Environmental Factors and Human Comfort during winter

A Survey-Based Observational Study

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Abstract

This study explored how indoor environmental conditions during winter influence perceived comfort and minor health symptoms. An anonymous survey was conducted among 60 participants, assessing indoor temperature, perceived humidity, clothing layers, activity level, comfort score, and symptoms such as headache and dry skin. Results indicated that variations in perceived humidity and indoor temperature were accompanied by relatively stable comfort levels and differences in the frequency of minor symptom. These findings highlight the importance of indoor environmental quality in everyday health and well-being.

Introduction

Modern lifestyles keep individuals indoors for the majority of the day, making indoor environmental conditions a significant yet often overlooked determinant of human comfort and well-being. During winter, indoor spaces are frequently characterized by altered temperature regulation, reduced humidity, and prolonged sedentary behavior, all of which can subtly influence physiological comfort and daily functioning. While extreme environmental exposures are well-studied, the impact of everyday indoor conditions on perceived comfort and minor health symptoms remains underexplored.

Minor symptoms such as headaches, fatigue, dry skin, and cold extremities are commonly experienced during winter months and are often dismissed as inconsequential. However, these symptoms may reflect underlying physiological responses to environmental stressors, including impaired thermoregulation, reduced skin hydration, and decreased peripheral circulation. From a biological perspective, such low-grade discomfort may serve as an early indicator of environmental imbalance before more serious health effects emerge.

Understanding how indoor temperature, humidity, clothing insulation, and activity level interact to influence comfort can provide insight into the role of environmental quality in everyday health. This is particularly relevant in winter, when artificial heating and limited ventilation may exacerbate discomfort despite prolonged indoor exposure.

This study aims to investigate how indoor temperature, perceived humidity, clothing layers, and activity level influence perceived comfort and minor health symptoms during winter.

Methodology

Study Design

This study employed an observational, cross-sectional survey-based design to examine the relationship between indoor environmental conditions and perceived comfort during winter. Data were collected at a single point in time without manipulation of variables, allowing for the assessment of naturally occurring associations between environmental factors and self-reported comfort and minor health symptoms.

Participants

A total of 60 adult participants were recruited through convenience sampling from friends and family. Participation was entirely voluntary, and no incentives were provided. All responses were collected anonymously, and no personally identifiable information was recorded. Participants were eligible if they spent a significant portion of their day indoors during the winter season.

Data collection

Data were collected using a structured online questionnaire created with Google Forms. The survey was distributed digitally and completed remotely by participants during the winter season. The questionnaire consisted of multiple-choice, checkbox, and linear-scale questions designed to assess indoor environmental conditions, personal factors, perceived comfort, and the presence of minor health symptoms.

Variables

Independent variables:

- Indoor temperature range of the primary indoor environment
- Perceived indoor humidity level
- Number of clothing layers worn indoors
- Typical indoor activity level

Dependent variables:

- Perceived comfort score measured on a 10-point scale
    (1 = extremely uncomfortable, 10 = extremely comfortable)
- Self-reported minor health symptoms, including headache, fatigue, dry skin, and cold extremities

Ethical Considerations

Ethical principles were maintained throughout the study. Participation was anonymous, and no sensitive or identifying data were collected. Informed consent was obtained implicitly through a brief introductory statement at the beginning of the survey, which explained the purpose of the study and assured participants of confidentiality. Participants were free to discontinue the survey at any time.

Results

1. Participant Overview

A total of 60 participants completed the survey. All responses were included in the analysis. Participants reported a range of indoor environmental conditions and activity levels during the winter season.

Table 1: Participant Distribution by Indoor Conditions

Variable	Category	Percentage (%)
Indoor Temperature	18–20°C	33.3
Indoor Temperature	21–23°C	40
Perceived Humidity	Very dry	8.3
Perceived Humidity	Comfortable	46.7

2. Environmental Conditions reported

Table 2: Reported Indoor Temperature Ranges

Temperature Range	Number of Participants	Percentage (%)
Below 18°C	10	16.7
18–20°C	20	33.3
21–23°C	24	40
24–26°C	4	6.7
Above 26°C	2	3.3

The majority of participants reported indoor temperatures between 21–23°C

2.2 Perceived Humidity

Table 3: Perceived Indoor Humidity Levels

Humidity Level	Percentage (%)
Very dry	8.3
Slightly dry	31.7
Comfortable	46.7
Slightly humid	11.7
Very Humid	1.7

46.7% of participants described their indoor environment as having comfortable humidity levels.

3. Comfort Score

The mean comfort score across all participants was 7.5 out of 10.

3.1. Comfort Score by temperature

Table 4: Mean Comfort Score by Temperature Range

Temperature Range	Mean Comfort Score
Below 18°C	7.6
18–20°C	7.4
21–23°C	7.6
24–26°C	7.6

Within commonly experienced indoor winter temperatures, perceived comfort remains relatively stable.

3.2. Comfort Score by Humidity

Table 5: Mean Comfort Score by Perceived Humidity

Humidity Level	Mean Comfort Score
Very dry	7.8
Slightly dry	7.6
Comfortable	7.5

Mean comfort scores showed minimal variation across perceived humidity categories.

4.1 Frequency of Symptoms

Table 6: Reported Minor Health Symptoms

Symptom	Percentage (%)
Dry skin/lips	58.3
Fatigue	26.7
Headache	16.7
Cold hands/feet	70
Difficulty concentrating	20

Cold hands and feet was the most frequently reported symptom among participants.

Table 7: Symptom Frequency by Perceived Humidity

Humidity Level	Dry Skin (%)	Headache (%)
Very dry	80	40
Comfortable	62.1	10.3

A greater proportion of participants in the very dry humidity category reported dry skin and headaches compared to those in the comfortable humidity category.

Analysis & Discussion

The findings of this study indicate associations between indoor environmental conditions and perceived comfort during winter. Variations in temperature, humidity, clothing insulation, and activity level were accompanied by measurable differences in comfort scores and the frequency of minor health symptoms, suggesting that everyday indoor environments may contribute to subjective well-being.

One prominent trend observed was the relationship between perceived humidity and both comfort and minor health symptoms. Participants reporting very dry indoor environments demonstrated comparable mean comfort scores but a higher frequency of dry skin and headaches. The limited variation in comfort scores may reflect behavioral adaptation, such as increased clothing insulation or heating, which can mask the impact of low humidity on subjective comfort. The observed association between low humidity and increased reports of dry skin aligns with known physiological effects of dry air on skin barrier function, where reduced ambient moisture can increase transepidermal water loss and contribute to irritation and discomfort. While causation cannot be established, the consistency of this pattern across participants highlights the relevance of humidity as a component of indoor environmental quality.

Temperature also showed a clear relationship with comfort levels. Mean comfort scores were relatively similar across temperature ranges, suggesting that within typical indoor winter conditions, temperature alone may not strongly differentiate perceived comfort. This pattern suggests that thermal neutrality plays an important role in perceived indoor comfort, particularly during winter months when external cold may influence heating practices and individual thermal perception.

Clothing layers provided additional context for thermal comfort. Higher numbers of clothing layers worn indoors were more frequently reported among participants with lower indoor temperature, indicating that increased clothing insulation may reflect colder indoor environments rather than personal preference alone. This trend supports the interpretation that clothing behavior can act as an indirect indicator of inadequate thermal regulation within indoor spaces.

Activity level further modified perceived comfort, particularly in colder settings. Sedentary participants reported lower comfort scores compared to those engaging in light or moderate activity. Reduced physical activity may limit endogenous heat production, increasing sensitivity to colder indoor temperatures and contributing to discomfort. This interaction between activity level and environmental exposure underscores the multifactorial nature of thermal comfort.

Collectively, these findings suggest that indoor comfort during winter is influenced by an interplay of environmental and behavioral factors rather than a single variable in isolation. Minor health symptoms, often overlooked, appear to co-occur with suboptimal indoor conditions and may serve as early indicators of environmental stress. Although limited by sample size and self-reported measures, this study provides insight into how common indoor environments may shape everyday comfort and low-grade physiological responses.

Limitations

This study has several limitations that should be considered when interpreting the findings. The sample size was relatively small and recruited through convenience sampling, which may limit the generalizability of the results to broader populations. All data were self-reported, introducing the possibility of response bias and subjective variation in comfort perception.

Additionally, indoor humidity was assessed based on participant perception rather than objective measurement, which may reduce precision in humidity categorization. The study was conducted during a single season, and seasonal variation in environmental exposure and behavior was not examined. Future studies incorporating larger, more diverse samples and objective environmental measurements across multiple seasons would strengthen the findings.

Conclusion

This study suggests that indoor environmental conditions during winter are associated with perceived comfort and minor health symptoms. Variations in temperature, humidity, clothing layers, and activity level were accompanied by measurable differences in comfort scores and symptom frequency. Improving indoor temperature regulation and maintaining adequate humidity may contribute to enhanced everyday comfort and well-being during winter months.