

# Perceived and Measured Indoor Environment Quality on a Cruise Ship

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Full Paper #247

Research funded by Finnish Work Environment Fund as part of LAIVA-project (Työsuojelurahasto, LAIVA 289161)



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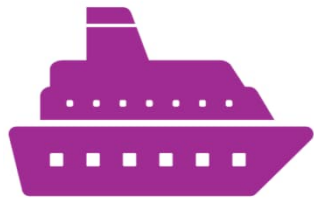
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# Background and research aims

- Cruise ship environment is little studied.
  - Cruise tourism is significant economically.
  - Most of the time onboard is spent indoors
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- Our study aimed to:
    1. Assess the cruise ship's indoor environment from the crew's perspective.
    2. Examine dissatisfaction variation across different onboard workstations.
    3. Investigate indoor air quality using real-time sensors.

# Methods



**Study conducted on one  
cruise ship operating on  
the Baltic Sea**



**Survey**

October 2023



**Continuous indoor air  
quality monitoring**

Airlyse IAQ Analyser -sensors  
August 1<sup>st</sup> 2024 to October 31<sup>st</sup>  
2024

# Perceived indoor environment quality

Distribution of respondents' dissatisfaction levels with environmental factors over the last three months across all workstations (n=289).

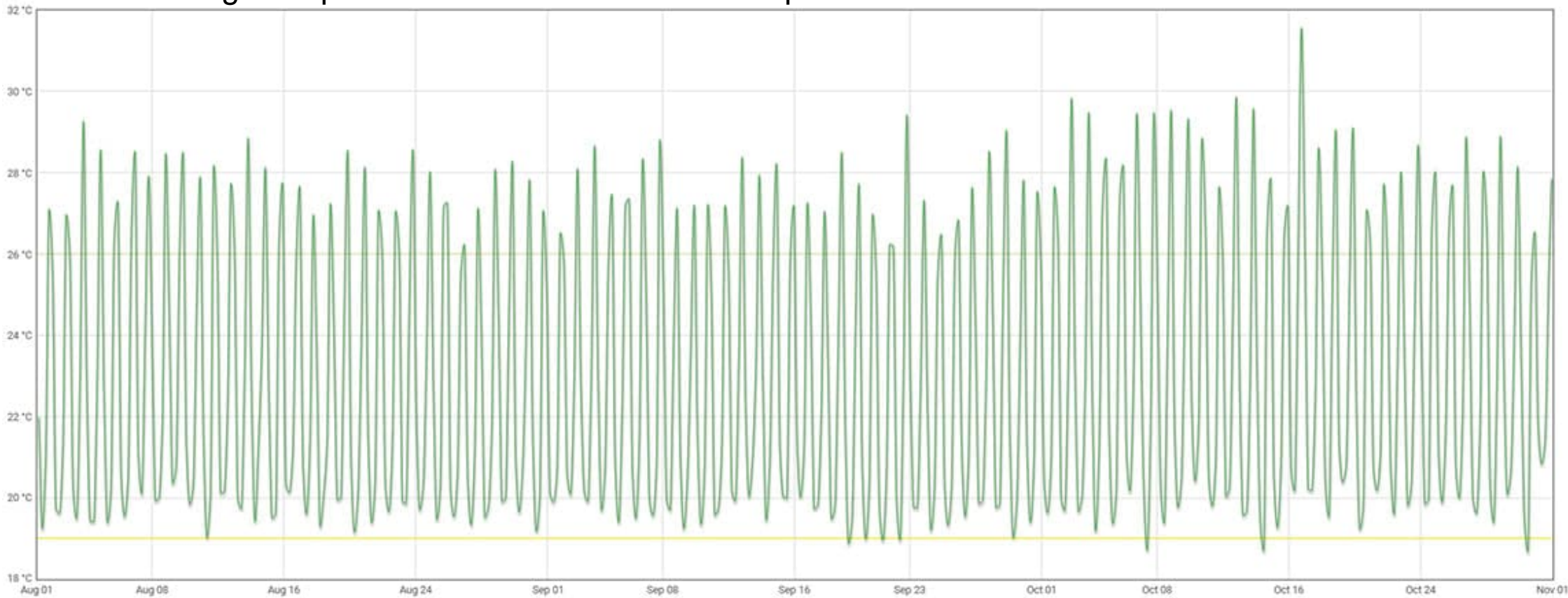
Factor	Yes (%)	Sometimes (%)	No (%)
Too high temperature	20.4	27.4	52.3
Too low temperature	17.7	34.3	48.1
Strong temperature fluctuations	15.6	24.1	60.3
Too strong ventilation	8.5	18.5	73.0
Insufficient ventilation	26.4	27.8	45.8
Stale air	22.2	19.7	58.1
Dry air	35.3	19.9	44.8
Moist air	13.2	16.4	70.5
Odor of mold or cellar	9.5	14.1	76.3
Odor of cigarettes	6.4	11.0	82.7
Other odors	16.4	23.9	59.6
Noise	37.1	30.8	32.2
Weak lighting	17.3	14.8	67.8
Light reflections	7.1	8.9	84.0
Noticeable dust or dirt	24.3	29.2	46.5

# Perceived indoor environment quality

- Dissatisfaction rates varied greatly depending on the workstation
  - Lowest at the command bridge (n=12)
  - Highest at information desk (n=5) and nightclub and casino (n=22)
- Open-ended questions
  - Temperature
  - Indoor air quality
  - Cabin temperature

# Measured indoor air quality

5-hour average temperature variation in a cruise ship restaurant kitchen



# Measured indoor air quality

- TVOC averages: 81 — 682 ppb
- Particulate matter
  - PM1.0: averages 1 — 6  $\mu\text{g}/\text{m}^3$   
extremes 0 — 2733  $\mu\text{g}/\text{m}^3$
  - PM2.5: averages 1 — 9  $\mu\text{g}/\text{m}^3$   
extremes 0 — 4498  $\mu\text{g}/\text{m}^3$
- CO2 averages: 440 — 608 ppm
- PM and CO2 high values in buffet restaurant dining hall.



# Discussion and Possible Applications

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- Dissatisfaction rates appeared lower in less occupied areas
  - Further research should include passengers and focus more on crew leisure areas
  - Possible ways to increase the comfort and well-being:
    - Cabin thermal control
    - Acoustic panels
    - Managing temperature fluctuations

# Thank you

The Finnish Work Environment Fund

Finnish Society of Indoor Air Quality and Climate (Sisäilmayhdistys)

Dr. Emmanuelle Castagnoli  
Dr. Tuomas Alapieti



Työsuojelurahasto  
Arbetarskyddsfonden  
The Finnish Work Environment Fund

