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Sick Building Syndrome on Healthcare Workers in Hospital Buildings

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ABSTRACT

Sick Building Syndrome (SBS) is characterized by discomfort, eye pain, nose problems, tightness in the chest, lethargy, and sore throat. However, there is currently a deficiency of study in this field on bibliometric analytical mapping investigations. This research aimed to identify hospital development strategies for the use of advanced future research. Information for the research is acquired by searching through the database (https://www.scopus.com) with the keyword "Sick Building Syndrome" from a publication starting from 2020 to 2022; there are 108 documents recorded. The data were analyzed with VOS viewer and NVivo 12 Plus software. The findings show that sick building syndrome research studies increased in 2021. The study on sick building syndrome revealed seven dominant theme groups. Indoor environmental quality and sick building syndrome in hospitals, infrastructure development and mobilizing human resources, green and healthy hospitals, and COVID-19 are current research trends. Through bibliometric analysis and network visualization, the researchers summarized recent developments in sick building syndrome research involving healthcare professionals to explain their research trends, boundaries, and popular issues. These results can offer helpful direction for future study and viewpoints in this quickly changing sector.

Keywords: *Sick Building Syndrome; Healthcare Workers; Hospital Buildings*

INTRODUCTION

Based on the WHO reports that 30% of new buildings worldwide gave complaints to their workers in 1984 [1]. The construction process, which generates the majority of the carbon emissions contributing to global warming, can have an impact on these grievances. Decisions taken on building and energy conservation will have a substantial impact on reducing air pollution-related illness and mortality and combating climate change [2]. Currently, 70 to 90% of employees are working in non-industrial and indoor environments [3]. The health of employees could be significantly impacted by the indoor environment, especially in cases of sick building syndrome (SBS) [4]. As most office workers spend up to 90% of their working hours indoors, SBS has emerged as a major public health and occupational hazard [5].

The term Sick Building Syndrome (SBS) was introduced by the United States Environmental Protection Agency (U.S. EPA) to represent a medical condition in which individuals in buildings exhibit symptoms or feel ill for no obvious reason [5]. Sick Building Syndrome (SBS) is characterized by discomfort, eye pain, nose problems, tightness in the chest, lethargy, and sore throat [2]. It usually gets worse the longer people stay in a building and gets better or disappears when people leave the building. SBS can happen in a variety of

workplaces, including offices, universities, and hospitals [6].

Hospitals are shown to have significantly higher rates of Sick Building Syndrome (SBS) than other public buildings. Hospitals use various chemicals influencing workers, such as stress, lights, noise, ergonomics, and vents [7]. Workers are more likely to have health issues because of poor Indoor Air Quality (IAQ), according to the Occupational Safety and Health Administration [8]. The International Institute of Occupational Safety and Health (NIOSH) 1997 stated that several things generally cause problems such as lack of vents (52%), contaminants in the room (16%), contaminants from the outside (10%), the presence of microbial (5%), building components (4%), and unidentified causes (13%) [9]. According to research conducted in a hospital in Slovenia, the prevalence of Sick Building Syndrome (SBS) increased from 41% to 87% [10]. In addition, temperature conditions that don't meet the standards have a risk four times [11].

In 2019 a new coronavirus variant was found in China, precisely in the city of Wuhan at the end of December [12,13]. A person who has been exposed to the virus may develop viral pneumonia-like symptoms known as severe acute respiratory syndrome (SARS-CoV-2) [14]. Healthcare workers are on the front lines and must deal with the responsibility of treating COVID-19 patients [15]. In this regard it is important for hospitals to develop the infrastructure and mobilize the human resources needed to fight rapidly emerging outbreaks of highly communicable or lethal diseases requiring responsive systems, leveraging a multi-disciplinary response [13]. However, in this research trends have not been found regarding the increase in sick building syndrome on healthcare workers in hospital buildings during the COVID-19 pandemic.

Therefore, this study intends to offer a bibliometric analysis of advances in research on SBS occurring in healthcare workers in hospitals. The purpose of this article is to evaluate the scope and popularity of the phenomenon-related research subjects in the scientific community that occurs with an explicit focus on SBS in hospitals during the COVID-19 pandemic. This study aimed to provide primary data and identify hospital development strategies for the use of advanced future research suggestions and provide recommendations for developing sustainable hospital buildings.

METHOD

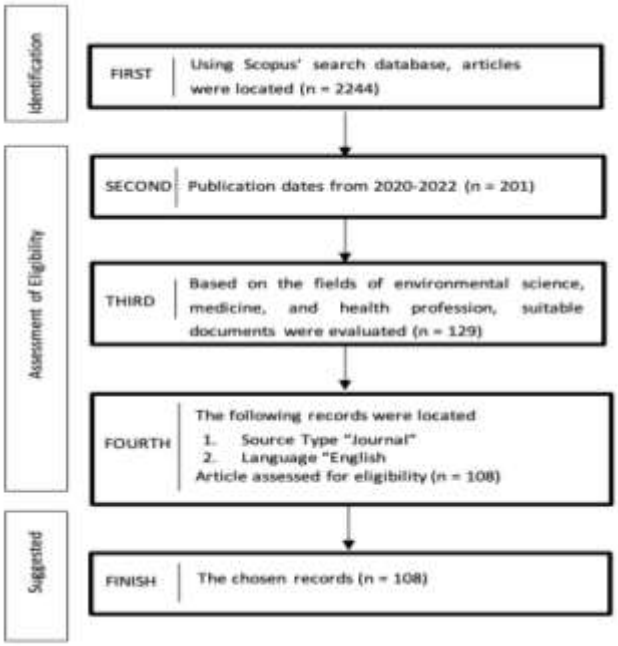

Figure 1. Procedures to looking for and choosing articles

A literature review study was used in this research to use a qualitative approach. An internationally renowned peer-reviewed journal database (https://www.scopus.com) was searched for research information. Scopus database search used the keyword "*Sick Building Syndrome*", with a publication from 2020 to 2022. One hundred eight documents were recorded on this topic. To eliminate the bias caused by the larger database, all data were collected at the same period, which was September 2022. In figure 1 the analysis procedure is shown.

The SBS context is based on the author's title or keywords. In the end, the following keywords are used to find research data information:

TITLE-ABS-
KEY (sick AND *building* AND *syndrome*) AND (LIMIT-
TO (PUBYEAR, *2022*) OR LIMIT-
TO (PUBYEAR, *2021*) OR LIMIT-
TO (PUBYEAR, *2020*) AND (LIMIT-
TO (SUBJAREA, *"ENVI")* OR LIMIT-
TO (SUBJAREA, *"MEDI")* OR LIMIT-
TO (SUBJAREA, *"HEAL")* AND (LIMIT-
TO (LANGUAGE, *"English")* AND (LIMIT-TO (SRCTYPE, *"j")*. One hundred eight documents were found using these keywords.

To disseminate information about study maps, files were exported in RIS Export. The examination of the results from a Scopus button search, the VOS viewer, and NVivo 12 Plus were used to create the bibliometric map. According to the year of publication, publishing company, nation, name of publication, and research topic, descriptive analysis of Scopus search results was performed. According to the substantial literature on SBS in hospitals and healthcare workers, a bibliometric map of the advancement of research is produced using VOSviewer. To learn more about SBS in hospitals, data that has been gathered has undergone multiple refinements. Association between indicators, variables, and keywords used in earlier studies was tested using the NVivo 12 Plus.

For bibliometric studies, the researchers organized the analytic units and dimensions; diverse citations were used. Co-authorships aid in assessing the social system of the study area; bibliographic coupling, which employs multiple references used in two documents as a comparative indicator; co-occurrence can understand the pattern of the document collection that underpins the study; and co-citation are all examples of citation. It can aid in defining a notion of the study topic's structure. To create the clusters and produce the information and figures from the citations, the authors used co-occurrence assessment of keywords, citation evaluation of documents and institutions, co-citation analysis of sources cited, co-authorship assessment of influential authors and national distribution, and co-citation source analysis methods of sick building syndrome in hospitals.

RESULT

Publications and Citations by Year

The development of research written with the theme of Sick Building Syndrome published in Scopus figure 2 displayed 108 published documents from 2020 to 2022. The analysis of this study showed that in the last three years, there had been a significant increasing trend, especially in 2021. Whereas 2020 has the highest number of citations in the last three years. In 2020, the trending research topics were humidity, health status, and well-being. Furthermore, in 2021 the main trends are sick building syndrome, health personnel, COVID-19, and hospitals. Recently, the trends concern intelligent buildings and environmental conditions.

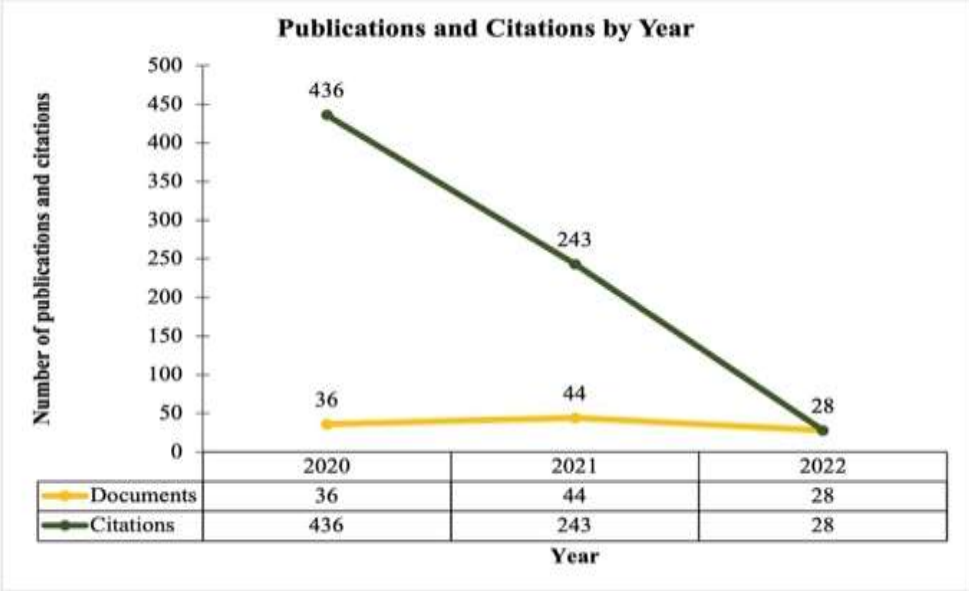

Figure 2. Number of publications and citations by year

Geographic Distribution

The publications distributed on sick building syndrome from various countries based on Scopus search results; fifty-six countries study the topic. China, the United States, Sweden, United Kingdom, Japan, Italy, Malaysia, Finland, Greece, and Indonesia are geographically dispersed to show national scientific progress (Figure 3). While figure 4 shows the number of citations in various world countries such as the United States, South Korea, China, United Kingdom, Italy, Sweden, Turkey, Japan, Malaysia, and Indonesia. The two images were created using the website "https://www.mapchart.net/" to create a geographic distribution map. This distribution can be seen from the colour of the country's territory and the number of documents from each country according to the information shown on the side of the picture.

Figure 3. Documents by country

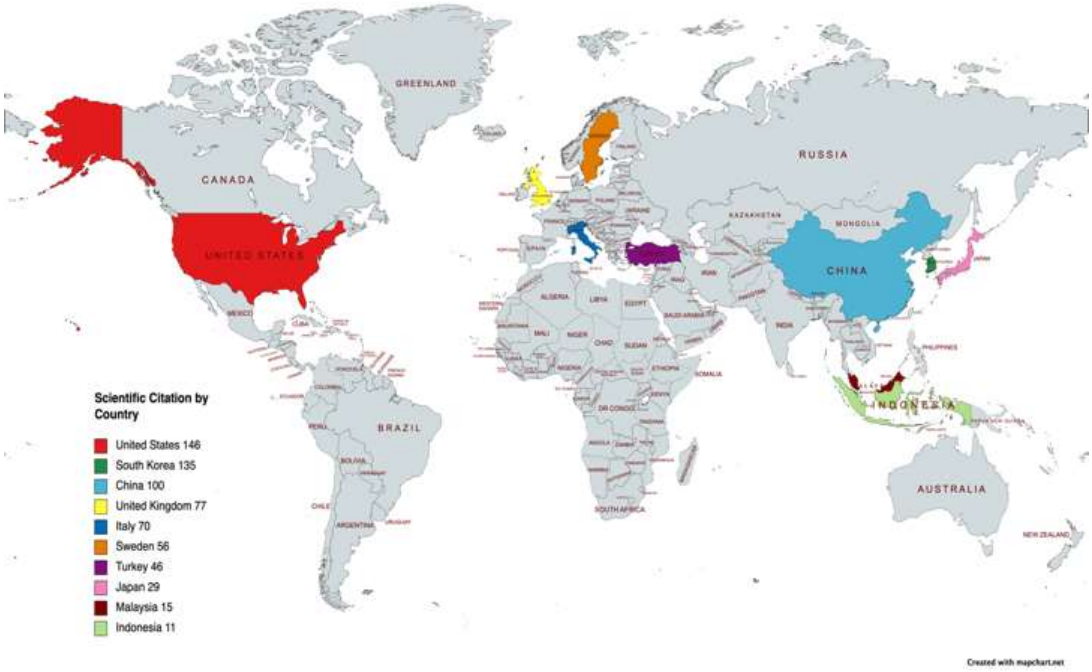

Figure 4. Citations by country

The world's countries were selected from the top 10 countries and arranged according to the quantity articles (Figure 3) then documents by citations (Figure 4). China is ranked top in this list of sick building syndrome study with 19 publications but ranks third in the number of citations with 100. Meanwhile, the United States ranks second in the number of publications with 16 publications and ranks first in the number of citations with 146.

Table 1. Distribution of articles by number of citations

Title	Author	Source	Citation
Indoor air pollution, related human disease, and recent treds in the control and improvement of indoor air quality	Van Tran, V., Park, D., Lee, Y.-C., 2020	International Journal of Environmental Research and Public Health	113
Ten questions concerning occupant health in buildings during normal operations and extreme events, including the COVID-19 pandemic	Awada, M., et al., 2021	Building and Environment	69
Indoor air pollution, physical and comfort parameters related to schoolchildren's health: Data from the European SINPHONIE study	Baloch, R.M., et al., 2020	Science of The Total Environment	41
The "quarantine dry eye": The lockdown for coronavirus disease 2019 and its implications for ocular surface health	Napoli, P.E., et al., 2021	Risk Management and Healthcare Policy	32
A long-term multi-parametric monitoring study: Indoor air quality (IAQ) and the sources of the pollutants, prevalence of sick building syndrome (SBS) symptoms, and respiratory health indicators	Mentese, S., et al., 2020	Atmospheric Pollution Research	28

Documents by Citation

According to the quantity of citations, Table 1 arranges the articles. Articles were used to map the research articles most pertinent to sick building syndrome issue. The database's total amount of article citations came from international sources. The top 5 publications both nationally and internationally mentioned from 2020 to 2022 are listed in Table 1. That is important to note that local citations form the basis of the rankings.

The three most frequently quoted articles were "Indoor air pollution, related human disease, and recent trends in the control and improvement of indoor air quality" (n: 113); "Ten questions concerning occupant health in buildings during normal

operations and extreme events including the COVID-19 pandemic" (n: 69); and an article entitled "Indoor air pollution, physical and comfort parameters related to schoolchildren's health: Data from the European SINPHONIE study" with 41 citations.

Subject Area

The majority of studies on SBS are in environmental science, medicine, and the health professions. The researcher chose the subject to choose articles with greater accuracy. Articles in this chosen field of study are interrelated with each other. The study area of medicine and health professions represents the problems of healthcare workers discussed in this research. Furthermore, environmental science studies have become a science that focuses on the environment, especially the hospital environment, which aligns with this research study.

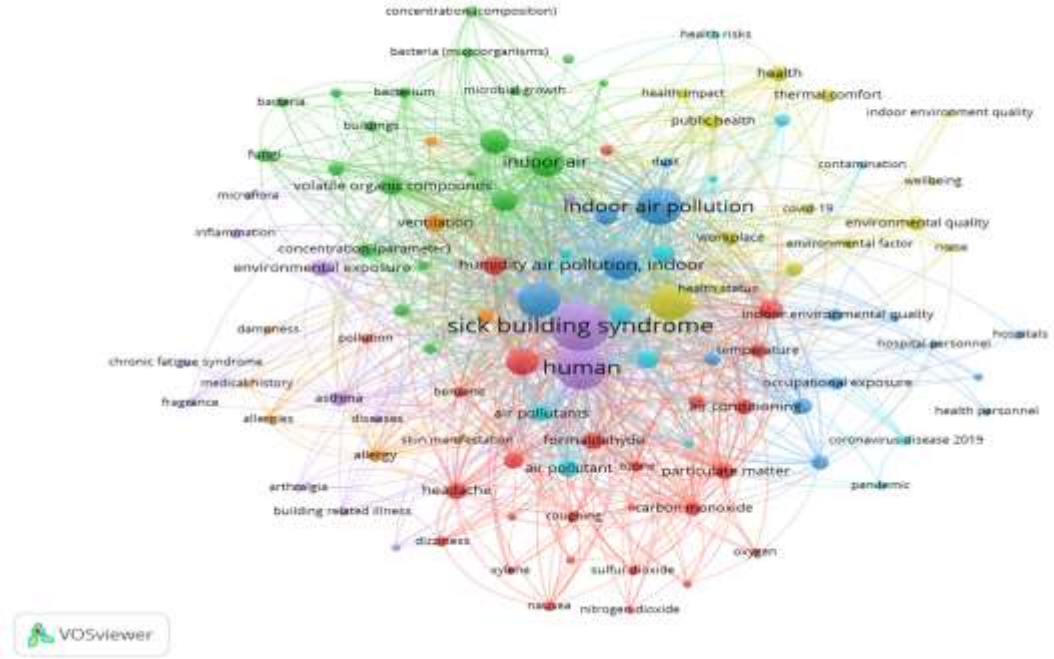

Figure 5. Network visualization

Table 2. Trending subject by keywords

Term	Range	Calculate	Weight Percent (%)	Term	Range	Calculate	Weight Percent (%)
Air	3	11906	3.80	Environment	11	1878	0.60
Indoor	6	9714	3.10	Human	5	1562	0.50
Building	8	6434	2.05	Volatile	8	1448	0.46
Quality	7	5098	1.63	Exposure	8	1410	0.45
Health	6	4970	1.59	Risk	4	1394	0.44
Syndrome	8	4570	1.46	Buildings	9	1202	0.38
Sick	4	4448	1.42	Temperature	11	1164	0.37
Pollution	9	3814	1.22	Disease	7	1002	0.32
Environmental	13	2786	0.89	Carbon	6	980	0.31
Symptoms	8	2050	0.65	Compounds	9	892	0.28

Keywords Analysis

The bibliometric network creation and visualization tool VOSviewer was used to describe the author's keywords. From 108 Scopus-indexed publications released from 2020 to 2022 and sorted for at least three terms, total number of 1554 keywords were discovered, from which 165 satisfied the data analysis criteria. One hundred nine keywords are related to one connecting point and

another point under the research topic. VOSviewer is used for bibliometric mapping of sick building syndrome, which is divided into 7 clusters.

Figure 5 uses colour coding to show how each cluster's network visualization is displayed. The shade here is utilized to describe the density of each cluster seen using a colour code applied to each cluster namely red, purple, light blue, dark blue, yellow, orange, and green. All articles containing main themes that commonly arise in this research are represented by the network representation. Cluster 1 discusses air quality and symptoms, while cluster 2 contains risk factors for SBS. Cluster 3 is a collection of topics about healthcare workers, hospitals, and the quality of the work environment. Cluster 4 deals with environmental quality parameters and impacts on health. Sick building syndrome is included in cluster 5. Intelligent buildings, air pollution, and COVID-19 were covered in cluster 6. Cluster 7 shows the topic of personal factors.

Based on the cluster analysis, healthcare workers are subjects who can be affected by the quality of the indoor environment, which causes healthcare workers to suffer from sick building syndrome. Because of the issue, four themes were selected by the researchers for this research: hospital buildings, healthcare workers, sick building syndrome, and COVID-19.

Trending subjects are shown in Table 2. Based on the need of a bibliographic periodicity of at least five words per year, the size or diameter indicates the number of phrases the author provides with keywords. From 2020 until 2022, air (n = 11906), indoor (n = 9714), building (n = 6434), quality (n = 5098), and health (n = 4970) are the keywords with the highest-ranking trends.

Table 3. Trending subjects using keywords

	Code A	Code B	Pearson correlation coefficient
Syndrome	Sick building syndrome	Indoor air pollution	0.91
	Sick building syndrome	Building	0.88
	Sick building syndrome	Environmental exposure	0.86
	Sick building syndrome	Intelligent buildings	0.81
	Sick building syndrome	Health status	0.79
	Sick building syndrome	Indoor air quality parameters	0.71
	Sick building syndrome	Environmental factors	0.70
	Sick building syndrome	Health care personnel	0.68
	Sick building syndrome	Work environment	0.68
	Sick building syndrome	Indoor air quality improvement	0.66

Keywords Relation

Pearson correlation is shown in Table 3. This correlation between the amount of SBS score and indoor air pollution, building, environmental exposure, intelligent buildings, health status, IAQ parameters, health care personnel, work environment, and IAQ improvement. The highest results show that the overall SBS score is positively related to indoor air pollution, building, and environmental exposure ranging from 0.86 to 0.91 for the correlation based on the point-biserial coefficient of correlation results.

DISCUSSION

Based on the results shown in Figure 2, the trending topics in the last two years as shown in the research conducted by Kalender-Smajlović et al., they found that healthcare workers had a higher risk of developing symptoms of SBS than other hospital staff [16]. Additionally, according to healthcare workers, inadequate relative humidity levels, poor air quality, and unsuitable room temperatures are the most commonly associated factors for SBS [16]. Studies on SBS in hospitals are increasing in 2021, in light of the global spread of the

COVID-19 pandemic and consequently. COVID-19 spreads from infected people through droplets from coughs, sneezing, talking, and touching contaminated surfaces that enter the respiratory tract of healthy people [17]. Healthcare workers who have SBS frequently experience an increase in respiratory symptoms such as runny nose, coughing, and dry throat. These symptoms are part of the SARS-CoV-2 symptoms, even though healthcare workers do not have COVID-19. These signs indicate that healthcare workers were likely exposed to SARS-COV-2 and its possible carriers [17]. The best nursing care for patients with droplets, contact, and airborne transmission patients depends on the capacity of constructions and health infrastructure, this case including isolated patient rooms, to meet technical criteria [18]. Provide a healthy work environment beginning with the hospital's construction [7].

In the last 3 years, China became the first place for the emergence of the COVID-19 virus in December 2019. In the city of Wuhan, China more than 2000 tons of disinfectants have been distributed to control or reduce the concentration of the SARS-COV-2 virus. Excessive use of disinfectants and their evaporation in the absence of proper ventilation can increase indoor air pollution which raises the potential for an increase in the occurrence of SBS in buildings with poor ventilation levels [19]. United States ranks first in the number of citations. The United States is a developed country rich in researchers and the best education system in the world. This can be seen from the guidelines on indoor air pollution associated with SBS that have been issued by the country. The guide contains indicators of SBS, causes of SBS, building investigation procedures, and solutions from SBS [1]. One of the studies in the United States reviewed several guidelines and standards related to indoor air pollutants and their health impacts [20].

Based on the cluster analysis result, indoor environmental quality and sick building syndrome in hospitals [6,16,21–23], infrastructure development and mobilizing human resources [13], green and healthy hospital [2,24], and COVID-19 [12,13,15,18,25] are current trends of the studies. The healthcare profession is among the first six most stressful professions [26]. Healthcare workers spend much time in hospitals and confined spaces. They are exposed to many factors associated with SBS, which can affect the health and quality of patient care [27]. Compared with healthcare workers (12.0%), healthcare colleagues (6.4%) had a lower prevalence of six or more SBS symptoms. The prevalence rates for the eye (23%), lower respiratory tract (22.5%), upper respiratory tract (40.7%), skin (36.3%), and (63.7%) non-specific SBS symptoms [22]. Healthcare personnel can experience burnout due to the COVID-19 pandemic, so it can affect a person's physical or mental health such as causing psychosomatic disorders, impaired mucosal changes, cardiorespiratory conditions, headaches, and others [12]. Based on research conducted by Moradpour et al, about 30% of workers stated that there was dust on the surface of the ward, it can increase infection transmission [28]. Analysis of the relationship between keywords about sick building syndrome shows that closer to number 1 the result of the correlation coefficient, the stronger the relationship between the 2 variables [29]. Indoor air pollution is one of the factors that cause SBS. It can be caused by many types of pollution in the air, such as CO_2 and VOCs, which affect quality of indoor air [4,30]. The increased prevalence of SBS symptoms is associated with different indicators of indoor air quality [4]. Indoor air pollution in hospitals may be influenced by human aspects such crowding in small spaces and building environment variables including construction materials, ventilation systems, and ventilation rates [22].This study was limited by the fact that the conclusions were based on the author's knowledge and the subject under discussion.

CONCLUSION

Most people have experienced SBS symptoms at work, especially in hospitals. In addition, they are also informed of the symptoms experienced, the influencing environmental factors, and the parameters that must be measured in an indoor environment. Many studies discuss sick building syndrome, and research on this topic will increase in 2021, especially for healthcare workers; this can happen because that year coincides with the COVID-19 pandemic, which has respiratory symptoms like SBS. The research's findings for clusters and trending subjects were based on analysis done with VOSviewer and NVivo 12 Plus. Three cluster themes were chosen by the researchers for this study: hospital buildings, healthcare workers, sick building syndrome, and COVID-19.

Based on this study, recent studies have shown that the face of this research, researchers experience found the indoor environmental quality and sick building syndrome in hospitals, infrastructure development and mobilizing human resources, green and healthy hospitals, and COVID-19. Based on the results of this research, the authors recommend for future research the development of a sustainable hospital building that helps healthcare workers prevent sick building syndrome and highly contagious or rapidly emerging diseases in hospitals.

Declaration by Authors

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REFERENCES

1. Environmental Protection Agency US, Environments Division I. Indoor Air Facts No. 4 Sick Building Syndrome. EPA - Air Radiat (6609J), Res Dev [Internet]. 1991;1–4. [Cited 2022 October 2]. Available from: https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf
2. Khairunnisa, R A., Ulfa, M., Azizi, M., Setyonugroho W. a Future Green and Healthy Hospital: a Review Article. Proc Int Healthc … [Internet]. 2021;82–94. [Cited 2022 October 2]. Available from: http://thejournalish.com/ojs/index.php/ichf/article/view/114
3. Lu CY, Tsai MC, Muo CH, Kuo YH, Sung FC, Wu CC. Personal, psychosocial and environmental factors related to sick building syndrome in official employees of Taiwan. Int J Environ Res Public Health [Internet]. 2018;15(1). [Cited 2022 October 2]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85039044713&doi=10.3390%2Fijerph15010007&partnerID=40&md5=29f709e8322358c68900ad45e7d7c0cf
4. Lu CY, Lin JM, Chen YY, Chen YC. Building-related symptoms among office employees associated with indoor carbon dioxide and total volatile organic compounds. Int J Environ Res Public Health [Internet]. 2015;12(6):5833–45. [Cited 2022 October 2]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84930672960&doi=10.3390%2Fijerph120605833&partnerID=40&md5=a0429a7d9b57743be52b673363c1deaf
5. Surawattanasakul V, Sirikul W, Sapbamrer R, Wangsan K, Panumasvivat J, Assavanopakun P, et al. Respiratory Symptoms and Skin Sick Building Syndrome among Office Workers at University Hospital, Chiang Mai, Thailand: Associations with Indoor Air Quality, AIRMED Project. Int J Environ Res Public Health [Internet]. 2022;19(17). [Cited 2022 October 3]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85137612391&doi=10.3390%2Fijerph191710850&partnerID=40&md5=453e92e6adf400db004162d0329baf69
6. Akova İ, Kiliç E, Sümer H, Keklikçi T. Prevalence of sick building syndrome in hospital staff and its relationship with indoor environmental quality. Int J Environ Health Res [Internet]. 2022;32(6):1204–19. [Cited

2022 October 3]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85097519132&doi=10.1080%2F09603123.2020.1862067&partnerID=40&md5=e24069e600e26521deedcccc9a6eaa82

7. Akova İ, Kiliç E, Sümer H, Keklikçi T. Prevalence of sick building syndrome in hospital staff and its relationship with indoor environmental quality. Int J Environ Health Res [Internet]. 2020. [Cited 2022 October 3]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85097519132&doi=10.1080%2F09603123.2020.1862067&partnerID=40&md5=e24069e600e26521deedcccc9a6eaa82
8. OSHA. Indoor air quality in commercial and institutional buildings [Internet]. United States of America: U.S. Department of Labor; 2011. 27–3 p. [Cited 2022 October 4] Available from: www. osha.gov
9. Dewi WC, Raharjo M, Wahyuningsih NE. Literatur Review : Hubungan Antara Kualitas Udara Ruang Dengan Gangguan Kesehatan Pada Pekerja. An-Nadaa J Kesehat Masy. 2021;8(1):88.
10. Smajlović SK, Kukec A, Dovjak M. Association between sick building syndrome and indoor environmental quality in slovenian hospitals: A cross-sectional study. Int J Environ Res Public Health [Internet]. 2019;16(17). [Cited 2022 October 5]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85071745068&doi=10.3390%2Fijerph16173224&partnerID=40&md5=57d790874bc10c56934da1d950df18c4
11. Murniati N. Hubungan Suhu dan Kelembaban dengan Keluhan Sick Building Syndrome pada Petugas Administrasi Rumah Sakit Swasta X. J Ilmu Kesehat Masy. 2018;07(03):148–54.
12. Ulfa M, Azuma M, Steiner A. Burnout status of healthcare workers in the world during the peak period of the COVID- pandemic. Front Psychol. 2022;1–12.
13. Agarwal A, Nagi N, Chatterjee P, Sarkar S, Mourya D, Sahay R, et al. Guidance for building a dedicated health facility to contain the spread of the 2019 novel coronavirus outbreak. Indian J Med Res [Internet]. 2020;151(2):177–83. [Cited 2022 October 4] Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85083266767&doi=10.4103%2Fijmr.IJMR_518_20&partnerID=40&md5=a3c30aad660a2dc33784cdd108e9ffc0
14. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia. N Engl J Med. 2020 Jan 29;382.
15. Ulfa M, Azuma M, Laras Wening D, Veda Yudanto A, Author C. The use of PPE Against the Incidence of COVID-19 Infection on Indonesian Healthcare Workers. JMMR (Jurnal Medicoeticolegal dan Manaj Rumah Sakit) [Internet]. 2021;10(3):230–40. [Cited 2022 October 5]. Available from: https://journal.umy.ac.id/index.php/mrs/article/view/13310
16. Kalender-Smajlović S, Dovjak M, Kukec A. Sick building syndrome among healthcare workers and healthcare associates at observed general hospital in slovenia. Cent Eur J Public Health [Internet]. 2021;29(1):28–37. [Cited 2022 October 6]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85104164698&doi=10.21101%2Fcejph.a6108&partnerID=40&md5=bafb7311f849a5750bfe7209c2a9c11b
17. Moradpour Z, Hesam G, Helmi_Kohnehshahri M, Bokharaei-Salim F, Pouyakian M, Zendehdel R. Investigating the Ventilation System of an Intensive Care Unit in the COVID-19 Crisis: A Study in a Hospital of Tehran, Iran. Tanaffos [Internet]. 2021;20(3):240–5. [Cited 2022 October 6]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85126994532&partnerID=40&md5=d0469ffa59abb28e1efa78411d604a2b
18. Dewanggana A, Ulfa M, Kusbaryanto K. Post Occupancy Evaluation of The COVID – 19 Isolation Room. J Aisyah J Ilmu Kesehat. 2021;6:231–40.
19. Hosseini MR, Fouladi-Fard R, Aali R. COVID-19 pandemic and sick building syndrome. Indoor Built Environ [Internet]. 2020;29(8):1181–3. [Cited 2022 October 5]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85086873735&doi=10.1177%2F1420326X

20935644&partnerID=40&md5=78ad86548b107e896f2802c221cb9c23
20. Zhang H, Srinivasan R. A systematic review of air quality sensors, guidelines, and measurement studies for indoor air quality management. Sustain [Internet]. 2020;12(21):1–40. [Cited 2022 October 7]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85094618906&doi=10.3390%2Fsu12219045&partnerID=40&md5=d4831b586e49ad6056aa0b813d4542ec
21. Quoc CH, Huong G V, Duc HN. Working conditions and sick building syndrome among health care workers in vietnam. Int J Environ Res Public Health [Internet]. 2020;17(10). [Cited 2022 October 8]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085529252&doi=10.3390%2Fijerph17103635&partnerID=40&md5=b047a90479eec20d363b32664256ea15
22. Babaoglu UT, Milletli Sezgin F, Yag F. Sick building symptoms among hospital workers associated with indoor air quality and personal factors. Indoor Built Environ [Internet]. 2020;29(5):645–55. [Cited 2022 October 7]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067832263&doi=10.1177%2F1420326X19855117&partnerID=40&md5=11ed28d1ea08e4beadcdedeaf0d34d41
23. Kalender-Smajlović S, Kukec A, Dovjak M. The problem of indoor environmental quality at a general Slovenian hospital and its contribution to sick building syndrome. Build Environ [Internet]. 2022;214. [Cited 2022 October 2] Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85124998526&doi=10.1016%2Fj.buildenv.2022.108908&partnerID=40&md5=a9f6f35d51eff555c6f5b362dfdaaa78
24. Khairunnisa RA, Setyonugroho W, Ulfa M. Green Hospital Implementation in Health Aspects: A Systematic Review. UIJRT | United Int J Res Technol |. 2022;03(09):2582–6832.
25. Wang M, Li L, Hou C, Guo X, Fu H. Building and Health: Mapping the Knowledge Development of Sick Building Syndrome. Buildings [Internet]. 2022;12(3). [Cited 2022 October 6]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85126471477&doi=10.3390%2Fbuildings12030287&partnerID=40&md5=c4f0dda30cf49d0b67fc3cc4b707d301
26. Crick P. Stress alarm: Living with Stress. Cary L. Cooper, Rachel Cooper, Lyn Eaker. Penguin.£ 4.95. Health Educ J. 1988;47(2–3):106.
27. Jafakesh S, Mirhadian L, Pasha A, Roshan ZA, Hosseini MJG. Sick Building Syndrome in Nurses of Intensive Care Units and Its Associated Factors. J Holist Nurs Midwifery [Internet]. 2019;29(3):145–52. [Cited 2022 October 9]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85104012157&doi=10.32598%2FJHNM.29.3.145&partnerID=40&md5=2b1e0d7af2fcee2962d8d1bc572d3fba
28. Qu G, Li X, Hu L, Jiang G. An imperative need for research on the role of environmental factors in transmission of novel coronavirus (COVID-19). ACS Publications; 2020.
29. Yanti CA, Akhri IJ. Perbedaan uji korelasi pearson, spearman dan kendall tau dalam menganalisis kejadian diare. J Endur Kaji Ilm Probl Kesehat. 2021;6(1):51–8.
30. Ghaffarianhoseini A, AlWaer H, Omrany H, Ghaffarianhoseini A, Alalouch C, Clements-Croome D, et al. Sick building syndrome: are we doing enough? Archit Sci Rev [Internet]. 2018;61(3):99–121. [Cited 2022 October 9]. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85046420077&doi=10.1080%2F00038628.2018.1461060&partnerID=40&md5=b8205dc1904c2b648ec0b8626cf0fe97

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