Balancing the plate: nutritional adequacy in sustainable diets

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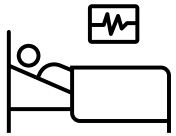
Dairy Council Northern Ireland Conference
7th May 2025

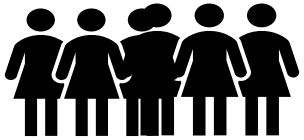
Why?



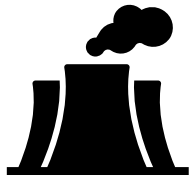
Impact of poor dietary choices on health

2017: 11m deaths due to poor dietary choices, 255m years of ill health (DALY) [1]

2025
8.2bn



2050
9.7bn



Environmental Impact of food production

27% of global emissions (52.3bn tonnes of Carbon dioxide equivalents) come from food

(73% non-food)[2]

[1](GBD Study, 2017) doi: 10.1016/S0140-6736(19)30041-8
[2]Ritchie et al. (2022) - “Environmental Impacts of Food Production” Published online at OurWorldinData.org. Retrieved from: 'https://ourworldindata.org/environmental-impacts-of-food’

Healthy diets

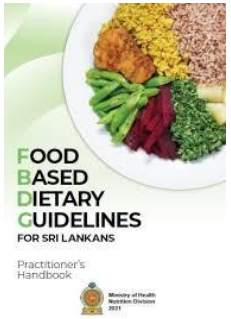


Image source: https://www.fao.org/nutrition/nutrition-education/food-dietary-guidelines/en/
https://hal.inrae.fr/hal-03660686/document

Sustainable diets

At the International Scientific Symposium on ”Biodiversity and Sustainable Diets – United Against Hunger” (2010) at FAO headquarters in Rome, experts agreed on a general concept:

“**Sustainable diets** those diets with **low environmental impacts** that contribute to food and nutritional security and to healthy lives for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, are nutritionally adequate, safe, and healthy, and optimize natural and human resources.”

FAO. (2012). Sustainable diets and biodiversity: directions and solutions for policy, research and action

EAT-Lancet

Eat-Lancet Commission

- Made up of 37 experts from 16 different countries

Goal

To determine how we can feed a future population of 10 billion people a healthy diet within planetary boundaries

Eat-Lancet Diet (2019)

Universal, healthy reference diet based on global scientific targets, derived from the best available evidence for healthy diets and sustainable food production

Willett et al. (2019). The Lancet Commissions Food in the Anthropocene : the EAT – Lancet Commission on healthy diets from sustainable food systems. Lancet, 393(10170):447–492

Some European food based dietary guidelines factoring sustainability

The Official Dietary Guidelines

– good for health and climate

Ministry of Food, Agriculture and Fisheries of Denmark
Danish Veterinary and Food Administration

Eat less meat – choose legumes and fish

Development of a Danish Adapted Healthy Plant-Based Diet Based on the EAT-Lancet Reference Diet

Anne D. Lassen *, Lene M. Christensen and Ellen Trolle

Regular and abundant **fruit, veg & wholegrain**

Avoid / Do not consume regularly/ Reduce **red & processed meats**

Regular and abundant / Increase / Choose more **plant protein, legumes and nuts**

THE SWEDISH DIETARY GUIDELINES

Find *your* way

to eat greener, not too much and be active

Livsmedelsverket (The Swedish Food Agency), 2015

Public Health Nutrition: 22(13), 2419–2435 doi:10.1017/S1368980019001435

Development of healthy and sustainable food-based dietary guidelines for the Netherlands

Elizabeth Brink[1,*], Caroline van Rossum[2], Astrid Postma-Smeets[1], Annette Stafleu[1], Danielle Wolvers[1], Corné van Dooren[1], Ido Toxopeus[2], Elly Buurma-Rethans[2], Marjolein Geurts[2] and Marga Ocké[2]

Nutritional adequacy in sustainable diets?

The population approach

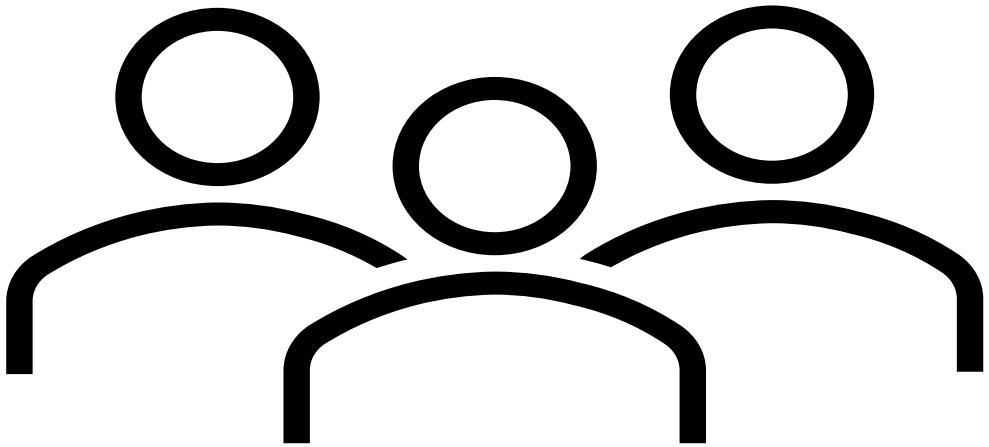
The single food approach

The interventionist approach

How will these manifest as dietary change?

Will there be improvements in nutrient intake & adequacy?

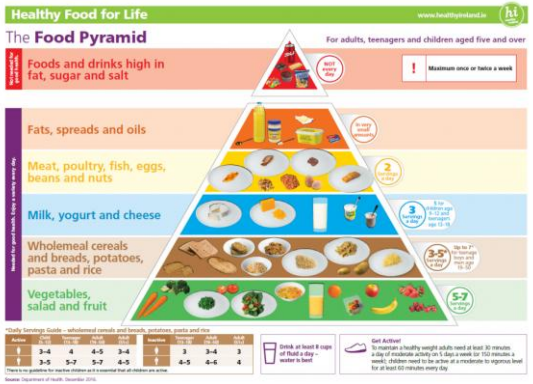
Will people be likely to accept such change?



The Population approach

Healthy for us and for the planet (sustainable diets for our population)

Associations with FBDG adherence



↑ Diet quality (Healthy Eating Index)[1]

↓ Greenhouse gas emissions (GHGE)

Aligns Eatwell Guide analysis [2] from Scheelbeek et al (2020)

Higher adherence associated with 30% lower GHGE

27% of GHGe in ROI come from 'other foods'(e.g. sugar/fat/ alcohol)[3]
19% in the UK [4]

[1] Davies KP *et al. (2025)* Br J Nutr. doi:10.1017/S0007114525000662; [2]Scheelbeek et al. BMJ Open doi:10.1136/ bmjopen-2020-037554; [1]Hyland et al (2017) doi: 10.1017/S1368980016002573· [4]Murakami & Livingstone, 2018 doi: 10.1186/s12937-018-0338-x.

Option 1: Sustainable diets for our population

Used mathematical modelling to create a diet that is nutritionally adequate and environmentally friendly with minimum change from the usual (baseline) diet to ensure acceptability.

Protein-i
Sustainable Healthy Nutrition

National food consumption data for island of Ireland (current dietary patterns)

What did we do?

Baseline diet **(National Diet and Nutrition Survey, National Adult Nutrition Survey)**

Scenario 1 

Scenario 2 

Key:

 Nutrient recommendations

 Irish food based dietary guidelines

 Environmental constraints

Linear Programming in R studio

What did the dietary changes look like?

Constraint	Baseline diet	Scenario 1 (Nutritional constraints only)	Scenario 2 (Nutritional and env. Constraints)
GHGe (kgCO2e/d)	~6	↓ 12%	↓↓ 46%
Blue water use (l/day)	~1200	↓↓ 81%	↓↓ 89%
Fibre (g/day)	Some challenges with respect to dietary quality/meeting nutrient recommendations	Satisfied Nutrient recommendations	
Protein (g/day)			
Vitamin B12 (µg/day)			
Iron (mg/day)			
Calcium (mg/day)			
Number of people that could meet all the constraints	1484	1032	506

Key take home 1

- It is possible to generate diets which would be acceptable, sustainable and healthy
- Changes in intake of many food groups, including dairy types
- Such diets would not be acceptable to many

Option 2: The single food approach?

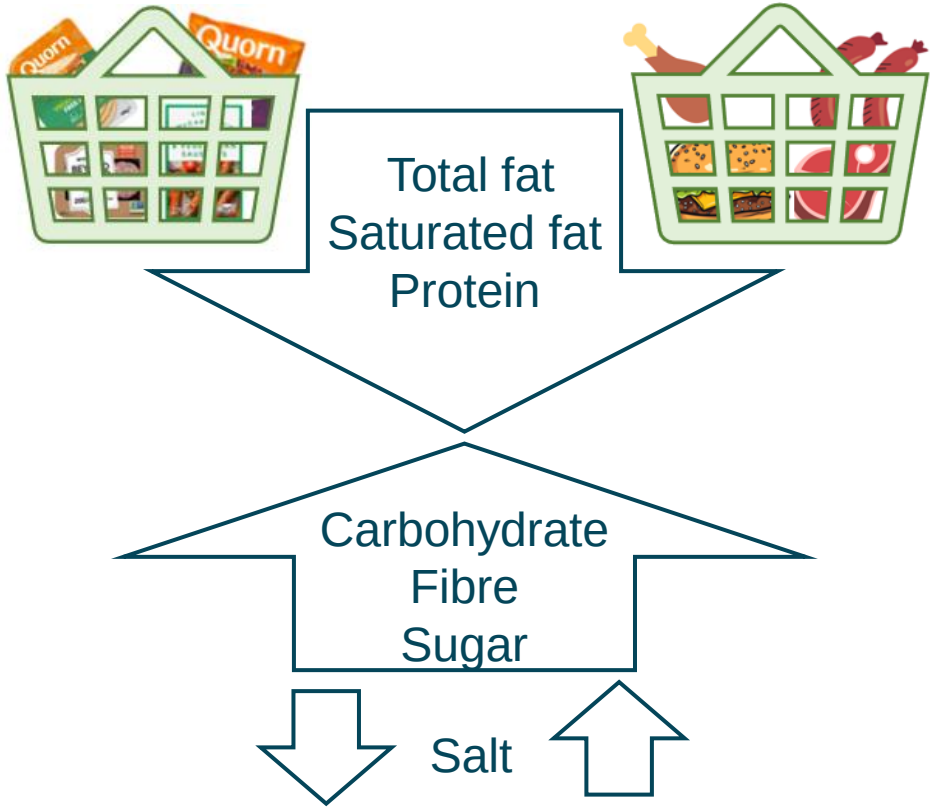
Would it be ‘easier’ to make single dietary swaps?

Product audit 2021-2024

Sainsbury's TESCO

PBMAs vs. **Meat**

NUTRITICS



Variability

FOOD ALLERGENS

Presence of allergens

Higher cost

Lindberg, L., Woodside, J.V., Fitzgerald, H., Campbell, N., Vogan, H., Kelly, C., Robinson, M. and Nugent, A.P., 2025. Plant-Based Meat Alternatives on the Island of Ireland: Changes in the Market and Comparisons with Conventional Meat. *Foods*, *14*(5), p.903; Coffey, A., Lillywhite, R., & Oyebode, O. (2023). *Journal of Human Nutrition and Dietetics*, *36*(6), 2147-2156; The Food Foundation (2024).

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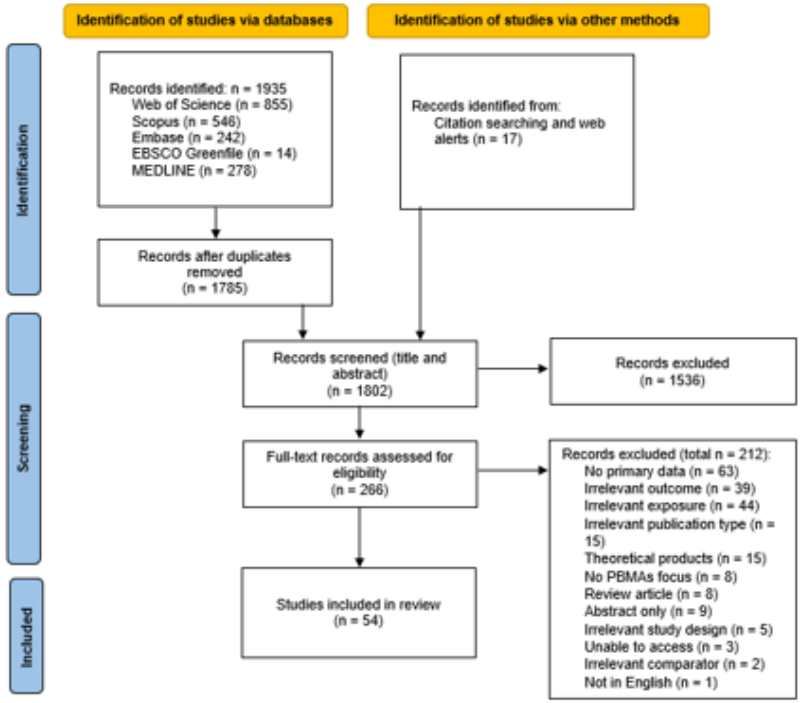
How do alternatives fare against meat?

Search strategy:

[Plant-based meat alternatives & synonyms] **AND** [nutrition & synonyms] **OR** [ingredients & synonyms] **OR** [health impact & synonyms] **OR** [environment & synonyms]



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Key findings

Negatives

- Ingredients, allergens and additives
- Protein, vitamin B12, iron & zinc intakes
- Salt/sodium intakes
- ? Limited data on health impact
- Environmental impact compared to chicken

Positives

- Saturated fat intakes
- Increased fibre and iron (if fortified) intakes
- No negative health outcomes
- Environmental impact than beef/pork

Trends in Food Science & Technology 149 (2024) 104483

Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: www.elsevier.com/locate/tifs

The environmental impact, ingredient composition, nutritional and health impact of meat alternatives: A systematic review

Leona Lindberg [a,b,*], Rachel Reid McCann [a,1], Beatrice Smyth [c], Jayne V. Woodside [a,b], Anne P. Nugent [b,d]

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Key take home 2

- Meat alternatives do provide an option for change as part of healthy sustainable diets but they are often not like for like with meat.

- What else do we eat them with?

Option 3: The interventionist approach?

….testing the hypothesis… why???

Estimated micronutrient shortfalls of the EAT–*Lancet* planetary health diet

Ty Beal, Flaminia Ortenzi, Jessica Fanzo

Unhealthy diets are a major contributor to the global burden of disease, and food systems cause substantial environmental destruction. To lay out how to achieve healthy diets for all, within planetary boundaries, the landmark EAT–*Lancet* Commission proposed the planetary health diet, which includes a range of possible intakes by food group and substantially restricts the intake of highly processed foods and animal source foods globally. However, concerns have been raised about the extent to which the diet provides adequate essential micronutrients, particularly those generally found in higher quantities and in more bioavailable forms in animal source foods. To address these concerns, we matched each food group point esti
representative food composition data. We then compared the re
harmonised recommended nutrient intakes for adults and women
are globally scarce. To fill the dietary gaps that were estimated for vi
modifications to the original planetary health diet to achieve mi
supplementation) for adults, which included increasing the proport
high in phytate.

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JN THE JOURNAL OF NUTRITION

journal homepage: www.journals.elsevier.com/the-journal-of-nutrition

Critical Review

Friend or Foe? The Role of Animal-Source Foods in Healthy and Environmentally Sustainable Diets

Ty Beal [1,2,*], Christopher D. Gardner [3], Mario Herrero [4], Lora L. Iannotti [5], Lutz Merbold [6], Stella Nordhagen [7], Anne Mottet [8]

ute for Social, Behavioral and Economic Research, University of California, ford University School of Medicine, Stanford, CA, USA; [4] Department of ell University, Ithaca, NY, USA; [5] Brown School, Washington University, St. Switzerland; [7] Global Alliance for Improved Nutrition, Geneva, Switzerland; y

The American Journal of Clinical Nutrition 119 (2024) 927–948

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The American Journal of CLINICAL NUTRITION

journal homepage: https://ajcn.nutrition.org/

Original Research Article

Impact of consuming an environmentally protective diet on micronutrients: a systematic literature review

Ursula M Leonard [1], Clarissa L Leydon [2,3], Elena Arranz [1,4], Mairead E Kiely [1,*]

[1] *Cork Centre for Vitamin D and Nutrition Research, School of Food and Nutritional Sciences, University College Cork, Cork, Ireland;* [2] *Centre for Health and Diet Research, School of Public Health, University College Cork, Cork, Ireland;* [3] *Department of Agrifood Business and Spatial Analysis, Teagasc Food Research Centre, Ashtown, Dublin, Ireland;* [4] *Department of Nutrition and Food Science, Faculty of Pharmacy, Complutense University of Madrid, Madrid, Spain*

MyPlanetDiet RCT: Environment, Food, Health and Nutrients

Can an environmentally protective diet reduce Green house gas emissions (GHGe), meet nutritional requirements and promote health, without adverse effects?

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MyPlanetDiet: randomised controlled trial

UCD DUBLIN

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh

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Participants: Healthy adults (18-64Y) with moderate/high greenhouse gas emitting diets (n=360 [3x 120])

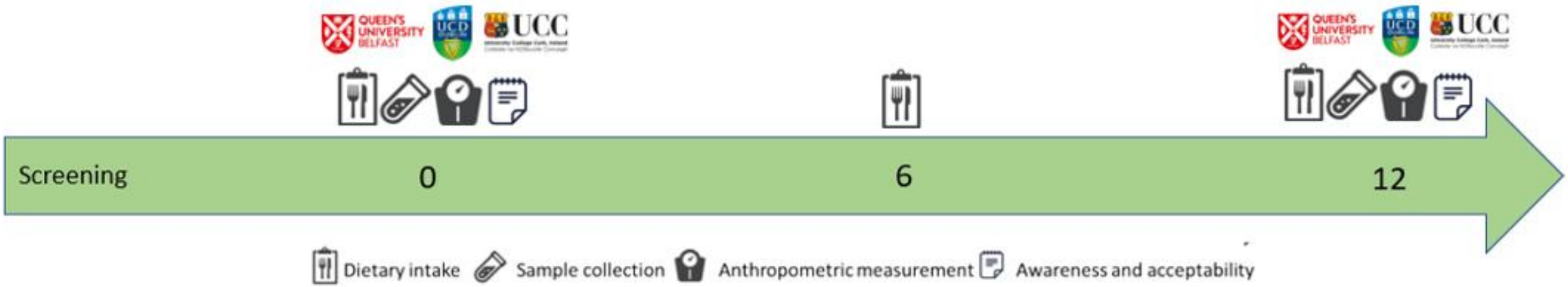
Intervention group:

Personalised advice based on proposed sustainable healthy guidelines

Control group:

Personalised advice based on existing Healthy Eating Guidelines

MyPlanetDiet Study Design



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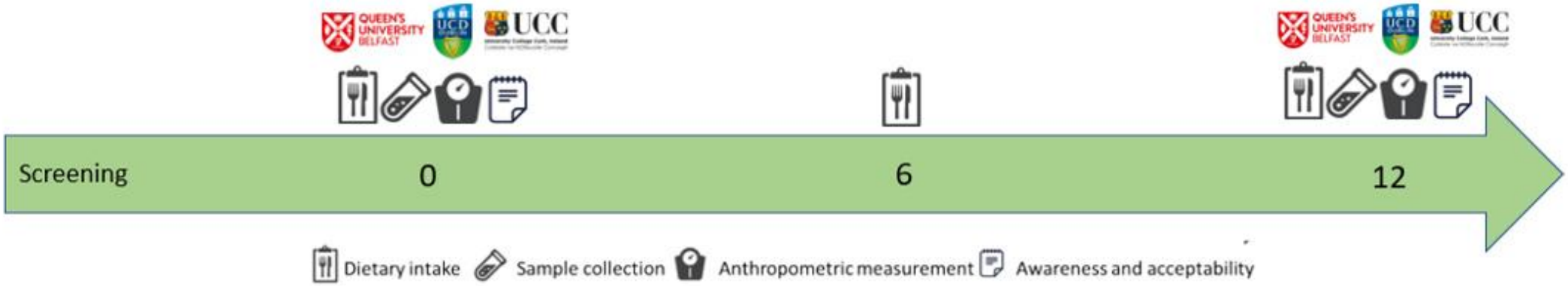
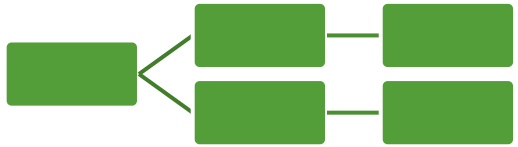
MyPlanetDiet Study Design



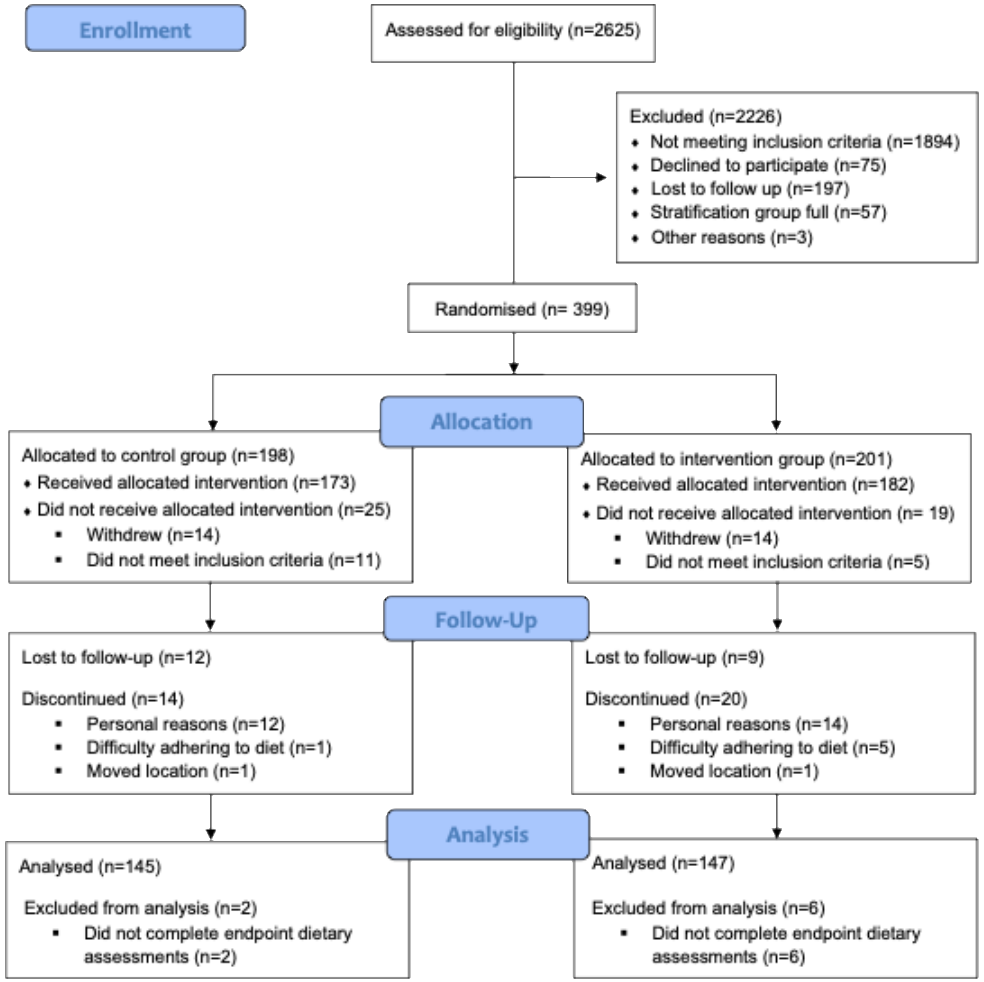


- Meat serving = 50-75g
- No more than one red meat per day
- 3 servings of dairy/day

- 3 servings meat per week, ≤ 1 red meat/wk (140g)
- 1 serving plant protein per day
- 1 serving nuts and seeds
- ≤ 1/day cheese (1.5-2.5 serving/d dairy)

MyPlanetDiet Particpants

- 355 participants began the study
- 58% female, 42% male
- 44% aged 18-40, 56% aged 41-64y
- Mean BMI 28.1 ± 5.4
- 51% living with partner and children
- 45% living in a city
- 43% postgraduate level education



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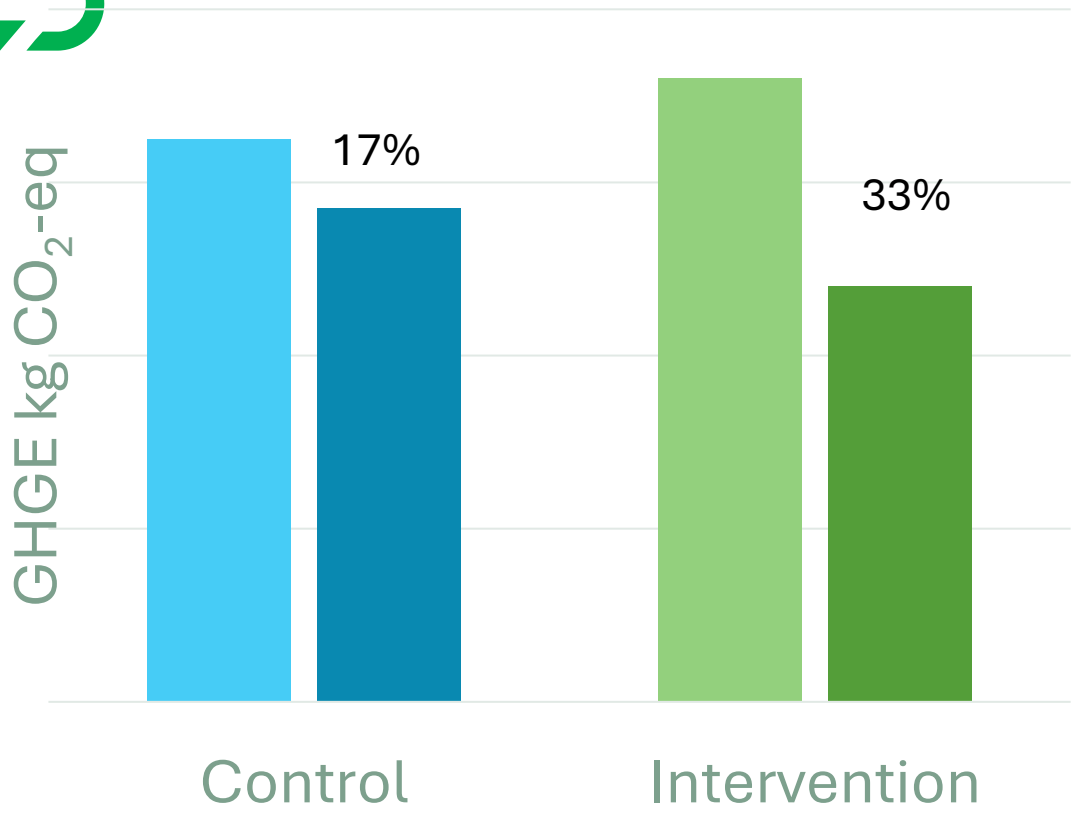
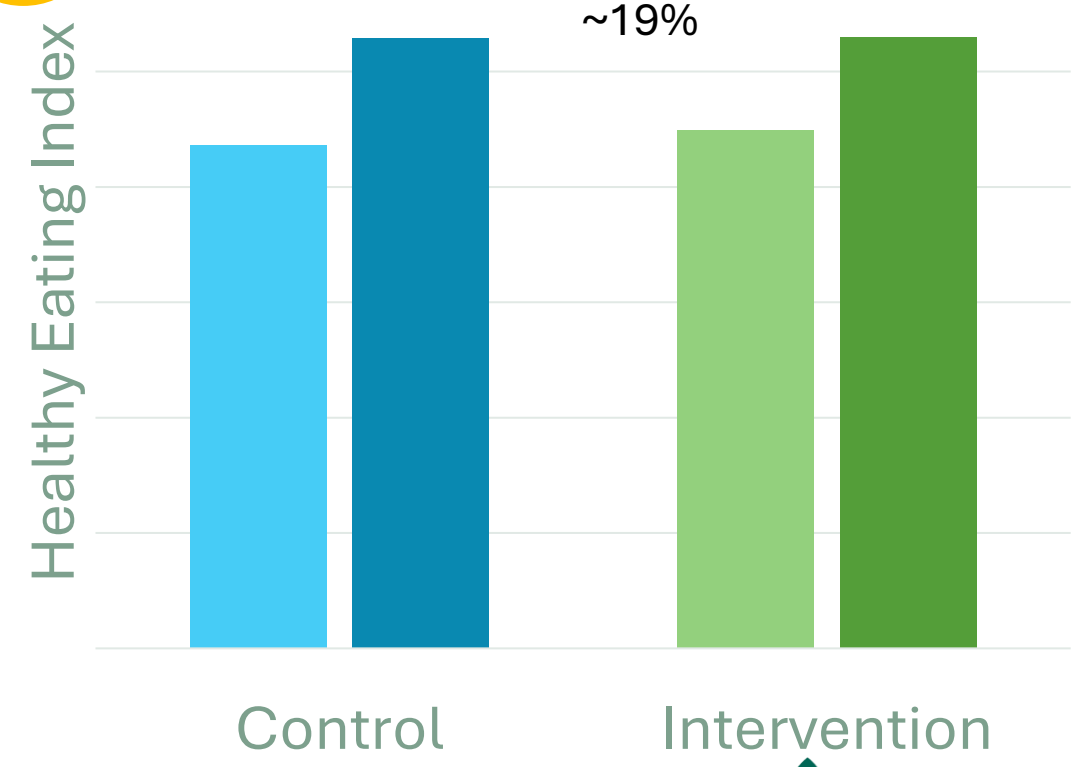
MyPlanetDiet Environment and Diet





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Did the MyPlanetDiet diet affect nutrient intakes?*

↑ Intervention vitamin K_1

↓ Intervention energy, retinol, thiamin, vitamin D, riboflavin, niacin, vitamin B_6, vitamin B_{12}, calcium, zinc, potassium, sodium, selenium, iodine

***Comparison of daily intakes between intervention and control at study end.**

Broadly similar results when controlled for energy intake

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Did the diet influence the proportion of males and females likely to have poor dietary intakes?*

Compared to control group at study end

riboflavin, vitamin B_6 , vitamin B_{12}, calcium, zinc & vitamin C

Vitamin E & Copper

riboflavin, selenium, iodine

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*Comparison of % of the population with usual intakes below the average requirement

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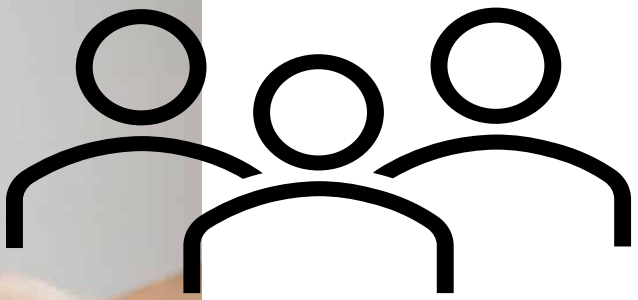
Key take home 3

- Compared to a diet based on healthy eating guidelines, a diet based on sustainable dietary principles reduced greenhouse gas emissions but resulted in a higher prevalence of inadequate intakes of several micronutrients, especially among women.

Will people be likely to accept such change?



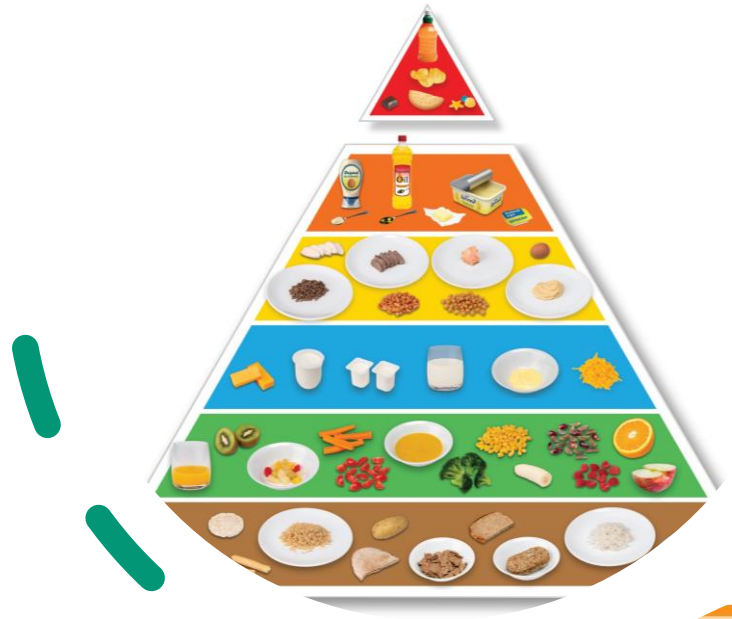
Adherence & acceptability

Adherence was similar between groups

Control	Intervention
Associated with higher diet quality (HEI)	Associated with higher HEI & lower GHGE
Most adhered to group: red and processed meat	Most adhered to group: red meat (beef/lamb)
Least adhered to group: dairy	Least adhered to group: beans, peas and lentils
Treat foods most difficult to follow (self-reported)	Treat foods most difficult to follow (self-reported)

Key take home messages

- There remains a considerable gap between current eating patterns and dietary patterns which are both healthy and sustainable
- Much remains unknown about how nutrient intake and adequacy may be impacted, especially in population subgroups
- It may be challenging for some (many) to accept such changes



Thank you

Queen's University Belfast

Hannah Griffin

Sinan Dong

Alexandra-Irina Mavrochefalos

Eva-Leanne Thomas

Rachel Moore

Dr. Leona Lindberg

Dr. Tony Benson

Dr. Rufielyn Gravador

Dr. David Wright

Prof. Moira Dean

Prof. Michelle McKinley

Prof. Jayne Woodside

University College Dublin

Dr. Katie Davies

Dr. Aoife O'Gorman

Assoc. Prof. Breige McNulty

Assoc. Prof Aifric O'Sullivan

Prof. Eileen Gibney

Prof Lorraine Brennan

University College Cork

Dr. Ursula Leonard

Prof. Mairead Kiely

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Protein-i Sustainable Healthy Nutrition

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An Roinn Talmhaíochta, Bia agus Mara Department of Agriculture, Food and the Marine

Department of Agriculture, Environment and Rural Affairs

Sustainability at the heart of a living, working, active landscape valued by everyone