Proceedings of Healthy Buildings 2000, Vol. 1

WHAT CAUSES SICK BUILDING SYNDROME – SICK WORKROOM OR SICK DWELLING?

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ABSTRACT

The cross-sectional questionnaire-based study was conducted in spring 1998 among indoor workers of 6 buildings in town Tartu, Estonia. The goal of this pilot study was to evaluate magnitude of possible problems related to indoor air quality in Estonian nonindustrial workrooms as well as in those workers' dwellings. Therefore, the questionnaire included questions about perceived indoor environment for both workplaces and homes. It merits consideration that prevalence of SBS symptoms was rather high (up to 64%) in Estonian offices and libraries though some variance between buildings also exists. The associations between symptoms and indoor environment demonstrate that the symptoms of sick building syndrome may often be result of combination of workroom-related factors as well as factors related to indoor environment in workers' homes. It could be concluded that in case of sick building syndrome, role of possible synergistic effects of factors occurring in and beyond workroom might remain underestimated if only workrooms are investigated.

KEYWORDS: SBS, residential, workplace, building-related symptoms

INTRODUCTION

It has been often pointed out that average North American or European man spends 70-90% of his time indoors and the air he breathes is mostly indoor air [1, 2]. Hence, the indoor air in our dwellings, offices, schools and other premises are of decisive importance for the health, comfort, morale, productivity and well being of the occupants. The Sick Building Syndrome (SBS) as the common outcome of poor quality of indoor environment has been, on one hand, widely accepted concept of certain set of non-specific symptoms that often appear in relation to certain building or room. On another hand, SBS has remained widely discussed subject because of unclear origin of symptoms plus inconsistent results of studies done on indoor environment. Most of studies done do deal with either office (or school or any other work-related settings) environment or with indoor environment in residential settings. However, the statement said above that "an average man spends up to 90 per cent of his time indoor" means that both time spend at workplace and at home is summarised. Probably there must be also recreational facilities and time spent in those added to the model in many cases. Till now, no good model has been proposed to estimate possible synergistic effects of factors present at home and at work – the locations indoors where we do spend most of our time. The author of current paper is convinced that when discussing possible harm of poor indoor environment to human health at least these both sites workplace and home must be considered, similar opinion share also some other authors [3].

The indoor environment and SBS have been not studied in Estonia during recent decades. Hence no background data about indoor environment neither of residencies nor of workplaces and its possible relations with health were available. However, rapid socio-economical

changes in last decade in Estonia challenge also researcher to answer the question, whether we are moving toward healthier indoor environment. Current study was induced by the situation described; with main goal to gather background dat that describe indoor environment in Estonia in late nineties as well as to analyse possible associations between indoor environment and health.

MATERIAL AND METHODS

The study population was formed by occupants of six randomly selected public buildings without known indoor air quality problems in town Tartu. Three of those were office buildings, two were libraries and one was small private vocational school. Hence, the indoor workers studied were several occupations (librarians, bookkeepers, managers, customer servants, cashiers and some others as well as several students) that did not require hard physical work or direct contact with any kind of hazardous factors, and who stayed indoors during at least ¾ of workday (6 hours). All together, 429 individuals met including criteria; among those 48 were absent during study period, thus not accessible. 329 responders yielded response rate 82,2%. A self-administered questionnaire was used as main tool for data collection. Some additional data about buildings and maintenance of those facilities were asked from building managers. The questionnaire included questions about experienced by occupants symptoms (those widely accepted as symptoms of Sick Building Syndrome), perceived indoor environment and comfort, and questions about some job-related as well as personal factors. Questions about indoor environment were asked considering both locations – worksite and home. The data were analysed by software package STATISTICA using mainly correlation analysis to seek for bivariate associations and multiple regression analysis for controlling possible influence of suspected factors on found associations. For multiple regression analysis, all variables being statistically significantly ($p<0,05$) related with reported symptoms in bivariate analysis were included into model. Then, variables with least p-value for association were excluded one by one until only factors with statistically significant coefficients were remained in model. The analysis was performed in three stages: first, only factors present at workplace were analysed, secondly only factors present at workers' homes were analysed, and thirdly, all factors were analysed together as one common model.

RESULTS

Generally, the prevalence of SBS related symptoms was considerable while WHO [4] accepts 20% prevalence as criterion for "sick" buildings. As presented in table 1, most prevalent were general symptoms, such as headache (54.7%), fatigue (62.8%) and dizziness (64.1%). However, while no background data about indoor environment in Estonia are available, those results must be considered with caution. There may be numerous factors controlled as well as not controlled through this study that make workers to complain. Data in table 1 also show that people rather link their symptoms to workplace. Symptom occurrence at home according to as reported by workers is negligible.

Abundant associations between SBS symptoms and factors of both work and home-environment appeared in two first steps of analysis (bivariate and multiple regression models for two separate data sets – workroom and dwelling). Though some of those associations disappeared in final step of analysis, several interesting associations still remained and will be presented below.

Table 1: Prevalence of SBS symptoms by buildings investigated (in percentage)

Symptom	Crude prevalence (%)	Reported as	
		work–related (%)	home–related (%)
Eye irritation	46.0	40	1,6
Nose irritation	48.5	44	1,4
Throat irritation	27.2	46	1,4
Irritation cough	38.7	47	1,0
Skin irritation	20.5	43	1,9
Headache	54.7	39	3,3
Fatigue	62.8	39	1,8
Dizziness	64.1	40	1,7
Vertigo	26.2	47	4,1
Irritability	39.4	41	2,8

Table 2. Factors at worksite and at home associated with symptoms: results of multiple regression analysis with one model for all factors

Symptom	Factors at workplace	Factors at home	Other factors
Eye irritation	dusty air more time spent on PC		female gender
Nose irritation	additional electric heater in room lack of natural light poor illumination		atopy
Throat irritation		additional electric heater in room poor illumination	atopy
Irritation cough	additional electric heater in room	bad general condition of building	job requires some physical exertion
Skin irritation	felt air stuffiness		
Headache	prolonged airing of room dusty air	bad general condition of building	less interesting job atopy
Fatigue	shorter time worked in this room felt air stuffiness poor illumination	bad general condition of building less/no use of chemicals while cleaning	job requires some physical exertion
Dizziness	felt air stuffiness newer building poor illumination windows directed to northern quarters larger room	noisy apartment building	older age job requires some physical exertion
Vertigo	carpeted floor dusty air bad general condition of building	less/no use of chemicals while cleaning	job requires some physical exertion
Irritativeness		additional electric heater noisy	lower job rank

The third step of analysis was to clarify whether those factors associated with SBS symptoms either in work or home settings become associated when controlled for each-others influence. Table 2 presents the results of multiple regression analysis when variables of both –

workroom and workers homes were forced into one common model. As shown in table 2, there are still several home-related factors that remained associated with SBS symptoms. However, those home-related factors are mainly "too" general and probably need more detailed analysis to explain those' essence.

DISCUSSION

Symptoms believed describe relationship between human health and indoor environment usually do not lead to high rate of sickness absence. The matter is rather comfort of occupants and its indirect outcome – lowered productivity and finally, economical loss. There are several problems while determining origin of symptoms believed being caused by unhealthy indoor environment. The dynamics of symptom occurrence is often not well enough expressed in order to associate symptoms to certain building. Also, most of symptoms considered are rather non-specific and widely common among general population [3], and may be caused either by outdoor factors or combined (outdoor + indoor) exposure [5]. In addition, there are probably many factors responsible for similar adverse health effects, and in many cases synergistic effect of several, different kind of factors might be the clue [6]. Therefore, it is not surprising that different kind of factors at different locations may work synergistically towards occurrence of non-specific symptoms. However, some factors in certain building may become of particular importance as demonstrated also through current study.

The perceived indoor environment as predictor of occupants' comfort has not often been published being associated with SBS symptoms. Mendell [7] summarises several studies and finds association with felt air dryness. Current paper shows, however, that also felt air stuffiness and dustiness might be considered as predictors of some SBS symptoms, though recent experimental study of Hauschildt et al. [8] did not find relationship between office dust and SBS symptoms. The excessive noise in workroom has often been demonstrated being related with increased prevalence of symptoms [9, 10, 11]; in current study, noisy environment at home became associated with symptoms rather than noise at work. Findings about associations between symptoms and poor illumination in workroom agree with studies of Hodgson [12] and Ooi [10], however, there is a hint that inadequate illumination even at home may either contribute to symptom occurrence or be a sign of some other factors not directly controlled. In current study, also factors such as "windows directed to northern quarters" as well as "lack of natural light in room" support that opinion. Carpeted floor is also found being associated with excessive prevalence of symptoms [7, 13], and results of current study agree with those. Similarly, Mendell concludes that improved cleaning decreases symptom prevalence in office environment [7]. As frequent use of chemical cleaning means was believed being measure of cleaning quality, then surprisingly, it turned out being rather home-related factor, that associates with SBS symptoms. However, no time-relationship can demonstrated for this association, hence it cannot be excluded that more frequent use of chemicals for cleaning is caused by desire to avoid further symptoms, or it can also reflect kind of lifestyle or even economical status of a household. Association found between SBS symptoms and newer building agrees with results of Nordström et al [11]; also found by Sieber et al [14] association between recent renovation and asthma-like symptoms supports validity of that finding. On another hand, the bad general condition of dwelling is not well enough defined to yield any reasonable conclusion. To some extent, this characteristic may go along results of studies that have demonstrated relationships with respiratory symptoms and factors related to dwelling, especially dampness [2, 15, 16]. The factor "additional electric heater in room" is probably measure of inadequate thermal environment that in turn

may depend on other factors, as does opinion about general bad condition of building. The further influence of additional electric heater on perceived indoor environment cannot describe through current study, but as common factor in Estonian dwellings it merits further investigation.

Personal and psychosocial factors are those, often associated independently with whatever health outcome; these factors also may often influence on any other association between SBS symptoms and factors of indoor environment, hence, these are always to consider. Female gender remained associated with eye irritation in current study. Similar associations between female gender and excessive prevalence of SBS symptoms have also found by other investigators [7, 14], however, the origin of such an effect is not easy to explain [17]. Another personal determinant of susceptibility is tendency to hyperreactivity. Estimation of that via questionnaires is assessed being good enough proxy measure for atopy if proper questions used. Though slightly differently approached, the findings of current study agree with those described by Norbäck et al. [18], Mendell [7], Hedge et al. [19] and Ooi et al. [10]. Age of employee seems playing some role as well. Younger employees tend to complain somewhat more often as shown by Ooi et al. [10] and second step of analysis of current study (when model consisting of factors present at work, only). However, some inconsistency appears while looking at results of final step of analysis. It might be, that age has different influence on occurrence of different symptoms. The findings of other authors are, unfortunately, hard to compare while usually various indices of SBS symptoms are used instead single symptoms. Job satisfaction is determinant of SBS symptoms found by current study, and this finding is similar to others' [7, 19, 20]. Crowding has also been one of the most frequently found predictor for SBS symptoms [7, 12], and this finding was confirmed by an indirect measure - larger size of workroom in current study. Use of PC (personal computer) has often found associated with increased reporting of symptoms [7], and also current study revealed an association between hours spent on PC and eye irritation. However, some other studies have not found associations between SBS symptoms and use of PC [19], hence these phenomena should investigated in more detail. In addition, several complaints associate with impact of physical load at work, in current study. It must be emphasised that the subjects of current study were not "usual office workers" but rather indoor workers including several library workers as well. This last group might be more often exposed to moderate physical exertion at work, but this supposition needs additional data analysis and till that interpreted with caution.

Based on results presented and discussed above, it can be concluded that SBS symptoms tend to occur rather in work environment, but may sometimes be to considerable extent influenced by factors beyond worksite. Among factors others than those at work, employees' homes are to consider carefully.

ACKNOWLEDGEMENTS

The study was supported by Estonian Science Foundation, grants 2484 and 3979.

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