

Prevalence of SBS-symptoms as an indicator of health and productivity in office buildings

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ABSTRACT

The prevalence of SBS-symptoms is commonly used to characterize the indoor air quality of buildings. For economical analysis in building refurbishment and improvements of indoor environment, it would be very useful if we could quantitatively relate the prevalence or intensity of SBS-symptoms to productivity. The purpose of this study was to summarize the links between the SBS-symptoms and productivity, and demonstrate with a case study how this information can be applied to a case building to evaluate the economical value of lower prevalence of symptoms with a selected remedial measure. Although several studies have been able to demonstrate a link between SBS-symptoms and productivity metrics, only a few of these studies give reliable quantitative data between symptoms and these outcomes.

INDEX TERMS

Building-related symptoms; Office building; Perceived air quality; Productivity

INTRODUCTION

The prevalence of SBS-symptoms is commonly used to characterize the indoor air quality and climate of buildings. High prevalence of symptoms is an indicator of potential building related problems. Many building-related factors are linked to the high prevalence of SBS symptoms. This has been shown with many cross sectional and intervention studies. Interventions have also shown that the prevalence of symptoms can be reduced if the indoor environment is improved. The value of this reduction should be expressed quantitatively to demonstrate the benefits of reduced prevalence of symptoms. For the cost–benefit analysis SBS-symptoms should be linked better with economical metrics such as illnesses or productivity.

The purpose of this study was to summarize the links between the SBS-symptoms and productivity, and demonstrate this linkage in a case study building.

SBS-SYMPTOMS AND PRODUCTIVITY

SBS-symptoms are probably the most common metrics used to measure human responses in health related building investigations. Characteristics of buildings and indoor environments have been linked to the prevalence of acute building-related SBS-symptoms experienced by the occupants of the building. IAQ conditions linked to the elevated prevalence of symptoms include high room air temperature, high concentration of dust on surfaces, and high airborne concentrations of certain groups of volatile organic compounds. Building characteristics linked to symptoms include e.g. low ventilation rates, carpets and air conditioning.

For economical analysis in building refurbishment and improvements of indoor environment, it would be very useful if we could quantitatively relate the prevalence or intensity of SBS-symptoms to productivity. We collected the literature from studies, which measured simultaneously the prevalence or intensity of SBS-symptoms and subjectively reported of or objectively measured productivity. We found eight field studies which reported association between SBS-symptoms and self assessed productivity in office environment

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(Woods and Morey, 1987; Hall *et al.*, 1991; Hedge *et al.*, 1993; Whitley *et al.*, 1995; Menzies *et al.*, 1997; Wyon *et al.*, 2000; Heslop, 2002). Another two studies reported association between SBS-symptoms and objectively measured performance in school environment (Myhrvold *et al.*, 1996; Myhrvold and Olesen, 1997). However, the validity of the self-reported productivity data is unclear. Also, these data do not confirm that increased SBS-symptoms would be the cause of the decreased self-reported productivity.

In addition to field studies, four laboratory studies (Nunes *et al.*, 1993; Wargocki *et al.*, 2000; Fang *et al.*, 2002; Kaczmarczyk *et al.*, 2002) reported association between SBS-symptoms and objectively measured performance in tests related to productivity in office work. None of the studies offered adequate information to establish the reliable quantitative relationship between the prevalence or intensity of symptoms and performance. However, the number of the studies with the association between SBS-symptoms and productivity suggests but does not prove that such relationship exists.

Four studies report an association, but not necessarily a causal relationship, between increased SBS-symptoms and diminished objectively measured performance in tests that have tasks emulating real work. These studies are perhaps the strongest evidence of a productivity decrement and the primary basis for previous estimates of an overall 2% decrease in productivity due to SBS-symptoms (Fisk, 2000; Mendell *et al.*, 2002); however, the high level of uncertainty in this 2% estimate has been emphasized by the authors.

METHODS IN THE CASE STUDY BUILDINGS

In the present pilot survey, the association between the prevalence of SBS-symptoms and productivity of workers in a telecommunication office building was investigated. An observational study design was applied in two call centres located on the seventh and eighth floor of the telecommunication building by comparing the prevalence of SBS-symptoms and a direct productivity indicator in both call centres.

The task of the workers in two call centres was to carry out inquiry assignments of telephone numbers by using their personal data terminals. The female employees worked under the same management although the call centres were located in different floors of the building. Altogether 16 employees worked in the call centre room on the seventh floor (area 148 m²) and 15 employees worked in the call centre room on the eighth floor (area 91 m²). Both call centres were landscape offices where workplaces were separated with partitions. Both floors were served by separate HVAC-systems.

Computerized systems were used in monitoring the frequency of contacts and the queuing times of clients. The system recorded the number of calls, the total work time and the active work time of each employee. It was estimated that the best productivity indicator was the number of telephone contacts divided by the active working time. The productivity was monitored from June to September. The monthly average productivity data of both call centres were available for the present study.

The indoor air questionnaire survey was performed once in both call centres during the 4-month monitoring period. The validated indoor air questionnaire (MM-40-FIN, Andersson, 1998; Reijula and Sundman-Digert, 2003) consisted of questions about symptoms related to indoor air, perceived indoor environment and psycho-social work organization of the workplace.

RESULTS

The results of the indoor air questionnaire survey show that the prevalence of the SBS-symptoms was remarkably higher among workers in the call centre on the seventh floor (Figure 1). Only the prevalence of 'feeling heavy headed' and 'dry/flushed skin' was slightly higher among workers on the eighth floor. Among employees of the seventh floor, the

prevalence of hoarse and dry throat, fatigue and eye symptoms were the highest. In these symptoms, the difference between the two floors was also most significant. The average prevalence of all symptoms in the seventh floor was 13% while that in the eighth floor was 5%.

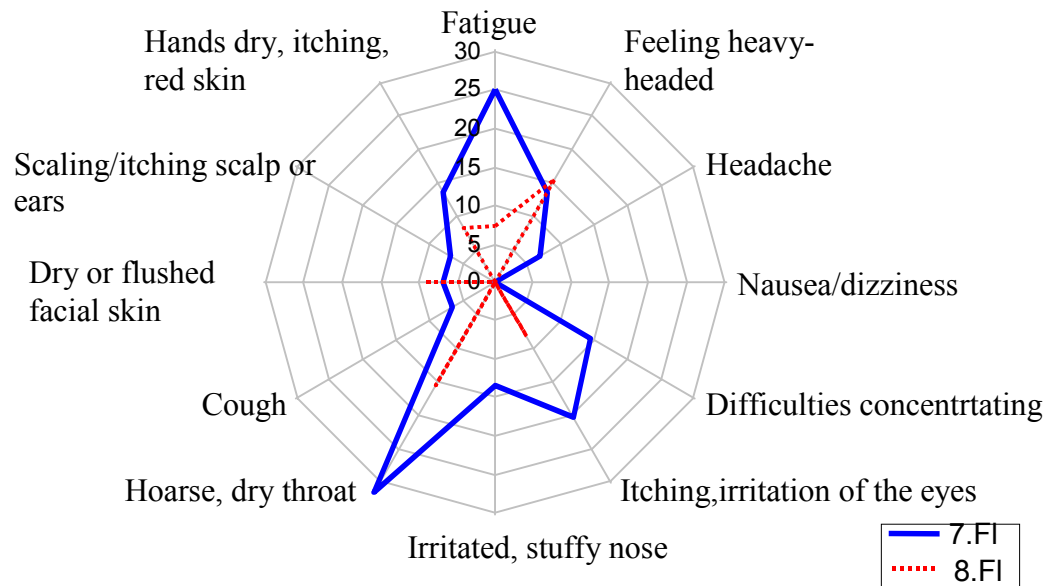


Figure 1 The prevalence of SBS-symptoms in the call centres on the seventh and eighth floors.

Figure 2 shows the relative productivity difference between the two call centres over the monitoring period of 4 months. The monthly productivity was always higher in the call centre of the eighth floor. The productivity was 0.7% higher in the eighth floor where the prevalence of the symptoms was lower than in the seventh floor. The data in the present case study indicates that the difference of the prevalence of the symptoms may contribute to the difference in the productivity between two call centres.

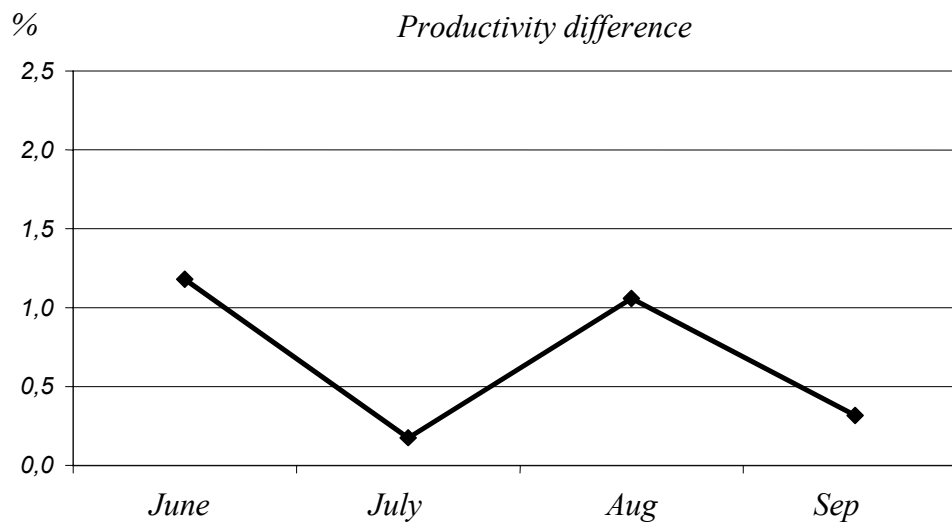


Figure 2 Relative productivity difference $(P_8 - P_7)/P_7 \times 100\%$ between the call centres in the seventh and eighth floors.

DISCUSSION

The case study in the telecommunication offices suggests an association between the SBS-symptoms and the direct productivity indicator. The prevalence of indoor air-related symptoms was lower among workers, who worked in a call centre with a higher productivity. However, the difference in productivity between two call centres was fairly small, 0.7%.

There was a significant difference between the prevalence of self-reported symptoms related to indoor environment among workers from the two call centres. The role of indoor-air related symptoms in decreasing the working capacity has not been fully elucidated. However, the symptoms of the central nervous system (CNS) (such as fatigue, feeling heavy headed, headache, nausea/dizziness and difficulties in concentrating) decrease the capability of workers in concentrating to the work tasks. On the other hand, symptoms of eyes and respiratory tract lead to difficulties in carrying out the telephone communication on the PC terminals which in turn may reduce the frequency of client contacts.

According to the findings of the present survey, we suggest that further investigations should be carried out to establish the role of different groups of indoor air-related symptoms (CNS, eye and respiratory symptoms) in causing reduction on working capacity in individual level which then may lead to changes in productivity.

Even though this finding was consistent with the papers reviewed earlier, there were notable limitations to this case investigation. The finding was based on a small sample size in both call centres and the monthly average data on productivity. In any event, the finding supports our hypothesis on an association between the prevalence of symptoms and productivity. Consequently, future research should be directed toward the quantitative examination of the linkage between the SBS-symptoms and productivity.

CONCLUSIONS

We found that several studies have been able to demonstrate a link between SBS-symptoms and task performance, sick leaves and productivity. Unfortunately, only a few of these studies give reliable quantitative data between symptoms and these outcomes. We used the best estimate between the prevalence and productivity, and applied this data in a telecommunication office building from which we had collected the symptom data in a previous study. In the paper we summarise the existing data on the links between SBS symptoms health and productivity.

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