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Objectives This study examined the influence of some organizational and management characteristics on the perception of indoor environment qualities such as thermal comfort and related stress.
Methods One open office in each of three organizations in Eindhoven was studied. An office environment survey, a questionnaire on extended cognitive failure, and a questionnaire on effort–reward imbalance were combined to assess the perceived management attitudes and perceived (dis)comfort of 50 workers in each of two of the offices and of 43 persons in the third. The study included data on perceived and measured thermal comfort and indoor-air quality, self-reported personal factors, and organizational factors (N=46).
Results Perceived thermal comfort correlated with perceived symptoms of the sick building syndrome; it also correlated or was associated with the following three management-related parameters: (i) employees' stress, (ii) employees' overcommitment to work, and (iii) employees' perceived privacy.
Conclusions The managerial characteristics of an organization influences thermal comfort as perceived by employees.

Key terms office environment survey; overcommitment; privacy; stress.

Management attitudes towards complaints, stress, privacy, and the like differ among organizations (1). In addition, the aging of society and the subsequent decrease in the workforce stresses the economy, and being employed until an older age is advocated (2). This effort calls for an increase in the part of the lifespan enjoyed in vitality and in good health and an accommodating work environment (3–4). Our research focused on the influence of some organizational and management characteristics on the perception of indoor environment qualities such as thermal comfort.

Study population and methods

Three office organizations (A, B, and C) were studied, all located in Eindhoven in the Netherlands. The buildings were erected in 1999–2002, had 3–6 floors, and contained radiators (convectors) for heating and a ventilation system with recirculation. The study concerned one floor of each of the buildings, that of B and C having 300 m^2 and that of A having 320 m^2, occupied by 43 (A) or 50 (B, C) employees, all working in an open-office environment.

The office-environment survey (5), a questionnaire on extended cognitive failure (6), and a translated questionnaire on effort–reward imbalance (7) were combined to assess perceived management attitudes and perceived (dis)comfort. Altogether 46 persons (28% to 37% of the employees) completed the questionnaires [32 men and 9 women, mean age 37.5 (range 24–59) years].

Indoor-air conditions were assessed for 1 week at 7-minute intervals at one central spot in each of the three open offices. The measurements included air temperature (°C), mean radiant temperature (°C), relative humidity (%), and air velocity (m/s) in order to calculate the percentage of time within the thermal comfort limits with the use of PMV/PPD (predicted mean vote/predicted percentage dissatisfied) methodology (8). The concentration of carbon dioxide (ppm) and airborne particles (0.3–0.9 µm, and ≥1.0 µm) (counts/minute) were recorded as a measure of indoor-air pollution. The Kruskal Wallis test (two-tailed) was used for the statistical analysis for possible differences among the organizations; Kendall's Tau and the principal component

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analysis (PCA) were used for possible correlations and associations, respectively.

Results

The three organizations appeared to be similar with respect to overcommitment to work (2 on a scale of 1–5), perceived privacy (3 on a scale of 1–7), reported health (1 on a scale of 0–5), effort–reward imbalance (1–2 on a scale from 0.2–5.0), and perceived symptoms of the sick building syndrome (3 on a scale of 0–8), as well as for air pollution from airborne particles (0.3–0.9 µm: $108–116 \times 10^3$; ≥1.0 µm: 2.6×10^3 counts/minute).

Organization B differed from A and C in several ways. The air was more polluted with carbon dioxide, the calculated duration of thermal comfort was larger, and the cognitive stress among the employees was low. In addition, the perceived control over the indoor environment was lower (table 1).

On the individual level, several correlations were found (table 2). The level of carbon dioxide and the management of complaints as perceived by the employees did not correlate with any other individual parameter.

Additional associations were found in the PCA (table 3). In the first component, perceived thermal comfort was negatively associated with overcommitment to work and positively associated with age and the number of perceived symptoms of the sick building syndrome.

Table 1. Median values of parameters that differed among the buildings (Kruskal Wallis test, α=0.05). (CO_2 = carbon dioxide)

Office	CO_2 level (ppm)	Stress (%)	Perceived control of environment (1–5)	Thermal comfort	
				Duration, calculated (%)	Perceived (1–7)
A (N=16)	620	40	2.0	70.0	3.0
B (N=14)	675	17	1.0	99.6	5.5
C (N=16)	517	40	1.5	85.1	5.5

Table 2. Kendall's tau (T) correlation matrix of selected parameters. (SBS = sick building syndrome)

	Gender		Function level		Effort–reward imbalance		Over-commitment		Perceived control of environment		Stress		SBS symptoms		Control or satisfaction					
															Thermal				Perceived privacy		Management of perceived complaints	
															Calculated duration		Perceived					
	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T
Age (years)	46	–0.32[a]	45	–0.34[b]	45	–0.06	45	–0.01	46	–0.17	42	–0.12	45	–0.23[a]	46	0.14	45	0.12	46	–0.07	18	–0.05
Gender (1=male, 2=female)	–		46	–0.52[b]	45	–0.07	45	–0.05	46	0.20	42	0.00	45	0.22	46	–0.26	45	–0.17	46	–0.07	18	–0.32
Function level (1= low, 3=high)			–		44	0.24[a]	44	0.08	45	–0.32[a]	41	–0.23	44	–0.35[b]	45	0.26	44	0.16	45	0.09	18	0.37
Effort–reward imbalance (0.2= balanced, 5.0= not balanced)					–		44	–0.01	45	–0.12	42	–0.10	44	–0.09	45	0.16	44	0.17	45	0.24[a]	17	0.19
Overcommitment to work (1=no, 5=much)							–		45	–0.10	42	–0.08	44	–0.24	45	0.07	45	–0.09	45	–0.21	17	–0.07
Perceived control of environment (1=no control, 5=control)									–		42	0.04	45	0.14	46	–0.57[b]	45	–0.07	46	0.19	18	0.08
Stress (0=no, 1=yes)											–		41	0.27	42	–0.18	42	–0.32[a]	42	–0.28[a]	15	–0.18
SBS symptoms (0–8)													–			–0.23	44	–0.25[a]	45	–0.16	18	–0.13
Comfort																						
Thermal																						
Calculated duration (%)															–		45	0.38[b]	46	–0.02	18	0.07
Perceived (1–7)																	–		45	0.33[b]	17	0.03
Privacy																						
Perceived (1–7)																			–		18	0.26

[a] 0.05>P>0.01.
[b] P<0.01.

Discussion

In contrast to offices A and C, office B was located on the terrain of the local busy airport, and this location explained the increased concentration of carbon dioxide in the indoor air. Apparently the regulation of the indoor thermal environment was good enough to lower the need for personal control of the indoor environment in this case.

As expected, thermal comfort, as perceived individually by the employees, was positively correlated with the calculated duration of thermal comfort and negatively associated with the number of perceived symptoms of the sick building syndrome (table 2).

Ooi & Goh (9), Thörn (10), and Lahtinen et al (4) have suggested that a relationship exists between the sick building syndrome or indoor-air complaints and psychosocial issues. We focused on thermal comfort and found correlations and associations between perceived symptoms (sick building syndrome or thermal comfort) and some management characteristics, such as employees' stress, employees' perceived privacy, and an overcommitment to work.

Table 3. Components explaining more than 10% of the variation (1: 24%, 2: 18%, 3: 15%) in the rotated component matrix of the principal component analysis. Varimax with Kaizer normalization was used. Values over 0.50 are considered significant and are in bold font. (SBS = sick building syndrome)

Parameter	Component		
	1	2	3
Age (years)	**0.69**	–0.46	0.36
Gender (1=male, 2=female)	–0.06	–0.07	0.07
Function level (1=low, 3=high)	0.07	0.07	0.25
Effort–reward imbalance (0.2=balanced, 5.0=not balanced)	0.14	**0.80**	0.34
Overcommitment to work (1=no, 5=much)	**–0.80**	0.05	–0.04
Perceived control of environment (1=no control, 5=control)	0.16	0.16	**–0.89**
Stress (0=no, 1=yes)	0.13	–0.20	–0.09
SBS symptoms (0–8)	**0.69**	0.26	–0.32
Comfort satisfaction			
Thermal			
Calculated duration (%)	0.20	0.40	**0.80**
Perceived (%)	**0.73**	0.19	–0.00
Perceived privacy (%)	–0.01	**0.79**	–0.17
Perceived complaint management	–0.04	0.46	0.06

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