Sick Building Syndrome and Effects in the Environment in Owerri IMO State

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Abstract

Buildings are integral parts of the community. They provide shelter for humans as well as places for economic activities that result in development of the community. Health issues associated with buildings is an observable fact in research and a concern for longevity. Among the outcome of building related concerns on residents are health issues such as Sick Building Syndrome (SBS), but if not detected and treated early enough would eventually result to reduction in life expectancy ratio of residents of the building. Therefore the aim of this research was to examine the effects associated with sick building syndrome in the environment so as to identify possible solutions. The research area was Ihiagwa in Owerri, Imo State. The research was conducted using questionnaires to obtain information and analyzed using SPSS. Results show that poor building maintenance, inadequate ventilation of buildings and uninformed occupant activities are the major causes of SBS. Educating occupants on the effects and causes of SBS go a long way in reducing its dominance.

Key words: *Sick Building Syndrome, Environment*

I. INTRODUCTION

Buildings play an important role in determining the general well-being of the society and by extension the economic well-being of the nation. This signifies that building is one of the essential physical facilities, which constitutes Parts of our most valuable assets. According to Levin (1995) a healthy building is one that adversely affects neither the health of its occupants nor the large environment. As Akinsola and Ojewole, (2008) Put it that, housing condition play a major role in the individual health state and also in environmental health as a wide variety of housing features may influence their physical, social and the mental well-being of occupants.

Consequently, despite the significance importance of buildings to mankind, not all buildings epitomize this. Sadly however, people living or working in some buildings today are becoming ill, especially in modern buildings with closed mechanically ventilated systems. This phenomenon according to Wan, (1992) came to be known as "Sick Building syndrome" or (SBS). Sick Building Syndrome (SBS) is used to describe cases in which building occupants experience general non – specific symptoms of malaise such as irritation of the eye, nose, and throat, lethargy and dizziness. (SBS) can also be describe as situations in which building occupants experience acute health and discomfort effect that appear to emanate from the building. As Okolie, Shakantu and Obodo (2009) put it that, a building is referred to as sick building if 20% of its occupants suffer from the symptoms of the syndrome and get relief soon after learning the building. As argued by freckless (2003), the term sick building is often used as a misnomer as buildings do not actually get sick but people do. He went further to state that in cases of SBS the cure involves a diagnosis of the problem of the building, sorting its remedy and applying it.

Poor environmental quality has its greatest impact on people whose health is already at risk. Therefore, environmental health must address the societal and environmental factors that increase the likelihood of exposure to disease. Most people believe that sickness can be as a result of food intake, exposure to dirty environment, etc. However, research shows that there are other Factors that can cause sickness, which include sick building syndrome (SBS). In recent years, a large number of incidents have been reported, where challenge on occupants' health and comfort have been linked with buildings where they spend time. These health issues have been sick building syndrome (SBS) or Building Related illness (BRI). Research shows that building material play a significant role in the cause of SBS or BRI Gustatsson (1992). In the case of BRI, the cause of illness is directly linked to the building and in many instances to the building material. While for SBS, it is difficult to find a direct connection between a single cause and the health challenges. It is been observed that pollutant from building materials, is one of the cause of health challenge among several others. Thus, indoor air pollution (IAP) caused by building materials and other source in the indoor space can be considered as possible causes of both BRI and SBS. However, the way building materials are handled is a major determinant of natural environment and people's health.

II. STATEMENT OF PROBLEMS

The sick building syndrome generally causes

discomfort in building. People can react differently to different environmental conditions particularly if they have pre-existing asthma or another medical condition or if they are just sensitive to an indoor pollutant this could be caused by inadequate ventilation, chemical contaminants from indoor or outdoor sources, and/or biological contaminants. "Bacteria, molds, pollen, and viruses are types of biological contaminants". If it's not looked into, it could result to death.

III. SIGNIFICANCE OF THE STUDY

At the end of this study it will help in enlightening the cases of acute health and discomfort experienced in sick buildings. This will ensure a better environment and improved standard of living.

IV. AIM AND OBJECTIVES

The aim of this project is to access the effect of sick building syndrome (SBS) in the environment.

A. Objectives

i. To articulate literature in sick building syndrome.
ii. To identify the causes and indicators of sick building syndrome.
iii. The effects of sick building syndrome on the occupant.
iv. Recommendation of measures to tackle sick building syndrome.

V. LIMITATION OF STUDY

The limitation envisaged in carrying out this study is the inability to get the respondents fill and bring it to me immediately and how Peoples responds is d function of how the environment applies to their senses.

VI. SCOPE OF STUDY

The study is limited to investigation of sick building syndrome and its effects in Ihiagwa Imo State, Nigeria. Nevertheless, the study would seek to suggest participatory ways to enlighten the public on the factors causing sick building and remediation.

VII. METHOD OF STUDY

The method of study to be adopted in the course of carrying out this is a well-structured questionnaire that was distributed to several building occupants in the sick buildings.

VIII. LITERATURE REVIEW

The primary purpose of buildings is to provide occupants with conducive, safe, comfortable, healthy and secured indoor environment to carry out different kinds of activities ranging from work, study, leisure and family life to social interactions. In order to achieve this purpose, buildings are designed, planned, constructed and managed based on standards and specifications established by governments, professionals and experts who are supposed to have adequate knowledge of users' needs and expectations. Kaitilla (1993), Ukoha and Beamish (1993), Zeiler and Boxem (2008), Mer et al (2009).

Buildings are regarded as enclosures designed and constructed to provide minimum level of comfort for the occupants. Buildings also provide safety, protect the occupants from effects of weather and give internal comfort (Ogunoh, 2008)

According to Obiegbu (2003) a building is an essential modifier of micro climate, a space isolated from climate, temperature and humidity, fluctuations, sheltered from prevailing winds and precipitation, and with artificial means. Fadamiro (2002) also emphasized that buildings are enclosures for space designed for specific uses, meant to control local climate, distribute services and evacuate wastes. Building being an essential part of human existence is regarded as a life supporting machine and ranks second to food. That is why people and building are inseparable. This is what prompted Akinsola (2006) to say that the existence of building structure is a basic necessity in every society, that their presence in most cases determines the level of growth and development in any developing society. While World Health Organization (WHO) (1989) maintained that housing is a residential environment which includes in addition to the physical structure that man uses for shelter, all necessary services, facilities, equipment and devices needed or desired for the physically, health and social well being of the family. Akinsola and Ojewole (2008) state that housing condition play a major role in individual health states and also in environmental health as a wide variety of housing features may influence the physical, social, and the mental well being of occupants.

However, in spite of the significant importance of building to mankind; today, we find that people living or working in some buildings are becoming ill, especially in modern buildings with closed mechanically ventilated systems. This phenomenon according to Wan, (1992) came to be known as " Sick Building Syndrome" or SBS.

A building cannot be regarded totally as a human body system but can be compared to human systems in some respects. However, buildings are faced with various threats especially their maintainability, in order to retain their economic, social and structural values. Buildings depreciate with time when necessary remedial measures

are not applied. When a building is allowed to get to a state of dilapidation i.e., when the cost of repairs is almost equal to the cost of erecting a new one, it is advisable not to carry out any maintenance work on it, the best solution is to demolish. The reason being that it has lost its social, economic and structural value and it is not even safe for human habitation.

IX. THE CONCEPT OF SICK BUILDING SYNDROME (SBS)

R.R.Omonikweinka (2005) stated that Sick Building Syndrome can be treated in two perspectives. The first perspective is from the user perspective: an occurrence of discomfort or unease or illness felt by the user of the building. The second perspective is when there are defects in the building structure, envelope and internal environment. The indoor environment is a creation of the modern era, Column, Slab, Substructure and foundation. Previously, buildings were notable for the extent to which they were really open to the outside air, a system that could be referred to as natural ventilation Omonikweinka(2005). But, technological advances have permitted us to seal buildings tightly, rearticulate the air within them and fill them with a variety of particle-and chemical-emitting materials and objects People spend most of their time indoors with some estimates being that humans spend more than 90% of their lives inside constructed environments. Over time, the construction of buildings has increasingly focused on energy efficiency and comfort. Central heating and cooling systems are the norms, and home and office construction has moved toward minimizing heat or cool air loss by making buildings more airtight and at the same time, more complex Omonikweinka (2005) Materials are being used for furniture, clothing fabrics, cleaners, detergents, and preservatives. Compared, these and other parallel trends have created buildings where exposure to foreign proteins, dusts, gases through inhalation has gone far beyond what historically has been the case. R.R.Omonikweinka (2005) stated that the concept of the "sick building syndrome", the types of allergens or stimuli most likely to be found in today's buildings, and how individuals can better cope with contemporary construction of indoor environments are going to be discussed in this lecture. In the 1970's, health care providers were faced with increasing numbers of people having headaches and allergic-like reactions to unspecified stimuli. Some of the reactions included lethargy, fatigue, headache, dizziness, and nausea, irritation of mucous membranes, eye and/or nasopharyngeal irritation and sensitivity to odors. Through exploration over several years, these reactions were linked to common symptoms of people in specific buildings and a lack of symptoms when these people were not in the buildings. This spectrum of specific and non-specific complaints, when tied to a particular building, became known as the "Sick Building Syndrome". It is what may be compounded by a variety of sources including rat/cockroach infestations, sanitary conditions, as well as indoor air pollution R.R.Omonikweinka (2005).

X. CAUSES OF SICK BUILDING SYNDROMES

Sick Building Syndrome is a worldwide Problem and is emerging as a severe problem in buildings. That is why it is currently the subject of numerous investigations and conferences, yet as Okolie, Shakantu and Obodoh, (2009) put it, little has actually been proven about the causes of sick building syndrome. According to Molina, Pickering, Valbjorn and Maurizio, (1989), the cause of SBS which is probably multifactorial, is not usually accompanied by any organic lesion or physical sign and is, therefore, diagnosed by exclusion. However, they maintained that SBS has been found in all the major cities of the Western world,among people who work or live for several hours a day in an artificial atmosphere, and can be diagnosed only after eliminating all other building related illnesses.

In another development, Research has consistently shown that the following design elements appear to increase the prevalence of SBS: wall to wall carpets, large areas of upholstery, large amount of shelving and horizontal surfaces, crowding, office size, poor lighting, poorly designed work stations, air quality and poor environmental control by individuals (Best & Valence, 1999). They state further, that the most significant determinant appears to be HVAC design: 50% of problems are due to poorly designed operated or maintained heating, ventilation and air conditioning systems. However, there is another consensus of opinion among authors that SBS is influenced in part by – indoor surface pollution such as dust, fibers and micro-organisms deposited on or in surfaces of buildings (Raw, Rays & Whith head 1993; Akin 7 Brooks, 2005, Firor, (2006) Others as stated by the United State Environmental Protection Agency (2006) include;

a) Poor design concept of building ion areas of illumination, Ventilation, Production and installation of air conditioning system.
b) Poor and uninformed occupant activities in buildings
c) Use of building materials that are hazardous to occupant health and
d) Operation and maintenance of building in manners inconsistent with their original design or prescribed operating procedure.

In a similar vein, Okolie, Shakautu and obodoh, (2009) emphasized that the sources of SBS are mainly influenced by architectural properties, organizational and facilities management processes. These causes include:

A. Chemical Contaminants From Outdoor Sources :

The air that enters a building from outdoors can be a source of indoor air pollution, especially in a situation where fumes from motor vehicle exhaust, plumbing vents and building exhaust (e.g. Bathrooms and kitchens) find their way into a building due to poorly located inlets, vents, windows, other openings and poor location of high voltage air conditioning (HVAC) system inlet vents (Burgez, 2004).

B. Chemical Contaminants From Indoor Sources:

Most indoor pollution comes from source with the building. Examples of these sources include adhesives for carpeting, upholstery, manufactured wood products chemical from copy machines, pesticides and cleaning, formal dehyde ozon and high level volatile organic compounds (Vocs). A major contributor or source of high level volatile organic compounds is environmental tobacco smoking in addition to other toxic compounds and irrespirable particulate matter (Health 2006) Volatile organic compounds have bee4n shown by researchers to cause chronic and acute and acute health effects at high concentrations. Same are known as carcinogen, (combination of products such as carbon monoxide, nitrogen, dioxide as well as repairable particles) which come from unvented kerosene and gas space heaters; woodstoves, fire place and gas stoves.

C. Biological Contaminants:

These include pollens, bacteria, viruses and moulds. These contaminants may breed in stagnant water that has accumulated in dust humidity and drain pains or where water has collected on ceiling tiles, carpeting or insulation. Bird and insect droppings can be a source of biological contaminants; some of these contaminants like mildew also breed on damp surfaces.

D. Inadequate Ventilation:

The design of air tight buildings with windows that do not open results to insufficient air necessary to maintain the health and comfort of building occupants. Inadequate ventilation may also occur if heating, ventilation and air conditioning system do not effectively distillate air to the occupants of a building and this is thought to be a very significant factor in sick building syndrome (EPA, 1990).

E. Poor Maintenance:

One of the causes of sick building syndrome is poor maintenance, ineffective and lack of frequent cleaning. According to Iyagba (2005) one of the greatest economic and social problems of a nation is the general absence of a maintenance culture. Buildings in development countries lack adequate maintenance, care or attention. Though unfortunate it is a glaring fact that these buildings are in very poor and deplorable condition of structural and decorative disrepair. Adequate maintenance frequency and effective cleaning will no doubt help in mitigating sick building syndrome.

F. Re – Circulation of Air and Pollutants:

Many buildings are now designed to reduce the intake of fresh air from outdoors because it is cheaper to re – circulate air that has already been warned in winter or cooled in summer than to take in outside air and heat or cool it repeatedly (Sawnor, 1995). Many synthetic materials are used in construction, insulation and furnishing. These materials emit varieties, of toxic chemicals and volatile organic compounds such as formaldehyde. The increasing use of machines also adds to indoor air pollution e.g. ozone from photocopiers, noise from printers and electromagnetic radiations from visual display units. But with the present design of building, that allows only very little fresh outdoor air intake, chemical pollutants are not diluted but are rather re – circulate by high Voltage Air Conditioning Systems. Air conditioning systems could also harbor pollutants or micro – organisms within their vents or ducts thereby adding to the contaminants in the work place. Improving ventilation of a building can help to reduce the amount of contamination with chemical or micro – organisms (BBC News Online, 1999).

G. Electromagnetic Radiation

Gadgets like microwaves, televisions and computers emit electromagnetic radiation, which ionizes the air. Extensive wiring without proper grounding also creates high magnetic fields, which have been linked to cancer.

H. Psychological Factors

Excessive work stress or dissatisfaction, poor interpersonal relationships and poor communication are often seen to be associated with SBS. Poor and inappropriate lighting with absence of sunlight, bad acoustics, poor ergonomics and humidity may also contribute to SBS. The symptoms of SBS are commonly seen in people with clerical jobs than in people with managerial jobs because professionals or managers have better working conditions. The symptoms are more common in females than in males probably because more females are in secretarial jobs, they are more aware of their health or a lesser dose of pollutants is required to manifest the effects. The symptoms are more common in air-conditioned buildings than in naturally ventilated buildings and are more common in a public sector building than in a private sector building.

XI. METHODOLOGY

A. Research area

***1. IHIAGWA*:** The Ihiagwa people are an Igbo speaking

ethnic-group in the south-eastern part of Nigeria. This people who number about 10,000 are easily identified among the Oratta people of Owerri in Imo state of Nigeria. They are located at Latitude-5N, Longitude-7E, Altitude-156M (Altitude 511ft) and 12km south from the Owerri capital territory. These people are grouped into an autonomous community otherwise called Ihiagwa autonomous community. The town Ihiagwa autonomous community is organized into eight villages namely: Iiriamogu village, Ibuzo village, Nnkaramochie village, Umuezeawula village, Aku/Umuokwo village, Mboke village, Umuelem village and Umuchima village. It is also home to the Federal University of Technology. (Wikipedia 2009)

2. Sampling Technique

For the purpose of this study, a random sampling technique was used in the distribution of question to the concerned occupants of the building.

3. data collection techniques.

Primary data was fetched using: Direct observation and a well structured Questionnaire in this research. Secondary data sources for this study are: journals, published articles, and textbooks to address the problem of limitations inherent in various methods of data collection.

B. Research instrument

The instrument used for gathering data for this study is a well structured questionnaire covering the effects of sick building syndrome to the health of its occupants. The questions were a mixture of open ended and close ended questions. They were administered to occupants of buildings with sick building syndrome to know the health implication of such buildings on its occupants. The questionnaires were self administered whereby they were hand delivered to the respondents to complete the questionnaires themselves.

C. Sampling size

The sample size that represents the targeted unknown population was determined from following the equation formula used below.

$$\mathbf{n= (z^2pq)/d^2} \quad \text{.....} \quad (3.1)$$

Where;

n = the targeted/desired sample size

z = known as the critical value

p = the proportion in the target population estimated to have particular character (normally between the range of 0.1-0.5)

q = 1.0-p

d = deviation

P = the proportion in the target population estimated to have particular characteristic (normal between the range of 0.1 - 0.5)

q = 1.0-p

d = degree of accuracy corresponding to the confidence level and Z selected.

Sample size calculation depends on: % confidence level.

Whether it's a known population or unknown population.

Confident level and its corresponding z and d value.

A 90% level of confidence has $\alpha = 0.10$ and critical value of $z_{\alpha/2} = 1.64$.

A 95% level of confidence has $\alpha = 0.05$ and critical value of $z_{\alpha/2} = 1.96$.

A 99% level of confidence has $\alpha = 0.01$ and critical value of $z_{\alpha/2} = 2.58$.

A 99.5% level of confidence has $\alpha = 0.005$ and critical value of $z_{\alpha/2} = 2.81$.

For the purpose of this study, a confidence level of 95% was adopted owing to the fact that the questionnaire was geared towards knowing the effect of sick building syndrome on the health of occupants dwelling in such buildings.

Consequently, the sample size is determined as thus,

z = 1.96, d = 0.05 where p = 0.1, q =0.9

$\mathbf{N} = (1.96^2 X 0.1 X 0.9)/ (0.05)^2 = 138$

It therefore means that a total of hundred and thirty eight occupants (respondents) will be sampled in the area using random sampling technique.

D. Techniques for data analysis

The data obtained were analyzed using descriptive statistics and use of tables and charts.

E. Statistical analysis

The descriptive statistics was used to evaluate the relative ranking of the factors that causes sick building syndrome and the health implication on its occupants.

The results is transformed to relative importance indices based on the linkert Scale, to determine the relative ranking of the factors and also effects, these scores were then transformed to Relative Importance Index (RII).

$$RII = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

…… (3.2)

Where w is the weighting given to each factor by the respondent, ranging from 1 to 5, ($n1$ = number of respondents for option designated as 1, $n2$ = number of respondents for option designated as 2, $n3$ = number of respondents for option designated as 3, $n4$ = number of respondents for option 4, $n5$ = number of respondents for option 5), A is the highest weight (i.e. 5 in the study) and N is the total number of samples. The relative importance index ranges from 0 to 1.

F. Data presentation and analysis

This chapter is concentrating on the data analysis of the various responses obtained from the distribution of the questionnaires used for this project topic. It will be divided into two parts; the first part for the analysis of the data obtained and the second part for the discussion of the findings.

1. Data Analysis

A total of one hundred and thirty eight (138) were distributed and on hundred and twenty (120) were returned, giving a response rate of 86.96%.

Table 4.1: Respondent Profile

S/N		OPTION	FREQUENCY	%
1	**Gender**	A-Male	66	55
		B-Female	54	45
		Total	**120**	**100**
2	**Marital Status**	A-Single	71	59.2
		B-Married	49	40.8
		Total	**120**	**100**
3	**Age**	19-24	43	35.8
		25-30	48	40
		31-36	19	15.8
		37-42	10	8.3
		Total	**120**	**100**

Source: Survey, 2015

Table 4.1 shows the respondents' profile and the different characteristics used to profile the respondents. These characteristics are gender, marital status and age, which each characteristic containing its own range bracket to enable easier grouping. From the table, it can be observed that the male(55%) respondents are more than the female(45%) respondents respectively. 71 people (59.2% of respondents) were single while the remaining 49 (40.8% of respondents) were married.

Respondents between the age bracket of 25-30 were of the highest response rate, leading with a percentage of 40%. The second highest age bracket with 35.8% is 19-24, the third 31-36 with 15.8% and the least being 37-42 with 8.3%.

Table 4.2: Subjective Evolution to Living Environment

S/N	CAUSES	1	2	3	4	EF	Efx	Mean	Rii	Rank
1	Inadequate ventilation	5	-	58	57	120	407	3.37	0.84	2nd
2	Chemical contaminant from indoor sources	20	29	48	23	120	314	2.62	0.66	10th
3	Chemical contaminant from outdoor sources	27	19	41	33	120	320	2.67	0.67	9th
4	Poor maintenance	-	16	40	64	120	408	3.40	0.85	1st
5	Re-circulation of air and pollutant	19	19	49	33	120	336	2.80	0.70	7th
6	Biological contaminants	13	31	48	28	120	331	2.78	0.70	7th
7	Asbestors and radon	15	27	35	43	120	346	2.88	0.72	5th
8	Poor design concept of building	15	26	39	40	120	344	2.87	0.72	5th
9	Poor and uninformed occupant activities in the building	10	10	48	52	120	382	3.18	0.80	3rd
10	Use of building materials that are hazardous to occupant	12	17	38	53	120	372	3.10	0.78	4th

	health									

Source: Survey, 2015
Where 1= None, 2= Diagreed, 3= Agreed, 4= Strongly agreed

Table 4.2 shows that respondents believe that poor building maintenance is the leading cause of building sickness. This is followed by inadequate ventilation as another cause of building sickness. Respondents agree that chemical contaminants from indoor source is the least concerning cause of building sickness.

Table 4.3: Health Impact of Sick Building Syndrome on Occupants

S/N	INDICATORS	1	2	3	4	Ef	Efx	Mean	RII	RANK
1	Headache	30	35	30	25	120	2109	1.83	0.46	9TH
2	Throat irritation	51	42	11	13	120	2233	1.86	0.47	8TH
3	Nose irritation	5	27	54	34	120	3557	2.98	0.75	1ST
4	Eye irritation	26	34	40	20	120	2944	2.45	0.61	4TH
5	Dry cough	25	37	48	10	120	2833	2.36	0.59	5TH
6	Dry skin	33	37	37	120	120	2988	2.48	0.62	3RD
7	Itchy skin	60	38	11	11	120	2113	1.78	0.45	10TH
8	Dizziness	40	22	23	25	120	3553	2.94	0.74	2ND
9	Nausea	40	57	10	5	120	2004	1.70	0.43	11TH
10	Fatigue	16	35	35	21	120	2755	2.29	0.57	6TH
11	Difficulty in concentrating	21	18	18	35	120	1500	1.25	0.31	12TH
12	Sensitivity to odour	33	31	20	20	120	2332	1.93	0.48	7TH

Source: Survey, 2015
Where 1= None, 2=Disagreed, 3=Agreed, 4= Strongly agreed

Table 4.3 shows the different health impacts sick building syndrome can have on occupants of the building. The leading impact on occupants from sick building syndrome is nose irritation. This is followed by dizziness felt by the occupants. Dry skin, eye irritation, dry cough and fatigue come in as third, fourth, fifth and sixth on the ranking of health impacts to occupants. The least concerning effect is difficulty for occupants to concentrate on daily tasks.

Table 4.4: Recommendation/Suggestions on Sick Building Syndrome

S/N	Question		Answer	Frequency	Percentage
1	Do you think routine maintenance of HVAC systems help reduce sick building syndrome?	I ii	Yes No	88 32	73.33 26.67
			Total	**120**	**100**
2	Do you think local exhaust ventilation for special rooms (e.g. smoking areas) can help to reduce sick building syndrome?	I ii	Yes No	94 26	78.33 21.67
			Total	**120**	**100**
3	Do you think replacement of water-stained ceiling tiles and carpeting will help in reducing sick building syndrome?	I ii	Yes No	92 28	76.67 23.33
			Total	**120**	**100**
4	Do you think more allowance of time is needed for building materials in new or remodeled areas to off-gas	I ii	Yes No	91 29	75.83 24.17

	pollutants before occupancy?				
			Total	**120**	**100**
5	Do you think venting contaminant source emissions to the outdoors will help to reduce sick building syndrome?	I ii	Yes No	80 40	66.67 33.33
			Total	**120**	**100**
6	Do you think storage and use of paints, adhesives, solvents and pesticides in well ventilated areas and use during periods of non-occupancy help reduce sick building syndrome?	I ii	Yes No	77 43	64.17 35.83
			Total	**120**	**100**
7	Do you think increasing ventilation rates and air distribution can be a solution to sick building syndrome?	I ii	Yes No	95 25	79.17 20.83
			Total	**120**	**100**

Source: Survey, 2015

XII. FINDINGS AND DISCUSSIONS

By studying the various results obtained from the questionnaires, the following observations can be made regarding Sick Building Syndrome;

i. Hazardous materials play a major role in the causes of building sickness.

ii. Poor and uninformed occupant activities are second to hazardous materials in the causes of building sickness.

iii. Nose irritation is the greatest impact of sick building syndrome on occupants of the building.

iv. A majority of the respondents think that routine maintenance of HVAC systems would help in reducing sick building syndrome.

v. A majority also think that local exhaust ventilation for specific rooms like copy rooms, printing facilities and designated smoking areas can help to reduce sick building syndrome.

vi. More respondents believe that the replacement of water-stained ceiling tiles and carpeting will help in reducing sick building syndrome.

vii. A higher percentage of respondents believe that more time allowance is required for building materials to remove gas pollutants before occupancy.

viii. More respondents believe that venting contaminant source emissions to the outdoors will help in reducing sick building syndrome.

ix. Proper storage of pollutant sources in well ventilated areas as well as use of these sources during periods of occupancy is a criterion more respondents believe will reduce sick building syndrome.

x. More respondents (as much as 79%) believe that an increase in ventilation rates and air distribution will help combat sick building syndrome.

XIII. CONCLUSION

The research has shown that SBS is consequence of indoor air pollutants from building materials which are a threat to health and longevity. Since building materials are products of chemical compounds and reactions, it becomes imperative to have a working knowledge of materials used for building construction. The research has itemized and evaluated the causes and effects of SBS as emissions from building materials. In the process, a generally applicable non-validated evaluation procedure for building materials emission was adopted. The study tries to inform the consumer of building materials that will likely have adverse effects on their health and sensory comfort as far as chemical emissions are concerned. Thus reduce the risk to health and threat to life caused by poor choice of building material amongst Nigerian urban dwellers. It is primarily expected to inform occupants, home owners, government,

environmental health personnel and policy-makers who are not laboratory specialists.

The research concludes that sick building syndrome is used to describe situations in which occupants of buildings experience acute health and discomfort effect that appear to emanate from the building. This research study therefore, identifies the major effects of SBS as: headaches, dry cough and eye irritation, throat irritation, itchy skin, nausea, fatigue etc. It was however, discovered that inadequate ventilation, chemical contaminants from outdoor and indoor cases, biological contaminants and lack of maintenance culture are found to be some of the major causative factors.

XIV. RECOMMENDATION

The paper recommends among others that education of building occupants and everyone involved with the design, construction and maintenance of buildings in the subject matter is important. This will enhance and promote efficient communication with each other to work more effectively together to prevent and solve the effects of SBS. The following recommendations should also be considered in finding solutions to SBS;

Routine maintenance of HVAC (High Voltage Air Conditioning) systems including periodic cleaning or replacement of filters;

i. Replacement of water-stained ceiling tile and carpeting
ii. Institution of smoking restrictions;
iii. Venting contaminant source emissions to the outdoors;
iv. Storage and use of paints, adhesives, solvents, and pesticides in well ventilated areas, and sue of these pollutants during periods of non occupancy;
v. Allowing time for building materials in new or remodeled areas to off-gas pollutants before occupancy.Increasing ventilation rates and air distribution.
vi. Local exhaust ventilation for rest rooms, copy rooms, printing facilities and designated smoking areas.
vii. Air cleaning – can be useful. Limitations: typical furnace filter is not effective for capturing small particles;
viii. HEPA (High-Efficiency Particulate Air) filters are expensive with high pressure droops;
ix. mechanical filters are useless against gaseous contaminants. Adsorbent filters for gases are expensive and lack end of use indicators.
x. Education and communication with building occupants – very important. Opening windows to let fresh air in may upset the balance of the ventilation system.

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APPENDIX I

DEPARTMENT OF BUILDINGG TECHNOLOGY
SCHOOL OF ENVIRONMENTAL SCIENCE
FEDERAL UNIVERSITY OF TECHNOLOGY
OWERRI, IMO STATE.

Dear Respondent;

I would be grateful if you can give me a little time of your tight schedule to complete the questionnaire below. The questionnaire on **'Sick Building Syndrome and Effect in Nigeria's Environment'** is divided into **sections 'A', 'B', 'C', and 'D'** and it is expected that someone faced with the effect of sick building syndrome and with good knowledge of it should be the one to supply the required information. Fully completed information would be much more appreciated. Thanks.

Yours sincerely.

Section A: Respondent Profile.

Gender
a) Male ( )
b) Female ( )

Marital status
a) Single ( )
b) Married ( )

Age
a) 19 – 24 ( )
b) 25 – 30 ( )
c) 31 – 36 ( )
d) 37 – 42 ( )

Section B: Subjective Evolution to Living Environment

To what extent do you agree that the following factors causes sick building syndrome

Where 1= None, 2= Disagreed, 3= Agreed, 4= Strongly agreed

S/N	CAUSES	1	2	3	4
1	Inadequate ventilation				
2	Chemical contaminant from indoor sources				
3	Chemical contaminant from outdoor sources				
4	Poor maintenance				
5	Re-circulation of air and pollutant				
6	Biological contaminants				
7	Asbestors and radon				
8	Poor design concept of building				
9	Poor and uninformed occupant activities in the building				
10	Use of building materials that are hazardous to occupant health				

Section C: Health Impact of Sick Building Syndrome on Occupants

To what extent do you experience the following effects/indicators of sick building syndrome in the building you reside?

Where 1= None, 2= Disagreed, 3= Agreed, 4= Strongly agreed

S/N	INDICATORS	1	2	3	4
1	Headache				
2	throat irritation				
3	Nose irritation				
4	Eye irritation				

5	dry cough				
6	Dry skin				
7 8 9 10	Itchy skin Dizziness Nausea Fatigue				
11	Difficulty in concentrating				
12	Sensitivity to odours				

Section D: Recommendation/suggestions on sick building syndrome

i. Do u think Routine maintenance of HVAC systems including periodic cleaning or replacement of filters will help reducing sick building syndrome?

Yes ( ) No ( )

ii. Do you think Local exhaust ventilation for rest rooms, copy rooms, printing facilities and designated smoking areas can help to reduce sick building syndrome?

Yes ( ) No ( )

iii. If No what do you think can be done using Local exhaust ventilation for rest rooms, copy rooms, printing facilities and designated smoking areas can help to reduce sick building syndrome?……
……..
……
……
……

iv. Do you think replacement of water-stained ceiling tile and carpeting will help in reducing sick building syndrome?

Yes ( ) No ( )

v. Do you think more allowance of time is needed for building materials in new or remodeled areas to off-gas pollutants before occupancy?

Yes ( ) No ( )

vi. If No what measures can be taken to enforce its implementation in other to reduce its causes of sick building syndrome?……
……
……
……
……

vii. Do you think venting contaminant source emissions to the outdoors will help to reduce sick building syndrome?

Yes ( ) No ( )

viii. Do you think storage and use of paints, adhesives, solvents, and pesticides in well ventilated areas, and sue of these pollutants during periods of non occupancy?

Yes ( ) No ( )

ix. Do you think Increasing ventilation rates and air distribution can be a solution to sick building syndrome?

Yes ( ) No ( )

x. If No what measures can be taken to ensure that this factors reduces sick building syndrome?
…….....
.....
.....
.....
…….....