297-302. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
11. Mahdavi F, Osquee H O. (2020). Comparison of serum levels of vitamin D after mastectomy in women with and without postoperative infection: Case-control study. *Iranian Journal of Obstetrics, Gynecology and Infertility.*; 23(3): 34-39. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
12. Owaysee H O, Pourjafar H, Taghizadeh S, Haghdoost M, Ansari F. (2017).

- Laboratory features of 160 CCHF confirmed cases in Zabol of Iran: A 10-year study. *Journal of Infection*.; 74(4): 418-420. [Crossref], [Google Scholar], [Publisher]
13. Shahidi N, Lotfi A. (2022). Epidemiology and Clinical Findings of Oral Squamous Cell Carcinoma. *Majallah-i Pizishki-i Danishgah-i ulum-i Pizishki-i Tabriz.*, 44: 67-71. [Crossref], [Google Scholar], [Publisher]
  14. Bonyadi M, Esmaeili M, Abhari M, Lotfi A. (2009). Mutation analysis of familial GJB2-related deafness in Iranian Azeri Turkish patients. *Genetic testing and molecular biomarkers*. 13: 689-92. [Crossref], [Google Scholar], [Publisher]
  15. Ronagh S M, Panahali A, Lotfi A, Ahmadpour P F. (2018). Comparison of body image and life satisfaction among patients undergoing cosmetic surgery and candidates for the surgery in maxillofacial department at Imam Reza Hospital in Tabriz. *Razi Journal of Medical Sciences*. [Crossref], [Google Scholar], [Publisher]
  16. Molaei A, Alizadeh Otaghvar H, Tarahomi M, Shojaei D, Mohajerzadeh L, Baghoori M, Niazi F. (2017). A bizarre presentation of Peutz-jegher's syndrome in a 2 year old, *Iranian Journal of Pediatric Surgery*, 3 (2): 104-106. [Crossref], [Google Scholar], [Publisher]
  17. Sadati L, Khanegah Z N, Shahri N S, Edalat F. (2022). Postoperative pain experienced by the candidates for gynecological surgery with lithotomy position. *Iranian Journal of Obstetrics, Gynecology and Infertility*, 24(12): 29-34. [Crossref], [Google Scholar], [Publisher]
  18. Nurmeksela A. *et al.*, (2020). Relationships between nursing management, nurses' job satisfaction, patient satisfaction, and medication errors at the unit Level: A correlational study. *Research Square*.; 1 (1): 1-22. [Crossref], [Google Scholar], [Publisher]
  19. Rezapour A, Qaderi N, Gosalipour S, *et al.*, (2022). Comparison of the Adhesion Rate of Implant Cemented Coatings with 3 Types of Glass Ionomer Cement, Zinc Phosphate and Resin on Blinds Made of Adhesive Composite after Thermal Stress, *Journal of Pharmaceutical Negative Results*, 3304-3316. [Crossref], [Google Scholar], [Publisher]
  20. Zeidani A, Qaderi N, Akbari Zavieh S, Gosalipour S, Golmohammadi M. (2022). Cardiovascular outcomes and Dental care of COVID-19: a systematic review and met analysis, *Neuro Quantology*, 20(8): 3060-3066. [Crossref], [Google Scholar], [Publisher]
  21. Ghahroudi A A R, Rokn A R, Shamshiri A R, Samiei N. (2020). Does timing of implant placement affect esthetic results in single-tooth implants? A cohort evaluation based on Mpes, *Journal of Esthetic and Restorative Dentistry*, 32(7): 715-725. [Crossref], [Google Scholar], [Publisher]
  22. Hosseini Khalili A R, *et al.*, (2008). Angiotensin-converting enzyme genotype and late respiratory complications of mustard gas exposure. *BMC Pulm Med.*, 8(1): 15. [Crossref], [Google Scholar], [Publisher]
  23. Mahmoodiyeh B, Etemadi S, Kamali A, Rajabi S, Milanifard M. (2021). Evaluating the Effect of Different Types of Anesthesia on Intraoperative Blood Glucose Levels in Diabetics and Non-Diabetics Patients: A Systematic Review and Meta-Analysis, *Annals of the Romanian Society for Cell Biology*, 2559-2572. [Crossref], [Google Scholar]
  24. Shakiba B. *et al.*, (2022). Medical Workplace Civility Watch: An Attempt to Improve the Medical Training



- Culture, *Journal of Iranian Medical Council*, 5(1): 227-228. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
25. Birman D H. (2023). Investigation of the Effects of Covid-19 on Different Organs of the Body, *Eurasian Journal of Chemical, Medicinal and Petroleum Research.*, 2(1): 24-36 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
26. Ghaibi E, *et al.*, (2022). Comparison of Marital Satisfaction, Emotional Divorce and Religious Commitment among Nurses and Staff of Ahvaz Government Hospitals, *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 1(1): 33-39 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
27. Ghaibi E. *et al.*, (2022). Comparison of Organizational Citizenship Behavior and Job Creativity between Male and Men's Education Personnel 1 Ahwaz, *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 1(2), 49-57. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
28. Afkar F, Golalipour S, Akanchi M, Sajedi SM, Zandi Qashghaie A. (2022). Systematic Reviews of Different Types of Drug Delivery in the Treatment and Prevention of Oral and Dental and Cardiorespiratory Diseases in Patients and Animals Involved, *NeuroQuantology*, 20(8): 632-642 [[Google Scholar](#)], [[Publisher](#)]
29. Atashzadeh-Shoorideh F, Parvizy S, Hosseini M, Raziani Y. *et al.*, (2022). Developing and validating the nursing presence scale for hospitalized patients, *BMC nursing.*, 21(1): 1-16 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
30. Karimzadeh F. *et al.*, (2021). Comparative evaluation of bacterial colonization on removable dental prostheses in patients with COVID-19: A clinical study, *The Journal of Prosthetic Dentistry*, 1-3 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
31. Mirakhori F, Moafi M, Milanifard M, Asadi rizi A, Tahernia H. (2022). Diagnosis and Treatment Methods in Alzheimer's Patients Based on Modern Techniques: The Original Article, *Journal of Pharmaceutical Negative Results*, 13(1): 1889-1907 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
32. Najafi F. *et al.*, (2018). The Relationship between General Health and Quality of Work Life of Nurses Working in Zahedan Teaching Hospitals. *Iranian J of Rehabilitation Research in Nursing*; 4(2): 53-9. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
33. Ashayeri H, Mohseni R, Khazaie Z, Golalipour S, Bondarabadi ZA. (2022). Systematic Investigation of the Occurrence of Dental Problems, Cardiopulmonary Injuries and Duration of Hospitalization in ICU in Patients Affected by Covid-19 and Intubation in them, *Tobacco Regulatory Science (TRS).*, 2124-2146. [[Google Scholar](#)]
34. Danesh H, Bahmani A, Moradi F, Shirazipour B, Milani Fard M. (2022). Pharmacological Evaluation of Covid 19 Vaccine in Acute and Chronic Inflammatory Neuropathies, *Journal of Medicinal and Chemical Sciences*, 5(4): 561-570. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
35. Daneste H, Sadeghzadeh A, Mokhtari M, Mohammadkhani H, Lavaee F, Moayedi J. (2022). Immunoexpression of p53 mutant-type in Iranian patients with primary and recurrence oral squamous cell carcinoma. *European Journal of Translational Myology* [[Google Scholar](#)], [[Publisher](#)]
36. Jahandideh H, Yarahmadi A, Rajaieh S, Shirazi A O, Milanifard M. *et al.*, (2020). Cone-beam computed tomography guidance in functional endoscopic sinus surgery: a retrospective cohort study, *J Pharm Res Int*, 31(6): 1-

- 7 [Crossref], [Google Scholar], [Publisher]
37. Kalantari H. *et al.*, (2020). Determination of COVID-19 prevalence with regards to age range of patients referring to the hospitals located in western Tehran, Iran. *Gene reports.*; 21: 100910. [Crossref], [Google Scholar], [Publisher]
38. Mirfakhraee H, Golalipour S, Ensafi F, Ensafi A, Hajisadeghi S. (2022). Survival rate of Maxillary and Mandibular Implants used to Support Complete-arch Fixed Prostheses & Investigation of internal and Neurological manifestations, *NeuroQuantology*, 20(6): 5118-5126 [Crossref], [Google Scholar], [Publisher]
39. Mirjalili H, Amani H, Ismaili A, Fard MM, Abdolrazaghnejad A. (2022). Evaluation of Drug Therapy in Non-Communicable Diseases; a Review Study, *Journal of Medicinal and Chemical Sciences*, 5(2): 204-214 [Crossref], [Google Scholar], [Publisher]
40. Tahernia H, *et al.*, (2022). Diagnosis and Treatment of MS in Patients Suffering from Various Degrees of the Disease with a Clinical Approach: The Original Article, *Journal of Pharmaceutical Negative Results*, 13 (1): 1908-1921. [Crossref], [Google Scholar], [Publisher]
41. Karampela I, Dalamaga M. (2020). Could Respiratory Fluoroquinolones, Levofloxacin and Moxifloxacin, prove to be Beneficial as an Adjunct Treatment in COVID-19? *Archives of medical research.*; 51(7): 741-2. [Crossref], [Google Scholar], [Publisher]
42. Seifi I, Shojaei D, Barbin SJ, Bahmani A, Seraj Z. (2022). Methods of Diagnosis and Treatment of MS Disease Based on a Clinical Trial: The Original Article, *Tobacco Regulatory Science (TRS)*, 2351-2384. [Crossref], [Google Scholar], [Publisher]
43. Montani J P, Vliet V B. (2004). General physiology and pathophysiology of the renin-angiotensin system. *Angiotensin Vol. I: Springer*; 3-29. [Crossref], [Google Scholar], [Publisher]
44. Goyal K. *et al.*, (2020). Fear of COVID 2019: First suicidal case in India! *Asian J of psychiatry.*, 49: 101989. [Crossref], [Google Scholar], [Publisher]
45. Sadati L, Askarkhah A, Hannani S, Moazamfard M, Abedinzade M, Alinejad PM, Saraf N, Arabkhazaei A. (2020). Assessment of staff performance in cssd unit by 360-degree evaluation method, *Asia Pacific Journal of Health Management*, 15(4): 71-77. [Crossref], [Google Scholar], [Publisher]
46. Sadati L, Khanegah Z N, Shahri N S, Edalat F. (2022). Postoperative pain experienced by the candidates for gynecological surgery with lithotomy position, *Iranian Journal of Obstetrics, Gynecology and Infertility*, 24(12): 29-34 [Crossref], [Google Scholar], [Publisher]
47. Aminzadeh M. *et al.*, (2015). The Frequency of Medication Errors and Factors Influencing the Lack of Reporting Medication Errors in Nursing at Teaching Hospital of Qazvin University of Medical Sciences, 2012. *J of Health*; 6 (2): 169-79. [Crossref], [Google Scholar], [Publisher]
48. Barzideh M, Choobineh A, Tabatabaei S. (2012). Job stress dimensions and their relationship to general health status in nurses. *Occupational Medicine.*, 4(3): 17-27. [Crossref], [Google Scholar], [Publisher]
49. Milanifard M, Hassanzadeha G. (2018). Anthropometric study of nasal index in Hausa ethnic population of northwestern Nigeria, *J Contemp Med*

- Sci.*, 4(1): 26-29. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
50. Mileski M, *et al.*, (2020). The impact of nurse practitioners on hospitalizations and discharges from long-term nursing facilities: a systematic review. *Healthcare.*, 8(2): 114-34. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
51. Borba M G S. *et al.* (2020). Effect of high vs low doses of chloroquine diphosphate as adjunctive therapy for patients hospitalized with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection: a randomized clinical trial. *JAMA network open.*; 3(4): e208857-e. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
52. Gadlage M J, *et al.*, (2010). Murine hepatitis virus nonstructural protein 4 regulates virus-induced membrane modifications and replication complex function. *J Virol.*, 84(1): 280-90. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
53. Fard M M. (2021). Effects of Micronutrients in Improving Fatigue, Weakness and Irritability, *GMJ Med.*, 5 (1): 391-395 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
54. Moghadam M R, Shams A, Moosavifard Z S, Shahnazari F, Shojaei D. (2022). Principles of Health Care for Patients Involved in Fracture, Multiple Trauma and Type of Burns in Operating Room & Intensive Care Unit: The Original Article, *Tobacco Regulatory Science (TRS)*, 2839-2854. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
55. Alrabadi N, *et al.* (2021). Medication errors: a focus on nursing practice. *J of Pharmaceutical Health Services Research*; 12(1): 78-86. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
56. Asadi N, *et al.*, (2020). Investigating the Relationship Between Corona Anxiety and Nursing Care Behaviors Working in Coronary Referral Hospitals. *IJPCP*; 26(3): 306-19. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
57. Shahkarami N, Nazari M, Milanifard M, Tavakolimoghadam R, Bahmani A, The assessment of iron deficiency biomarkers in both anemic and non-anemic dialysis patients: A systematic review and meta-analysis, *Eurasian Chemical Communications.*, 4 (6): 463-472 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
58. Zaimzadeh N, *et al.*, (2018). Comparison of vitamin D dietary intake among four phenotypes of polycystic ovary syndrome and its association with serum androgenic components, *Razi Journal of Medical Sciences*, 25(2): 87-96. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
59. Zaimzadeh N, *et al.*, (2018). The study of dietary intake of micronutrients in four phenotypes of polycystic ovary syndrome separately based on Rotterdam criteria, *Razi Journal of Medical Sciences*, 25(3): 59-68 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
60. Azizi Aram S, Bashar poor S. (2020). The role of rumination, emotion regulation and responsiveness to stress in predicting of Corona anxiety (COVID-19) among nurses. *Quarterly J of Nursing Management*; 9(3): 8-18. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
61. Ghorbanizadeh S, Raziani Y, Amraei M, Heydarian M. (2021). Care and precautions in performing CT Scans in children, *Journal of Pharmaceutical Negative Results*, 12(1): 54 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
62. Golalipour S. *et al.*, (2022). Examination of Dental Problems and Radiological and Cardiac Evaluations in Patients Affected by Covid-19, *Neuro Quantology*, 20(8): 1519- 1527 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

63. Hariri S, Golalipour S. *et al.*, (2022). Examining the Fracture Strength of Implant-based Fixed Partial Prostheses with Different Dimensions of Connectors in the System CAM/CAD/Zir, *Tobacco Regulatory Science (TRS)*, 2310-2329. [Crossref], [Google Scholar], [Publisher]
64. Mahmoodi S, *et al.*, (2015). General health and related factors in employed nurses in Medical-Educational Centers in Rasht. *JHNM.*, 25(1):63-72. [Crossref], [Google Scholar], [Publisher]
65. Musaei S. (2023). The Effect of Pregnancy on the Skin, *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 2(1): 17-23 [Crossref], [Google Scholar], [Publisher]
66. Sheikh S, Hatami F, Shojaei D, Shams A, Sourani R. (2022). The Principles Of Treatment Staff Care Of Elderly Patients Under Burn & Plastic Surgery And With Covid-19 In ICU & Operating Room Based On Clinical Points: The Original Article, *Journal of Pharmaceutical Negative Results*, 1967-1983. [Crossref], [Google Scholar], [Publisher]
67. Salehi S H, As'adi K, Mousavi S J, Shoar S. (2015). Evaluation of Amniotic Membrane Effectiveness in Skin Graft Donor Site Dressing in Burn Patients, *Indian J Surg*, 77(Suppl 2):427-31. [Crossref], [Google Scholar], [Publisher]
68. Salehi S H, Fatemih M J, As'adi K, Shoar S, Der Ghazarian A, Samimi R. (2014). Electrical injury in construction workers: a special focus on injury with electrical power, *Burns*, 40(2): 300-4. [Crossref], [Google Scholar], [Publisher]
69. Ahmadi S E, Farzanehpour M, Fard A M M, Fard M M, Ghaleh H E G. (2022). Succinct review on biological and clinical aspects of Coronavirus disease 2019 (COVID-19), *Romanian Journal of Military Medicine.*, 356-365. [Crossref], [Google Scholar], [Publisher]
70. Nazardani S Z, *et al.*, (2023). A comprehensive evaluation of the Sports Physiotherapy curriculum. *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 2(1): 10-16. [Crossref], [Google Scholar], [Publisher]
71. Abadi T S H, *et al.*, (2020). Depression, stress and anxiety of nurses in COVID-19 pandemic in Nohe-Dey Hospital in Torbat-e-Heydariyeh city, Iran. *J of Military Med.*, 22(6): 526-33. [Crossref], [Google Scholar], [Publisher]
72. Raziani Y, Othman B S. (2021). Ointment therapy and prevention of cannulation-induced superficial phlebitis, *Veins and Lymphatics*, 10 (2). [Crossref], [Google Scholar], [Publisher]
73. Raziani Y. *et al.*, (2022). Pistacia atlantica as an effective remedy for diabetes: a randomised, double-blind, placebo-controlled trial, *Australian Journal of Herbal and Naturopathic Medicine*, 34(3): 118-124. [Crossref], [Google Scholar], [Publisher]
74. Raziani Y, Raziani S. (2021). Evaluation of Mental Health of Chemotherapy-Treated Cancer Nurses, *Journal of Medicinal and Chemical Sciences*, 4(4): 351-363. [Crossref], [Google Scholar], [Publisher]
75. Raziani Y, Raziani S. (2021). The effect of air pollution on myocardial infarction, *Journal of Chemical Reviews*, 3(1): 83-96. [Crossref], [Google Scholar], [Publisher]
76. Raziani Y., *et al.*, (2021). A common but unknown disease; A case series study, *Annals of Medicine and Surgery*, 69: 102739. [Crossref], [Google Scholar], [Publisher]
77. Helmy Y A. *et al.*, (2020). The COVID-19 pandemic: a comprehensive review

- of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. *Journal of Clinical Medicine.*; 9(4): 1225. [Crossref], [Google Scholar], [Publisher]
78. Khezerlou Z, Shojaei D, Jafari S, Arabkhazaie A, Abadi S H A. (2022). The Principles of Care of the Treatment Staff for the Elderly with Fracture Problems and Corona Virus in the Special Care Unit, *Tobacco Regulatory Science (TRS)*, 2825-2838. [Crossref], [Google Scholar], [Publisher]
79. Malekpour-Dehkordi Z, Nourbakhsh M, Shahidi M, Sarraf N, Sharifi R. (2022). Silymarin diminishes oleic acid-induced lipid accumulation in HepG2 cells by modulating the expression of endoplasmic reticulum stress markers. *Journal of Herbal Medicine.*; 33: 100565. [Crossref], [Google Scholar], [Publisher]

**How to cite this article:** Hamid Owaysee Osquee, Ali Reza Lotfi\*. Investigating Factors Affecting Mortality from Mucormycosis after COVID-19 Infection: A Systematic Review. *International Journal of Advanced Biological and Biomedical Research*, 2023, 11(1), 35-47. Link: [http://www.ijabbr.com/article\\_703997.html](http://www.ijabbr.com/article_703997.html)