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Topics Related on Biological Disasters in the Last Decade

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Abstract

Organisms or living-derived components that can cause disease or death can cause disasters of biological origin. Biological disasters, which are observed as epidemics, are more common in societies. The effects of biologically induced disasters on society can be experienced directly, or they can be observed together with or after another type of disaster. This can increase the impact of disasters exponentially.
In this study, it was aimed to investigate the issues related to biological disasters in the literature in the last decade. In the method; Biological disasters experienced in the decade have been examined and the topics have been evaluated using the literature data in Web of Science, Scopus and PubMed databases. The bibliometric data tools were used to access the relevant sources.
Due to the fact that there are many sources of biohazards; time-based, hazard source-based assessment may make a useful contribution to the management of biological risks

Keywords: Disaster management, health, risk, review, virus

1. Introduction

Since ancient times, biological disasters and biologically induced events have been recognized as a subgroup of disasters, causing death, injury, and economic losses in societies, often accompanied by both primary and post-disaster effects [1,2]. Many factors related to biological disaster hazards are involved; among these factors, epidemic-related diseases are the most prevalent [2]. Any source of material like toxins that can cause disease from an organism and the organism itself can lead to a biological disaster [2]. Biological disasters can potentially lead to catastrophic events stemming from natural or man-made. Furthermore, secondary biological disasters may occur as health issues arising from compromised living conditions following other disasters, such as earthquakes, floods, and tsunamis, as shown in Figure 1 [3–6]. The prevalence of secondary health issues is consistently observed more than primary biological disasters, attributable to the challenges associated with accessing water and food resources, as well as sanitation difficulties in the aftermath of nearly all disasters [7,8].

Primary biological disasters are able to be sourced from viruses, bacteria, fungi, zoonotic organisms, vector organisms, insects, plants, pests, desert locusts, rodents, algae, and prions, as well as from substances with toxic properties that can be derived from them. [2,11–13]. At the beginning of the diseases that can be observed as secondary disaster effects, waterborne diseases

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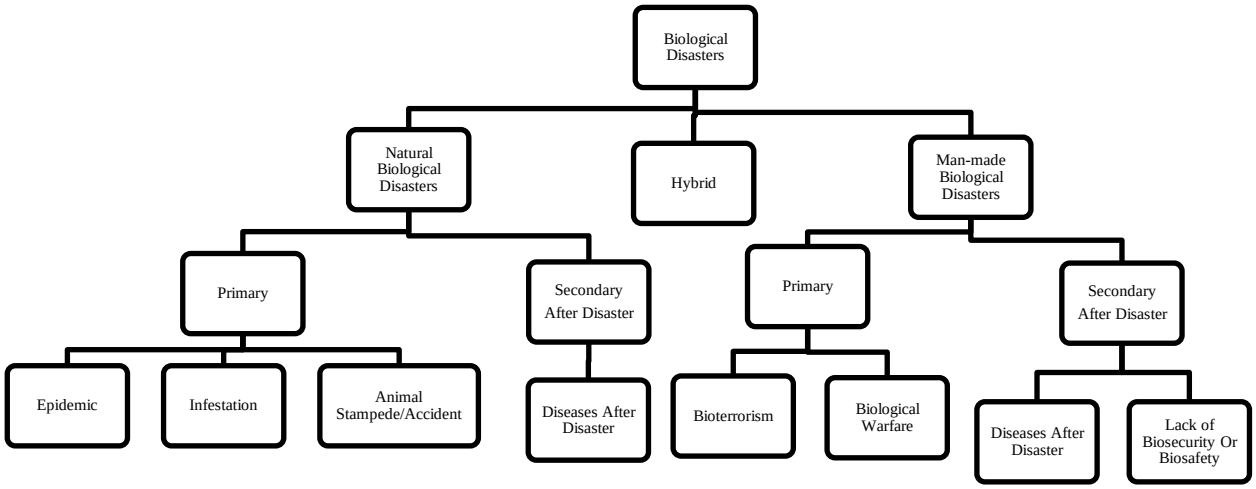

Figure 1. Biological Disaster Sub-Groups. Adopted from Alshehri, 2016 [5], Rauner, 2016 [6], Oliveria et. al., 2020 [9], and Chaudhary & Piracha;2021 [10]

causing diarrhea, respiratory system-related diseases, skin infections due to injuries, cholera, coccidiomycosis, malaria, tetanus, measles, leptospirosis, hepatitis A, C, and E, and fungal infections occurring after floods can be mentioned [8,14,15]. In fact, as seen in the COVID-19 pandemic, the development of diseases caused by fungal infections, such as pneumonia and aspergillosis, may be facilitated by lung inflammation that follows a biological disaster [16,17]. Additionally, damage to natural habitats, increased interaction among organisms in their environments, ecological changing dependent on disaster, and mutational changes that occur as living things adapt to shifting conditions have triggered the emergence of infectious diseases with new potential and changes for example as plague, polio, yellow fever, Marburg, Ebola, Tularemia, and Leishmaniasis [4].

This area has gained importance in recent years due to cases caused by mutational changes and newly encountered pathogens. This review was focused on the topics covered in articles and reviews published in the last decade regarding biological disasters.

2. Materials and Method

In this review, the workflow outlined in Table 1 was implemented to evaluate the related of biological disasters over the decades. More appropriate results were observed when "biological" was selected as the subject and "disaster" was chosen as the content subject. To access literature data, three academic databases were searched: Web of Science (WOS), Scopus, and PubMed, focusing on biological disasters. After recording the data as bibliometric files in the search tools, the Zotero program was used to determine whether the obtained data were related to biological disasters, to extract the same multiple files, and to export the data for bibliometric evaluation as BibTeX raw data file [18]. For review, bibliometric analyses were conducted using R Studio with the Bibliometrix package with Biblioshiny [19].

Table 1. Summary of Study Design

Step	Flow
1	Keywords selected from MeSH related to biological disasters, and a time interval study designed.
2	Searched for the keywords "Biological" and "Disaster" from 2015 to 2025, using the data selection paths outlined in Figure 2.
3	Three bibliometric data sets were downloaded as texts from WOS, Scopus, and PubMed using search tools.
4	Three bibliometric datasets were examined using the Zotero 7.0.15 program; duplicate documents were excluded, and fully accessible data were combined.
5	Data information was converted to BibTeX data format using the Zotero program.
6	R Studio opened, and the "Bibliometrix" package was used to analyze dependent "Biblioshiny" for graphs and other analyses.

Figure 2 shows the search criteria for the papers included in the study and the number of selected articles. Upon a thorough examination of the articles and review regarding their titles, abstracts, and content, 48 articles aligned with the subject matter from 2015 to 2025, and evaluations were conducted based on the data from these 48 articles.

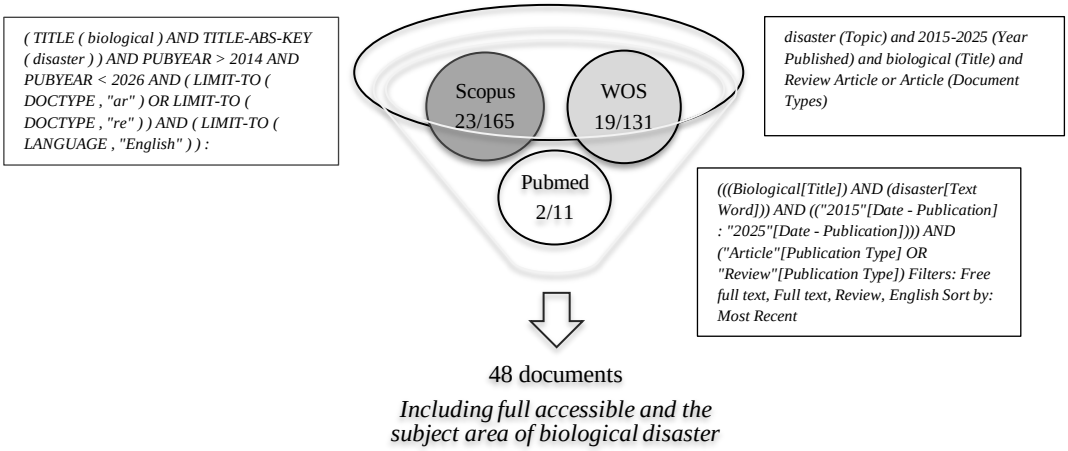

Figure 2. The Decision of Data Selections

3. Results

In the course of evaluating the data within the R Studio Bibloshiny interface, topics pertaining to biological disasters were assessed regarding trends by term, topic, and author, contingent upon their interrelationships and temporal aspects.

3.1. Trends of Biological Subtopics

The subjects pertaining to disasters were categorized into broad subtopics, which arose from the existence of multiple sources of hazards. These subtopics were primarily organized under two main

clusters in accordance with the keywords extracted from the scholarly literature. The first cluster encompasses and frames terms such as biological disasters, resilience, biological accidents, religion, communicable disease, health risk, health education, virus transmission, vaccination, biological events, coronavirus, impact, and preparedness. The second cluster of keywords predominantly focuses on and frames with psychology, psychology stress, stress disorders, fear, and post-traumatic stress disorder (refer to Figure 3).

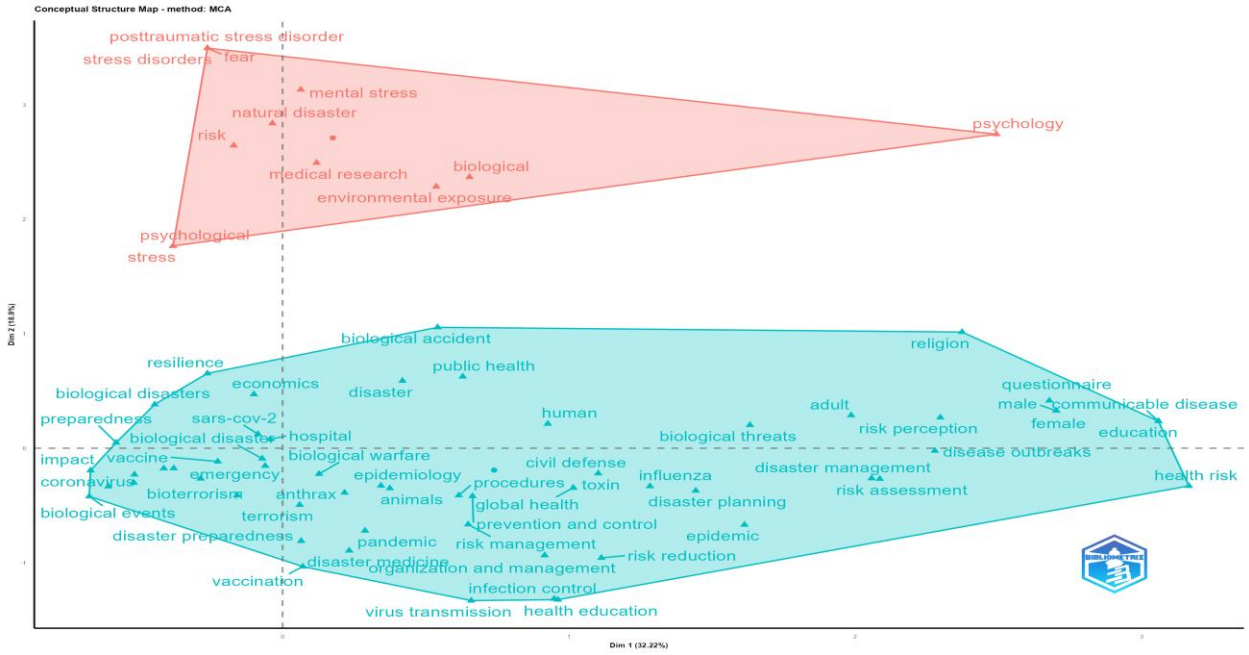

Figure 3. Merged Two Clusters of Biological Disaster Keywordplus via Bibloshiny

When comparing the simultaneous display of keywords in the literature, it was observed that the keywords used in the journal literature on COVID-19 in relation to the pandemic process were; infection control, biological disaster, multiple acute respiratory syndrome and disaster preparedness words were associated together. In relation to human, disaster and epidemic diseases; influenza risk problems, procedures, adult, civil defense, biological accidents, prevention and control and global health were associated together. Bioterrorism and biological warfare topics were limited and displayed together. The center of all keywords were formed by the word as disaster planning (Figure 4).

3.2. Time-Dependent Trends of Biological Disasters

An analysis of trending topics within article abstracts over time reveals that preparedness, public health, hospital risk control, collaboration, intervention, biological factors, education, and emergency incidence were more prevalent than other terms. From 2019 to 2025, the subjects as “disaster risk”, “public health”, “preparedness”, “economic”, “communication”, “hospital control”, “interventions,” and “collaborative” were shown as most trend topics. Specifically, at the outset of 2015, discussions about the terms “water” and “exposure” were more prevalent. (Figure 5).

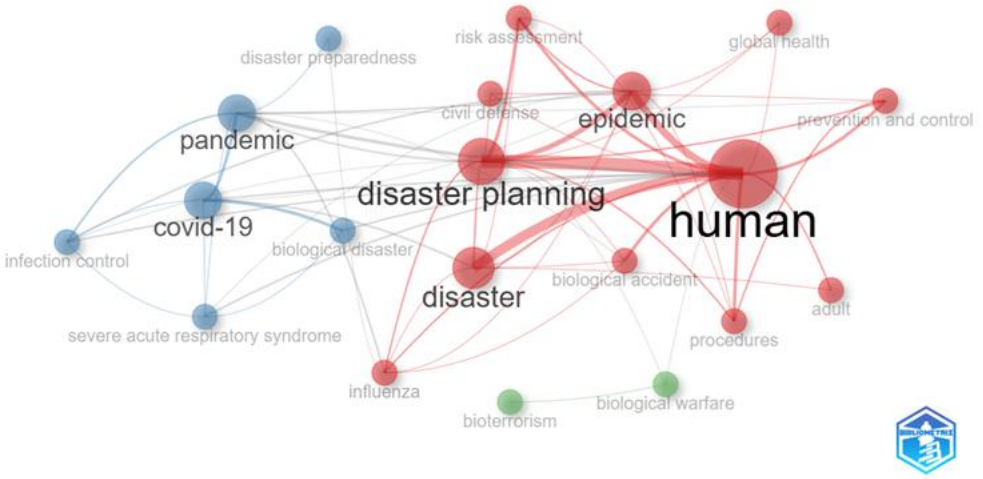

Figure 4. Co-occurrence Network of Keywordplus about Biological Disaster

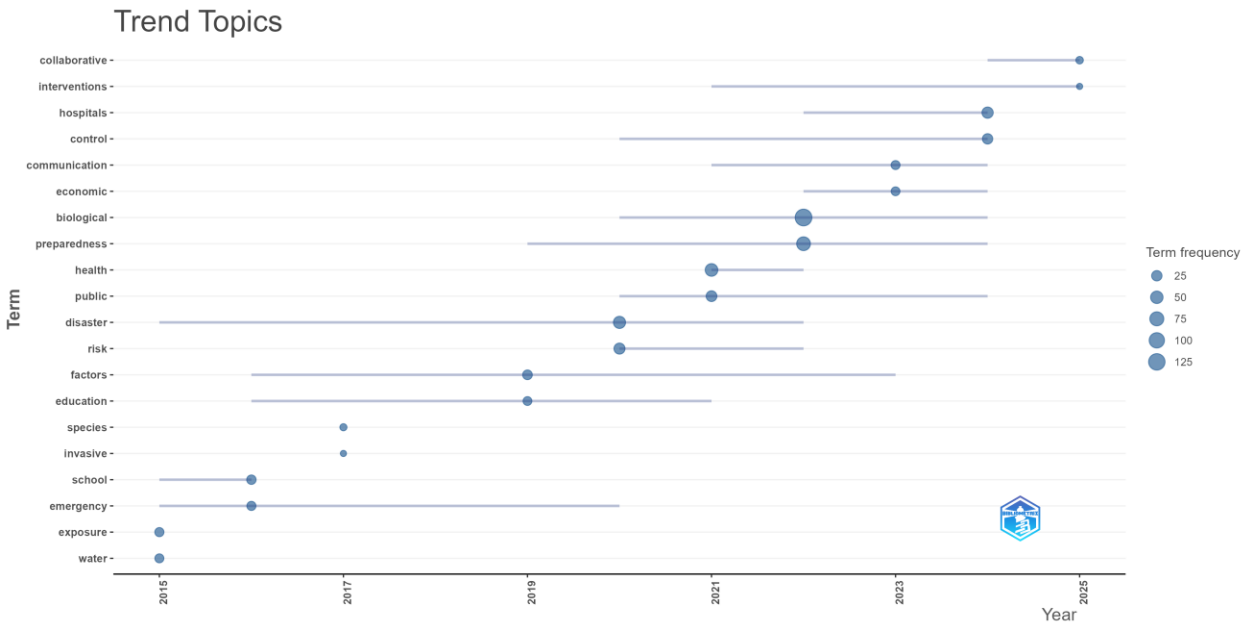

Figure 5. Most Trend Topics about Biological Disaster in The Abstracts

In the course of the last decade, used to the article titles related to biological disasters, a breakpoint was observed with the term of biological, especially in 2019. Similar to the frequent use of the word of "biological"; the words that "China", "COVID", "disaster", "events", "hazards", "management", "preparedness", "intervention", and "threats" were also observed to increase in usage rates until 2025. (Figure 6).

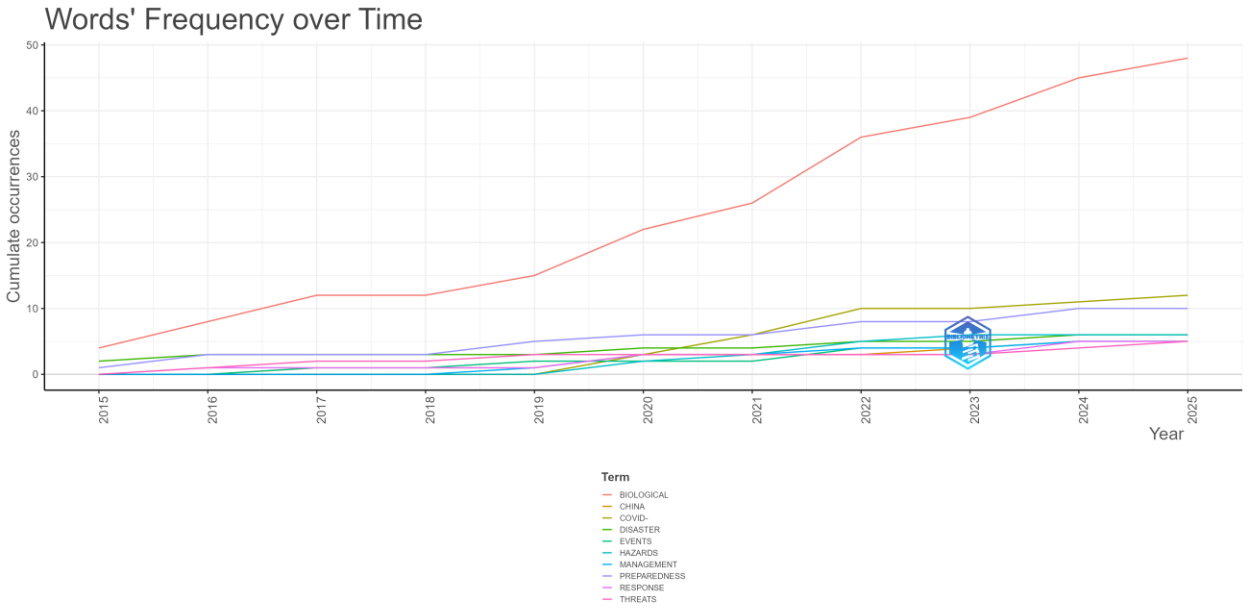

Figure 6. Most Frequent Ten Words in Title Time Dependency

The names of the primary authors of the 48 most evaluated papers, illustrating the frequency of articles produced by these authors over time (Figure 7). It was observed that the frequency and volume of articles had notably increased, particularly since 2019. Furthermore, the number of authors contributing more than one article among the selected 48 was relatively limited, and the total number of research or compilation articles pertaining to biological disasters authored did not exceed two per author.

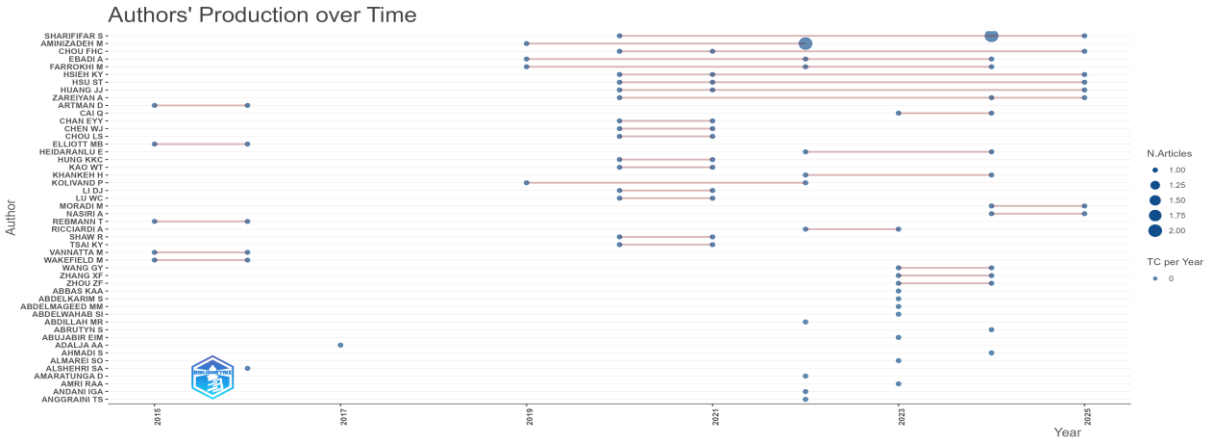

Figure 7. Most Author's Papers Over Time

4. Discussion

The issues related to biological disasters in the last decade about the reports of biological events,

types of hazards, prepradness of biological disaster, and their psychological impacts in multiple ways. Natural, accidental, or deliberate epidemics, pandemics, and emergency infectious diseases can lead to significant mortality rates in societies [20]. As an example of biological disasters, what should be done for hospital preparations, communications of multi institutional coordinations, vaccine, capacities, therapeutic interventions, environmental pollution, community vulnerabilities and resilience in COVID-19-related pandemics were focused [21–27]. The hospital preparations related to biological disasters are complex and important in spreading biological hazards to the community, in this respect, the conversion of public spaces into temporary hospital areas is beneficial for capacity building, patient triage and flow meet patient safety and needs, appropriate response plan preparation and biological disaster planning are important for social resistance [28–32]. Collaborative management, effective interventionals, optimum strategic plans and policies are emphasized for reducing the impact of biohazards, protecting public health, and enhancing safety hospital resilience [20,31,33]. The subjects of biological agents, biological warfare, education, bioterrorism, antibiotic-resistant bacteria, and biological weapons are related topics of man-made biological disaster [34,35].

Another biological disaster subject is infestation. In cases where the forest ecosystem exceeds its resistance, biological disasters such as rodents, rabbits, insect pests, locust diaster, and plant infestations may cause the loss of species and crops, forming another group of disasters that harm the structure and function of the ecosystem and destroy the economy [11,12,36,37]. Other disasters, such as earthquakes, floods, dam collapses, are also deteriorating in the biologically viability of habitats, multiple hazard model scenarios can aid in safe building selection [38,39]. In addition, it is mentioned that with the melting of the glaciers in Antarctica, the possibility of habitat degradation that may change with the invasion of antibiotic-resistant bacteria on the coasts living in the seals, seabirds, and the bilateral transport of unknown organisms by space travels [40].
From a psychological perspective, the necessity for intervention and psychological support systems concerning the psychological distress and post-traumatic stress disorder triggered by biological disasters for both disaster victims and employees is underscored [41,42]. It is advisable to create post-COVID-19 recovery and rehabilitation strategies addressing the adverse effects of SARS and COVID-19 on mental health [43]. The studies mentioned are mainly from 2019 onwards, with fewer earlier studies included on waterborne contamination in 2015 [44]. Studies on biological disasters, hazards and agents have increased in the last six years.

Conclusions

In the domain of disaster management, biological disasters constitute one of the subdivisions within the broader category referred to as chemical, biological, radiological, and nuclear (CBRN) events. Biological disasters exhibit a multitude of sub-sources of risk. Primary research in this domain is notably less extensive in comparison to disaster-related issues such as earthquakes and floods. Biological disasters may manifest directly or as a consequence of precursor events, often accompanied by secondary effects in the form of diseases. Nevertheless, investigations concerning secondary diseases associated with disasters that have occurred previously are prevalent. Since 2019, there has been a notable increase in the number of studies concentrating on biological disasters. This surge can be attributed to the multifaceted impact of the pandemic on societies.

Furthermore, even following a biological disaster, diseases associated with secondary effects can be identified, as demonstrated by the COVID-19 pandemic. Research pertaining to biological disasters predominantly focuses on those of natural origin. Concurrently, with the swift advancement of technology, biological hazards are able to be detected even at the genetic level. Among the academic articles published in the past decade, the subject of disaster planning has emerged as a primary focus in relation to human-centered studies, epidemics or pandemics. These papers predominantly cluster around two main sub-themes: health risk and psychology. There exists rare studies addressing bioterrorism and biological warfare. Living mutations that adapt to the changing ecological conditions following experienced disasters may influence the emergence of diseases that reappear or new biological disasters. In light of these conditions, it can be articulated that the challenges associated with biological disaster management prominently occupy the forefront of the pandemic instigated by the COVID-19 virus, which has incurred detrimental consequences for society, as evidenced by recent studies. Considering the diversity of hazard groups associated with biological disasters, a systematic approach to biological management must be tailored specifically to these threats. The characteristics of the biological threat source, including the virulence of unknown or newly detected species, which can spread rapidly through contact between living organisms and have a high mortality rate, possess a significant potential to cause adverse effects in the disaster realm for societies. Therefore, it is essential to establish collaborative and applied biological disaster management frameworks, alongside comprehensive biological risk assessments and preparedness and response plans, particularly for inter-institutional biological disasters, to be incorporated into forthcoming research and strategic initiatives. In conclusion, similar to other disaster hazards, it is considered that swift detection methods for biological hazards, researchs on harm reduction, the dissemination of biological incidents reporting databases, and an emphasis on modeling studies that can forecast potential biological risks in the future may prove advantageous for the management of biological disasters.

References

[1] Chaudhary MT, Piracha A. Natural disasters—origins, impacts, management. Encyclopedia 2021;1:1101–31. https://doi.org/10.3390/encyclopedia1040084.

[2] Artik Y, Cesur NP, Kenar L, Ortatatli M. Biological disasters: an overview of the COVID-19 pandemic in the first quarter of 2021. J Disaster Risk 2021;4:163–82. https://doi.org/10.35341/afet.977488.

[3] Watson JT, Gayer M, Connolly MA. Epidemics after natural disasters. Emerging Infectious Diseases 2001;13.

[4] Topluoglu S, Taylan-Ozkan A, Alp E. Impact of wars and natural disasters on emerging and re-emerging infectious diseases. Front Public Health 2023;11:1215929. https://doi.org/10.3389/fpubh.2023.1215929.

[5] Alshehri S, Rezgui Y, Li H. Public perceptions and attitudes to biological risks: Saudi Arabia and regional perspectives. Disasters 2016;40:799–815. https://doi.org/10.1111/disa.12179.

[6] Rauner M, Niessner H, Sasse L, Tomic K, Neville K, Pope A, et al. Decision support for strategic disaster management: first release of a wiki. In: Dawid H, Doerner KF, Feichtinger G, Kort PM, Seidl A, Editors. Dynamic Perspectives on Managerial Decision Making. Springer 2016; 413–39. https://doi.org/10.1007/978-3-319-39120-5_23.

[7] Jafari N, Shahsanai A, Memarzadeh M, Loghmani A. Prevention of communicable diseases after disaster: A review. J Res Med Sci 2011;16:956–62.

[8] Saatchi M, Khankeh HR, Shojafard J, Barzanji A, Ranjbar M, Nazari N, et al. Communicable diseases outbreaks after natural disasters: A systematic scoping review for incidence, risk factors and recommendations. Progress in Disaster Science 2024;23:100334. https://doi.org/10.1016/j.pdisas.2024.100334.

[9] Oliveira M, Mason-Buck G, Ballard D, Branicki W, Amorim A. Biowarfare, bioterrorism and biocrime: A historical overview on microbial harmful applications. Forensic Science International 2020;314:110366. https://doi.org/10.1016/j.forsciint.2020.110366.

[10] Chaudhary MT, Piracha A. Natural disasters—origins, impacts, management. Encyclopedia 2021;1:1101–31. https://doi.org/10.3390/encyclopedia1040084.

[11] Shuang L, Shi-qian F, Ullah H, Xiong-bing T, Ze-hua Z. IPM- Biological and integrated management of desert locust. Journal of Integrative Agriculture 2022;21:3467–87. https://doi.org/10.1016/j.jia.2022.09.017.

[12] Cai Q, Sun B, Zhang X, Bo W, Wang G, Zhou Z. Forest biological disaster control behaviors of forest farmers and their spatial heterogeneity in china. Forests 2024;15. https://doi.org/10.3390/f15060970.

[13] Lababpour A. Potentials of the microalgae inoculant in restoration of biological soil crusts to combat desertification. Int J Environ Sci Technol 2016;13:2521–32. https://doi.org/10.1007/s13762-016-1074-4.

[14] Yang Z, Huang W, McKenzie JE, Yu P, Ju K, Wu Y, et al. Mortality and morbidity risks associated with floods: A systematic review and meta-analysis. Environmental Research 2024;263:120263. https://doi.org/10.1016/j.envres.2024.120263.

[15] Lu JLD, Herbosa TJ. Epidemics, diseases, and health emergencies in the aftermath of natural disasters in the philippines. Acta Medica Philippina 2009;43.

[16] Lorente-González M, García-Fadul C, Gijón-Herreros N, Terán-Tinedo JR, Zevallos-Villegas A, Laorden D, et al. Sars-cov-2 pneumonia, acute pulmonary infarction secondary to acute pulmonary embolism, secondary spontaneous pneumothorax and subacute invasive pulmonary aspergillosis: are they related to each other? Open Respiratory Archives 2022;4:100173. https://doi.org/10.1016/j.opresp.2022.100173.

[17] Ölmez H, Tosun M, Ünver E, Arslan Işik N. COVID-19 pneumonia with ARDS and secondary haemophagocytic lymphohistiocytosis: a case report. The European Research Journal 2021;7:533–40. https://doi.org/10.18621/eurj.783155.

[18] Ivey C, Crum J. Choosing the right citation management tool: EndNote, Mendeley, RefWorks, or Zotero. Jmla 2018;106. https://doi.org/10.5195/jmla.2018.468.

[19] Aria M, Cuccurullo C. bibliometrix : An R-tool for comprehensive science mapping analysis. Journal of Informetrics 2017;11:959–75. https://doi.org/10.1016/j.joi.2017.08.007.

[20] Younesi S, Ghomian Z, Hatami H, Sharififar S. Preparedness assessment of teaching hospitals affiliated with Shahid Beheshti University of Medical Sciences in Response to Biological Incidents. Health Emerg Disaster Quart 2024;9:145–58. https://doi.org/10.32598/hdq.9.2.560.1.

[21] Djalante R, Shaw R, DeWit A. Building resilience against biological hazards and pandemics: COVID-19 and its implications for the Sendai Framework. Prog Disaster Sci 2020;6:100080. https://doi.org/10.1016/j.pdisas.2020.100080.

[22] Abrutyn S. Disintegration in the age of COVID-19: biological contamination, social danger, and the search for solidarity. American Behavioral Scientist 2024;68:740–59. https://doi.org/10.1177/00027642221132176.

[23] Maharajan M, Rajiah K, Pogula B, Chigurupati S, Katragadda S. Pharmaceutical, biological agents, and vaccines under clinical trials for COVID-19 and roles of pharmacists to combat COVID-19, an update. Journal of Research in Pharmacy 2022;26:1513–26. https://doi.org/10.29228/jrp.246.

[24] Jayasekara R, Siriwardana C, Amaratunga D, Haigh R. Evaluating the network of stakeholders in Multi-Hazard Early Warning Systems for multiple hazards amidst biological outbreaks: Sri Lanka as a case in point. Progress in Disaster Science 2022;14. https://doi.org/10.1016/j.pdisas.2022.100228.

[25] Maharajan MK, Rajiah K, Pogula B, Chigurupati S, Katragadda S. Pharmaceutical, biological agents, and vaccines under clinical trials for COVID-19 and roles of pharmacists to combat COVID-19, an update. J Res Pham 2022;26:1513–26. https://doi.org/10.29228/jrp.246.

[26] Behera J, Mishra P, Jena A, Bhattacharya M, Behera B. Understanding of environmental pollution and its anthropogenic impacts on biological resources during the COVID-19 period. Enviromental Science and Pollution Research 2022. https://doi.org/10.1007/s11356-022-24789-6.

[27] Aminizadeh M, Farrokhi M, Ebadi A, Masoumi G, Kolivand P, Khankeh H. Hospital preparedness challenges in biological disasters: a qualitative study. Disaster Medicine and Public Health Preparedness 2022;16:956–60. https://doi.org/10.1017/dmp.2020.434.

[28] Moradi M, Zareiyan A, Sharififar S, Nasiri A, Shokouh S. Designing the structural model of temporary medical centers in biological emergencies. International Journal of Healthcare Management 2025. https://doi.org/10.1080/20479700.2023.2264033.

[29] Moradi M, Sharififar S, Zareiyan A, Shokuh S, Nasiri A. Design criteria of shelter hospitals in response to biological accidents: a systematic review. Disaster Medicine and Public Health Preparedness 2024;18. https://doi.org/10.1017/dmp.2024.82.

[30] Heidaranlu E, Tavan A, Aminizadeh M. Investigating the level of functional preparedness of selected Tehran hospitals in the face of biological events: a focus on COVID-19. International Journal of Disaster Resilience in the Built Environment 2022;13:150–62. https://doi.org/10.1108/IJDRBE-08-2021-0088.

[31] Sehdeh AM, Ebadi A, Saghafi A, Basiri A, Heidaranlu E. Audit of preparedness of selected military hospital in the face of biological threats: action research study. Int J Emer Med 2024;17. https://doi.org/10.1186/s12245-024-00786-z.

[32] Hadinejad Z, Farrokhi M, Saatchi M, Ahmadi S, Khankeh H. Patient flow management in biological events: a scoping review. Bmc Health Services Research 2024;24. https://doi.org/10.1186/s12913-024-11502-1.

[33] Wihatno E, Moeljadi M, Istiqomah M, Solimun S. Determinants analysis of collaborative governance in biological threats: a prisma method approach. Wseas Transactions on Environment and Development 2025;21:72–82. https://doi.org/10.37394/232015.2025.21.7.

[34] Tin D, Sabeti P, Ciottone G. Bioterrorism: An analysis of biological agents used in terrorist events. American Journal of Emergency Medicine 2022;54:117–21. https://doi.org/10.1016/j.ajem.2022.01.056.

[35] Abdelkarim S, AlMarei S, Elyas A, Amri R, Khawaji E, Khormi G, et al. Knowledge and attitude toward biological warfare among health-related students: A cross-sectional questionnaire-based survey. Journal of Family Medicine and Primary Care 2023;12:276–81. https://doi.org/10.4103/jfmpc.jfmpc_1123_22.

[36] Cai Q, Wang G, Wen X, Zhang X, Zhou Z. Perceived Effectiveness and Responsibilities of the Forest Biological Disasters Control System of China: A Perspective of Government Administrators. Forests 2023;14. https://doi.org/10.3390/f14010006.

[37] Turbelin AJ, Cuthbert RN, Essl F, Haubrock PJ, Ricciardi A, Courchamp F. Biological invasions are as costly as natural hazards. Perspect Ecol Conserv 2023;21:143–50. https://doi.org/10.1016/j.pecon.2023.03.002.

[38] Zebral YD, Costa PG, de Souza MM, Bianchini A. Avian blood and feathers as biological tools to track impacts from trace-metals: Bioaccumulation data from the biggest environmental disaster in Brazilian history. Sci Total Environ 2022;807. https://doi.org/10.1016/j.scitotenv.2021.151077.

[39] Sakti AD, Rahadianto MAE, Pradhan B, Muhammad HN, Andani IGA, Sarli PW, et al. School location analysis by integrating the accessibility, natural and biological hazards to support equal access to education. ISPRS Int J Geo-Inf 2022;11. https://doi.org/10.3390/ijgi11010012.

[40] Ricciardi A, Cassey P, Leuko S, Woolnough A. Planetary Biosecurity: Applying Invasion Science to Prevent Biological Contamination from Space Travel. Bioscience 2022;72:247–53. https://doi.org/10.1093/biosci/biab115.

[41] Chang C-C, Hsieh K-Y, Hsu S-T, Wang Y-Y, Chou FH-C, Huang J-J. Understanding the mental health impacts of biological disasters: Lessons from Taiwan's experience with COVID-19. J Formos Med Assoc 2025;124:6–14. https://doi.org/10.1016/j.jfma.2024.03.015.

[42] Liang M, Li Y, Chen Q, Tan H, He L, Sheng C, et al. The Difficulties and Mental Health Intervention Need of Doctors and Nurses in Biological Emergencies: A Qualitative Study. Front Psychiatry 2021;12. https://doi.org/10.3389/fpsyt.2021.696823.

[43] Hsieh K-Y, Kao W-T, Li D-J, Lu W-C, Tsai K-Y, Chen W-J, et al. Mental health in biological disasters: From SARS to COVID-19. Int J Soc Psychiatry 2021;67:576–86. https://doi.org/10.1177/0020764020944200.

[44] Lindell MK, Mumpower JL, Huang S-K, Wu H-C, Samuelson CD. Exposure Path Perceptions and Protective Actions in Biological Water Contamination Emergencies. Environ Health Insights 2015;9. https://doi.org/10.4137/EHI.S33383.