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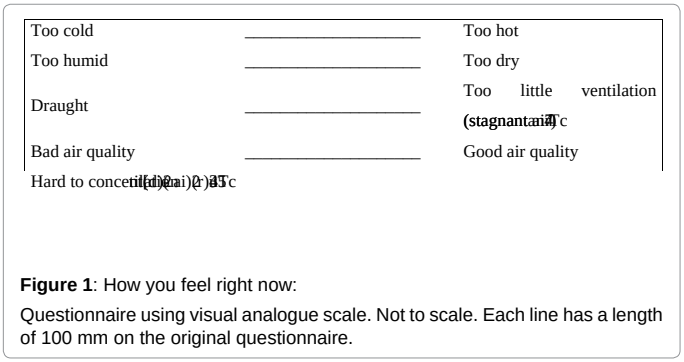

Figure 1: How you feel right now:

Questionnaire using visual analogue scale. Not to scale. Each line has a length of 100 mm on the original questionnaire.

heat- and humidity-controlled 34.8 m^2 chamber isolated from sound, light, and natural ventilation already described in other chamber studies [16] (The chamber's air supply came exclusively from a fan coil with a nominal output of 340 m^3/h and from a chiller with 5 tons of refrigeration capacity. The experimental system ensured air exchange rates of more than 27 m^3/hour/person. Levels of indoor pollution were monitored for biological (viable fungal spores), inorganic (total particulate matter) and personal (carbonic dioxide levels) pollutants. Subjects were exposed to different thermal conditions of 14, 18, 22 and 26 degrees Celsius (°C) – or, correspondingly, 57.2, 64.4, 71.6 and 78.8 degrees Fahrenheit (°F) – with a relative humidity of the indoor air of 65 ± 7%. After 1 hour of acclimatization, individuals were asked to fill out the visual analogue scale and leave the chamber. During challenges individuals were asked to perform their daily intellectual activities on separate personal computers.

Statistical analysis

Individual perception of IAQ was analyzed for each group by factor analysis using the principal components method and varimax rotation with Kaiser normalization. Factors (components) with eigenvalues > 1 and r > 0.30 were selected. The characteristics of study groups were compared using Chi-squared and Student's t tests. Differences between VAS scores were analyzed using the Mann Whitney U test.

Results

In the chamber, we achieved air temperatures equivalent to radiant heat temperature. Considering that thermal protection of 1.0 CLO was used, we obtained thermal neutrality for an operative temperature around 22°C. Study compliance rate was 98.5%. One male volunteer did not complete the intermediate temperatures of 22 and 18°C due to suggestive symptoms of upper airways viral infection during the protocol.

Comparison of means: There was a significant gender difference concerning temperature perception. The female group reported a colder sensation than the male group at 14°C (p=0.016). All other IAQ perceptions did not differ between genders (Table 1).

Principal component analysis: At 14°C (57.2°F), three components were selected in the Female group. The first was responsible for 38.3% of the total variance and showed a correlation among good IAQ, feelings of freshness, well-being and easy mental concentration. The second component accounted for 21.6% of the total variance and showed a correlation between dryness and good IAQ, as opposed to a perception of stagnant air. The third component accounted for 16.5% of the total variance, correlating hot and dry indoor air perception (Table 2). In

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At 18°C (64.4°F), both groups also showed similarities, correlating freshness, well-being and draughty (non-stagnant) air. The Male group also correlated good indoor air and easy mental concentration, whereas the Female group correlated cold (non-hot) air perception and the preceding factors. The second component comparison at this temperature showed important differences concerning correlations between sensations of dry and stagnant air. While the Male group correlated good IAQ perception, dry and stagnant air, the female group showed a correlation among dry and stagnant air, poor IAQ and not feeling good (poor well-being). This component accounted for 22.8 and 24.1% of the total variance of the Male and Female group, respectively.

At 22°C (71.6°F), the first component also had similar profiles in both groups. A strong correlation among non-dry air, easy mental concentration, freshness and well-being appeared in both groups, whereas the Male group also correlated the above with good IAQ and the Female group correlated these sensations inversely with stagnant air. Total variance explained by this component (43.9 and 42.4) and KMO results were similar.

Indoor temperatures of 26°C (78.8°F) are normally exceedingly high and not recommended for indoor air settings. Similarities between the two groups were also evident at this temperature, in which there was a correlation among easy mental concentration, freshness and well-being. The female group also correlated dry and cold (non-hot) air among the preceding factors.

This finding supports the notion that clothing is a more important determinant than physiological differences concerning thermal perception between gender as previously reported [20]. Field studies recently conducted in hot-humid climates showed no significant differences (0.1°C) between males and females at an indoor operative temperature at which thermal sensation was most frequently neutral, although the rate of thermal dissatisfaction was higher among females than males [21].

Conclusions

This study suggests that independent of comfort indices, males and females have a very similar pattern of thermal and indoor environment perception in experimental studies in the tropics. The practical implications of this study suggest that less stringent standards of social dressing in formal workplaces could lead to fewer disparities among gender thermal perception. Further field studies using this approach are needed to confirm this result.

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