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RESEARCH ARTICLE

EPIDEMIOLOGY AND RISK FACTORS OF SICK-BUILDING SYNDROMEAMONG HEALTH CARE WORKERS AT PRIMARY HEALTH CARE CENTER IN AL-AHSA,SAUDI ARABIA

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Abstract

Objective: This study aimed to investigate the Epidemiology and risk factors of Sick-building Syndrome among health care workers at primary health care center in Al- Ahsa, Saudi Arabia

Methods: cross-sectional study was conducted to evaluate different parameters for sick building syndrome and intrinsic, extrinsic factors involved in it. SBS symptoms and perceptions of various environmental aspects from a sample of 281 participants. The participants were asked to rate their symptoms and evaluate the environmental conditions based on specific factors such as air quality, temperature comfort level, air movement, light, vibration, overall comfort, and noise.

Results: 18.1%of individuals reported experiencing symptoms associated with SBS. The results revealed a significant association between air quality and the presence of SBS symptoms ($p = 0.001$), with SBS symptoms being more prevalent in perceived stuffy air conditions. However, no significant associations were found between SBS symptoms and other environmental aspects, including temperature comfort level, air movement, light, vibration, and overall comfort. Notably, noise in winter showed a statistically significant association with SBS symptoms ($p = 0.021$), with 23.5% of participants reporting dissatisfaction.

Conclusion: The findings suggest that air quality, particularly the perception of stuffy air, is significantly associated with the occurrence of SBS symptoms. These results align with previous research highlighting the importance of proper ventilation and reducing pollutant sources to mitigate SBS symptoms. With prevalence of SBS OF 18.1% among participants. Additionally, the study emphasizes the impact of noise pollution on SBS symptoms during the winter season. Further research is needed to explore the complex interactions between individual susceptibility, specific pollutant exposures, and building characteristics in the development of SBS symptoms.

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Introduction:-

Sick-building syndrome (SBS) is a complex and multifaceted issue that profoundly impacts the health and productivity of individuals working in indoor environments[1]. The symptoms associated with SBS can vary in intensity and include headaches, fatigue, irritation of the upper respiratory tract, nasal congestion, eye irritation, dryness or itchiness of the skin, and throat discomfort. These symptoms can significantly impair work performance and lead to increased absenteeism among affected individuals[2,3]

Diagnosing SBS poses a challenge due to the diverse range of potential causes. It is believed that a combination of personal and environmental factors contributes to the development of SBS symptoms[4]. Personal factors include individual susceptibility, such as pre-existing allergies, depression, anxiety, and a history of respiratory issues. Additionally, psychosocial work stress can exacerbate the manifestation of symptoms[5]. Environmental factors play a crucial role as well, encompassing elements such as poor indoor air quality, inadequate ventilation, improper humidity levels, temperature fluctuations, outdoor air pollution, and the presence of allergens or irritants in the indoor environment[6].

The prevalence of SBS in different indoor environments, including healthcare centers, has become a matter of concern. Healthcare workers, who spend a substantial amount of time in these settings, are particularly vulnerable to the effects of SBS[7]. They encounter various factors that can contribute to the development of SBS symptoms. In healthcare centers, employees are exposed to a multitude of chemicals and biological agents, such as disinfectants, cleaning agents, medications, and biological hazards[7]. The frequent use of these substances, coupled with the demanding nature of their work, can further increase the risk of SBS[8].

Furthermore, healthcare centers often prioritize efficiency and functionality in their design and operation. This focus on efficiency can inadvertently lead to compromised indoor environmental quality[9]. Inadequate ventilation systems, poorly maintained HVAC (Heating, Ventilation, and Air Conditioning) systems, suboptimal lighting conditions, and high noise levels are common issues in healthcare settings[10]. These factors contribute to the accumulation of indoor pollutants, reduced air quality, and discomfort among healthcare workers, making them more susceptible to SBS symptoms[11].

Addressing the prevalence of SBS in healthcare centers is crucial for maintaining a healthy and productive workforce. By identifying the contributing factors and implementing effective strategies to improve indoor environmental quality, healthcare organizations can significantly reduce the incidence of SBS and enhance the health and well-being of their employees[12]. It is imperative to establish comprehensive policies and procedures that prioritize the promotion of a healthy indoor environment, including regular maintenance and cleaning routines, proper ventilation and filtration systems, adequate lighting, noise control measures, and employee education and awareness programs[13].

According to a research study, occurrence of SBS increased from 41 to 87 percent in hospitals[8]. While a study conducted in Turkey concluded that SBS occurrence was found to be 20.9 percent[14]. Another study conducted in Vietnam highlighted that SBS is found in over 30% of health workers in hospitals and other buildings. Hence, factors that address the management of this syndrome need vital consideration[15]**.**

Numerous research studies have been conducted to shed light on the prevalence and impact of Sick-building syndrome (SBS) in various indoor environments, particularly healthcare centers. These studies provide valuable insights into the extent of the problem and emphasize the importance of addressing the contributing factors to effectively manage SBS[16].

A study examined the occurrence of SBS in hospitals and found a significant increase from 41% to 87%. This study emphasizes the alarming prevalence of SBS within healthcare settings, where healthcare workers are exposed to numerous factors that can contribute to the syndrome's development. The findings highlight the urgent need for effective management strategies to mitigate the impact of SBS on the health and well-being of healthcare workers[17].

In China, a research study specifically focused on SBS occurrence and reported a prevalence rate of 20.9%. The study highlighted the presence of SBS symptoms among individuals working in various indoor environments, including healthcare centers. These findings further underline the significance of addressing the contributing factors associated with SBS to improve the indoor environmental quality and overall well-being of workers in healthcare settings[18].

Another study conducted in Thailand revealed that SBS is found in over 30% of health workers in hospitals and other buildings. This study underscores the widespread nature of SBS among healthcare professionals and emphasizes the need for comprehensive strategies to manage and alleviate the symptoms. The results suggest that factors contributing to SBS, such as indoor air quality, ventilation, and other environmental aspects, must be carefully considered to create healthier and more productive work environments in healthcare settings[15].

These studies collectively support the notion that addressing the management of Sick-building syndrome requires vital consideration, particularly in healthcare centers. The prevalence of SBS among healthcare workers is a significant concern due to their high risk of exposure to various chemicals and biological agents[19]. The use of disinfectants, cleaning agents, and medications, combined with suboptimal indoor environmental quality and inadequate ventilation, can contribute to the development of SBS symptoms[20].

Moreover, a comprehensive case study from Greece projected that indoor air quality factors accounted for about 63% of the prevalence of SBS. Fatigue was the most frequently reported symptom, affecting 34.1% of individuals, followed by general symptoms (40.8%), mucosal symptoms (19.8%), and dermal symptoms (8.1%). These findings further emphasize the impact of indoor environmental quality on the manifestation of SBS symptoms and highlight the need to address specific factors contributing to SBS prevalence, such as air quality and fatigue management[21].

The consequences of SBS on the workforce are significant, as it increases absenteeism by causing fatigue, illness, and exhaustion while decreasing productivity[22]. Research has shown that improving the working conditions and indoor environment of employees can lead to productivity gains of 7 to 15% and reduce absenteeism due to illness or unwillingness. Thus, recognizing the importance of addressing diseases like SBS, along with the factors contributing to their prevalence, is crucial for promoting a healthy and productive workforce[23].

In the context of the Kingdom of Saudi Arabia (KSA), where this study takes place, there is a notable gap in research investigating the relationship between SBS and indoor environmental quality in healthcare centers. This highlights the need for the present study, which aims to determine the prevalence of SBS among individuals working in primary healthcare centers in Al Ahsa, KSA, while identifying the specific factors that influence its occurrence. By filling this research gap, the study will contribute to the body of knowledge on SBS management and aid in the development of targeted interventions to improve indoor environmental quality and enhance the well-being of healthcare workers in the region.

The rationale for conducting this study stems from the recognition of the impact of sick building syndrome on the performance of healthcare workers, as highlighted in various studies conducted in different countries. The current research assess the intrinsic and extrinsic factors that contribute to such ailments specifically in Al Ahsa.The study has two primary objectives. Firstly, estimate the prevalence of sick building syndrome among healthcare workers. This will involve assessing the frequency and severity of symptoms experienced by the healthcare staff within the Al Ahsa region. Secondly, the research identify the specific factors that contribute to the dissemination of sick building syndrome among healthcare workers. The hypothesis guiding this research is centered around the notion that personal, and environmental factors play a significant role in contributing to the occurrence of sick building syndrome among healthcare workers.

Material and Methods:-

Study Design and area

A validated questionnaire (14) based cross-sectional study was conducted to evaluate different parameters for sick building syndrome and intrinsic, extrinsic factors involved in it. The questionnaire translated from English to Arabic. Furthermore, validity of questionnaire evaluated by a pilot study, in which 10 random healthcare workerswere selected to completed the questionnaire in Al-Ahsa governorate and its reliability wereconfirmed by Cronbach's alpha test.

Demographic Parameters

Census method used to ask subjects using the questionnaire to answer. Demographic data of each selected candidatewere collectedbased on age, sex, job,smoking, sector, doctor degree, educational level. In addition, Landscape design and building division, into different groups were compared. The questionnaire also intended to identify those patient’s symptoms i.e. headache, nausea, dry skin, skin redness during working hours etc to determine positive and negative level of illness.

The list of healthcare facilities and associated staff will be obtained from concerned authorities. From provided list Random candidates will be selected as a respondent for sampling.

Physical parameters of primary health care

Indoor parameters of the healthcare center e,g light intensity, Temperature, humidity, air flux and noise level along with age of building will be estimated at two different time intervals i.e. winter and summerfrom primary health care centers

Sample size

The sample size was 274 calculated based on the formula which is z^2 pq/e^2 [24]. However, we have collected data from 281 in order avoid any error in data collection.

Sampling technique

This region has 66 primary health care centers in Al-ahsa. All these centers are divided into four sectors, These sectors are:

1. Southern sector– 2 PHC
2. Middle sector– 4 PHC
3. Northern sector – 10 PHC
4. Eastern sector – 14 PHC

The PHC centers have been included based on nearby centres, not furnished recently, and not on the bases of yearly rent.

Ethical Consideration

An approval was taken from IRB KFHH (No.74-EP-2022 Dated:11/24/2022) and approval from preventive medicine program .They have full right to refuse to participate to the study .The confidentiality of the participants will be maintained and no identification of any participant will be made public

Inclusion and Exclusion Criteria

This study involved doctors, nurse’s laboratory assistant and clinic pharmacist, Midwiferies and other allied health field professionals. The data will be gathered from government institutions(primary health care) excluding private sector health care centers in al-AhsaSaudi Arabia

Statistical analysis

The collected data was revised, coded in MS excel then feed and analyzed by SPSS software (version 26 - SPSS, Inc. Chicago). Descriptive analysis based on the frequency and percent distribution was done for all variables. The appropriate statistical tests were applied,chi-square and t tests according to the categories of the data . Level of significance consideredP-value less than 0.05.

Results:-

We approached to 281 participants and all were responded, therefore, the response rate was 100%. Table 1 shows that the largest proportion of age was falling within the 36-50 age group (47.3%). This was followed by the 26-35 age group (40.9%). Individuals between the ages of 17-25 represented the smallest proportion of the sample (5.0%), while no individuals above the age of 65 were included. Females (52.3%) was higher compared to males (47.7%). Among the participants, the healthcare sector was well-represented, with doctors comprising 27.0% of the sample and nurses accounting for 34.5%. Other job categories included pharmacists (5.3%), administrative staff (19.2%), lab technicians (6.0%), dental assistants (2.8%), and individuals in other occupations (5.0%).

In terms of education, the majority of participants held a bachelor's degree (40.9%) or a diploma (40.6%). A smaller proportion had a master's degree (9.6%), while individuals with a high school education were the least represented (8.9%). Doctorate holders primarily held GP degrees (61.8%), while smaller percentages were attributed to deputy specialists (5.3%), specialists (21.1%), and consultants (11.8%). In addition, the sample was drawn from various sectors, with the largest representation from the Eastern sector (36.7%), closely followed by the Northern sector (35.6%). The Southern sector accounted for 11.7% of the sample, and the Middle sector represented 16.0% of the participants.

Furthermore, the majority of individuals in the sample reported being non-smokers (84.7%), while 15.3% were smokers. Regarding healthcare practices, a significant proportion of participants (66.2%) reported undergoing periodic health exams, while 33.8% indicated that they had not. For the vaccination status, participants demonstrated a high uptake of vaccinations. The majority had received the flu vaccine (63.0%) and the Covid-19 vaccine (97.2%). Only a small proportion had not received the flu vaccine (37.0%) or the Covid-19 vaccine (2.8%).

Table 1:- Demographic variables characteristics.

		n	%
Age (in years)	17-25	14	5.0%
	26-35	115	40.9%
	36-50	133	47.3%
	51-65	19	6.8%
	>65	0	0.0%
Sex	Male	134	47.7%
	Female	147	52.3%
Job	Doctor	76	27.0%
	nurse	97	34.5%
	Pharmacist	15	5.3%
	Administrative	54	19.2%
	Lab Tech	17	6.0%
	dental assist	8	2.8%
	other	14	5.0%
Education level	High school	25	8.9%
	diploma	114	40.6%
	bachelor	115	40.9%
	Master	27	9.6%
doctor degree	GP	47	61.8%
	Deputy specialist	4	5.3%
	Specialist	16	21.1%
	Consultant	9	11.8%
Sector	Eastern	103	36.7%
	Southern	33	11.7%
	Northern	100	35.6%
	Middle	45	16.0%
Smoking	no	238	84.7%
	yes	43	15.3%
periodic health exam	no	95	33.8%
	yes	186	66.2%
flu vaccine	no	104	37.0%
	yes	177	63.0%
Covid-19 vaccine	no	8	2.8%
	yes	273	97.2%

Figure 1 presents data on various symptoms experienced by a group of individuals. The most prevalent symptoms include headaches (49.8%), lethargy and tiredness (49.1%), runny nose (39.1%), and blocked or stuffy nose (36.7%). Eye-related symptoms such as dryness (35.6%) and itchiness or watery eyes (30.6%) are also reported. A smaller percentage of individuals reported symptoms like dry throat (25.6%) and other work-related symptoms (7.1%). These findings suggest that a significant portion of the group may be experiencing discomfort and health issues, emphasizing the need for further investigation and appropriate medical attention.

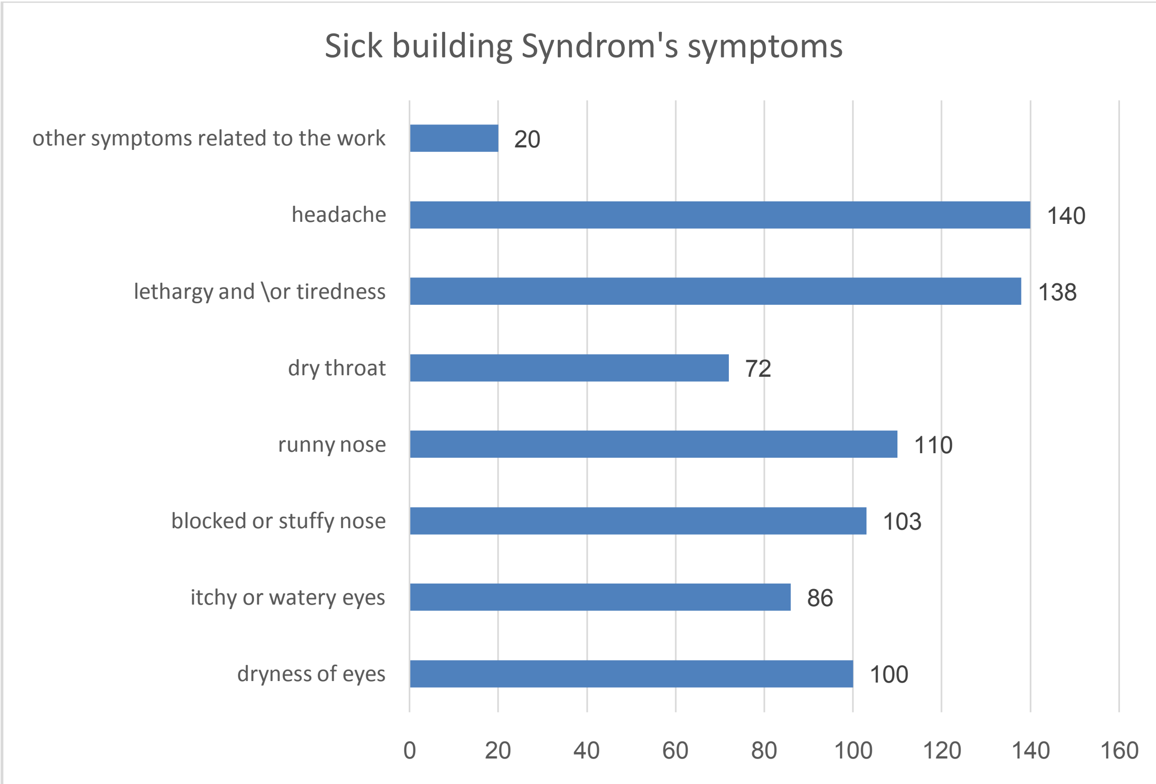

Figure 1:- Sick Building Sydrome's symptoms among study group

The distribution of sick building syndrome (SBS) among the study participants. Out of a total of 281 individuals, 51 individuals (18.1%) reported experiencing symptoms associated with SBS, while 230 individuals (81.9%) did not exhibit any symptoms. These findings suggest that a considerable proportion of the study population is affected by SBS.

Table 2 shows that the majority of participants (84.3%) reported having full control over the temperature in their workspace, indicating a high level of personal satisfaction and comfort. Similarly, a significant majority (75.1%) expressed having full control over ventilation, suggesting that most participants could adjust the airflow in their workspace according to their preferences. The data reveals that a substantial portion of participants (78.6%) had full control over lighting in their workspace, which contributes to their ability to personalize their environment and potentially improve productivity.

A majority of respondents (71.5%) reported being satisfied with the level of privacy they had at work, suggesting that their workspace provided an adequate sense of seclusion. The majority of participants (58.0%) expressed a strong preference for the layout of their office environment, indicating a positive perception of the spatial arrangement. Similarly, a significant number of participants (60.5%) indicated a strong liking for the office décor, suggesting that it contributes positively to their overall satisfaction and well-being.

A little over half of the respondents (54.1%) expressed a desire for improvements to the heating, ventilation, or air conditioning system, indicating that there may be areas for enhancement in the environmental control systems. Regarding the speed of response to requests or inquiries, slightly more than half of the participants (54.6%) reported being satisfied overall. However, the results also highlight a significant number (45.4%) who found the response time unsatisfactory. Participants reported a higher satisfaction rate (58.6%) in terms of the effectiveness of responses received. Nonetheless, a notable proportion (41.4%) expressed dissatisfaction with the effectiveness of the responses.

Nearly half of the participants (44.1%) requested improvements to other aspects of their office environment, indicating that further enhancements may be necessary beyond heating, ventilation, or air conditioning. In terms of the speed of response satisfaction for other aspects of the office environment, the majority of participants (54.8%) reported being satisfied overall. However, a notable proportion (45.2%) found the response time unsatisfactory. Regarding the effectiveness of responses for other aspects of the office environment, slightly more than half of the participants (54.0%) reported being satisfied overall. Nonetheless, a significant number (46.0%) expressed dissatisfaction with the effectiveness of the responses.

Table 2:- Distribution of other aspects of office environment.

		n	%
temperature personally control	not at all	44	15.7%
	full control	237	84.3%
ventilation personally control	not at all	70	24.9%
	full control	211	75.1%
lighting personally control	not at all	60	21.4%
	full control	221	78.6%
privacy at work	satisfactory overall	201	71.5%
	unsatisfactory overall	80	28.5%
layout like	like very much	163	58.0%
	do not like at all	118	42.0%
décor like	like very much	170	60.5%
	do not like at all	111	39.5%
request for improvement to heating, ventilation or air conditioning	yes	152	54.1%
	no	129	45.9%
speed of response satisfaction	satisfactory overall	83	54.6%
	unsatisfactory overall	69	45.4%
effectiveness of response satisfaction	satisfactory overall	89	58.6%
	unsatisfactory overall	63	41.4%
request for improvement to other aspect of your office environment	yes	124	44.1%
	no	157	55.9%
speed of response satisfaction	satisfactory overall	68	54.8%
	unsatisfactory overall	56	45.2%
effectiveness of response satisfaction	satisfactory overall	67	54.0%
	unsatisfactory overall	57	46.0%

Regarding health practices, table 3 shows that most participants had undergone periodic health exams (69.1%). SBS symptoms are less prevalent when the participants had undergone the periodic health exams (p = 0.027).

However, there were no significant associations between SBS symptom presentation and all environmental aspects

Table 3:- Chi-square test results for the association between SBS symptoms and demographic variables.

		SBS symptoms n(%)				Chi-square	P-value
		Absent		Present			
age	17-25	11	4.8%	3	5.9%	2.864	0.413
	26-35	91	39.6%	24	47.1%		
	36-50	110	47.8%	23	45.1%		
	51-65	18	7.8%	1	2.0%		
	>65	0	0.0%	0	0.0%		
sex	Male	114	49.6%	20	39.2%	1.792	0.181
	Female	116	50.4%	31	60.8%		
job	Doctor	59	25.7%	17	33.3%	5.304	0.506
	nurse	76	33.0%	21	41.2%		
	Pharmacist	13	5.7%	2	3.9%		
	Administrative	47	20.4%	7	13.7%		
	Lab Tech	15	6.5%	2	3.9%		
	dental assist	8	3.5%	0	0.0%		

	other	12	5.2%	2	3.9%		
certificate	High school	21	9.1%	4	7.8%	1.705	0.636
	diploma	96	41.7%	18	35.3%		
	bachelor	90	39.1%	25	49.0%		
	Master	23	10.0%	4	7.8%		
doctor degree	GP	35	59.3%	12	70.6%	4.743	0.192
	Deputy specialist	4	6.8%	0	0.0%		
	Specialist	11	18.6%	5	29.4%		
	Consultant	9	15.3%	0	0.0%		
sector	Eastern	88	38.3%	15	29.4%	2.193	0.533
	Southern	28	12.2%	5	9.8%		
	Northern	78	33.9%	22	43.1%		
	Middle	36	15.7%	9	17.6%		
smoking	no	194	84.3%	44	86.3%	0.12	0.73
	yes	36	15.7%	7	13.7%		
periodic health exam	no	71	30.9%	24	47.1%	4.889	0.027
	yes	159	69.1%	27	52.9%		
flu vaccine	no	85	37.0%	19	37.3%	0.002	0.968
	yes	145	63.0%	32	62.7%		
Covid-19 vaccine	no	6	2.6%	2	3.9%	0.26	0.61
	yes	224	97.4%	49	96.1%		

Table 4 shows that there is a significant association between air quality (fresh vs. stuffy) and the presence of SBS symptoms (p = 0.001). SBS symptoms are less prevalent when the air quality is fresh. The results indicate that temperature comfort level, air movement, light, vibration, and overall comfort are not significantly associated with SBS symptoms. Similar analyses were conducted for the environmental aspects in winter. The results indicate that temperature comfort level, air movement, air quality, light, vibration, and overall comfort are not significantly associated with SBS symptoms. However, SBS symptoms are less prevalent when the participants more satisfied about noise in winter (p = 0.021).

Table 4:- Chi-square test results for the association between SBS symptoms and environmental comfort.

environmental comfort		SBS symptoms n(%)				Chi-square	P-value
		Absent		Present			
temperature in summer1	comfortable	166	72.2%	33	64.7%	1.127	0.289
	uncomfortable	64	27.8%	18	35.3%		
temperature in summer2	hot	206	89.6%	47	92.2%	0.313	0.576
	cold	24	10.4%	4	7.8%		
temperature in summer3	stable	200	87.0%	44	86.3%	0.017	0.896
	varies during the day	30	13.0%	7	13.7%		
air movement in summer	still	165	71.7%	39	76.5%	0.47	0.493
	draughty	65	28.3%	12	23.5%		
air quality in summer	dry	204	88.7%	46	90.2%	0.096	0.757
	humid	26	11.3%	5	9.8%		
air quality in summer	fresh	188	81.7%	31	60.8%	10.66	0.001
	stuffy	42	18.3%	20	39.2%		
air quality in summer	odourless	187	81.3%	37	72.5%	1.98	0.16
	smelly	43	18.7%	14	27.5%		
air quality in summer	satisfactory overall	190	82.6%	39	76.5%	1.04	0.307
	unsatisfactory overall	40	17.4%	12	23.5%		
light in summer	satisfactory overall	193	83.9%	38	74.5%	2.52	0.112
	unsatisfactory overall	37	16.1%	13	25.5%		
noise in summer	satisfactory overall	189	82.2%	37	72.5%	2.46	0.117

	unsatisfactory overall	41	17.8%	14	27.5%		
vibration in the building in summer	satisfactory overall	209	90.9%	47	92.2%	0.09	0.77
	unsatisfactory overall	21	9.1%	4	7.8%		
comfort over all in summer	satisfactory overall	188	81.7%	37	72.5%	2.21	0.137
	unsatisfactory overall	42	18.3%	14	27.5%		
temperature in winter	comfortable	203	88.3%	47	92.2%	0.65	0.422
	uncomfortable	27	11.7%	4	7.8%		
temperature in winter	hot	10	4.3%	0	0.0%	2.3	0.129
	cold	220	95.7%	51	100.0%		
temperature in winter	stable	195	84.8%	42	82.4%	0.19	0.666
	varies during the day	35	15.2%	9	17.6%		
air movment in winter	still	205	89.1%	44	86.3%	0.34	0.561
	draughty	25	10.9%	7	13.7%		
air quality in winter	dry	210	91.3%	46	90.2%	0.06	0.801
	humid	20	8.7%	5	9.8%		
air quality in winter	fresh	217	94.3%	47	92.2%	0.35	0.553
	stuffy	13	5.7%	4	7.8%		
air quality in winter	odourless	208	90.4%	45	88.2%	0.23	0.635
	smelly	22	9.6%	6	11.8%		
air quality in winter	satisfactory overall	217	94.3%	47	92.2%	0.35	0.553
	unsatisfactory overall	13	5.7%	4	7.8%		
light in winter	satisfactory overall	207	90.0%	48	94.1%	0.84	0.359
	unsatisfactory overall	23	10.0%	3	5.9%		
noise in winter	satisfactory overall	204	88.7%	39	76.5%	5.34	0.021
	unsatisfactory overall	26	11.3%	12	23.5%		
vibration in the building in winter	satisfactory overall	212	92.2%	48	94.1%	0.23	0.633
	unsatisfactory overall	18	7.8%	3	5.9%		
comfort overall in winter	satisfactory overall	209	90.9%	46	90.2%	0.02	0.881
	unsatisfactory overall	21	9.1%	5	9.8%		

Table 5shows that there were not significant association between other environmental aspects and the presence of SBS symptoms. ($p>0.05$)

Table 5:- Chi-square test results for the association between SBS symptoms and other environmental aspects.

Other environmental aspects		SBS symptoms n(%)				Chi-square	P-value
		Absent		Present			
temperature personally control	not at all	39	17.0%	5	9.8%	1.62	0.203
	full control	191	83.0%	46	90.2%		
ventilation personally control	not at all	60	26.1%	10	19.6%	0.94	0.333
	full control	170	73.9%	41	80.4%		
lighting personally control	not at all	51	22.2%	9	17.6%	0.51	0.475
	full control	179	77.8%	42	82.4%		
privacy at work	satisfactory overall	166	72.2%	35	68.6%	0.26	0.612
	unsatisfactory overall	64	27.8%	16	31.4%		
layout like	like very much	136	59.1%	27	52.9%	0.66	0.418

	do not like at all	94	40.9%	24	47.1%		
décor like	like very much	142	61.7%	28	54.9%	0.82	0.366
	do not like at all	88	38.3%	23	45.1%		
request for improvement to heating, ventilation or air conditioning	yes	125	54.3%	27	52.9%	0.03	0.855
	no	105	45.7%	24	47.1%		
speed of response satisfaction	satisfactory overall	70	56.0%	13	48.1%	0.55	0.457
	unsatisfactory overall	55	44.0%	14	51.9%		
effectiveness of response satisfaction	satisfactory overall	75	60.0%	14	51.9%	0.61	0.436
	unsatisfactory overall	50	40.0%	13	48.1%		
request for improvement to other aspect of your office environment	yes	101	43.9%	23	45.1%	0.024	0.877
	no	129	56.1%	28	54.9%		
speed of response satisfaction	satisfactory overall	57	56.4%	11	47.8%	0.56	0.454
	unsatisfactory overall	44	43.6%	12	52.2%		
effectiveness of response satisfaction	satisfactory overall	55	54.5%	12	52.2%	0.039	0.843
	unsatisfactory overall	46	45.5%	11	47.8%		

Discussion:-

Sick building syndrome (SBS) is a complex and multifactorial condition characterized by a range of nonspecific symptoms experienced by individuals who spend a significant amount of time in indoor environments[25]. Understanding the factors contributing to SBS is crucial for promoting healthy indoor environments and improving the well-being and productivity of occupants. This study aimed to investigate the relationship between SBS and indoor environmental quality (IEQ) parameters, including air exchange rate, carbon dioxide (CO_2) levels, room temperature, relative air humidity, outdoor air pollution, personal and psychosocial factors, and their impact on different occupational settings[26].

The prevalence of SBS symptoms reported in this study is consistent with previous research conducted in different settings. For example, a study examining SBS symptoms in office workers found a similar prevalence of symptoms, including headaches, tiredness, and nasal symptoms[5]. Another study investigating SBS symptoms among healthcare workers reported comparable findings, with a significant proportion of individuals experiencing symptoms such as headaches, eye irritation, and nasal congestion [12]. These studies, along with our findings, provide additional evidence of the widespread occurrence of SBS symptoms in various indoor environments.

The distribution of Sick-building syndrome (SBS) accounting for 18.1% of the study population, reported SBS symptoms. These results are consistent with previous studies that have reported varying prevalence rates of SBS in different settings. For example, a study examined the prevalence of SBS symptoms in office buildings and found that approximately 20% of the occupants experienced symptoms associated with SBS [27]. Similarly, a study investigated the prevalence of SBS among employees in Swedish buildings and reported a prevalence rate of 17% [28].

Moreover, a study conductedin hospitals observed an even higher prevalence of SBS symptoms, with the occurrence increasing from 41% to 87%[29]. These findings highlight the substantial impact of SBS on various populations, including office workers, employees in different occupational settings, and healthcare professionals.

The high prevalence of SBS symptoms among the study participants highlights the need for further investigation and appropriate medical attention. Recognizing and addressing the factors contributing to SBS is crucial for improving the health and well-being of individuals in indoor environments[30]. Several studies have explored the potential causes and risk factors associated with SBS symptoms.

One study investigated the association between indoor environmental factors and SBS symptoms in office buildings. The researchers found that factors such as poor ventilation, elevated CO_2 levels, and presence of airborne pollutants were significantly associated with increased prevalence of SBS symptoms[31]. These findings suggest that improving ventilation systems, reducing pollutant sources, and ensuring adequate air quality are essential strategies for mitigating SBS symptoms.

Another study examined the relationship between building-related factors and SBS symptoms in residential buildings. The researchers identified factors such as inadequate ventilation, moisture problems, and presence of building materials emitting volatile organic compounds (VOCs) as significant contributors to SBS symptoms [32]. These findings highlight the importance of addressing building design and maintenance practices to create healthier indoor environments and reduce the occurrence of SBS symptoms.

In terms of temperature control, the majority of participants (84.3%) reported having full control over the temperature in their workspace. This high level of personal satisfaction and comfort aligns with the research which found that individuals who have control over their thermal environment experience improved comfort and satisfaction [33]. This control over temperature allows employees to tailor their workspace to their preferences, promoting a conducive environment for productivity and well-being.

Similarly, a significant majority of participants (75.1%) expressed having full control over ventilation. This indicates that most participants could adjust the airflow in their workspace according to their preferences. Research has demonstrated that providing occupants with the ability to control ventilation can lead to improved indoor air quality and occupant satisfaction [34]. The participants' ability to personalize the ventilation in their workspace contributes to their overall satisfaction and comfort.

The data also reveals that a substantial portion of participants (78.6%) had full control over lighting in their workspace. This finding is consistent with studies which emphasize the importance of personal control over lighting for individual satisfaction and well-being[35]. Having control over lighting allows employees to customize their workspace according to their visual preferences and potentially enhance productivity.

The positive perception of the spatial arrangement and office décor is evident from the results. The majority of participants expressed a strong preference for the layout of their office environment (58.0%) and a strong liking for the office décor (60.5%). These findings are supported by research which suggests that a well-designed and aesthetically pleasing office environment positively influences employee satisfaction and well-being [36]. A visually appealing workspace can contribute to a positive and enjoyable work atmosphere, enhancing employee motivation and engagement.

However, the study also identified areas for improvement. Slightly over half of the respondents (54.1%) expressed a desire for improvements to the heating, ventilation, or air conditioning system. This finding highlights the importance of addressing issues related to environmental control systems. Studies emphasize the significance of providing efficient and effective heating, ventilation, and air conditioning systems to ensure occupant satisfaction and comfort .Implementing improvements in these systems can contribute to a more favorable indoor environment and enhance employee well-being[8,37]

Several studies have examined the relationship between air quality and SBS symptoms, supporting the findings of this study. A study investigated the association between air exchange rate and SBS symptoms in university computer classrooms and found that insufficient fresh air supply and poor ventilation were related to increased prevalence of SBS symptoms[38]. Similarly, a study examined the impact of indoor air quality on SBS symptoms in office buildings and found that inadequate ventilation and elevated levels of indoor pollutants were associated with a higher risk of experiencing SBS symptoms[39].

The results also indicated that other environmental factors such as temperature comfort level, air movement, light, vibration, and overall comfort were not significantly associated with SBS symptoms. This suggests that while these factors may contribute to overall comfort and satisfaction, they may not have a direct influence on the occurrence of SBS symptoms.

In the winter analysis, similar results were observed for temperature comfort level, air movement, air quality, light, vibration, and overall comfort, indicating no significant associations with SBS symptoms. However, it was found that participants who were more satisfied with noise in winter had a lower prevalence of SBS symptoms ($p = 0.021$).

Although limited research specifically focuses on the association between noise satisfaction and SBS symptoms, several studies have explored the impact of noise on indoor environmental quality and occupant well-being. A study investigated the relationship between noise annoyance and perceived air quality in office buildings and found that higher noise annoyance was associated with lower perceived air quality [40]. This suggests that addressing noise issues in indoor environments may contribute to a more favorable perception of the overall environment and potentially reduce the occurrence of SBS symptoms.

This association between periodic health exams and reduced prevalence of SBS symptoms aligns with the notion that regular health check-ups and monitoring can contribute to better overall health and well-being. While the specific mechanisms underlying this relationship require further investigation, several studies have examined the impact of health practices on SBS symptoms and related health outcomes.

A study explored the association between preventive health behaviors and SBS symptoms among office workers. The findings indicated that individuals who engaged in regular exercise, received periodic health check-ups, and maintained a healthy lifestyle had a lower risk of experiencing SBS symptoms[41]. This suggests that proactive health practices, including periodic health exams, may play a role in reducing the prevalence of SBS symptoms.

The results of our study suggest a significant association between air quality and the presence of Sick-building syndrome (SBS) symptoms. Specifically, we found that SBS symptoms are more prevalent when the air quality is perceived as stuffy. While other environmental aspects such as temperature comfort level, air movement, light, vibration, and overall comfort did not show a significant association with SBS symptoms. These findings contribute to our understanding of the specific factors that may contribute to the development and exacerbation of SBS.

Supporting our findings, a study investigated the relationship between air quality and SBS symptoms in office environments. Their results align with our study, showing that poor air quality, characterized by high levels of pollutants and inadequate ventilation, is significantly associated with the occurrence of SBS symptoms [42]. This highlights the importance of maintaining good air quality through proper ventilation and reducing pollutant sources to mitigate the prevalence of SBS symptoms.

In regard to the environmental aspects in winter, our study found no significant associations between temperature comfort level, air movement, air quality, light, vibration, and overall comfort with SBS symptoms. However, we did observe a statistically significant association between noise and SBS symptoms, with 23.5% of participants reporting dissatisfaction. This finding suggests that noise pollution may contribute to the development of SBS symptoms during the winter season.

A study supports our finding regarding the association between noise and SBS symptoms. Their research investigated the impact of indoor environmental factors on the prevalence of SBS symptoms in office workers. They found that exposure to high levels of noise was significantly associated with the occurrence of SBS symptoms [8]. This emphasizes the need for effective noise control measures in indoor environments to reduce the risk of SBS and improve occupant comfort and well-being.

Although our study did not find significant associations between certain environmental aspects and SBS symptoms, it is important to note that the development of SBS is influenced by multiple factors, including individual susceptibility, specific pollutant exposures, and building characteristics. Therefore, further research is needed to explore the complex interplay between these factors and their contribution to the manifestation of SBS symptoms.

In conclusion, our study highlights the significant association between air quality and the presence of SBS symptoms, particularly in terms of perceived stuffy air. These findings are supported by previous research indicating that poor air quality and inadequate ventilation contribute to the occurrence of SBS symptoms. Additionally, our study identified noise pollution as a significant factor associated with SBS symptoms during the winter season. These findings underscore the importance of addressing air quality and noise control measures in indoor environments to mitigate the prevalence of SBS symptoms and promote occupant well-being.

Limitations:

While this study contributes to the existing knowledge on SBS and its relationship with IEQ, there are some limitations to consider.The data collected in this study relied on self-reporting from participants, which introduces the potential for recall bias and subjective interpretations. Participants' perceptions of environmental aspects and SBS symptoms may vary, leading to potential inaccuracies or misinterpretations of the data.Although the study examined various environmental aspects, it did not consider all potential factors that could influence SBS symptoms. Other variables such as, CO2, pollutants, and specific sources of air contamination were not included, which could have impacted the results.SBS symptoms are subjective and can be influenced by individual perception and psychological factors. The study did not account for individual differences in symptom reporting, making it difficult to ascertain the exact impact of the environmental aspects on SBS symptoms.

Conclusion:-

This study aimed to examine the association between environmental aspects and the presence of Sick Building Syndrome (SBS) symptoms. The results revealed that 18.1%of individuals reported experiencing symptoms associated with SBS. The findings indicate a significant association between air quality (fresh vs. stuffy) and the presence of SBS symptoms, with SBS symptoms being more prevalent when the air quality is stuffy. However, other environmental aspects such as temperature comfort level, air movement, light, vibration, and overall comfort were not found to be significantly associated with SBS symptoms. Additionally, in the winter season, noise was found to have a statistically significant association with SBS symptoms.

These findings contribute to the existing body of knowledge on SBS and provide valuable insights into the specific environmental factors that may influence the occurrence of SBS symptoms. The identification of air quality as a significant factor highlights the importance of maintaining adequate ventilation and fresh air supply in indoor environments to mitigate the risk of SBS. Addressing air quality issues, such as stuffiness, can potentially help reduce the prevalence of SBS symptoms and create a healthier and more comfortable indoor environment.This study contributes valuable insights to the field of indoor environmental quality and its impact on occupant health. The results emphasize the need for continuous efforts to improve indoor air quality and address potential factors that contribute to the development and exacerbation of SBS symptoms. By implementing appropriate measures to enhance air quality and considering the impact of noise, building managers, architects, and policymakers can create healthier and more productive indoor environments.

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