Prevalence of respiratory symptoms of the upper and lower airways in office block workers, Rio de Janeiro, Brazil

J.L. Boechat[a], J.L. Rios[a], A. Gioda[b], J.R. Lapa e Silva[c], F.R. Aquino Neto[d,*]

[a]*Allergy and Immunology, Clementino Fraga Filho University Hospital, Federal University of Rio de Janeiro, Brazil;* [b]*Analytical Chemistry, Chemistry Institute, Federal University of Rio de Janeiro, Brazil;* [c]*Institute of Thoracic Diseases/Clementino Fraga Filho University Hospital, Federal University of Rio de Janeiro, Brazil;* [d]*Organic Chemistry Department, Chemistry Institute, Federal University of Rio de Janeiro, Brazil*

ABSTRACT

A sample of 269 workers, selected randomly from 1600 employees of a sealed 42-storey office building of a major bank in Rio de Janeiro, Brazil, responded to the standard Royal Society of Health Advisory Group questionnaire about Sick Building Syndrome.

Upper airways respiratory symptoms occupied a prominent position, with a prevalence of around 40%, whereas the lower airways manifestations frequencies were below 20%. The most prevalent symptoms were lethargy/tiredness and headache, with values over 50%, although these are the symptoms that least improved out off the work environment.

The nasopharyngeal and ophthalmic manifestations seem to be those that suffer a greater influence from the internal environment, for they present the highest indices of improvement when the worker is away from the workplace.

INDEX TERMS

Building-related symptoms; Office work; Air quality; Asthma; Allergic rhinitis

INTRODUCTION

The indoor environment affects the occupants mainly by means of the air. Contaminant agents, whether volatile or in suspension, enter into direct contact with the occupants through the skin and the eyes, nose and lungs mucosae (Samet *et al.*, 1998).

Modern man spends much of his daily life in enclosed places, above all in the workplace. These environments usually present high pollutant levels due to the low internal/external air exchange rate, in addition to diverse materials used in linings, finishing and furniture that contain various types of volatile chemical substances. In Brazil, as in other tropical countries, there is growing concern with regard to the increasing utilization of air conditioning systems in sealed buildings, drawing the attention of researchers from several areas and of the Ministry of Health (Brickus and Aquino Neto, 1999; Ministerio da Saude, 2000).

The set of health problems related to the internal environment of non-industrial, non-residential buildings, the majority of which are office blocks, are denominated building related illnesses (BRI) (Menzies and Bourbeau, 1997). The BRI are considered specific when characterized by objective abnormalities under clinical and laboratorial evaluation, with a well-defined causal agent. They are non-specific when they refer to a heterogeneous group of symptoms: respiratory, cutaneous, ocular or even ill defined, such as headache, fatigue and difficulty of concentration, related to the work environment (Bardana and Montanaro, 1991; Menzies and Bourbeau, 1997; Brickus and Aquino Neto, 1999; Meggs, 2002).

Various international studies have sought to evaluate the prevalence of BRI symptoms. With the aim of standardizing the diagnosis and enabling comparison between different

* Corresponding author.

studies, the Royal Society of Health Advisory Group on Sick Building Syndrome has developed a standard questionnaire (Raw, 1995). Through conjugation of the responses, it is possible to calculate a symptoms score that reflects the quality of the indoor environment (Raw, 1995).

OBJECTIVE

To determine the prevalence of respiratory symptoms of the upper and lower airways, and other BRI symptoms, in workers in a sealed building located in Rio de Janeiro, Brazil.

METHODS

Cross-sectional study involving 1600 workers in a sealed 42-storey office building situated in the downtown area of Rio de Janeiro, Brazil. A sample of 269 workers were selected at random and asked to respond to the standard Royal Society of Health Advisory Group questionnaire about Sick Building Syndrome (Raw, 1995). Microsoft Excel software was used to perform the statistical analysis of the data.

The prevalence of each symptom was calculated and the following symptom scores were obtained: Person Symptom Index 5 (PSI_5) and Building Symptom Index 5 (BSI_5) (Raw, 1995). The conjugation of each individual's responses to questions about the five principal symptoms (dryness of the eyes, blocked nose, dry throat, headache and lethargy/tiredness) constituted the PSI_5. The BSI_5, which evaluates the level of problems in a building, is composed of the mean PSI_5 of all the respective workers (Raw, 1995).

RESULTS

Of the 269 workers evaluated, 61.3% were male, had an average age of 39.8 years, and an average service time of 5 years in the building. Only 10.4% of the workers reported that they smoked in the work environment.

Respiratory symptoms of the upper airways, as well as ophthalmic symptoms, occupied a prominent position, with a prevalence of around 40%, whereas manifestations in the lower airways (respiratory difficulty, chest tightness and wheezing) were among the least prevalent.

The symptoms most frequently reported were lethargy/tiredness and headache, with prevalence values over 50%. Despite their high prevalence, these symptoms are among those that least improved when the worker was away from the work environment.

Table 1 shows the prevalence of the symptoms evaluated and the improvement percentage.

Table 1 Prevalence of BRI symptoms and improvement percentage

	Number	% Prevalence	% Improvement away from the office
Dryness of the eyes	82	30.48	85.37
Itchy or watery eyes	113	42.01	71.68
Blocked or stuffy nose	134	49.81	70.90
Runny nose	106	39.41	64.15
Dry throat	115	42.75	69.57
Lethargy and/or tiredness	149	55.39	53.02
Headache	147	54.65	45.58
Dry, itching or irritated skin	72	26.77	50.00

Difficult breathing	58	21.56	60.34
Chest tightness	56	20.82	57.14
Wheezing	27	10.04	40.74

Table 2 shows the distribution of PSI_5 in the sample, and the percentage of workers with each score. The BSI_5 for the building, which is the mean PSI_5 of all the workers researched, was calculated at 2.33.

Table 2 Distribution of PSI_5 values per worker

Score	No. of workers	% of workers per score
$PSI_5 = 0$	53	19.70
$PSI_5 = 1$	37	13.75
$PSI_5 = 2$	53	19.70
$PSI_5 = 3$	52	19.33
$PSI_5 = 4$	42	15.61
$PSI_5 = 5$	32	11.90

DISCUSSION

A predominance of males was observed in the sample studied, probably due to the characteristics of the institution evaluated: the head office of a major bank.

The majority of the workers have worked in this place for many years (average 5), which, hypothetically makes them more susceptible to the influences of the internal environment.

The nasopharyngeal and ophthalmic manifestations, with a prevalence of around 40%, seem to be those that suffer a greater influence from the internal environment, for they present the highest indices of improvement when the worker is away from the workplace. It is important to highlight that the allergic rhinoconjuntivitis symptoms prevalence (ocular itchiness, watery eyes and runny nose), is twice as high in the population studied as that observed in the general population, indicating probable environment's influence on these symptoms (Wuthrich *et al.*, 1995; Strachan *et al.*, 1997; Bousquet *et al.*, 2001).

The lower airways manifestations are among the least prevalent in the study sample. The anatomical characteristics of the airways could explain this discrepancy between the nasal and bronchial symptoms. The nose mucosae, as the entrance to the respiratory system, is more exposed to volatile substances and inhalable particles, and the nose's configuration hinders progress of these substances toward the lower airways (Salvaggio, 1994).

The low prevalence of wheezing and other respiratory symptoms observed in the sample is similar to the prevalence of asthma in the general population (European Community Respiratory Health Survey, 1996; Beasley *et al.*, 1998; Boechat, 2001; Rios, 2001). Although occupational asthma is a classic condition described in the literature, there are no up-to-date references associating this ailment with the type of environment studied in this research (James, 1994; Bardana, 2003).

Among the other BRI symptoms evaluated, there was a predominance of the non-specific (lethargy/tiredness and headache). Such symptoms may reflect a low air exchange rate with the outdoor environment, leading to CO_2 accumulation and deficient cerebral oxygenation, or may be due to exposure to volatile organic compounds (James, 1994; Molhave *et al.*, 1986).

They could also be associated to stress arising from the workloads. On the other hand, the low improvement index of these symptoms away from the workplace may signify that these are not only related to the quality of the indoor environment.

Although the cutaneous manifestations are rarely ever considered a significant complaint, they constitute around 25% of the symptoms detected in our study. The mechanisms involved in the cutaneous manifestations related to indoor environment are still not well defined, but reports of itching, skin redness and dryness are common (James, 1994).

The PSI_5 values in the sample follow a normal or Gaussian distribution, with approximately 40% of the individuals presenting scores of 2 or 3. This fact proves that the BSI_5 value, calculated by the average of all the PSI_5, is representative of the population studied, for the individual score values do not present extreme deviations, above or below.

According to the results of the Office Environment Survey (OES) (Burge *et al.*, 1987; Wilson and Hedge, 1987), BSI_5 values below 1.5 indicate minimal problems related to the BRI, while values over 2.5 determine the need for immediate action to handle the indoor condition. Results between 1.5 and 2.5 are inconclusive and opened to interpretation, depending on the frequency of the symptoms observed. In the present study, the BSI_5 was found to be 2.33, close to the limit of 2.5, above which the indoor environmental are considered inadequate.

COMMENTS

This is an ongoing study that will now evaluate the indoor environment by chemical and microbiologic analyses. The employees will be followed up by medical and laboratorial investigations, during 18 months. The purpose of this prospective study is to check if there is a causal relation between indoor environmental and the workers health.

ACKNOWLEDGEMENTS

Banco do Brasil, CNPq and CAPES.

REFERENCES

Bardana, E.J., Jr (2003). Occupational asthma and allergies. *J. Allergy Clin. Immunol.* **111**, S530–S539.

Bardana, E.J., Jr and Montanaro, A. (1991). Formaldehyde: an analysis of its respiratory, cutaneous and immunologic effects. *Ann. Allergy Asthma Immunol.* **66**, 441–452.

Beasley, R., Keil, U., Mutius, E. *et al*. (1998). Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjuntivitis, and atopic eczema: ISAAC. Steering Committee. *The Lancet* **351**, 1225–1232.

Boechat, J.L. (2001). Avaliação da prevalência e gravidade da asma em escolares no município de Duque de Caxias, RJ [Dissertação de Mestrado]. Rio de Janeiro: Universidade Federal do Rio de Janeiro, 143 pp.

Bousquet, J., Van Cauwenberge, P. and Khaltaev, N. (2001). Allergic rhinitis and its impact on asthma. *J. Allergy Clin. Immunol.* 108(Suppl), S147–S334.

Brickus, L.S.R. and Aquino Neto, F.R. (1999). A qualidade do ar de interiores e a química. *Química Nova* **22**, 65–74.

Burge, P.S., Hedge, A., Wilson, S. *et al*. (1987). Sick building syndrome: a study of 4373 office workers. *Ann. Occup Hyg.* **31**, 339–349.

European Community Respiratory Health Survey (1996). Variations in the prevalence of respiratory symptoms, self-reported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS). *Eur. Respir. J.* **9**, 687–695.

Meggs, W.J. (2002) Sick building syndrome, chemical sensitivity and irritant rhinosinusitis. *J. Allergy Clin. Immunol.* **109**, S51 (Abstract 105).

Menzies, D. and Bourbeau, J. (1997). Building-related illnesses. *N. Engl. J. Med.* **337**, 1524–1531.

Ministério da Saúde (2000). Agência Nacional de Vigilância Sanitária. Resolução – RE n° 176.

Molhave, L., Bach, R. and Pederson, O.F. (1986). Human reactions to low concentrations of volatile organic compounds. *Environ Int* **12**, 167–175.

Raw, G.J. (1995). A questionnaire for studies of sick building syndrome. A report to The Royal Society of Health Advisory Group on sick building syndrome. In: Raw, G.J. (ed.), *Building Research Establishment Report*, pp. 1–9, 1st edn. London: Construction Research Communications Ltd.

Rios, J.L. (2001). Prevalência de asma em escolares e poluição atmosférica em dois municípios do Rio de Janeiro [Dissertação de Mestrado]. Rio de Janeiro: Universidade Federal do Rio de Janeiro. 137 pp.

Salvaggio, J.E. (1994). Inhaled particles and respiratory disease. *J. Allergy Clin. Immunol.* **94**, 304–309.

Samet, J.M., Spengler, J.D. and Mitchell, C.S. (1998). Indoor air pollution. In: Rom, W.N. (ed.), *Environmental and Occupational Medicine*, 3rd edn, pp. 1523–1537. Philadelphia, PA: Lippincott-Raven.

Seltzer, J.M. (1994). Building-related illnesses. *J. Allergy Clin. Immunol.* **94**, 351–362.

Strachan, D., Sibbald, B., Weiland, S. *et al*. (1997). Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr. Allergy Immunol*. **8**, 161–176.

Wilson, S. and Hedge, A. (1987). The office environment survey. A study of building sickness. London: Building Use Studies.

Wuthrich, B., Schindler, C., Leuenberger, P. *et al.* (1995). Prevalence of atopy and pollinosis in the adult population of Switzerland (SAPALDIA study). Swiss Study on Air Pollution and Lung Diseases in Adults. *Int. Arch. Allergy Immunol.* **106**, 149–156.