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Optimising people's diets using linear programming: to what extent are the Eatwell guidelines a barrier?

M. Galazoula, D.C. Greenwood, A. Martin and J.E. Cade

People's diets are not always good for their health or the planet. Studies suggest that healthier diets have lower environmental footprints and typically cost less(1). But efforts to encourage people to change their diet might not be easily accepted by the population, partly because of their reluctance to make large changes to their food habits. Firstly, we explored the feasibility of optimising diets towards the national dietary guidelines whilst minimising changes in the portions of foods that people would have to make. Secondly, the impact of these changes on the environmental footprint and diet cost was measured. An average daily diet was estimated for each participant (N = 2,165 adults) based on four food diaries from the 2014–2017 National Diet and Nutrition Survey (NDNS)(2). The environmental impact was calculated for greenhouse gas emissions (GHGE), land use and freshwater withdrawals(3). Food prices were assigned to each food subgroup to calculate the diet cost(4). Diets were optimised using linear programming to identify diets that meet the dietary guidelines of the Eatwell Guide whilst minimising the changes in the portions of the foods consumed by each participant. The dietary guideline constraints were relaxed in steps of $\pm 10\%$ in each iteration. Without relaxing these constraints somewhat, the dietary guidelines were unachievable without unrealistic changes to most people's diets. Additional analyses were performed to identify which nutrient guidelines were hardest to achieve and the optimisation failed on. Using the Eatwell constraints for energy, protein, carbohydrates, fat (total, saturated, polyunsaturated and monounsaturated), salt, free sugars and fibre, only 24 (1%) diets could be optimised. Relaxing these constraints by $\pm 10\%$, $\pm 20\%$, $\pm 30\%$, $\pm 40\%$ and $\pm 50\%$, the number of diets that could be optimised whilst only making minimal changes were 96 (5%), 286 (13%), 592 (27%), 1040 (48%) and 1555 (71%) respectively. The restrictions were also lifted entirely for each of the recommendations while relaxing the recommendations for all other nutrients by $\pm 50\%$. The nutrients that led to the highest number of diets being optimised were salt, free sugars and fibre with 1587 (73%), 1796 (83%) and 1800 (83%) respectively. People's daily diets were associated with 5.8kgGHGE, 5.7m²year land use, 601litres of freshwater and cost £5.10. After relaxing $\pm 50\%$ of the recommendations, the GHGE, land use, freshwater and costs fell in the optimised diets by 6–15%. We show that achieving the Eatwell Guide recommendations is not feasible with only minimal changes to people's current diets, even when relaxing constraints for some nutrients by $\pm 50\%$. Shifting to healthier diets may be marginally cheaper and better for the environment, but making minimal dietary changes are not sufficient to meet the Eatwell nutrient guidelines.

References

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