The influence of sick building syndrome on self-reported productivity and work disruption amongst office employees in two buildings in South Africa

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ABSTRACT
The aim of this quasi-experimental research was to investigate the influence of building related symptoms on self-reported productivity and work disruption based on a random sample comprising 348 employees. The investigations were carried out in two air-conditioned, high rise office buildings located in South Africa. Respondents' self-reported productivity was assessed by their own ratings of how frequently symptoms reduced their ability to work and caused them to leave work early or stay at home. In addition, work disruption due to sick building syndrome (SBS) symptoms was determined. Results indicate there was a significant relationship between self-reported productivity and the number of SBS symptoms in both buildings ($p < 0.05$). In essence, the greater the number of symptoms reported by respondents, the greater was the corresponding reduction in productivity. Moreover, significant differences were found between the buildings in terms of self-reported productivity. Work disruption attributed to SBS symptoms was consistently higher in building B. In building A, more than one-third of the employees (37%) reported that symptoms reduced their ability to work sometimes, often or always, while the corresponding figure for building B was 55%.

INDEX TERMS
Sick building syndrome; Perceived indoor air quality; Symptoms; Work disruption; Self-reported productivity

INTRODUCTION
Although it is generally assumed that there is a linear relationship between the quality of the indoor environment and employee productivity, there has been a dearth of experimental evidence to demonstrate such a relationship. McCartney and Humphreys (2002) maintain that perceived productivity does not vary with perceptions of indoor environments. Freitag *et al*. (2002) suggest that there is a potential significant loss of productivity in 'problem' buildings known to have sick building syndrome (SBS). The current research investigates perceptions of environmental conditions, the prevalence of SBS, the relationship between SBS and self-reported productivity and work disruption amongst building occupants in South Africa.

METHOD
Buildings Surveyed, Measuring Instrument and Procedure
The 'Office Environmental Quality Survey' (Hedge, 1988) questionnaire was administered to a random sample of office employees occupying two air-conditioned, high rise buildings, assessing the frequency of occurrence of 16 indoor climate conditions (WHO, 2000) during the previous month. Building A was not a known sick building whereas building B was a known sick building as determined by objective assessments. Productivity was based on

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self-estimated or subjective ratings of how frequently symptoms and environmental conditions reduced their ability to work and how frequently symptoms caused them to stay home from work or leave work early during the past month.

Data Analysis

The Statistical Package for the Social Sciences (SPSS), version 8 facilitated analysis of the data. Pearson's product moment correlation analysis was used to ascertain the relationships between productivity and the number of SBS symptoms in building A and B, respectively. *t*-Tests were used to determine differences in self-reported productivity between the two buildings.

RESULTS AND DISCUSSION

Environmental Conditions

In building A, the environmental condition perceived to be most problematic every day was dusty air (29%), while in building B, the most problematic environmental conditions as perceived by employees every day were insufficient ventilation (28.5%), followed by complaints of dry air (21%) (Table 1).

Table 1 Comparison of perceived environmental conditions[a] experienced in the month prior to administration of the questionnaire

Environmental condition	Building A (%)	Building B (%)	Building A (%)	Building B (%)
	1–3 times per week		Every day	
Temperature too warm	25.3	41.9	4.3	17.2
Temperature too cold	27.8	38.7	6.2	14.5
Insufficient ventilation	27.8	31.7	13.6	28.5
Too little air movement	29.0	47.3	16.7	12.9
Air too dry	25.3	45.2	4.3	21.0
Dusty air	34.6	16.7	29.0	4.8

[a]Only the most problematic environmental conditions are reported.

Prevalence of SBS Symptoms

While only selected results are reported on in Table 2, 12 of the 15 SBS symptoms, that is, 80%, of the symptoms were perceived to be more problematic on a daily basis in building B compared to building A. The frequency of a large number of these symptoms exceeds the 20% that Lenvik (1990, p.508) regards as being indicative of having to 'deal with an epidemic, not only endemic symptoms, and the costs for a "cure" may be high'.

Table 2 Comparison of SBS symptoms for the two buildings[a]

Symptoms	Building A (%)	Building B (%)	Building A (%)	Building B (%)
	1–3 times per week		Every day	
Mental fatigue	25.3	26.3	20.4	28.5
Irritated, sore eyes	30.9	26.3	25.3	28.5
Tiredness, lethargy	40.1	33.3	15.4	21.0
Congested nose	30.2	28.0	10.5	22.0
Sore throat	43.8	33.9	13.0	26.9
Runny nose	27.8	33.9	22.2	25.8

Nausea	25.9	24.7	20.4	29.0

[a]Only the most problematic SBS symptoms are reported.

Relationship between Self-Reported Productivity and the Number of SBS Symptoms

Results indicate there is a significant relationship between productivity and SBS in both buildings (Table 3). However, the relationship was moderately stronger in building B ($r = -0.46$, $p = 0.03$) than in building A ($r = -0.39$, $p = 0.02$). Employees in building B rated their productivity as having decreased more substantially as compared to those in building A.

Table 3 Correlation between productivity and the number of SBS symptoms

	Building A		Building B	
Variable	*R*	*p* value	*r*	*p* value
Self-reported productivity	–0.39	0.03*	–0.46	0.02*

*$p < 0.05$

Difference in Productivity of Employees in Buildings A and B

There was a tendency towards a decrease in productivity by employees in building A (Mean = 3.63, SD = 4.67) and building B (Mean = 4.17, SD = 2.76). This mean value is significantly higher in building B ($t = -1.99$, $p = 0.048$), indicating building B's productivity was lower compared to that of building A. However, in both buildings, productivity was rated as either decreased or substantially decreased (Table 4).

Table 4 Difference in productivity of employees in buildings A and B.

Productivity[a]	Mean (*M*)	Standard deviation	*t*-Value	2-Tailed prob.
Building A	3.63	2.45	–1.99	0.048*
Building B	4.17	2.76		

*$p < 0.05$.

[a]Where lower scores are indicative of high productivity.

Work Disruption by Environmental Conditions

Results show the greatest disruptions in building A were from too little air movement (75.9%), dusty air (73.5%) and stale air (64.2%). In building B, the most disruptive environmental conditions were insufficient ventilation (74.8%), temperature too warm (72.1%) and too little air movement (71.5%) (Figure 1).

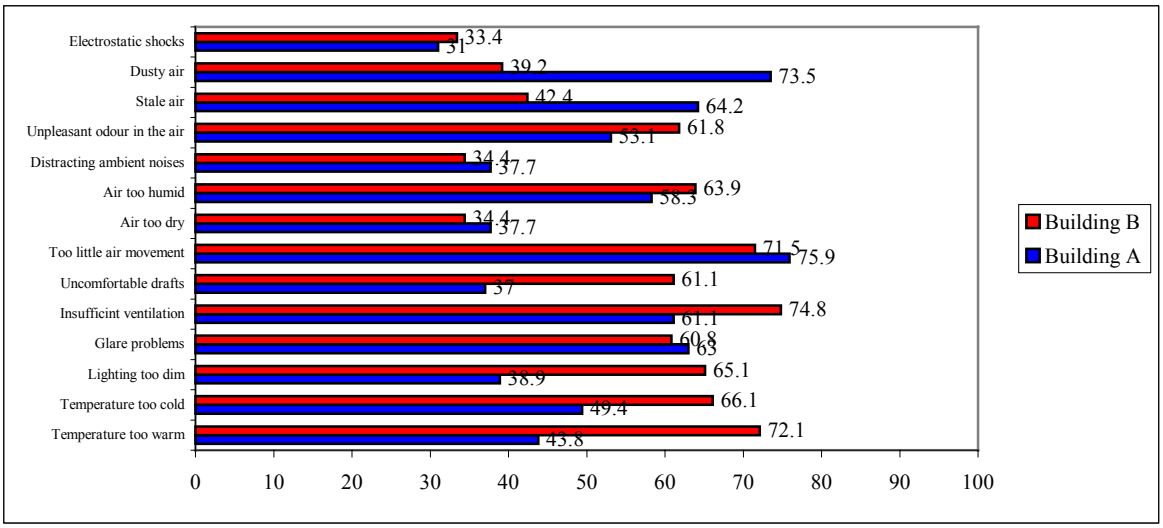

Figure 1 Comparison of work disruption by environmental conditions for the two buildings.

Work Disruption by Symptoms

Figure 2 shows work disruption attributed to SBS symptoms was consistently higher in building B. Results show the greatest disruptions in building A were from excessive mental fatigue (52.4%), followed by headaches across the forehead (50.5%), irritated, sore eyes (45.9%) and unusual tiredness, lethargy (44.5%). In building B, unusual tiredness, lethargy was rated as most disruptive (69.2%), followed by excessive mental fatigue (68%), headaches across forehead (67.2%) and irritated, sore eyes (52.1%).

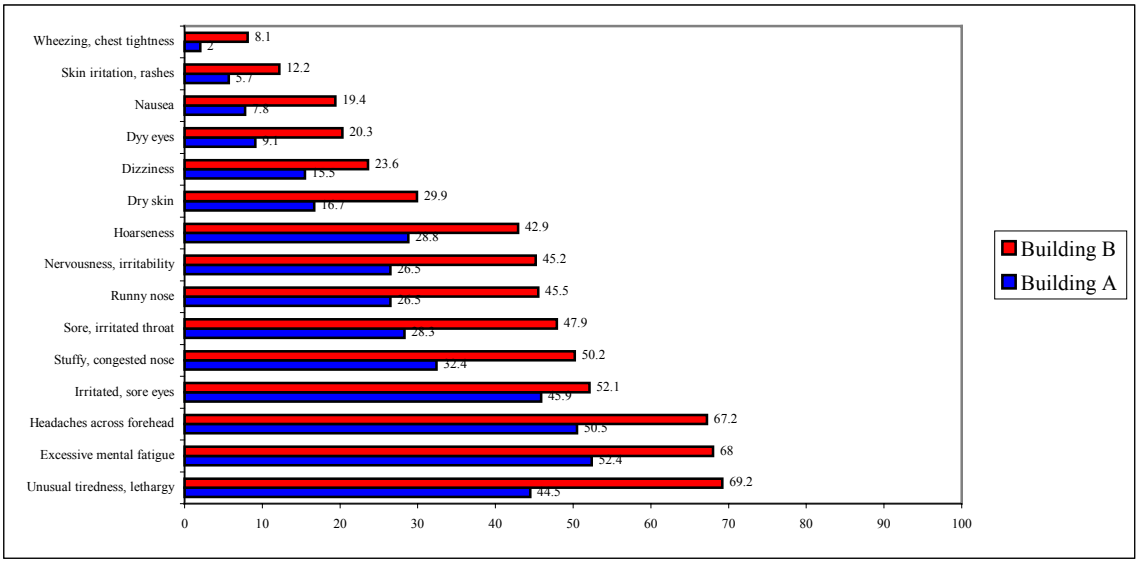

Figure 2 Comparison of work disruption by SBS symptoms for the two buildings.

Influence of SBS symptoms on ability to work and tendency to leave work early/stay home

Figure 3 compares self-reported impact of symptoms on ability to work and Figure 4 compares the impact of symptoms on tendency to leave work early/stay home. In building A, more than one-third of the employees (37%) reported symptoms that reduced their ability to work sometimes, often or always, while in building B, the majority of employees (55%) indicated symptoms reduced their ability to work sometimes, often or always.

Results depicted in Figure 4 indicate almost one-third (33%) of the employees in building A reported symptoms caused them to leave work early or stay home sometimes, often or always, while corresponding figures for building B were two-thirds of employees (66%).

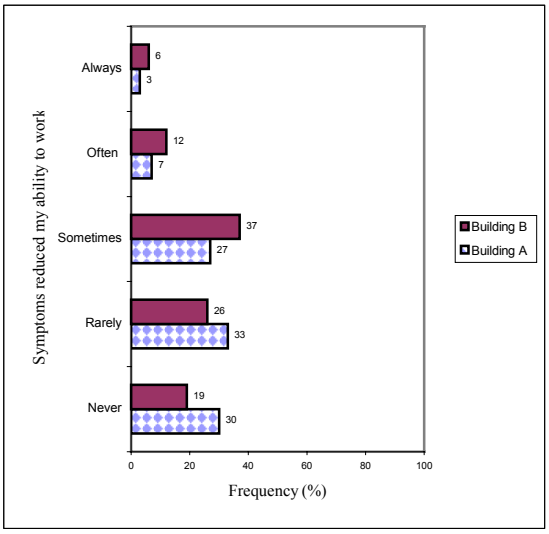

Figure 3

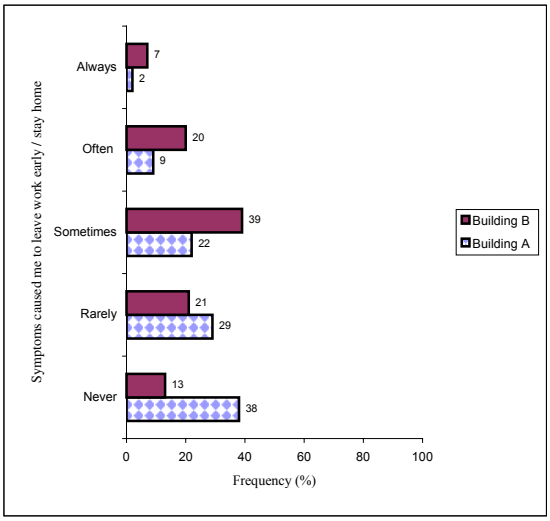

Figure 4

CONCLUSION AND RECOMMENDATIONS

Research endeavours to establish a definite link between thermal comfort and occupant productivity (Bordass *et al*., 2001; McCartney and Humphreys, 2002) have been beset with a wide range of methodological shortcomings. This is also evident in the research reported in this case. Although respondents in building B reported greater work disruption attributed to environmental conditions, the extent of the problem in the 'healthier' building cannot be overlooked. Moreover, while the results of the current research indicate that building-related symptoms and perceived adverse physical conditions in the work environment may lead to decreases in self-reported productivity, more objective evidence attesting to the actual influence on productivity is required. Although both buildings had a high prevalence of SBS symptoms, symptoms were generally more prevalent in the 'sick' building as opposed to the 'healthy' one. In lieu of the absence of any objective data, building A could be classified as a 'temporary' sick building (WHO, 1983). In this case, symptoms could be attributable to office

redecoration, building maintenance or renovation work, which building A was undergoing at the time of the survey. While the research also indicated employees in building B evidenced higher stress levels, lower job satisfaction, lower control over their environment and lower overall environmental satisfaction (Heslop, 2002), additional research should be conducted in order to further refine measures of relevant physical, psychological and social factors, epidemiological investigation of their interrelationships and qualitative investigation of office workers' interpretation of SBS.

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