Increased consumer demand for convenient ready-to-heat food, along with changes in consumer purchasing/consumption patterns, has resulted in increased reliance on refrigeration to maintain food safety. UK recommendations for domestic refrigeration are set at £C. Firstly, this study identified and reviewed consumer food safety studies (n=155) using a content analysis approach. Only 44 studies were found that specifically addressed consumer knowledge of food safety and self-reported practices (14). Forty-five per cent of studies included refrigeration operating temperatures. In 1990, the Swedish National Board of Health and Welfare recommended 0.5°C above the national average temperature. However, in several studies, temperatures were determined by a single temperature data-log, which, given temperature fluctuation, may not be a true indicator of refrigerator performance.

Consequently, this study conducted a time-temperature profiling study of domestic refrigeration in consumer kitchens (n=79) using a low-cost self-reporting refrigerator usage and assessment of consumer cognition relating to refrigeration performance (n=230).

Findings: A significant difference (p<0.05) between on-off and operating temperatures. No refrigerator operated at ≤-0.5°C for the entire study. Mean temperatures (5°C) were recorded in 35% of refrigeration. A positive correlation (r=0.05) between room temperature and refrigerator temperature was determined. Refrigerated door opening frequency correlated with temperature fluctuation (p<0.05). Although the majority of consumers reported that 0°C is the correct temperature for food storage, 47% had positive attitudes towards the importance of checking refrigerator temperature. The majority (87%) did not know the recommended temperature and 72% did not know the operating temperature of their refrigerator; 67% reported that cold meals were often served because of lack of knowledge regarding food safety. Despite 74% of consumers reported that they ‘never’ check the operating temperature of their refrigerator.

Methodology

Review of consumer food safety studies:

A systematic literature review was conducted to obtain consumer food safety data; primary research papers were reviewed and analysed using a content analysis approach.

Domestic time-temperature profiling:

- Time-temperature profiles of refrigerators (n=43) in domestic kitchens were determined using three Signal300S self-contained button dataloggers [range: -40°C to +45°C, accuracy: ±0.5°C, frequency: every minute] over 113 hours, positioned in the centre & door areas, and outside of the refrigerator.
- Households (n=43) documented refrigerator usage during profiling.

- Cognitive analysis of consumer refrigeration behaviors:
  - Consumers (n=100) completed qualitative self-complete questionnaires to determine knowledge, self-reported practices and attitudes towards domestic refrigeration practices.
  - All components of this research received ethical approval from the Cardiff Metropolitan University Health and Ethics Panel.

Results

Review of consumer food safety studies: focus on refrigeration

- A comparison of knowledge, attitude, self-reported practice and actual behavioural data relating to domestic refrigeration is found in Table 1.
- Review analyses determined that in the UK, 35% of consumers who do not refrigerate food are believed to be operating, although only 18% were correct.
- Self-report data determined that ownership of a refrigerator thermometer was low in countries including Europe and USA.
- In total, 26% of studies presented data on measured operating temperatures of domestic refrigerators; between 9% and 100% were found to be operating above recommended temperatures to ensure food safety.

<table>
<thead>
<tr>
<th>Table 1: Consumer knowledge, attitudes, self-reported practices and actual behaviour associated with domestic refrigeration practices (adapted from reviewed studies)</th>
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<tbody>
<tr>
<td>Knowledge</td>
</tr>
<tr>
<td>44-60% consumers did not know recommended refrigeration temperatures</td>
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<tr>
<td>44-60% consumers did not know recommended refrigeration temperatures</td>
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</tbody>
</table>

Consumer cognitive influences regarding domestic refrigeration

- Consumers had positive attitudes towards the perceived importance of refrigeration in relation to food safety and were aware of practices to ensure the refrigerator remains cold; however, knowledge of the recommended operating temperature was lacking (Table 2).
- Attitudes towards checking the refrigerator operating temperature were negative.

<table>
<thead>
<tr>
<th>Table 2: Attitudinal responses to domestic refrigeration practices</th>
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<tbody>
<tr>
<td>Attitudes towards food safety</td>
</tr>
<tr>
<td>I am concerned about the length of time my food is stored</td>
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<tr>
<td>Ensuring a refrigerator runs at 5°C or less is essential for maintaining the safety of foods</td>
</tr>
<tr>
<td>I never check the actual temperature of my refrigerator</td>
</tr>
</tbody>
</table>

Knowledge and self-reported practice:

- The majority (70%) of consumers in this study reported that they did not know the operating temperature of their own domestic refrigerator.
- The majority (56%) reported that they ‘never’ check the operating temperature of their domestic refrigerator.

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Conclusions

- Although consumers were aware of the importance of refrigeration to ensure food safety, knowledge of safe refrigeration practices was lacking, attitudes towards checking temperatures were negative and the majority reported to never check the temperature.
- Temperature profiles indicate that majority of consumers store RTE foods at unsafe temperatures which may increase risk of listeriosis.
- Findings highlight the need for consumers to improve domestic kitchen refrigeration practices and data to inform development of targeted food-safety strategies.

References