# Impact of Indoor Air Quality on Mucosal Irritation in Danish Apartment Buildings

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Dry indoor air is a significant concern in residential buildings, particularly in Nordic climates where heating systems often reduce indoor humidity levels. This study investigates the relationship between indoor environmental conditions – specifically, temperature and relative humidity – and symptoms of dry eyes, nasal, and throat irritation among residents of Danish apartment buildings. Using survey responses and indoor climate measurements from 75 participants in Copenhagen and Odense, the study found a weak inverse correlation between indoor humidity/temperature and irritation symptoms. However, variations in symptoms suggest other contributing factors, such as air pollutants and ventilation rates, require further investigation.

**Keywords:** IAQ, relative humidity, residential, mucosal irritation, survey.

## Introduction and Background

Dry eyes are a common condition influenced by multiple factors, including environmental conditions such as humidity, temperature, and air quality. Previous studies have indicated that dry indoor environments can contribute to mucosal irritation, particularly in office settings and urban residential areas. Studies have shown that indoor relative humidity (RH) levels below 70% are associated with increased symptoms of dry eyes and skin irritation (Martin, 2023). However, the relationship between indoor climate and mucosal irritation in residential settings—especially in Nordic countries—remains underexplored. According to EN 16798-1, the recommended indoor relative humidity (RH) for comfort and health ranges typically from 30% to 50%. Maintaining RH within this range helps minimize the risk of mucosal irritation and reduces the likelihood of microbial growth or other related indoor air quality issues.

The impact of air pollutants on dry eye symptoms has been documented, with particulate matter ($PM_{2.5}$) and volatile organic compounds (VOCs) contributing to eye irritation independently of humidity levels (Mo et al., 2019; Tan et al., 2018). Furthermore, studies have demonstrated that poor indoor ventilation can exacerbate the accumulation of these pollutants, thereby increasing irritation symptoms (Jones et al.,

2022). Despite these findings, there remains a lack of consensus on the direct effect of indoor humidity on dry eyes and other mucosal symptoms (Huang et al., 2020).

The present study aims to assess indoor environmental conditions in Danish apartment buildings and their potential impact on dry eye symptoms. Through a combination of survey responses and environmental monitoring, this study seeks to provide insights into the role of indoor air quality in occupant comfort and health.

## Methods

The study included a two-stage survey and indoor climate monitoring. The first questionnaire collected demographic data and self-reported symptoms of irritation in the eyes, nose, and throat over four weeks. Participants willing to continue were provided with an indoor climate monitor (LASCAR EL-USB-2) (**Figure 1**) to measure temperature and relative humidity over seven days. A follow-up survey collected additional symptom data after the monitoring period.

## Results and Discussion

A total of 75 participants completed the first questionnaire, and 59 continued to the monitoring phase. Indoor temperature and humidity were recorded from March to May 2023. The results indicated that 46.3% of apartments had temperatures between 20–22°C, with 40.7% in the 22–24°C range. The majority (59.3%) had RH levels between 30–40%, which is within typical indoor comfort ranges.

**Figure 2** presents the distribution of self-reported symptoms from the first questionnaire, showing that 51% of participants reported eye irritation, 60% reported nasal irritation, and 44% experienced throat discomfort.


**Figure 1.** Indoor climate monitoring device (LASCAR EL-USB-2) used in the study.

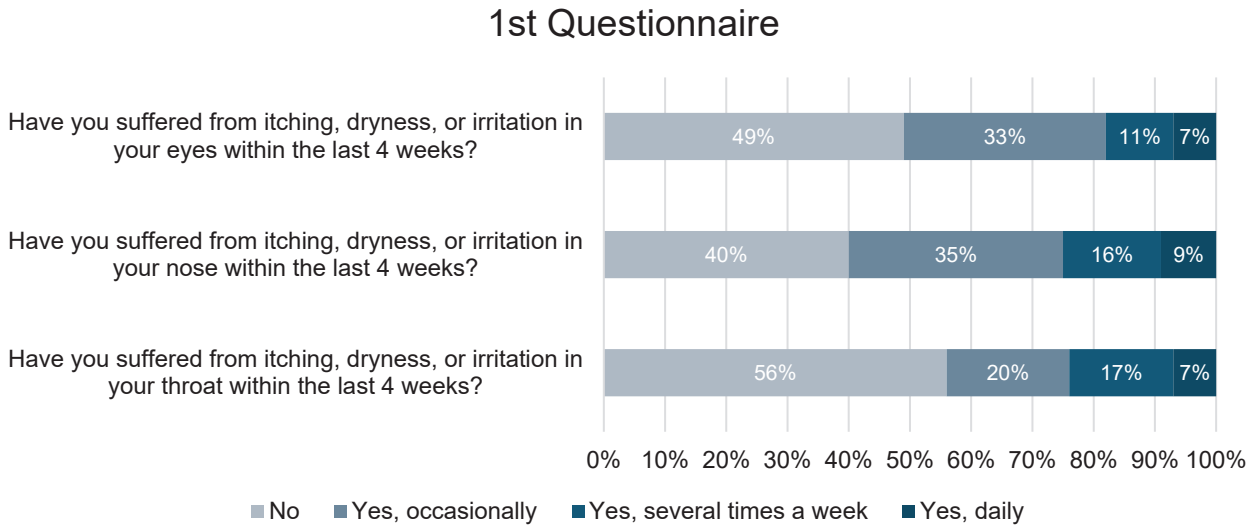


**Figure 2.** Prevalence of reported symptoms from the first questionnaire.

In contrast, the second questionnaire showed a slight decline in irritation prevalence, but an increase in daily symptoms for some participants (**Figure 3**).

Pearson correlation analysis indicated weak negative correlations between temperature/humidity and symptoms (r = –0.16 for temperature and –0.17 for RH). These findings suggest that while temperature and humidity may play a role, other indoor air quality factors such as particulate matter and volatile organic compounds (VOCs) could have a more significant impact. **Figure 4** (on the next page) illustrates the correlation trends between symptoms and environmental parameters, highlighting the lack of strong statistical significance.

## Conclusion

This study found no strong evidence linking indoor temperature and humidity levels to mucosal irritation in Danish apartment buildings, though slight inverse correlations were observed. These findings suggest that other factors, such as air pollutants and ventilation rates, may contribute to irritation symptoms. Future studies should incorporate measurements of particulate matter, VOCs, and ventilation efficiency to provide a more comprehensive understanding of indoor environmental impacts on occupant health.

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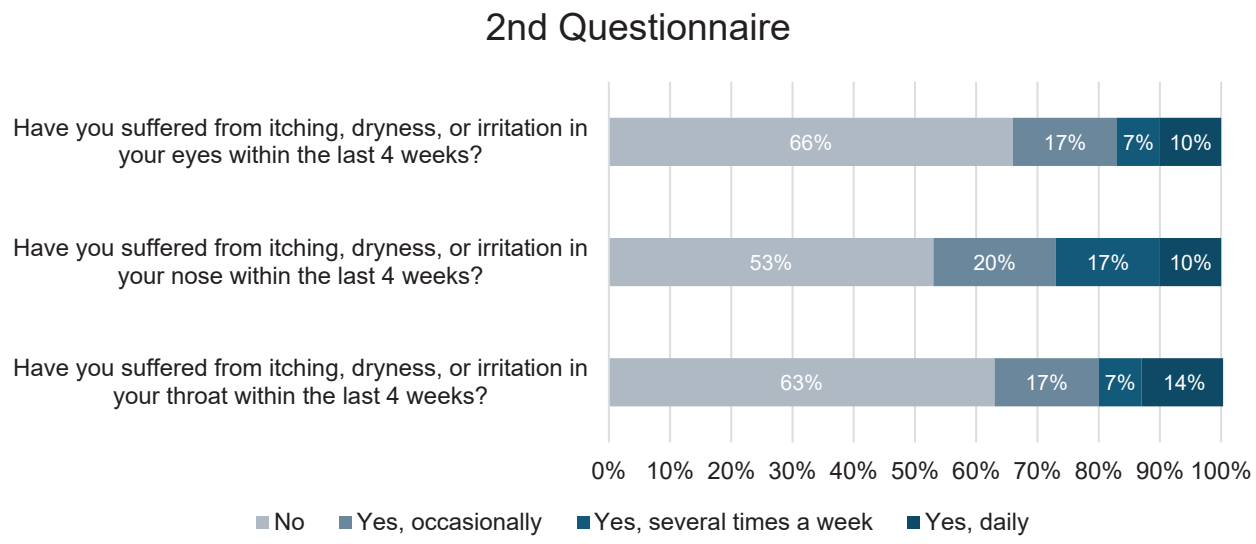


**Figure 3.** Comparison of symptom reports between the first and second questionnaires.

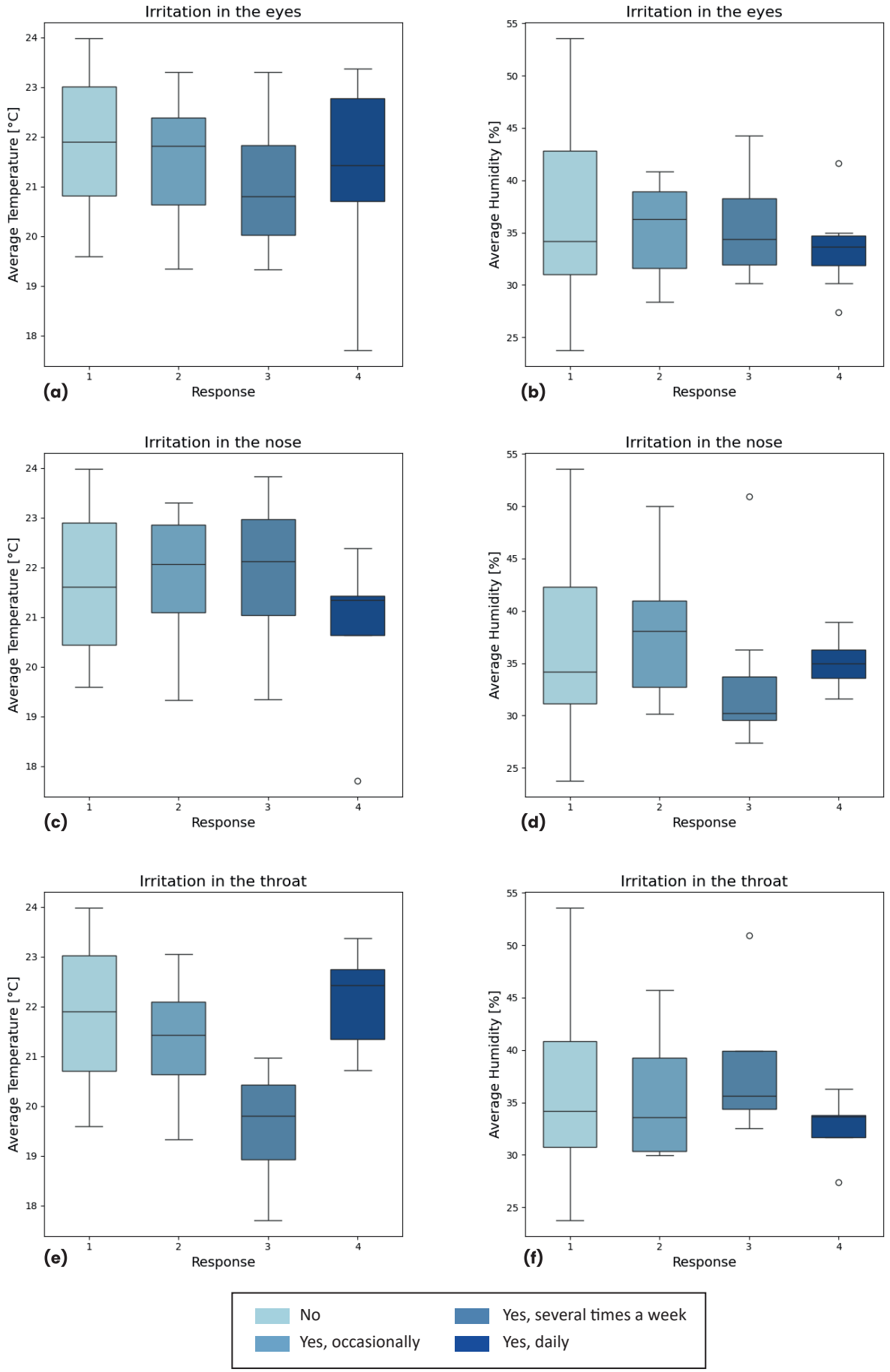


**Figure 4.** Correlation trends between indoor temperature/humidity and reported irritation symptoms.