

# Practices of meat consumption and cold storage in Australian households

Consumer fridge behaviour and waste reduction of red meat

## Insights Report B

Quantitative research – Refrigerator monitoring (winter round)

Project code V.MFS.0456

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## Introduction

Meat waste is one of the main food waste items in Australian households, with 140,300 tonnes of meat wasted per year (FIAL 2021). Most meat waste comes from households (FIAL 2021). A better understanding of refrigerator use in households can help to identify ways to reduce meat wastage.

This insights report focuses on the quantitative aspect of a larger study that also involved a qualitative analysis, which used semi-structured interviews with fridge rummages and photographic ethnographies of fridges to learn about red meat storage and consumption in households. The quantitative project utilised tools such as data-logging devices, a written form, and photographs to:

- Learn about refrigerator use
- Develop a baseline of refrigerator performance.

The quantitative project is currently in progress. This report addresses the first two of three rounds of refrigerator monitoring.

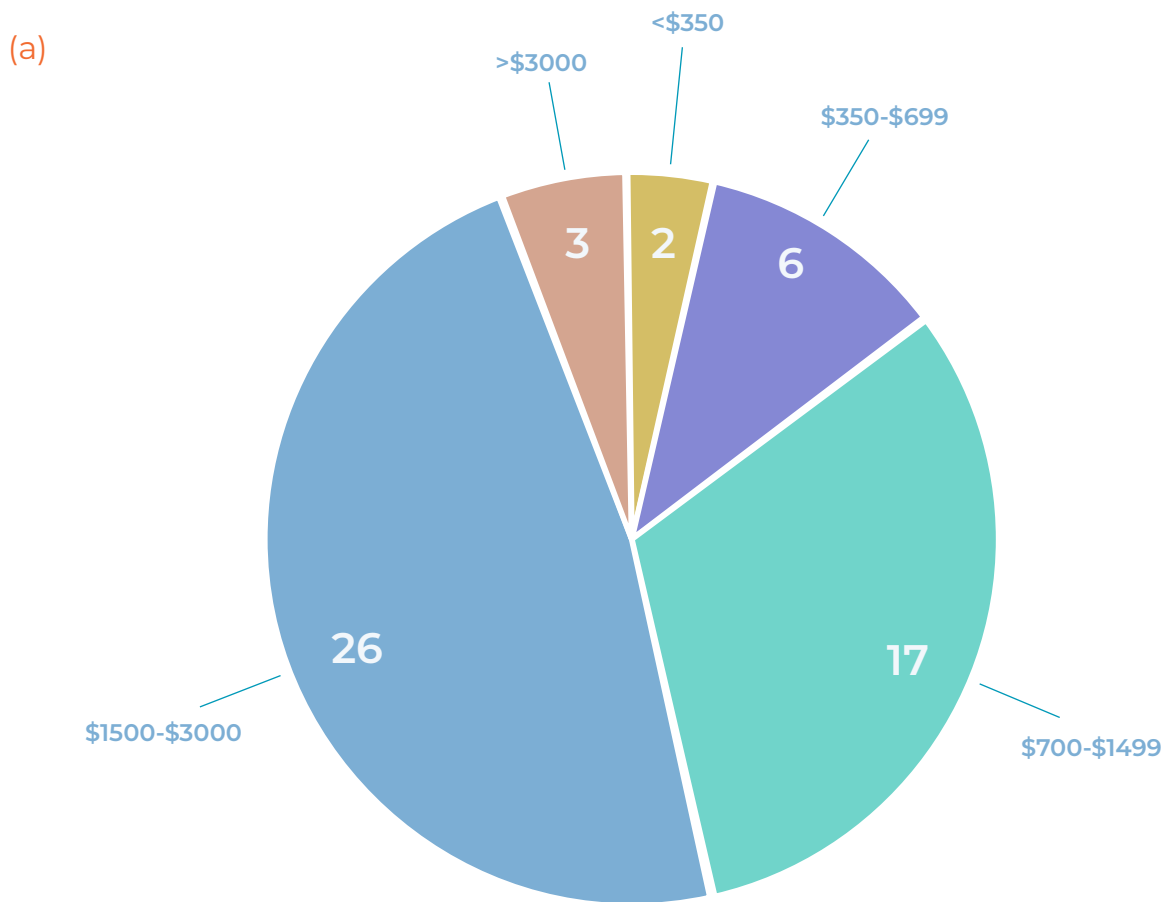
## Method

Households participated in the quantitative study during two seasons—winter 2022 and summer 2022-2023. A total of 56 out of 79 invited households completed sufficient study requirements. To reduce bias, the categories and proportions of invited households was consistent with those in 2016 (Australian Bureau of Statistics 2019), households from each Australian state and territory were invited, and the recruitment of households was blind. Figure 1. shows other characteristics of households that completed the study requirements. The number of residents was a mean of 3.2 persons/household. The number of pets was a mean of 1.2 animals. The period of monitoring was a mean of 12.5 days, range [5, 31.5]. Only two households monitored their fridges for less than seven continuous days.

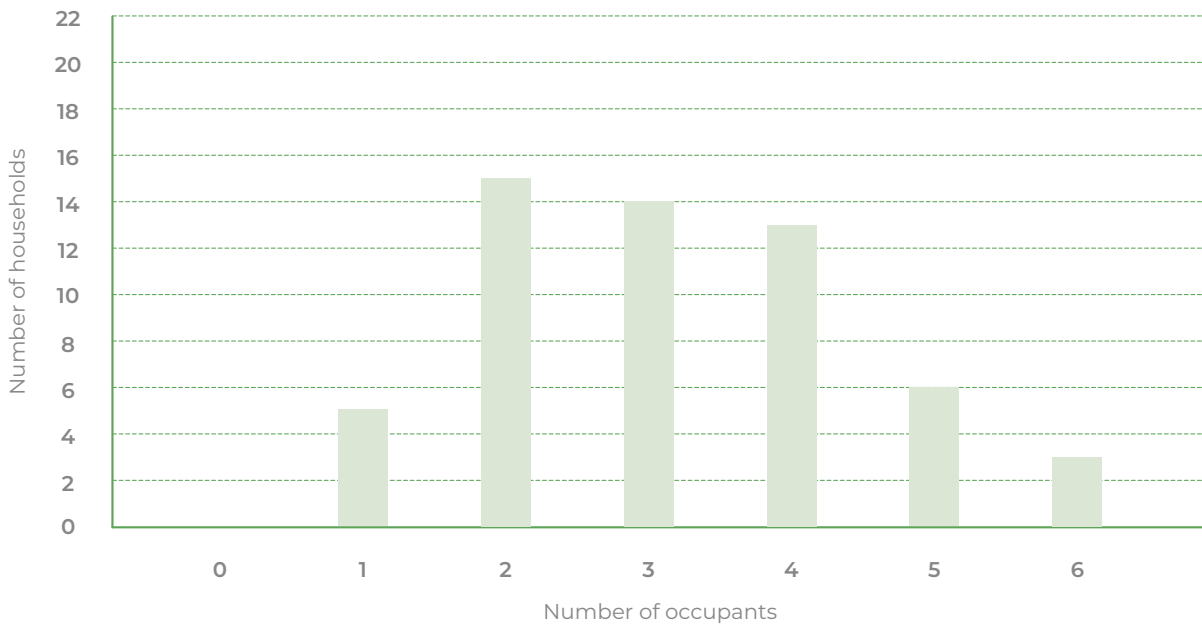


FIGURE 1

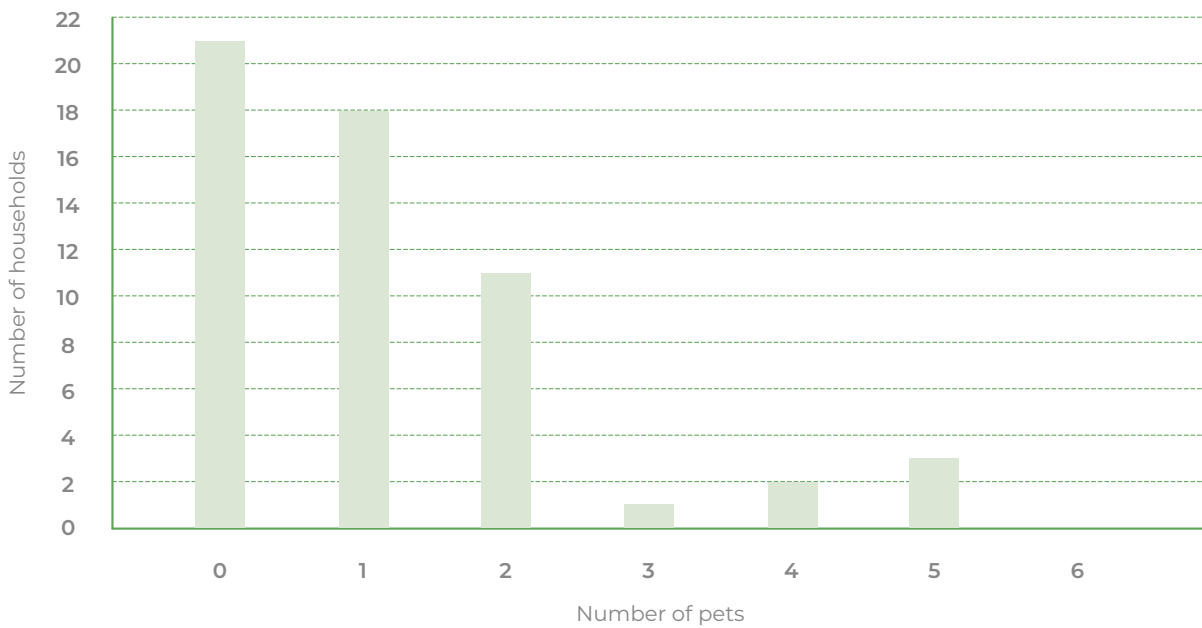
(a) Weekly income, (b) number of occupants, and (c) number of pets of households that completed sufficient study requirements.



(b)



(c)



Data sources and data-collection tools comprise the research services agency's records, a written form, photographs, and Tive Solo 5G data-loggers and Tive Temperature Beacon data-loggers. Participants completed the written form and took photographs. The data-loggers were typically arranged in refrigerator units as shown in Figure 2. Those tools were used to collect household data, including the weekly income, the number and type of occupants, and the use of space cooling and heating during the monitoring period. They were also used to collect fridge and freezer data, including the number of refrigerator units, the year of manufacture or acquisition, the interior temperatures and humidity, the condition of door seals, and the temperature setpoints.

Statistical analyses were conducted on the quantitative data. Analyses comprised the calculation of descriptive statistics using Microsoft Excel and two-tailed, bivariate correlation analysis using IBM SPSS Statistics version 21. The correlation analysis tested for, and identified, significant correlations between all parameter pairs at the 0.01, 0.05, and 0.1 levels.

FIGURE 2

Typical arrangement of data loggers (adapted from Winnings 2023).



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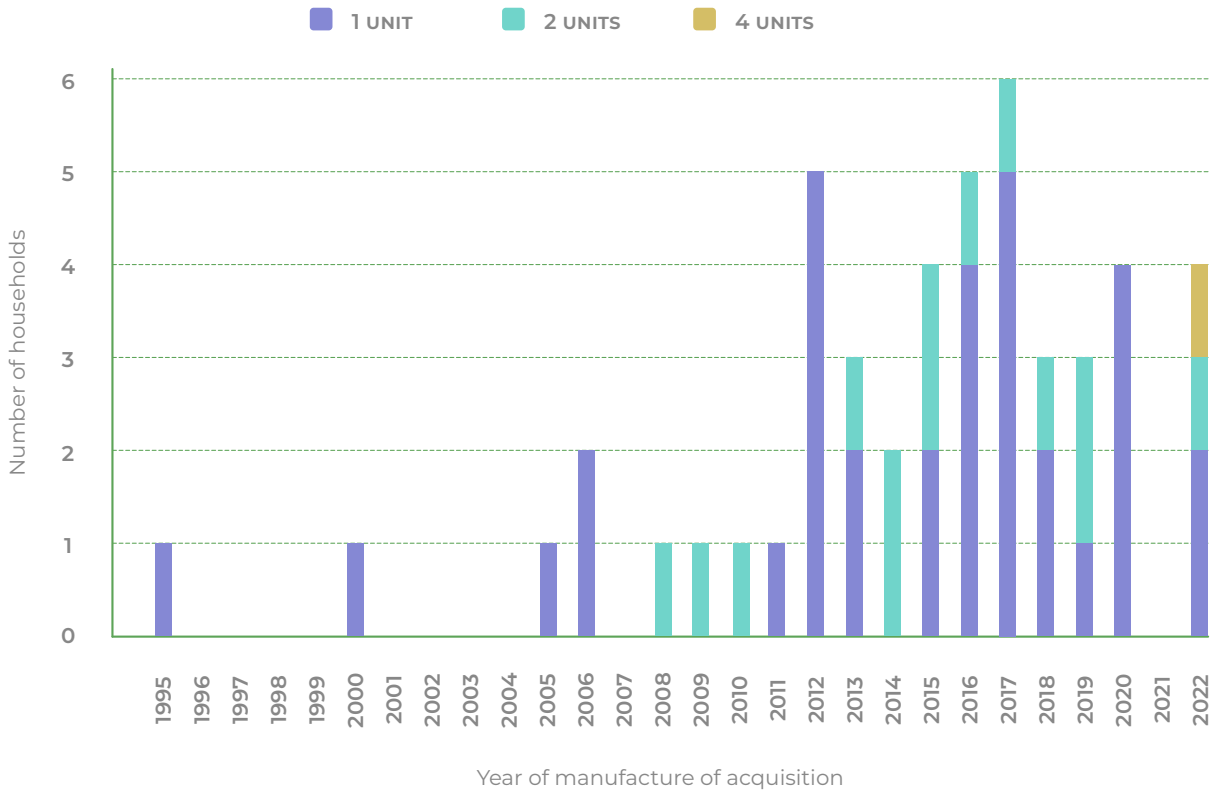
## Results

Results related to refrigerator use are summarised below.

- Most (70%) households had one refrigerator unit. Sixteen households had two units. One household had four units.
- The main refrigerator unit was, on average, newer in households with multiple units than in households with one unit, as shown in Figure. 3. The year of manufacture or acquisition of refrigerator units had a mean of 2014.5, range ['1990s' (assumed to be 1995), 2022].
- Fridges had a mean setpoint of 3.4°C, range [-3.0, 8.0]. Freezers had a mean setpoint of -17.8°C, range [-23.0, -10.0].
- Nearly all door seals were in good condition, enabling them to slow the infiltration of heat, as designed. Only two refrigerator units, manufactured in 2006 (fridge compartment only) and 2010 (fridge and freezer compartments), had wet seals, indicating seal damage.

FIGURE 3

Distribution of year of manufacture or acquisition of refrigerator units.



Results related to refrigerator performance are summarised below.

- Average temperatures across all but two fridge shelves are different, but they vary together.
- Average fridge temperature (over multiple shelves) had a mean of 4.4°C, range [0.9, 8.9].
- Some fridges had mean temperatures outside of the optimal range—8% were above 7°C and 9% were below 2°C.
- Average freezer temperature had a mean of -15.9°C, range [-21.2, -5.1].
- Many freezers had mean temperatures outside of the optimal range—33% were above -15°C and 10% were below -20°C.
- Temperature control at some shelves was imprecise. If temperature control is precise, then the temperature is expected to be above the setpoint, but that was the case for only 64% of fridge and freezer shelves.

Various parameters were significantly correlated, as indicated in Figure 4. The arrow heads indicate a proposed direction of causation, but the analysis cannot indicate the direction. Of the correlations that were significant at the 0.01 or 0.05 level, all but one had a Pearson correlation coefficient of at least 0.3 and may be considered at least moderate (Field 2013). Of the correlations that were significant at the 0.1 level, the lowest Pearson correlation coefficient was 0.23.

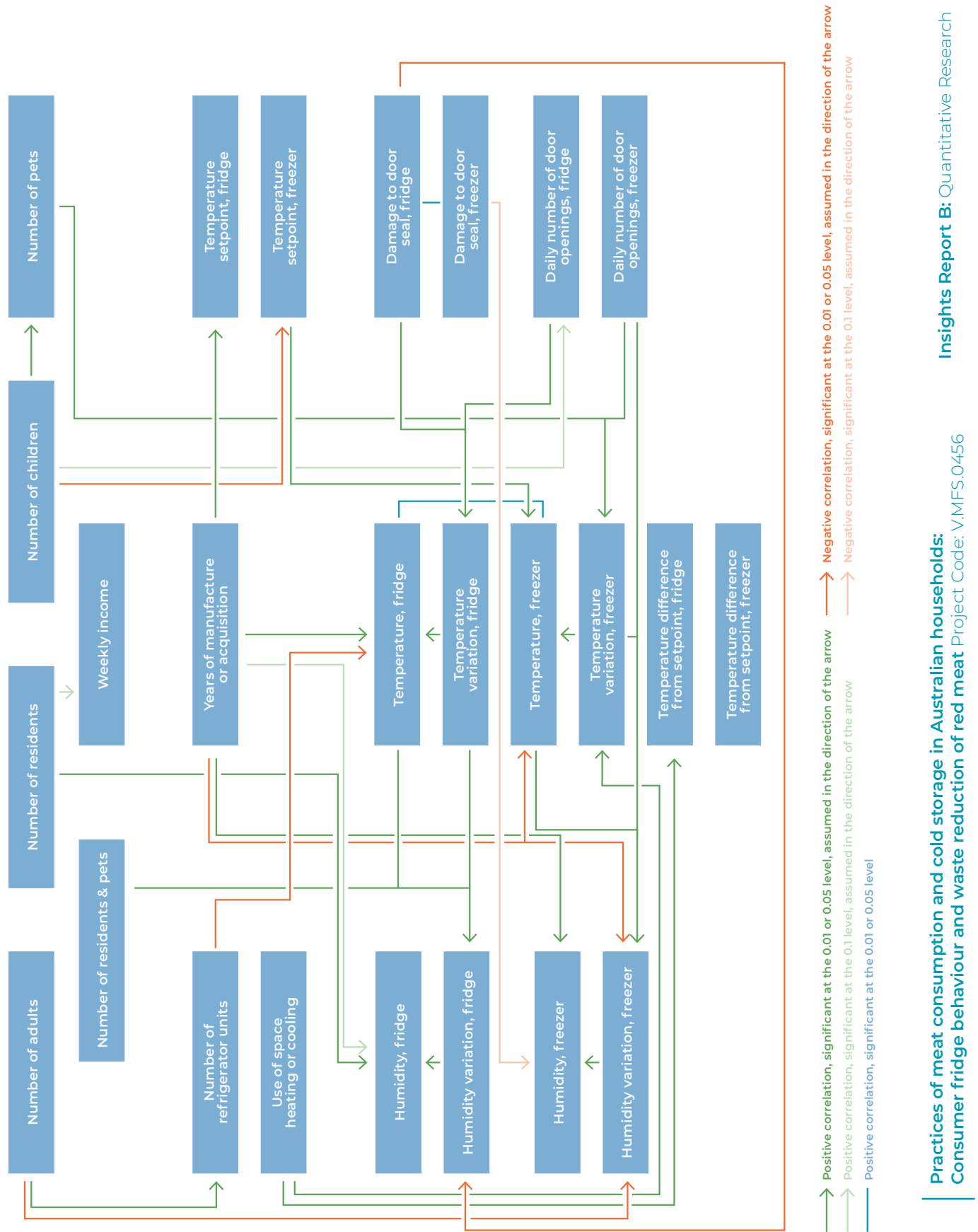
The correlation analysis indicates many relationships that are as expected or are relatively easy to explain. The direction of the relationship is assumed.

- The number of adults, but not the number of children or pets, drove the acquisition of additional refrigerator units.
- Income had no effect on any other parameter studied.
- The year of manufacture or acquisition was independent of the parameters studied.
- Newer refrigeration units had higher fridge temperature setpoints, higher fridge temperatures, and lower freezer temperatures.
- In households with two refrigerator units, the temperature of the main fridge was lower than in households with one refrigerator unit, suggesting that having a second unit enabled a different use pattern for the main fridge.

- For fridges, the use of space heating or cooling drove the difference between the setpoint and actual temperature, and the temperature variation.
- In fridges, damage to door seals drove temperature variations and dampened humidity variations.
- In freezers, the setpoint temperature drove the actual temperature, as expected, but no such relationship was detected for fridges.
- There was no relationship between temperature setpoints of fridges and freezer, suggesting that householders adjusted the two setpoints independently. The actual fridge and freezer temperatures varied together, though.

FIGURE 4

Relationships among the parameters studied.



## Recommendations

The following recommendations are based on the results of refrigerator monitoring. The effectiveness of recommendations that indicate householder or manufacturer action is unknown; further investigation is recommended.

- Given that many households had multiple refrigerator units, each having a different purpose, manufacturers might (re)consider developing and promoting units that are optimised for storing frozen meat, storing chilled drinks, or other purposes.
- Given that the mean age of refrigerator units was approaching 10 years, householder education is a key intervention point. Improvements that rely on households acquiring new refrigerator units (with special technology) would be insufficient because they are limited by the long delay of householders replacing current units.
- Given that the refrigerators with damaged door seals were older than the average refrigerator, householders should attempt to frequently check the seals of refrigerators that are older than about 10 years and address any damage.

- Given that, for some fridges and freezers, temperatures were different to the setpoints and mean temperatures were outside of the optimal range, householders should monitor the condition and life of perishable food, and adjust the setpoint accordingly; Food Standards Australia New Zealand (FSANZ), manufacturers, and retailers should better communicate the optimal fridge and freezer temperatures for optimum food shelf life; and manufacturers could (re)consider more-robust, more-precise temperature control functions and new alert functions.



## Future research pathway

The quantitative project is currently in progress. Future work includes further refrigerator monitoring during autumn 2023, with an objective of capturing and analysing data for about 80 refrigerator units; and conducting analyses at the household and regional levels.

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Find out more about the [Fight Food Waste CRC](#)



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Meat and Livestock Australia,  
RMIT University, Fight Food Waste CRC

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