

SICK BUILDING SURVEY OF SEVEN NON-COMPLAINT UNIVERSITY BUILDINGS

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ABSTRACT

A self-administered questionnaire survey of occupants of seven non-complaint university buildings was conducted with an overall response rate of 44% (range 36-61%). Symptom prevalence rates were summarized based on two classification criteria. Significantly higher prevalence rates were observed when building/work-related symptoms were summarized on a sometimes/often/always basis as compared to often/always. Using both classifications, criteria symptom prevalence rates were generally lower than those reported in other studies. The most prevalent symptoms which appeared to be associated with the building/work environment using the often always classification were headache (12%), stuffy nose (9%), eye irritation (9%), fatigue (7%), runny nose (6%), and dry/itchy skin (6%). A relatively large percentage of respondents (20-40%) were dissatisfied with building temperature, humidity, air movement and dustiness.

INTRODUCTION

A number of systematic survey questionnaire-based indoor air quality studies have been conducted in office buildings in the United Kingdom (1), Denmark (2), Sweden (3), the Netherlands (4), and the United States (5,6). For the most part these studies have focused on buildings in which occupants have expressed no previous dissatisfaction with air quality. Despite this fact survey studies have reported significant symptom prevalence rates which appear to be related to the work or building environment, that is, symptoms improved when respondents were away from their building. These studies indicate that work or building-related general and mucous membrane symptoms are common to office buildings in the countries where such studies have been conducted.

In the United States survey questionnaire-based studies have been limited to those conducted in the USEPA headquarters building (6), the John Madison Building of the Library of Congress (5), and the more expanded on-going studies of Hedge (7). In the first two cases studies were conducted because of the expressed dissatisfaction of occupants.

In this study we attempt to broaden the scope of systematic survey questionnaire studies in the United States by focusing on seven university buildings. With the exception of the library, these buildings serve the multiple-purpose function of classroom instruction, offices and teaching/research laboratories. As such they in general differ in the functional use of building spaces reported in other studies.

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METHODS

The university campus buildings surveyed were selected to include a diversity of use functions (classroom/science laboratories/office, classroom/office, computer center/classroom/office, creative arts laboratories/classroom/office, library, etc.) and building ages (3-40 years). A survey questionnaire adapted from the USEPA headquarters/John Madison building studies (5,6) was used to survey the full-time occupants of each of the seven campus buildings. The self-administered questionnaire sought to elicit responses on symptoms experienced in the building, workspace characteristics, the physical environment and comfort concerns, job satisfaction and a variety of other factors which may be related to symptom prevalence rates. The questionnaire was submitted through the campus mail, and faculty and staff were requested to respond and return it within a two-week period. To increase the response rate, faculty/staff who had not responded were contacted by phone. Though cooperation from supervisors was requested, the survey was conducted from the "bottom up," that is, no administrative obligation of faculty and staff to respond was imposed or requested.

Selected survey parameters including symptom prevalence rates, satisfaction/dissatisfaction with the physical environment, prevalence of allergy and asthma, etc. were summarized and are presented in this report. Symptom prevalence rates reported are based only on those responses in which building occupants indicated improvement when away from the building. Prevalence rates were evaluated for those respondents who reported symptoms to have occurred sometimes/often/always and those reported to occur often or always. Using these two classifications, symptom prevalence indices (1) were calculated for each building using 10 selected symptoms often associated with indoor air quality complaints.

RESULTS

Compared to previously reported studies where overall response rates to self-administered questionnaires were high (circa 67-90%), the overall response rate in this study was relatively low. Out of approximately 1100 questionnaires distributed about 44% were completed and returned. The response rate from building to building varied from 36-61%. This relatively low overall response rate appeared to reflect a variety of factors which included the time demands to complete the 16 page questionnaire, questions deemed to be too personal, concerns about anonymity, and university faculty/staff perceptions that they had already been intensively surveyed on a large variety of social/political/health and economic issues over the past several years.

In this study respondents were asked to indicate the frequency of a given symptom as being experienced never, rarely, sometimes, often and always. Because prevalence rates can depend on the criteria selected, in this study they were based on the two classifications for comparison. As was expected symptom prevalence rates were significantly higher using the sometimes/often/always classification. This can be seen in symptom prevalence indices for 10 indoor air quality symptoms in Table 1. By including the response category "sometimes" the symptom prevalence index (S.P.I.) was increased by a factor of 2-3. The frequency of 10 selected IAQ symptoms for each of the seven campus buildings (based on an often or always response) is

summarized in Table 2. Highest frequencies were reported for headache, stuffy nose, eye irritation, fatigue, runny nose and skin irritation. In addition to the IAQ symptoms, respondents also reported relatively high frequencies of allergies (46%) to such inhalant allergens as dust and mold, sinus infection in the last year (46%), bronchitis (13%), asthma (8%), and treatment for skin symptoms (15%).

Table 1. Symptom Prevalence Indices for 10 Selected IAQ Symptoms in Seven University Buildings.

Building	Symptom Prevalence Index	
	Often/Always	Sometimes/Often/Always
A	0.44	1.31
B	0.50	1.02
C	0.50	1.23
D	0.74	1.68
E	0.46	1.23
F	0.67	1.38
G	0.93	2.16

Table 2. Prevalence Rates (%) of Work/Building-Related Symptoms in Seven Campus Building*

Symptom	Building							Total
	A	B	C	D	E	F	G	
Headache	10	15	9	16	9	8	24	12
Runny Nose	4	6	8	11	6	8	8	6
Stuffy Nose	7	9	12	16	11	4	12	9
Cough	0	3	3	16	0	6	4	3
Shortness of Breath	0	2	2	5	3	2	0	1
Eye Irritation	8	6	6	5	11	17	15	9
Sore Throat	2	0	2	0	0	4	5	2
Fatigue	5	2	6	0	6	13	15	7
Dizziness/light headedness	4	0	2	0	0	0	0	1
Dry/itchy skin	5	8	5	5	0	6	12	6

*based on symptoms occurring often or always in the last year and improving when away from the building

With the exception of building G significant gender differences were observed in symptom prevalence rates. Symptom prevalence rates were generally 1.5 - 3 times

higher in females as compared to males and as much as five times higher in building E.

Relatively high percentages of respondents in each building surveyed expressed dissatisfaction with a number of physical environmental parameters including air movement (\bar{X} = 35%, range 27-68%), temperature (\bar{X} = 38%, range 27-50%), relative humidity (\bar{X} = 28%, range 23-37%), and dustiness (\bar{X} = 25%, range 13-42%).

In addition to the survey questionnaire, CO₂ levels were monitored in each building as a measure of general ventilation adequacy. CO₂ varied from background levels of approximately 350 ppm to a high of 1700 ppm in an occupied classroom. The range of CO₂ levels measured in a variety of spaces in each building and average levels for each building are reported in Table 3. Based on CO₂ measurements general ventilation appeared to be adequate in four buildings and marginal in 3 buildings. There appeared to be no apparent relationship between symptom prevalence rates and measured CO₂ levels.

Table 3. CO₂ Levels in Seven Campus Buildings.

Building	Average CO ₂ Level	Range (ppm)
A	460	375-600
B	451	350-675
C	872	575-1200
D	852	525-1075
E	474	375-650
F	919	600-1700
G	458	375-600

DISCUSSION

Occupants of seven university campus buildings in which no dissatisfaction with air quality had been recently expressed were surveyed by means of a self-administered questionnaire. Compared to other studies, the overall response rate was relatively low (44%) reflecting in part the fact that the survey was conducted without any administrative requirements for faculty/staff to respond, the length of the survey questionnaire, and feelings by faculty/staff that they have already been oversurveyed on all types of other issues in the last few years.

In general the lower response rate would be expected to bias the prevalence rates given the assumption that those with symptoms/complaints are more likely to respond. In general, however, symptom prevalence rates in all seven campus buildings were lower than that of the USEPA headquarters building when using the same criteria of comparison (symptoms occurring often or always and improving on leaving the building).

Significant differences in symptom prevalence rates were observed when assessed on an: often/always basis compared to a sometimes/often/always basis. The former reflect the symptom prevalence assessment approach used in the USEPA and John Madison Library of Congress building studies (5,6); the latter is similar to the United Kingdom studies of Burge et al (1) where symptom prevalence rates were based on occupants experiencing a symptom related to their work or building environment at least twice in the past year. This would presumably include many responses in our study in which symptoms were reported to occur sometimes in the past year.

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