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Sick building syndrome—A case study in a multistory centrally air-conditioned building in the Delhi City

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Abstract

Recently, airtight envelope system has become popular in the design of office buildings to reduce heating and cooling loads. Maintaining allowable indoor air quality (IAQ) for such airtight buildings totally depends on mechanical ventilation systems. Subsequently, poor operation of the ventilation system in such office buildings causes ineffective removal of polluted indoor air, and displays a sign of "sick building syndrome" (SBS). User's perception is an important parameter for evaluating IAQ. A questionnaire study was carried out to investigate the prevalence of the SBS at a multistory centrally air-conditioned Airport Authority of India (AAI) building in the New Delhi city. Quantification of the perceptions of the users regarding IAQ was done by converting their responses to a SBS score. The quantified answers were then subjected to statistical analysis. Qualitative analysis of the questionnaire was carried out to evaluate relationships between SBS score and carbon dioxide (CO_2) and other parameters related to building and work environment. Quantitative analysis of IAQ was also conducted by monitoring indoor concentrations of four pollutants, namely, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), suspended particulate matter (SPM) and carbon monoxide (CO). Concentrations of pollutants were complying with IAQ standards as given by ASHRAE and WHO. The SBS was higher on the third floor as compared to other floors and the control tower. The main symptoms prevailing were headache (51%), lethargy (50%), and dryness in body mucous (33%). The third floor and the control tower were affected by infiltration, mainly from entrance doors. A direct relation between the average SBS score and CO_2 concentration was found, i.e., the average SBS score increased with CO_2 concentration and vice versa, clearly signifying the usefulness of SBS score in IAQ.

Keywords: SBS; Indoor air pollution; Air-conditioned building; SBS score

1. Introduction

In order to satisfy the increasing demands on indoor environment quality, heating, ventilation and air conditioning (HVAC) systems become more and more complex. Inadequate control of system may result in poor indoor air quality (IAQ). The general terminologies used to describe the effect of poor IAQ on health are SBS, tight building syndrome, and building related illnesses, e.g. nausea, skin irritation, lethargy, etc. The symptoms of SBS are difficult to diagnose as they are dominated by sensory reactions about which very little is known even from the medical point of view [1]. SBS is defined as a set of sub-clinical symptoms with no identified cause. Sundell [2] found in his study that effect of SBS symptoms depend on a number of factors, that included sex, allergy, job nature, psychosocial factors, building and room characteristics etc. Factors associated with a high prevalence of SBS are the age of the building, the outdoor air flow rate, dampness problems, the presence of photocopiers or humidifiers and a low standard of cleaning. The SBS symptoms include irritation in the eyes, blocked nose and throat, complaints in upper airways, headache, dizziness, sensory discomfort from odors, dry skin, fatigue, lethargy, wheezing, sinus, congestion, skin rash, irritation and nausea [3].

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A research study conducted by Hedge [4] showed that IAQ complaints and the SBS are the outcome of complex processes initiated by a set of stressful multiple risks, which create personal strain. The term SBS is used to describe situations in which building occupants experience acute health effects that appear to be linked with time spent in a building, but no specific illness or cause can be identified [5]. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. Other cases of IAQ problems may be related to building-related illness in which a known 'agent' or 'pollutant' is involved. ASHRAE [6] defines acceptable IAQ as being air in which there are no known contaminants at harmful concentrations and where the substantial majority (80% or more) of the people exposed, do not express dissatisfaction.

Indoor air pollution has become a major concern in India in recent past years. Khare et al. [7,8] carried out a questionnaire survey at four different sites of an academic institute–Indian Institute of Technology (IIT) Delhi. User's perceptions regarding IAQ were quantified by converting their responses to a SBS score. CO_2 was taken as a variable in establishing a relationship between average SBS score and indoor pollutant concentration.

2. Outline of the measurements

2.1. The Airport Authority of India building—Test site

The object building was a centrally air conditioned Airport Authority of India (AAI) building at Indira Gandhi International (IGI) airport. It had four floors and an attached garage in the basement. The building was located in the outskirts of Delhi, surrounded by cargo shed on one side and a four lane road in front of the building approaching towards the international terminal. The plan of AAI building is shown in Fig. 1. The traffic volume was 'low' (100 vehicles/h) [9]. The building was occupied for 24-h, having shifts for staff.

2.2. Data surveyed

The monitoring was carried out during the months of February and March, 2000, which was winter season in India, having average temperature of about 22 °C. At each floor, a room with maximum occupancy density was selected for monitoring. Questionnaires were distributed only 1 day among the occupants of the room having maximum occupancy level at each floor [10]. The occupancy density in selected rooms, at each floor and control tower, is given below:

Ground floor	35
Third floor	48
First floor	30
Second floor	37
Control tower	18

2.3. Air-conditioning system

The mechanical air-conditioning system for the building consisted of 25 Air Handling Units (AHU). The outdoor air intakes were located with each AHU to provide fresh air.

3. Environmental sampling and analysis

Carbon dioxide and four other pollutants, namely, SO_2, NO_2, SPM and CO were monitored for 8-h duration, using integrated sampling technique. The data emerging from it has been expressed as average concentration over the period of sampling (Table 1). Indoor monitoring of SPM was carried out using four handy samplers, APM820 [11], at four different locations, on each floor, as shown in Fig. 1. Gravemetric method of analysis was used to calculate the SPM concentration. The gases were sampled using absorption technique, followed by spectro-photometric analysis that provided the SO_2 and NO_2 concentrations in indoor air. Indoor air monitoring of CO and CO_2 was done using IAQ monitors [12]. CO and CO_2 measurements were taken for 8-h duration with a sampling frequency of 3 min. IAQ monitors were also used for temperature and humidity measrements (results not presented herein). Additionally, Velometer [13] was used to collect air-flow rate at AHUs.

In test building, the potential sources of indoor air pollutants were attached garage, staff canteen at ground floor, gas stoves at second floor in the test room and tobacco smoke. All the measured pollutants were at highest concentrations at ground floor as compared to other test sites. Higher concentration of CO was resulting from use of gas stoves and other combustion appliances in staff canteen. Presence of combustion appliances resulted in increased levels of NO_2, SO_2 and particulates. Specially, SPM concentration was quite high ($=138\,\mu g/m^3$) at ground floor. This elevated concentration of SPM was probably due to the presence of attached garage as vehicle exhaust emits particulates in addition to CO, NO_2, and SO_2 [3]. The entrance door with frequent human traffic was the predominant pathway of infiltration inside the building.

4. Results and discussion

4.1. SBS score

In order to take into account the occupant's perception, a questionnaire was designed, taking into consideration various factors as described in the questionnaire specimen (Appendix A). Table 2 shows different components of the designed questionnaire and the main symptoms used to evaluate the SBS score are presented in Table 3.

In order to evaluate the total amount of SBS, an integerated index, SBS score was formed. The SBS score described the total amount of SBS symptoms that included

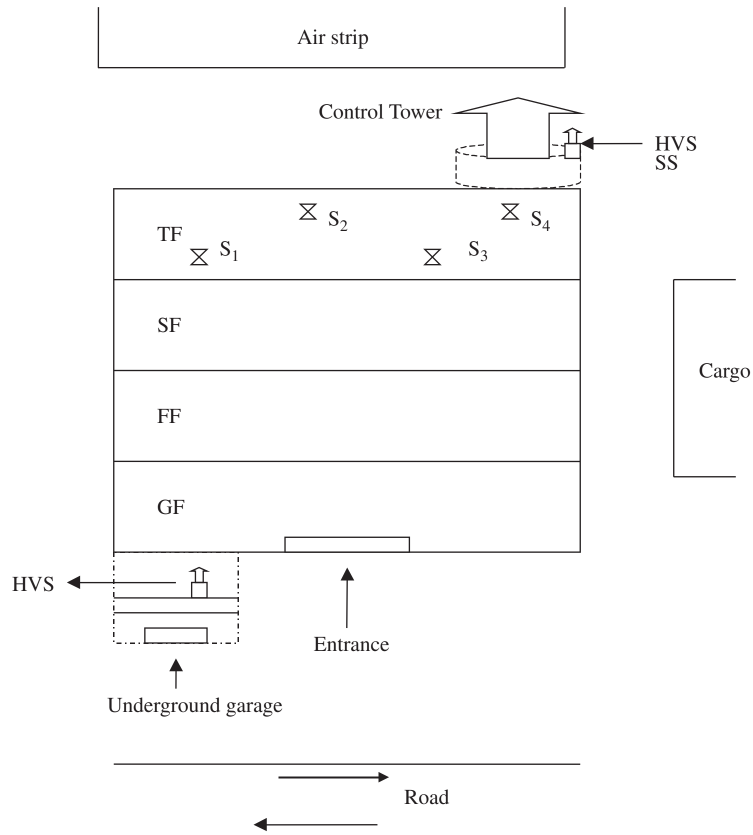

Fig. 1. Monitoring sites and other features of the Airport Authority Building at IGI airport. GF, FF, SF, and TF = ground, first, second, and third floor with seperate air handling unit's and fresh air intake. S_1, S_2, S_3, and S_4 = sampling points at each floor and control tower. HVS = high volume sampler.

Table 1
Concentration of pollutants indoor

Pollutants	Floors	Concentration (8-h average for a week)
CO (ppm) [acceptable limit: 9 ppm [6]]	Ground floor	3.33
	First floor	2.19
	Second floor	3.16
	Third floor	2.15
	Control tower	1.15
SPM (μg/m^3) [acceptable limit: 180 μg/m^3 [3]]	Ground floor	138.2
	First floor	91.3
	Second floor	75.7
	Third floor	55.5
	Control tower	44.9
NO_2 (μg/m^3) [acceptable limit: 60 μg/m^3 [3]]	Ground floor	5.65
	First floor	4.52
	Second floor	4.22
	Third floor	3.63
	Control tower	2.51
SO_2 (μg/m^3) [acceptable limit: 60 μg/m^3 [3]]	Ground floor	1.64
	First floor	1.40
	Second floor	1.36
	Third floor	1.35
	Control tower	1.25

nasal, eye and mucous membrane symptoms, lethargy, skin symptoms and headache. It indicated directly the number of different types of SBS symptoms. The questions in part IV of Table 2 asked for information related to SBS symptoms which were analyzed on a scale of 0–6 [3]. It was also used by Seppanen and Jaakkola [14]. The answers

Table 2
Components of the SBS questionnaire

Part I	Cover sheet with personal data
Part II	Questions about the workplace and conditions at the workplace
Part III	Questions about disturbing or bothering factors at the workplace
Part IV	Questions about diseases and six main symptoms and signs of SBS
Part V	Questions about job satisfaction
Part VI	Questions about overall subjective rating for the working area

Table 3
The six main symptoms of the SBS questionnaire

Number	Symptoms
1	Dry, itching or irritated eyes
2	Headache
3	Sore or dry throat
4	Unusual tiredness, fatigue, or drowsiness
5	Stuffy or runny nose, or sinus congestion
6	Dry or itchy skin

Sampling site	SBS score
(a) SBS score on different floors and control tower	
Ground floor	1.96
First floor	1.57
Second floor	2.89
Third floor	3.01
Control tower	0.97

Symptoms	Prevalence (%usually)[a]				
	Ground floor (GF)	First floor (FF)	Second floor (SF)	Third floor (TF)	Control tower (CT)
(b) Prevalence of SBS symptoms on different floors					
No. of questionnaires used in the analysis (%)	29 (Male—21; Female—8)	24 (Male—19; Female—5)	32 (Male—25; Female—7)	44 (Male—38; Female—6)	15 (Male—11; Female—4)
Irritation in the eyes (%)	19	24	52	49	14
Irritation in the nose (%)	31	23	27	43	21
Dryness in mucous (%)	16	18	61	53	41
Lethargy/drowsiness/tiredness (%)	43	29	72	58	49
Dryness on the face/hands (%)	23	14	27	37	63
Headache (%)	37	25	79	65	49
CO_2 concentration (ppm)	573.3	371.3	684.7	722.9	268.3

[a] %Usually = %often + %sometimes.

might be 'often', 'sometimes', or 'never'. They were assigned the scores of 1.0, 0.5, and 0, respectively. The responses of occupants suffering from chronic ailments to questions 2–7 of part IV (Health) of questionnaire (Table 2) were neglected in analyzing the SBS score. Further, chronic ailments were identified on the basis of occupants responses in question number 1 of part IV (Health), (Table 2) and question number 3 of part VI (Overall subjective rating for the working area) of questionnaire, i.e. if occupants response was 'positive' in both the questions of parts IV and VI, he/she was then categorized as being suffering from some chronic disease. In analysing the SBS symptoms, standard statistical test, chi square (χ^2) was used.

Table 3a presents the SBS score on different floors and control tower of the building. The third floor of the building was having maximum SBS score (= 3.01) and the control tower was having minimum (= 0.97). It implies that occupants of the third floor were having, on an average, three SBS symptoms out of six and in the control tower, it was almost negligible. It can be concluded that a score of three may be cosidered as 'unacceptable' because 50% of the SBS symptoms affected the occupants, creating an unhealthy indoor environment; a score of less than 1 may be considered as "acceptable" as no SBS symptoms would be present in that case.

Further, Table 3b presents data on CO_2 concentration and prevalence of various SBS symptoms on different floors and the control tower of the test site based on occupants response in the questionnaire. Only those responses, choosing 'often' and 'sometimes' as an alternative to questions 2–7 of part IV (Health), (Table 2) of the questionnaire were considered while analyzing the percentage response.

5. Correlation among different parameters and mean SBS symptoms/person

The questionnaire responses were used to set up a correlation between mean SBS symptoms/person and different parameters e.g. age, sex, eyewear, computer use, job stress, perceived IAQ (PIAQ), weekly environmental conditions on all the floors. The main symptoms prevailing were headache, lethargy, and dryness in mucous. The SBS score was found to be high on third floor as compared to other floors and the control tower. Moreover, the percentage of persons experiencing SBS symptoms were quite high on this floor [10].

5.1. Age vs. SBS symptoms

Fig. 2 describes the distribution of SBS symptoms/person for respective age groups on all the floors and the control tower of the AAI building. It was found that the number of occupants in the age group of 20–29 were maximum on the third floor and minimum in the control tower. Occupants in the age group of 20–29 were more susceptible to SBS symptoms as compared to the occupants in the age group of 50–59. It did not necessarily reflect that occupants in the age group of 50–59 were not having any health complaints. They might be having chronic health problems, which remained unaffected even after leaving the building (see Section 4.1).

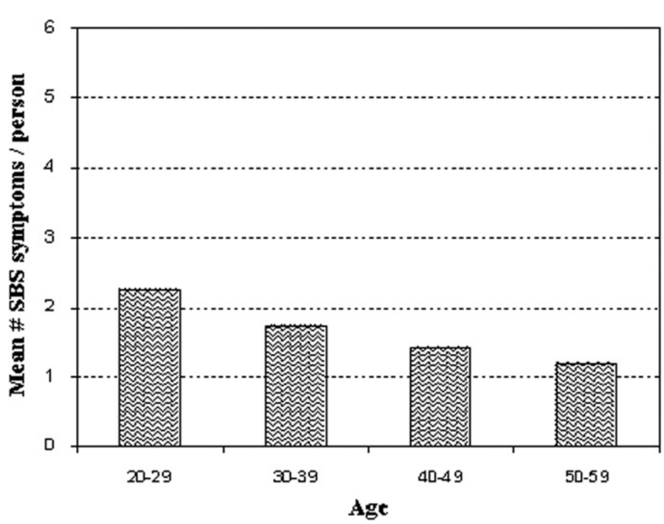

Fig. 2. Distribution of SBS with age.

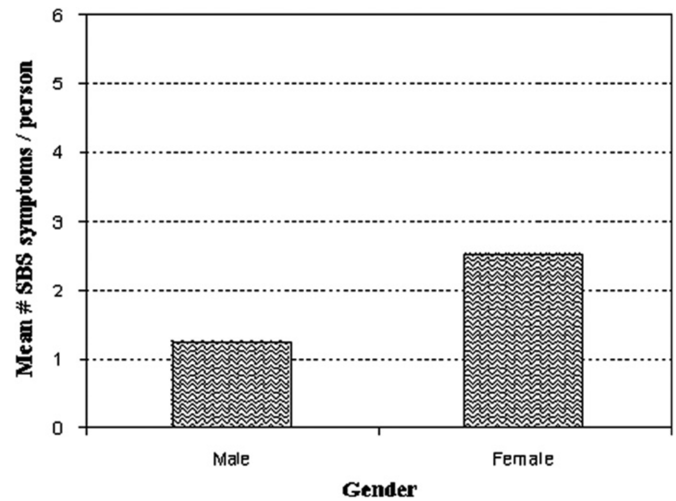

Fig. 3. Worker's gender and SBS symptoms.

5.2. Workers gender vs. SBS symptoms

Out of the total occupancy level in the building, there were 34% females and 66% males. Females were showing 50% more SBS symptoms as compared to males on all the floors as well as the control tower (Fig. 3). It shows that female gender was more sensitive to SBS symptoms than male, thus needing a lesser dose of pollutants to response to the sick building symptoms [10]. Previous investigations carried out in different countries also reported that females were more susceptable to SBS symptoms then males [15–18]. Lenvik [19] also observed that the prevalence of SBS symptoms did not differ by job type or job satisfaction among 764 workers in three office buildings, but did differ by worker's gender, with women reporting most symptoms.

5.3. Use of eyewear vs. SBS symptoms

Occupants wearing the eyewear were more susceptible to SBS symptoms on all the floors as well as the control tower (Fig. 4). Further, on second and third floors, SBS symptoms were remarkably high, i.e. 3.76 and 3.79, respectively, among the occupants wearing eyewear and working on computers; and it was 2.89 and 3.01, for occupants not wearing eyewear.

5.4. Computer use vs. SBS symptoms

Fig. 5 shows the effect of the time spent on computers by occupants on different floors and the control tower on SBS symptoms. SBS symptoms were increasing steadily with the computer use-hours. Mean SBS symptoms per person ranged between 2.11 and 4.02 corresponding to computer use of more than 1-h. It was maximum i.e. 4.02 for occupants working on computer for 6-h or more. Hence, there was a direct relationship between SBS symptoms and computer use-hours. Number of computer terminals were maximum on the third floor and minimum in the control

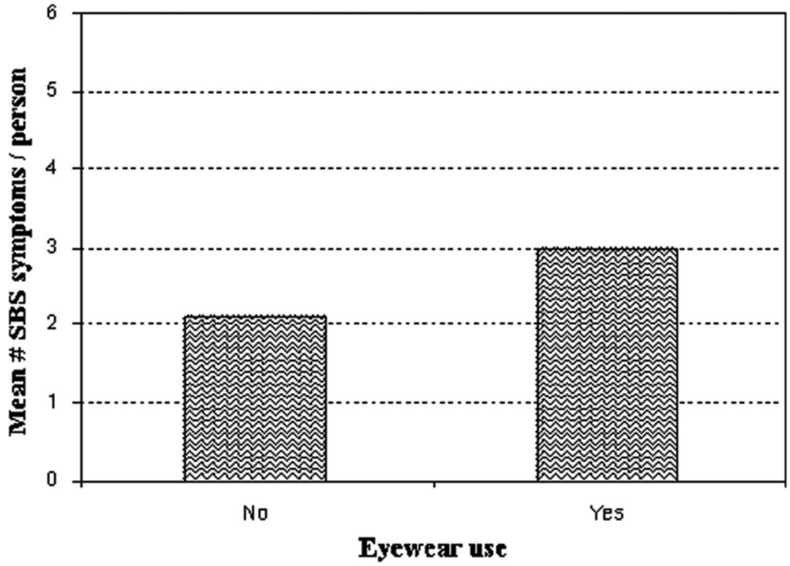

Fig. 4. Eyewear and SBS symptoms.

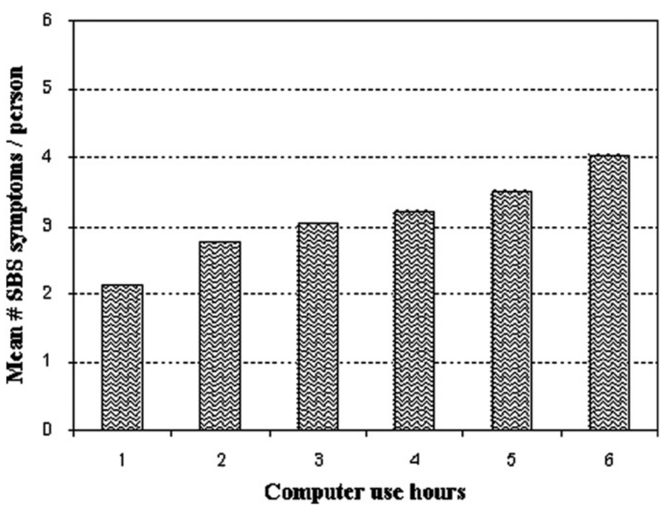

Fig. 5. Computer use and SBS symptoms.

tower. Occupants on the third floor were showing highest level of SBS symptoms, and in the control tower, the occupants were less affected by SBS symptoms. There were no computer terminals on the ground floor.

5.5. *Job stress vs. SBS symptoms*

Fig. 6 describes the relation between SBS symptoms/person and job stress rating on all the floors and the control tower. The second floor of the building was having maximum SBS symptoms as the nature of the job was quite tough and demanding. It included continuous monitoring of airplanes arrival and departure along with passing off instructions directly to pilots of the airplanes. The occupants on this floor were getting stress allowance as well. Fig. 6a shows the percentage distribution of job stress on each floor and the control tower. It was highest on the second floor.

5.6. *Perceived weekly environmental conditions and percentage response*

Questionnaire was also incorporating questions to evaluate the perception of occupants towards indoor environmental conditions. Fig. 7 shows the response of occupants towards environmental conditions inside the building. Occupants on the ground and third floors were more susceptible to tobacco and other odours. The ground floor test site was adjacent to the staff canteen, which might be the possible reason of odour perception by the occupants.

In the control tower, occupants responses to all environmental conditions, except for air movement, were quite ‘low’ as compared to other test sites in the AAI building. The control tower was quite high (120 m from ground level) and it was not interconnected with main part of the AAI building except one passage to the lift. In the control tower, 74% and on the third floor, 43% of the occupants perceived ‘too much’ of air movement. It might be due to the maximum exposure of exterior walls of the building to ambient atmosphere.

5.7. *Perceived IAQ vs. SBS symptoms*

PIAQ factor was calculated on the basis of occupant’s response on overall IAQ. The PIAQ rating varied from 1 to 5, in which, rating of ‘1’ implied “very comfortable” IAQ, and ‘5’ implied “uncomfortable”. Fig. 8 shows the variations in SBS symptoms (between 1.39 and 3.09) corresponding to PIAQ ratings of 1–5.

6. SBS: an useful indicator of IAQ

The second and third floors were having poor IAQ. On the third floor, high SBS symptoms were due to heavy use

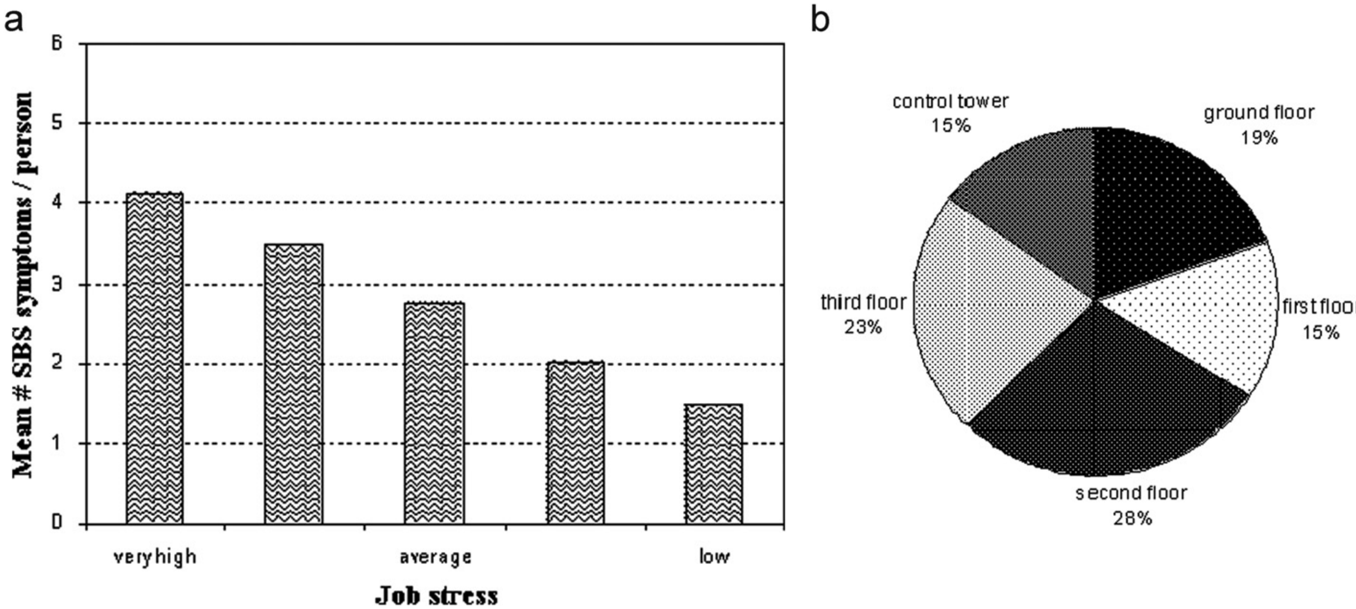

Fig. 6. Job stress and SBS symptoms. (a) Percentage distribution of job stress.

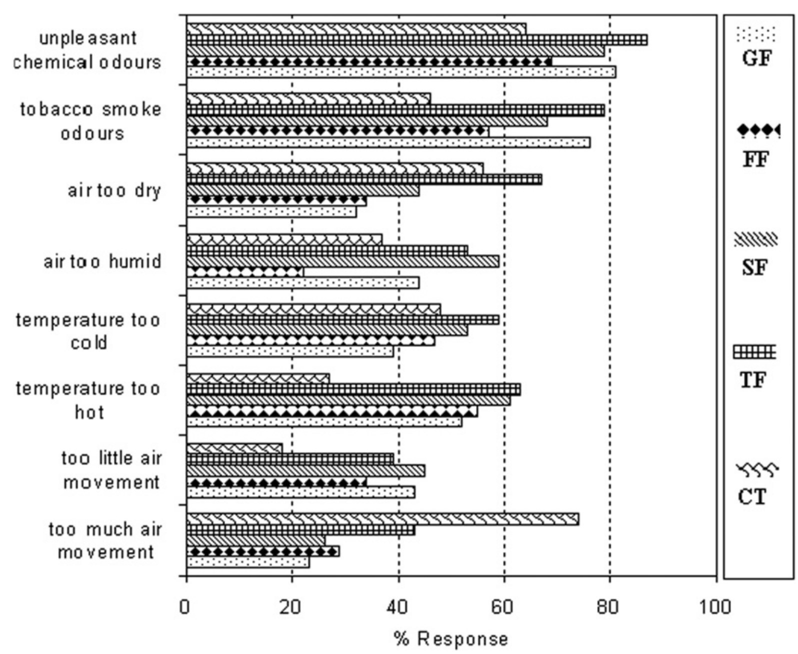

Fig. 7. Perceived environmental conditions.

of computers and eyewear. On the second floor, high job stress and use of eyewear increased the SBS symptoms. Fig. 9 shows the distribution of mean SBS symptoms/person on each floor and the control tower. On these two floors, PIAQ rating was high as compared to the control tower and the first floor having low SBS scores. This investigation also showed that on second and third floors, percent outdoor air intake rate was quite low which resulted in increasing the CO_2 concentration. Fig. 10 shows variations in CO_2 concentration with percent outdoor air intake rate. Table 4 shows the percent outdoor air intake rate and CO_2 concentration at each floor and the control tower. Percent outdoor air intake rate has been calculated using the following equation, based on mass balance of air and CO_2 [20].

$$\% \text{ outdoor air} = \frac{(C_r - C_s)}{(C_r - C_{out})} \times 100,$$

where C_r, C_s, and C_{out}, are CO_2 concentrations in the recirculation air-stream, supply air-stream, and outdoor air, respectively. The main factor affecting the precision in percent outdoor air is the magnitude of the difference between C_r and C_{out} [21].

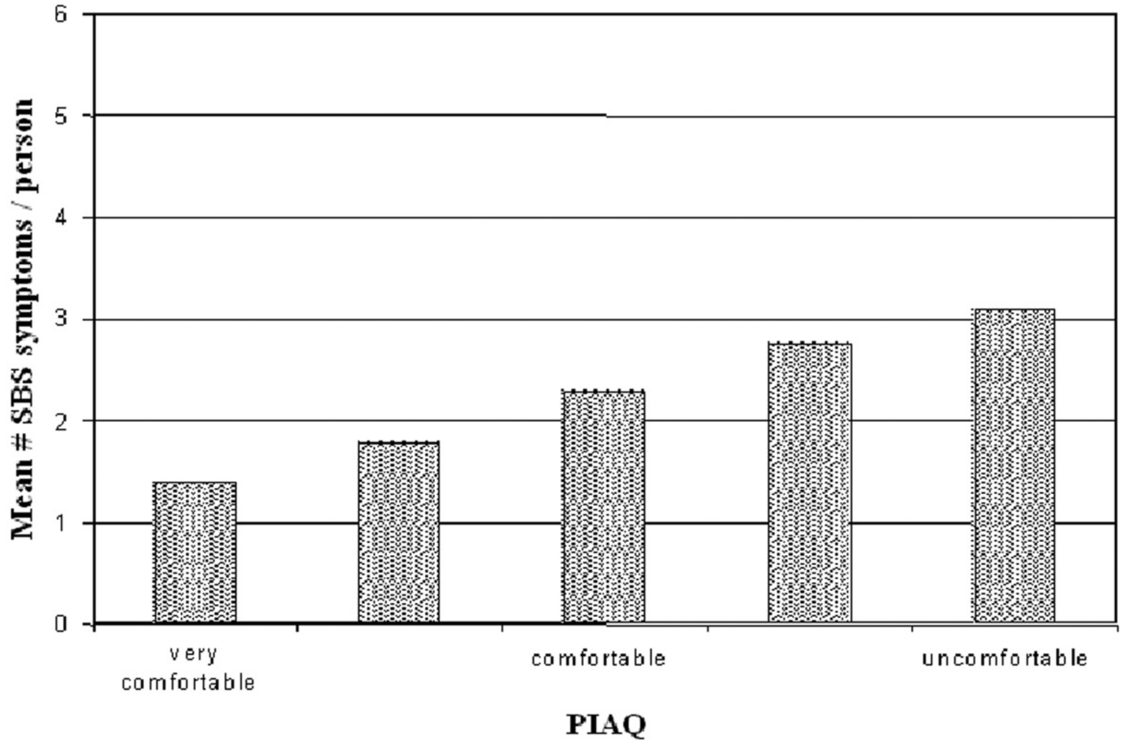

Fig. 8. PIAQ and SBS symptoms.

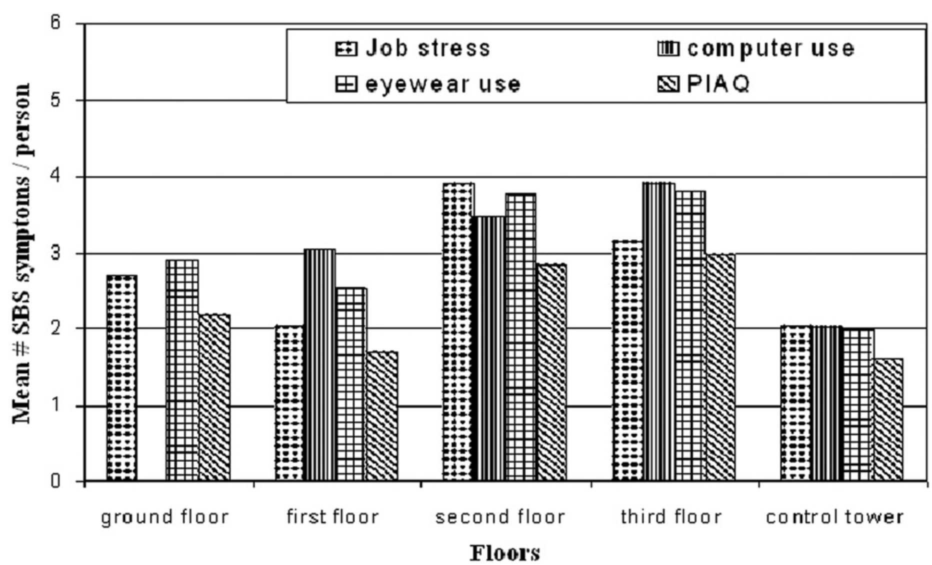

Fig. 9. SBS score due to qualitative parameters.

7. CO_2 as an indicator of IAQ

Fig. 11a, describes CO_2 concentrations at each floor and the control tower and corresponding SBS scores. The higher the CO_2 concentration, the more the SBS score. On the control tower, the concentration of CO_2 was minimum (268.3 ppm), correspondingly, the SBS score was (0.92). Fig. 11b shows a linear relationship between CO_2 concentration and SBS score ($R^2 = 0.9499$), which shows a good correlation between them. The above analysis does not necessarily imply that CO_2 is the only influencing parameter affecting the SBS score in a building. However, CO_2 acts as an 'indicator' or 'marker', indicating likely presence of indoor air pollutants. The concentration of CO_2 in a building may lie within ASHRAE standard limits but the occupants may still complain about sick building symptoms. It may be due to other building and work related parameters (not aligning with CO_2 present indoors) producing sick building symptoms. Helsing et al. [22] reported the presence of SBS symptoms in the occupants of

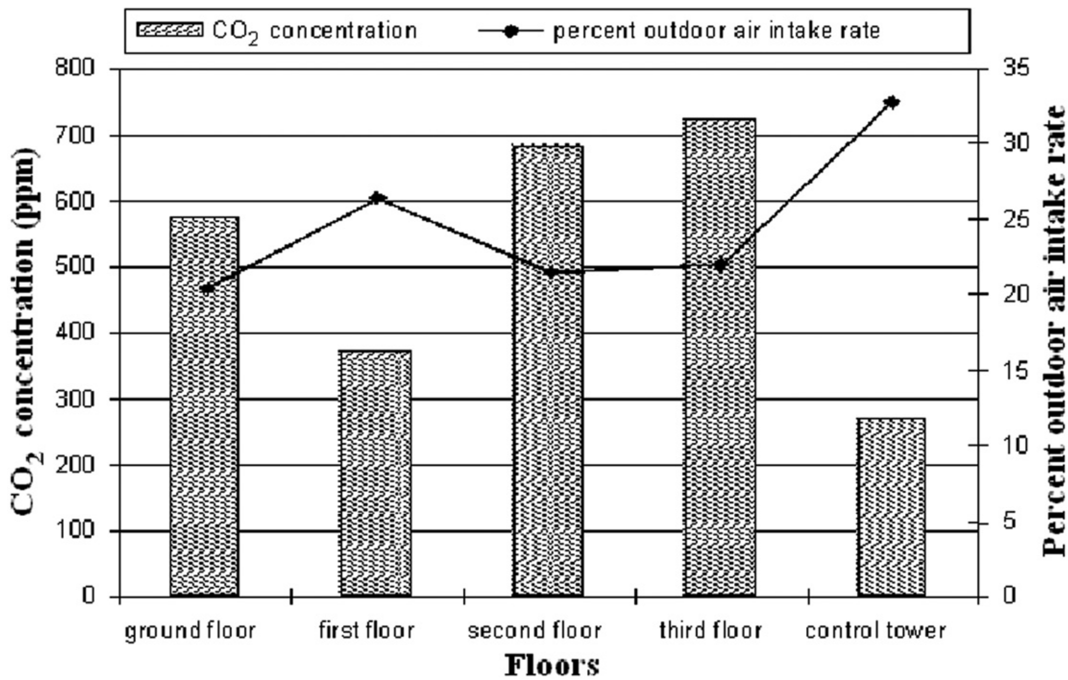

Fig. 10. CO_2 concentration and percent outdoor air intake rate.

Table 4
Daily CO_2 concentrations and percent outdoor air intake rate

Day	Ground floor		First floor		Second floor		Third floor		Control tower	
	CO_2 (ppm)	Percent outdoor air intake rate	CO_2 (ppm)	Percent outdoor air intake rate	CO_2 (ppm)	Percent outdoor air intake rate	CO_2 (ppm)	Percent outdoor air intake rate	CO_2 (ppm)	Percent outdoor air intake rate
Mon	45.4	23.8	342.5	33.4	679.2	26.3	756.1	21.1	269.4	33.1
Tue	463.1	24.9	361.1	29.7	722.1	15.2	780.2	19.3	298.6	27.3
Wed	1123	9.2	378.6	24.3	663.9	24.1	790.6	16.5	240.3	38.7
Thu	498.1	21.7	333.1	36.2	710.1	17.2	691.2	24.6	310.1	25.2
Fri	510.2	17.3	391.3	21.5	656.2	28.1	721.3	23.4	250.7	35.4
Sat	489.3	21.3	410.2	17.3	684.7	19.3	610.4	26.9	230.4	39.3
Sun	452.3	25.2	382.4	22.4	677.2	20.8	710.5	22.6	278.9	30.8

the building even though concentration of CO_2 and other indoor air pollutants were below the ASHRAE [6] limits.

8. Conclusions

The questionnaire analysis indicated that occupants of AAI building (mainly on second and third floors) experienced a variety of illness symptoms those occurred 'often' or 'always' and subsequently disappeared after leaving the building. The main symptoms prevailing were headache (51%), lethargy (50%), and dryness in mucous (33%). Results clearly depicted that some test sites in the building were 'sick'. Females were more susceptible to SBS symptoms (50% more) as compared to men. Significant relationships between symptoms and hours of computer use, level of job stress, and use of eyewear were observed. Heavy use of computers on the third floor caused high SBS symptoms among the ocupants; and on the second floor, it was due to the job stress. Workers who used their computers for 6 or more hours reported, more SBS symptoms than infrequent users or non-users. Occupants in the age group of 20–29 were having more SBS symptoms, mainly due to computer and eyewear use.

The third floor and the control tower were mainly affected due to the resulting infiltration, wherein the occupants complained about too much of air movement. CO_2 concentration varied linearly with SBS score, which shows that CO_2 may be categorized as an 'indicator' or 'marker' of IAQ. Parameters related to building and work environment influenced the SBS symptoms significantly. Occupants responding high rating of PIAQ were having more SBS symptoms and vice versa.

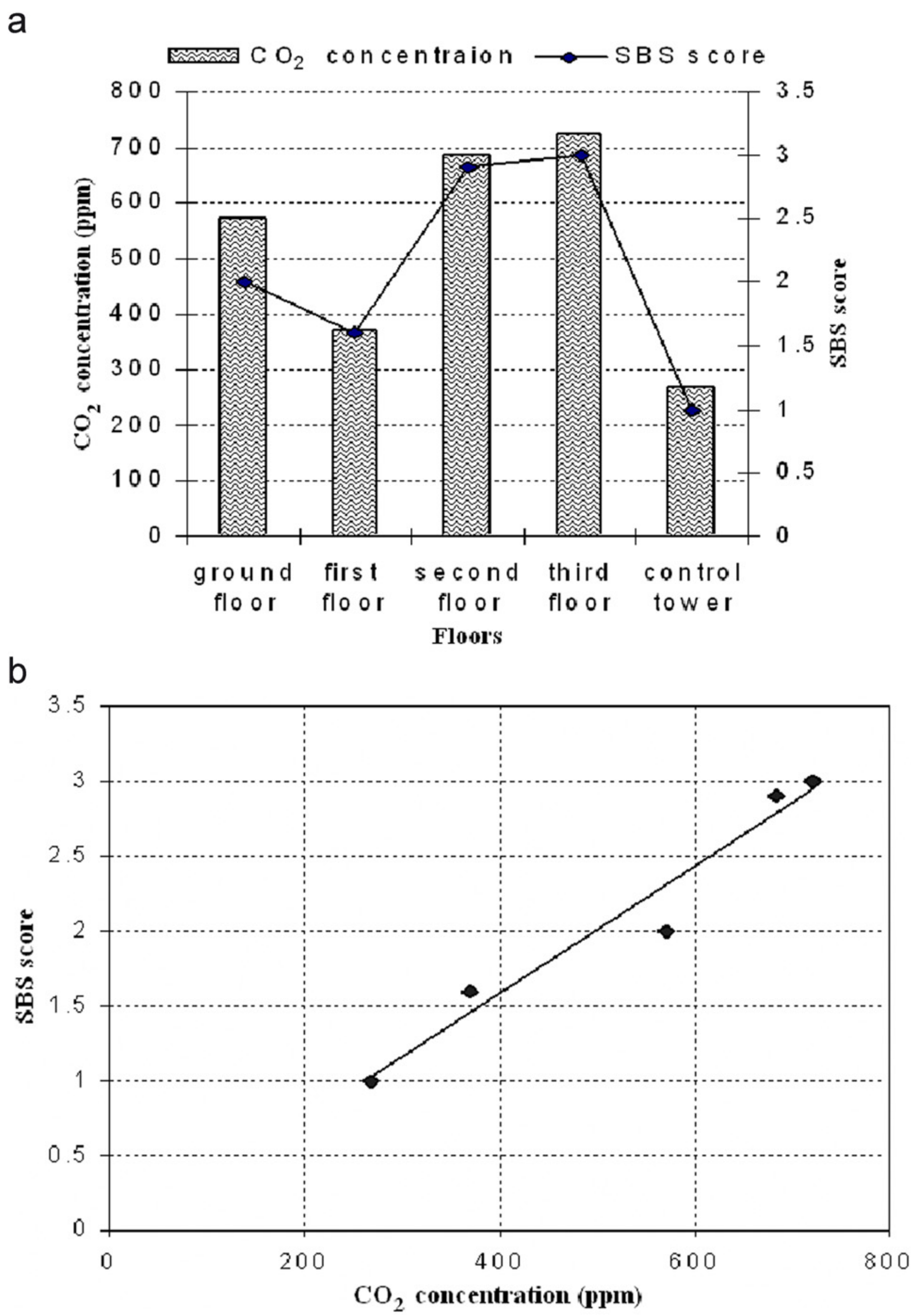

Fig. 11. (a) CO_2 concentration vs. SBS score at each floor and control tower. (b) CO_2 concentration vs. SBS score.

The findings of this study can help to improve the existing IAQ in the studied building, specially on second and thrid floor. The main imphasis should be put on reducing the infiltration inside the building and managing the work activities. One appropriate solution may be to replace or modify the existing windows material, such as with double glazed tinted glass windows, that may help in redcing the infiltration. The entrance door may also be better controlled by installing a protective device, such as an 'air-curtain', that may result in reducing the infiltration or exfiltration without hindering the passage. Building should be strictly declared a 'non-smoking zone'. The prevailing situation of high stress on some test sites inside the building may be improved by more frequent shift changes of the officials.

Acknowledgment

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Appendix A. Indoor air quality and work environment symptoms questionnaire

I. GENERAL INFORMATION

1. Room no. ———— Floor———— Date————
2. My gender is: M ——— F ——
3. My age is: –under 20 –20–29 –30–39 –40–49 –50–59 –over 59

II. WORKPLACE INFORMATION

1. How long have you worked in this building, to the nearest year? _ Years
2. If less than one year, how many months have you worked in this building? _ Months
3. On average, how many HOURS per WEEK do you work in this building? _ Hours per week
4. Which best describes the space in which your current workstation is located?
   __ Private office (1), __ shared private office (2), __ Open space with partitions (3)
   __ Open space without partitions (4), __ Other (specify) (5)
5. How many people work in the room in which your workstation is located (including yourself)?
   __ 1 __ 2–3 __ 4–7 __ 8–10 __11or more
6. Is there carpeting on most or all of the floor at your workstation? __ Yes(1) __ No(2)
7. In general, how clean is your workspace area?
   __ Very clean (1) __ Reasonably clean (2) __ Somewhat dusty or dirty (3)
   __ Very dusty or dirty (4)
8. Please rate the lighting at your workstation.
   __ Much too dim (1) __ A little too dim (2) __ Just right 3)
   __ A little too bright (4) __ Much too bright (5)
9. How comfortable is the current set-up of your desk or worktable? (i.e., height and general arrangement of the table, chair, and equipment you work with)
   __ Very comfortable (1) __ Reasonably comfortable (2) __ Somewhat uncomfortable (3)
   __ Very uncomfortable (4) __ Don't have one specific desk or work table (5)
10. About how many HOURS per DAY do you work with a computer or word processor, to the nearest hour? __ Hours per day __ Don't use one

10a. If you use a computer or word processor, do you usually wear glasses when you use these machines?
   __Yes __No

III. DESCRIPTION OF WORKPLACE CONDITIONS

1. During the PAST THREE MONTHS, have the following changes taken place within 15 feet of your current workstation?

	YES (1)	NO (2)
New carpeting	__	__
Walls painted	__	__
New furniture	__	__
New partitions	__	__
New wall covering	__	__
Water damage	__	__

2. What is your tobacco smoking status?
   __ Never smoked (1) __ Former smoker (2) __ Current smoker (3)
3. Do you consider yourself especially sensitive to the presence of tobacco smoke?
   __ Yes(1) __ No (2)
4. Do you consider yourself especially sensitive to the presence of chemicals in the air of your workspace? __ Yes(1) __ No(2)
5. TODAY, while working at your usual workstation, did you experience this environmental condition?

CONDITIONS	YES (1)	NO (2)
too much air movement	__	__
too little air movement	__	__
temperature too hot	__	__
temperature too cold	__	__
air too humid	__	__
air too dry	__	__
tobacco smoke odors	__	__
unpleasant chemical odors	__	__
other unpleasant odors (e.g., body odor, food odor, perfume)	__	__

IV.HEALTH

1. Have you ever been told by a doctor that you have or had any of the following?

	YES (1)	NO (2)
Sinus infection	__	__
Asthma	__	__
Migraine	__	__
Eczema	__	__
Hay fever	__	__
Allergy to dust	__	__

Do you feel the following symptoms while working in the room?

2.	Irritation in the Eyes	———Often	——— Sometimes	———Never
3.	Irritation in the Nose	———Often	——— Sometimes	———Never
4.	Dryness in mucuous membrane (throat etc)	———Often	———Sometimes	———Never
5.	Lethargy/drowsy/tired?	———Often	———Sometimes	———Never
6.	Dryness on the face/hands	———Often	———Sometimes	———Never
7.	Do you get headache?	———Often	———Sometimes	———Never

V. CHARACTERISTICS OF YOUR JOB

1. What is your job category?
   __ Managerial (1) __ Professional (2) __ Technical (3)
   __ Secretarial or Clerical (4) __ Other (specify)________________ (5)
2. All in all, how satisfied are you with your job?
   __ Very satisfied (1) __ Somewhat satisfied (2) __ Not too satisfied (3) __ Not at all satisfied (4)
3. What is your rating for the stress in work?
   ——— Very High (1) —— High (2) ——— Average (3) ——— Low (4) —— Very Low (5)

VI. OVERALL SUBJECTIVE RATING FOR THE WORKING AREA

1. Do you like the internal environment? ———Yes ——No
2. What is your feeling towards the working area?
   — Very Comfortable (1) — Acceptable (2) — Comfortable (3)
   — Uncomfortable (4) — Very Uncomfortable (5)

3. Do you find that some/all of the symptoms you experienced as stated in IV also occurred in the past during office hours?
——— Very often ———Seldom ———Sometimes ————Never
4. Do you find that these symptoms are more obvious at the beginning of a week e.g. on Mondays and Tuesdays? ————Yes ————No
5. Do you have any other comments on the internal environment?

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THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

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