Prevalence of irritative symptoms in a nonproblem air-conditioned office building

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Abstract Objectives: To assess the prevalence of work-related complaints and symptoms in employees in an air-conditioned office building (Building AC) in a mild climatic area (Italy). No discomfort had previously been reported. Methods: A total of 198 employees in Building AC and 281 controls working in three naturally ventilated buildings (Building NV) answered a questionnaire investigating work-related complaints and symptoms. Results: A significantly higher percentage of workers in Building AC reported a lack of comfort in the working environment as compared with the controls (30.6% versus 18.9%). The most common complaints were strong lighting, high temperature, and dry, dusty, and/or stuffy air. The prevalence of ocular, upper airway, and cutaneous symptoms was significantly higher (29.8% versus 14.9%, 25.3% versus 9.6%, and 14.1% versus 3.6%, respectively). No significant difference was observed in respiratory or general symptoms. Logistic regression analysis showed that working with video display units and photocopiers influenced ocular symptoms; upper airway and cutaneous symptoms were influenced by female gender and working in the air-conditioned building. Conclusions: In an apparently healthy air-conditioned office building, complaints and symptoms are reported more often than in a naturally ventilated edifice, but the prevalence is lower than that usually observed in sick buildings. Symptoms are influenced by individual and work-related characteristics.

Key words Sick building · Office work · Video display units

Introduction

New office blocks, hospitals, and schools are modern in design and light in structure. Synthetic materials are widely used and the buildings are often air-conditioned or mechanically ventilated and well insulated from the outdoor environment. Construction criteria have aimed at a more functional use of space, at improving access, and at containing construction and running costs. The well-being and comfort of people occupying the buildings are aspects that have emerged, perhaps unexpectedly, only recently [13, 24, 35, 37]. Indeed, disturbances or real diseases that are often prevalent in modern air-conditioned buildings have been called building-related illnesses [12, 31]. Some, such as bronchial asthma and extrinsic allergic alveolitis, are associated with low prevalence, a specific etiological agent, and a slow progressive improvement after exit from the building. Irritative symptoms (e.g., burning and/or redness of the eyes, blocked nose, dry throat, cutaneous dryness) or general disturbances (headache, drowsiness, lack of concentration) associated with high prevalence, which improve rapidly after exit from the building, are typical of the so-called sick building syndrome (SBS) [7, 13, 33].

To date, epidemiology and environmental studies on building-related illnesses, particularly in the United States [35, 37], have been performed mainly after occupants report health problems so as to identify the sources of discomfort or disease. Several surveys on suspected sick buildings in the United States [27] have demonstrated that about 50% have ventilation problems; 5%, indoor contamination from products containing chemicals; 10%, outside contamination; and 15%, biological contamination. In about 10% of cases a specific cause could not be identified. Two reports exist of building-related illness in Italy [1, 5]; one describes a high prevalence of SBS symptoms in a new air-conditioned problem office block, where civil servants work, investigated at the request of the civil service and trade unions after many occupants had reported work-related symptoms [1].
The state of health of occupants of apparently non-problem buildings, i.e., where the occupants have never complained of building-related disturbances, has also been studied. The data available [7, 13, 28, 29, 33] have mainly been obtained from buildings in cold countries (e.g., northern Europe), with their typical architecture and a special dark-light pattern during the year.

This epidemiology study on employees in a modern, nonproblem air-conditioned office block, built to suit the mild Italian climate, assessed the prevalence of work-related sources of complaints and symptoms. Office workers in a naturally ventilated and traditionally built complex were enrolled as controls.

Subjects and methods

The survey was performed over a 4-week period in Perugia (central Italy) during the late spring (May to June), when the maximal daily temperature averages 23 °C and humidity levels are approximately 52%. Employees (n=219) of a private company working in an air-conditioned building (building AC) without air recirculation were recruited. A control group of 335 civil servants working in three similar, traditionally built, naturally ventilated, and centrally heated office blocks, which were considered as one edifice (building NV), was also enrolled.

An environmental inspection (including a careful examination of the air-conditioning plant in building AC) was conducted in both buildings. Management staff as well as maintenance personnel were asked what type of maintenance tasks were necessary and how often they had to be performed.

No one taking part in the study was informed about either the purpose or the results until afterward. Participants answered a questionnaire administered by a specialist in occupational medicine that was based on recommendations contained in the WHO Regional Office for Europe Report [39]. Part I requested details of the subject's personal life style, educational standard, professional qualifications, job category, time of experience, work procedures, and equipment used. Part II of the questionnaire contained multiple-choice questions leading to a subjective assessment of the workplace as well as queries on atopy, previous and current illnesses and medication, and individual symptoms.

Examples of the multiple-choice questions are:

1. Is the temperature of your workplace (a) high, (b) low, or (c) acceptable?
2. Is the lighting (a) strong, (b) dim, or (c) acceptable?
3. Is the air (a) dry, (b) humid, or (c) acceptable?
4. Do you use a video display unit (VDU)? [(a) No, (b) less than 2 h/day, (c) more than 2 h/day]
5. Is your work load (a) too light, (b) too heavy, or (c) acceptable?

Examples of the questions requiring yes or no answers that were used to investigate each symptom are:

1. Have you felt any burning or noticed redness of the eyes in the last 3 months?
2. Does it appear/worsen at the beginning of the work day?
3. Does it disappear/improve when you stop work and/or at the weekends and/or when you are on holiday?

Only work-related symptoms that had occurred in the previous 3 months were considered. They appeared or became exacerbated after the start of the work day in the building and improved or disappeared at the end of the work day and/or during weekends or holiday periods [13, 29].

Symptoms were classified as follows: ocular (burning and/or redness,); upper airway (rhinorrhea, blocked nose, itchy nose, prolonged sneezing, nasal bleed, dry throat, sore throat, thirst); respiratory (dysnea, shortness of breath, wheeziness, dry cough); cutaneous (erythema, papules, wheals, blisters, dryness, general itchiness, itchy exposed parts); and general (headache, lethargy and/or drowsiness, lack of concentration, irritability, nausea, dizziness).

The chi-square test or Fisher's exact test and Student's two-tailed t-test were used for comparison of proportions and means. The influence of personal and occupational factors (predictor variables) on the prevalence of groups of symptoms (dependent variables) was evaluated by means of an unconditional logistic regression model [17]. Personal data (age, gender, smoking habits, atopy) were initially considered in the model and the significant variables were maintained. Occupational variables (type of building, job category, use of VDU and photocopiers) were then inserted one by one. All significant personal and occupational factors were maintained; nonsignificant variables were excluded from the final model. All statistical analysis were performed using the SAS program [32] and a 5% level of significance was set. Adjusted odds ratios (ORs) with a 95% confidence interval (95% CI) were calculated from the logistic regression model [17].

Results

Environmental inspection

Building AC had been constructed in the late 1980s using reinforced concrete and a light external shell. Synthetics had been chosen for indoor fittings and furnishings. The air-conditioning system did not provide recirculation of returning air as the plant on the roof captured fresh air and then preheated, humidified, and reheated it centrally before circulating it throughout the building. In each room, emission of air took place at floor level, whereas extraction was accomplished via airducts in the corridor. All rooms were also provided with a fan coil unit for reheating and cooling of the air. Humidity levels in the rooms could not be regulated. Maintenance personnel checked the air-conditioning system daily and the fan coil filters once a week.

Building NV had been built early in the 1900s and had been remodeled for the last time in the 1960s, when a central heating system was installed. Maintenance personnel checked the system twice a year and on request.

In both buildings, offices were of different dimensions, had white walls, and were equipped with well-kept furniture. One to four persons worked in each room. The offices did not contain wall or floor carpets or large open shelves. In building NV, all windows could be opened, whereas in building AC the exterior wall in most rooms was made of plate glass and only some sections could be opened. In this building, artificial lighting, provided by fluorescent tubes in the ceilings, could not be regulated by the workers.

Questionnaire – part I

In building AC, 198 (90.4% of the total) workers took part in the study, whereas in building NV, participants numbered 281 (83.9% of the total). All employees had worked in the same building for a minimum of 5 years. The main characteristics of the study populations are