

Foods and dietary patterns that are low-cost, healthy, and environmentally sustainable: Results of optimisation modelling

Nhung Nghiem

Nick Wilson, Cliona Ni Mhurchu,
Helen Eyles, Michael Baker, Tony Blakely

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Background

- Improving nutrition is a key component of advancing non-communicable disease control internationally.
- Dietary RFs and physical inactivity accounted for 10% of global DALYs in 2010, with prominent dietary risks being diets low in fruits and high in sodium.
- Meeting all the key nutrients via daily diets and achieving food security is getting harder for some populations with rising food prices.

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Background

- In NZ, along with some other high-income countries, there is evidence that food insecurity is a problem for low-income populations and is associated with psychological distress.
- There are also increasing concerns regarding the sustainability and impact of food production on the environment, particularly greenhouse gas emissions (an estimated 19 to 31% of global GHG emissions are food-related).

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Objective

This work aimed to identify foods and dietary patterns that are

- low-cost,
- healthy
- and associated with low GHG emissions

to help inform food policies available to central governments (e.g., taxes/subsidies on foods and food voucher policies).

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Method

- We conducted scenario development and linear programming to model 16 diets (some with uncertainty) for the NZ population.
- This technique allows the generation of optimal solutions such as identifying the lowest cost mix of foods that satisfy various constraints such as min & max nutrient levels.
- LP has been used for decades for informing nutrition, with numerous recent examples for optimising diets in healthier directions.

Method

- We designed four groups of dietary scenarios:
 - focused on achieving the lowest daily food cost while meeting recommended nutrient levels.
 - achieving the lowest GHG profile.
 - specific dietary patterns (Mediterranean- & Asian-style)
 - scenarios with “familiar meals” that would be fairly acceptable to most NZers.
- Data inputs included nutrients in NZ foods, NZ food prices, food wastage and food-specific GHG emissions (adapted from UK data).

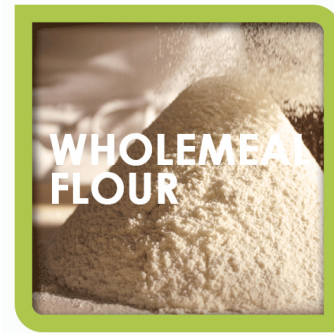
Findings

- This study identified daily dietary patterns that met key nutrient requirements for men for as little as a median of NZ\$ 3.17 per day (US\$ 2.41/d) (95% simulation interval [SI] = NZ\$ 2.86 to 3.50/d).
- Increasing the extent to which diets had “more familiar” meals, more variety of foods, & more F&Vs increased the cost.

Table 1: Daily costs, emissions of greenhouse gases and nutrient intakes for the different dietary scenarios

| Scenario / Nutrients | Min Cost | Min GHGs | ASIAN | MED | NZ Mince |
|--|-------------|-------------|-------------|-------------|-------------|
| Emissions (kg CO ₂ e) | 2.72 | 1.67 | 4.03 | 4.68 | 5.25 |
| Price (\$NZ) | 3.19 | 4.99 | 4.95 | 5.64 | 6.22 |
| Fruit and vegetables (g) | 63 | 80 | 500 | 912 | 249 |
| Energy (≥ 11,450 kJ) | 11,450 | 11,450 | 11,723 | 11,788 | 12,650 |
| Saturated fatty acids (≤ 30 g) | 6 | 18 | 5 | 13 | 20 |
| Polyunsaturated fatty acids (≥ 13.1 g) | 14 | 83 | 13 | 14 | 15 |
| Protein (≥ 52 g) | 124 | 98 | 109 | 100 | 133 |
| Dietary fibre (≥ 30 g) | 51 | 54 | 57 | 57 | 64 |
| Sodium (≤ 2,300 mg) | 475 | 237 | 1,523 | 1,670 | 2,300 |
| Total sugars (g) | 90 | 22 | 43 | 125 | 45 |
| Iron (≥ 8 mg) | 23 | 33 | 19 | 24 | 31 |

Common foods selected in all scenarios



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Foods selected in Mediterranean style



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Findings

- These diets also had low GHG emission profiles e.g., 1.62 kg CO₂e/d for one scenario (95%SI = 1.39 to 1.85 kg CO₂e).
- This contrasts with the higher emission profile estimate for the “typical NZ diet” we modelled for comparison purposes (10.1 kg CO₂e/d).
- All of the optimised low-cost and low-GHG dietary patterns had likely health advantages over the current NZ dietary pattern (i.e., lower CVD disease and cancer risk).

Figure 1. Cost and greenhouse gas (GHG) emissions per day of the various optimised daily dietary scenarios.

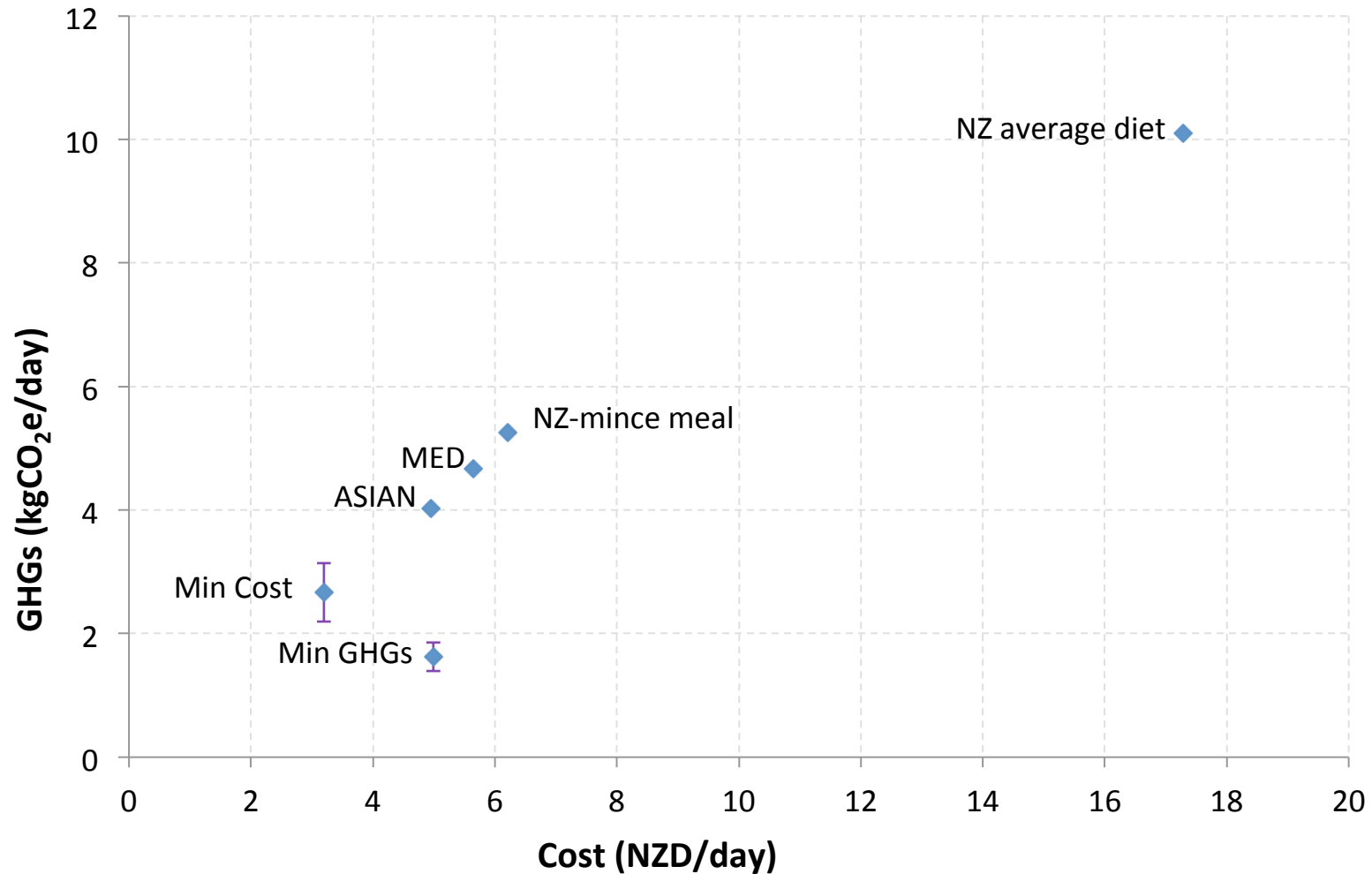


Figure 2. Saturated fatty acids intake in various dietary scenarios.

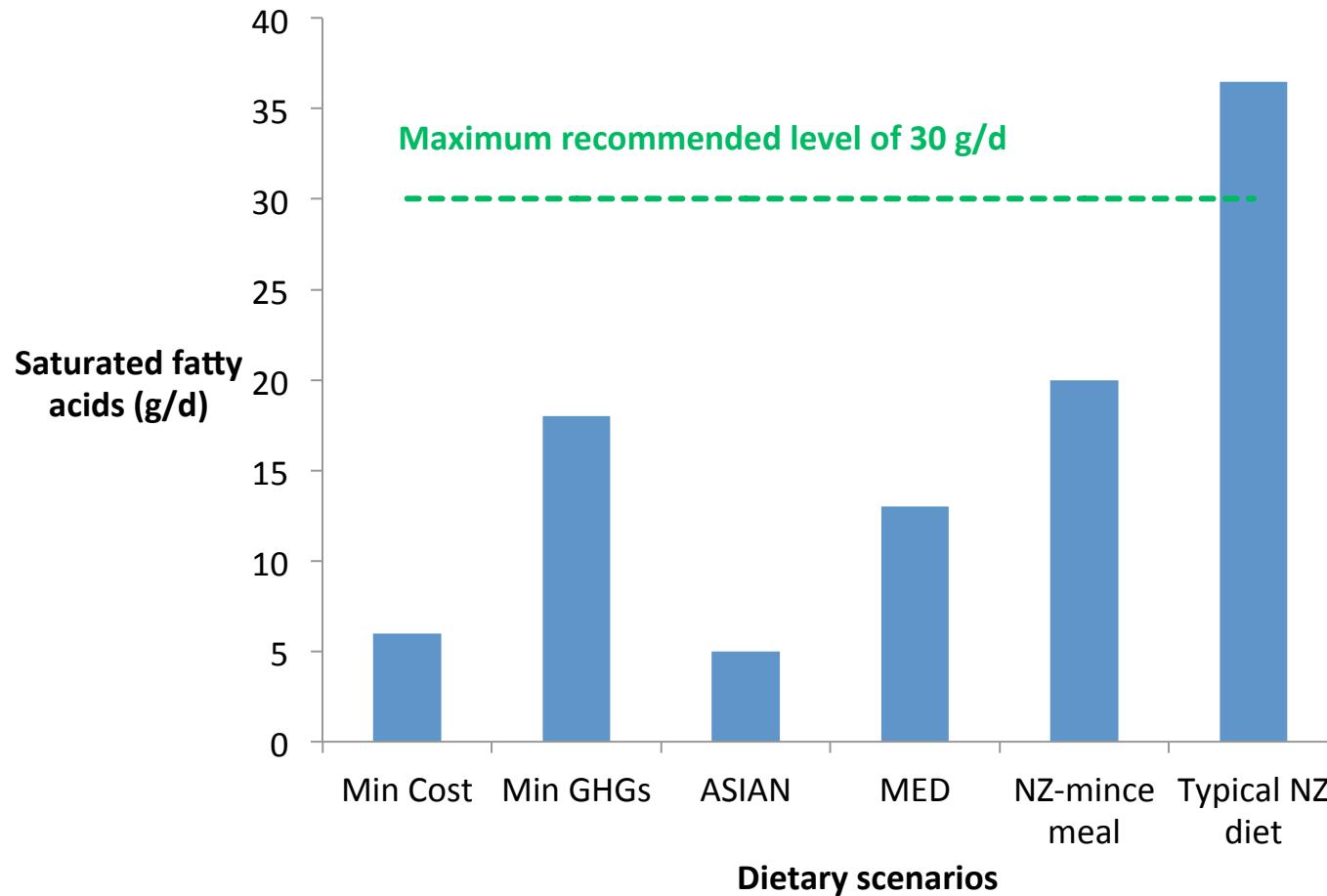
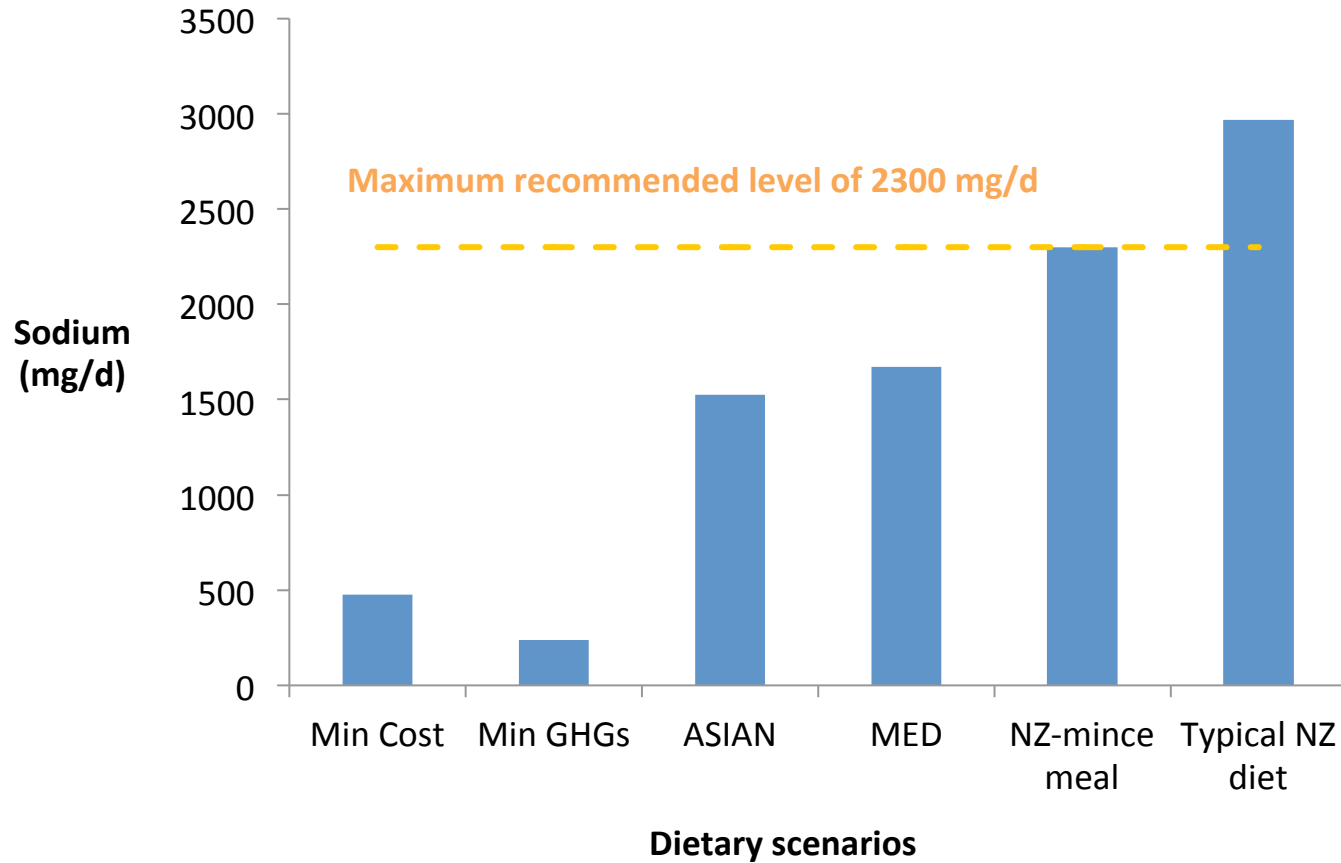


Figure 3. Sodium intake in various dietary scenarios.



Study limitations

- The food-specific GHG emissions were from the UK and may differ from those for NZ. But sensitivity analyses with NZ adapted data showed a small difference.
- The GHG emissions are likely to be underestimates: the land use required for food production; the emissions from transport of food to home; & the emissions from food being refrigerated & prepared in the home.
- Haven't included externalities: biodiversity, water depletion, waterway pollution with pathogens from livestock, and excess nitrogen in the environment.

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Conclusions

- We identified optimal foods and dietary patterns that were low cost and would lower the risk of NCD and reduce food-related GHG profiles.
- These results could help guide central and local gov. decisions around which foods to focus on e.g., food taxes (additions and exemptions), healthy food vouchers and subsidies, or priority foods for use by public institutions involved in food preparation, eg hospitals and schools.

Further details please check:

Wilson N, Nghiem N, Ni Mhurchu C, Eyles H, Baker MG, Blakely T. Foods and Dietary Patterns That Are Healthy, Low-Cost, and Environmentally Sustainable: A Case Study of Optimization Modeling for New Zealand. *PLoS ONE* [Published 27 March 2013]
[Full text available online.](#)

Thank you.

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