Web Annex G

Estimation of minimal risk and maximum acceptable temperatures for selected cities

Lidia Morawska and Phong Thai

In:

WHO Housing and health guidelines
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### High indoor temperatures – Estimation of minimal risk and maximum acceptable temperatures for selected cities

<table>
<thead>
<tr>
<th>City &amp; Lancet’s curve</th>
<th>Papers used as evidence</th>
<th>Information extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boston</strong></td>
<td>1. Nguyen et al. 2013. Relationship between indoor and outdoor temp (in Harvard staff/student homes) → linear regression for warmer temperature</td>
<td>- Only one home in each city - Indoor temp in Boston is stable year round (without extreme heat) - Linear indoor/outdoor relationship from &gt;21°C</td>
</tr>
</tbody>
</table>
|                       | 1. Quinn et al. 2014. Predicting indoor heat exposure<br>
\[\text{Indoor}(T) = \text{outdoor}(T) + \text{lag}_1\text{day}_{\text{outdoor}}(T) + \text{lag}_2\text{days}_{\text{outdoor}}(T)\] | - 265 homes of low & middle incomes |
|                       | Parameters of the equation shown in next column |                       |
|                       | 2. Uejio et al. 2015. Summer indoor heat exposure & emergency calls in NY | - Multivariate model for best fit |
|                       | - Temp measured by emergency staffs during home visits |                       |

The minimal risk indoor temperature would be 21-22°C.
The maximum acceptable temperature would be 25°C.

The minimal risk indoor temperature would be 22-24°C.

![Graph showing temperature relationship in Boston and New York](image-url)
### London/Manchester

- **Minimal Risk Indoor Temperature:** 22-23°C
- **Maximum Acceptable Temperature:** ~25°C


### Harbin

- **Minimal Risk Indoor Temperature:** ~24°C
- **Maximum Acceptable Temperature:** 26°C

1. Wang et al. 2010

Thermal responses for naturally ventilated residential buildings in Harbin since people have the custom of opening their windows

- During summer, range and average temperature is similar between indoor and outdoor

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3. Tamerius et al., 2013
Socioeconomic and Outdoor Meteorological Determinants of Indoor Temperature and Humidity in New York City Dwellings

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- The maximum acceptable temperature would be 27-28°C
- The minimal risk indoor temperature would be 22-23°C
- The maximum acceptable temperature would be ~25°C
- The minimal risk indoor temperature is ~24°C
- The maximum acceptable temperature would be 26°C

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The minimal risk temperature is ~25-26°C
The maximum acceptable temperature would be ~29-30°C

   Indoor ~outdoor + 2°C

2. Moon et al. 2014. Seasonal evaluation of bioaerosols
   In spring & summer, indoor temperature ~ outdoor temperature

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The minimal risk temperature is ~30°C
The maximum acceptable temperature would be ~32°C

1. Studies in neighbouring countries like Malaysia, Singapore, Vietnam indicated that Indoor temperature ≥ Outdoor temperature (Kamar et al., 2012; Wong & Li, 2007; Nguyen & Dockery, 2016)

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Table 3 Seasonal temperature and relative humidity for 25 apartments according to seasons

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Indoor</td>
<td>Outdoor</td>
</tr>
<tr>
<td>Spring</td>
<td>26.2±2.3</td>
<td>25.9±3.0</td>
</tr>
<tr>
<td>Summer</td>
<td>29.1±1.8</td>
<td>29.0±3.3</td>
</tr>
<tr>
<td>Autumn</td>
<td>22.7±3.6</td>
<td>15.1±1.2</td>
</tr>
<tr>
<td>Winter</td>
<td>20.6±2.8</td>
<td>7.7±3.08</td>
</tr>
</tbody>
</table>

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Contributors
The analysis was conducted by Lidia Morawska and Phong Thai (International Laboratory for Air Quality and Health, Queensland University of Technology, Australia).
References

Abdul-Wahab SA, Salem N, Ali S. Evaluation of indoor air quality in a museum (Bait Al Zubair) and residential homes. Indoor and Built Environment 2013; 24: 244-255.


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Moon KW, Huh EH, Jeong HC. Seasonal evaluation of bioaerosols from indoor air of residential apartments within the metropolitan area in South Korea. Environ Monit Assess 2014; 186: 2111-20.


