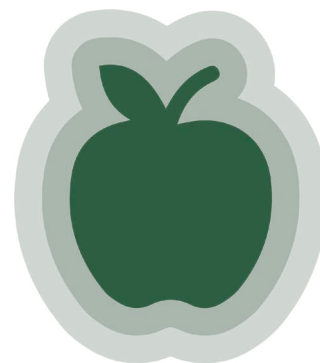


Plant-based diets and their impact on health, sustainability and the environment

A review of the evidence



In the WHO European Region, more and more people are shifting towards plant-based diets for reasons relating to health, as well as to ethical considerations about climate change and animal welfare. In some countries changes in dietary patterns are only just emerging, while in others this trend is increasing rapidly. Nevertheless, the evidence on the long-term health impacts of vegetarian and vegan diets remains incomplete. This fact sheet aims to review the current evidence and highlight knowledge gaps in this area.



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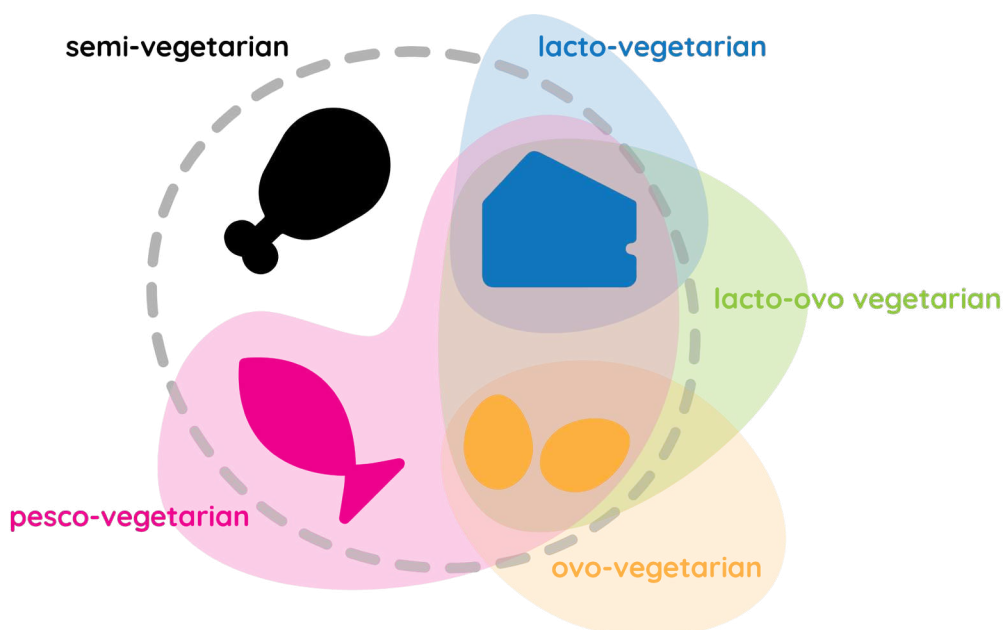
Plant-based diets

Plant-based diets constitute a diverse range of dietary patterns that emphasize foods derived from plant sources coupled with lower consumption or exclusion of animal products. Vegetarian diets form a subset of plant-based diets, which may exclude the consumption of some or all forms of animal foods (see box).

Common vegetarian diets

- **Vegan** diets omit all animal products, including meat, dairy, fish, eggs and (usually) honey.
- **Lacto-vegetarian** diets exclude meat, fish, poultry and eggs, but include dairy products such as milk, cheese, yoghurt and butter.
- **Lacto-ovo vegetarian** diets include eggs and dairy, but not meat or fish.
- **Ovo-vegetarian** diets exclude meat, poultry, seafood and dairy products, but allow eggs.
- **Pesco-vegetarian** (or **pescatarian**) diets include fish, dairy and eggs, but not meat.
- **Semi-vegetarian** (or **flexitarian**) diets are primarily vegetarian but include meat, dairy, eggs, poultry and fish on occasion, or in small quantities.

Overall, a diet that is predominantly plant-based and low in salt, saturated fats and added sugars is recommended as part of a healthy lifestyle.¹ Such diets are widely associated with a lower risk of premature mortality and offer protection against noncommunicable diseases (NCDs). This advice complements the overall evidence indicating that limiting consumption of red meat (beef, pork and lamb) and processed meat (such as sausages and cured, smoked and salted meats) could protect against various NCDs. Nevertheless, strict plant-based diets, such as vegan diets, also raise concerns about micronutrient deficiencies (such as iron and vitamin B12).



NCD prevention and plant-based diets

NCDs are responsible for 71% of all premature deaths (41 million deaths a year) globally.² Of these, 80% are due to the four most common NCDs: cardiovascular diseases account for 17.9 million deaths, followed by cancers (9 million), chronic respiratory diseases (3.9 million) and diabetes mellitus (1.6 million). Of the six WHO regions, the European Region has the greatest burden of NCD-related morbidity and mortality, at almost 90% of all deaths. Overweight and obesity are a major NCD risk factor and affect over 59% of adults and 29% of children in the European Region. Globally, one in every five deaths in adults is associated with unhealthy diet.

Low fruit and vegetable consumption is linked to poor health and increased risk of NCDs.

Recent studies have shown that high fruit and vegetable intake is associated with lower risks of **heart disease and stroke**.^{4,5} WHO recommends consuming at least 400 g (five portions) of fruits and vegetables (excluding potatoes and other starchy tubers) per day. There is large variation in fruit and vegetable intake across Europe. In more than half of the countries in the WHO European Region, consumption of fruits and vegetables is lower than 400 g per day, and in one third of the countries (particularly those in eastern Europe), the average intake is less than 300 g per day.^{6,7}

Cardiovascular disease causes more than half of all deaths across the European Region.

Overall, evidence suggests that vegetarian and vegan diets have a protective effect against coronary heart disease,^{8,9,10,11} but increased risk of stroke has been reported in recent analyses.¹⁰

The strongest association found so far between diet and **cancer** risk is for bowel cancer (also known as colorectal cancer). Frequent consumption (four or more portions per week) of processed meat and unprocessed red meat has been found to increase the risk of bowel cancer.¹² However, calcium – mainly from dairy products – offers some protection against colorectal cancer.^{13,14} Vegans, vegetarians and pescatarians have been found to have a lower risk for all cancers compared to non-vegetarians.¹⁵ According to the World Cancer Research Fund, diets that reduce the risk of cancer contain no more than modest amounts of red meat and little or no processed meat.¹⁶

Diabetes is inextricably linked to obesity rates since a high body mass index (BMI) is the most critical risk factor. Various studies have found that vegetarians and vegans generally have a lower BMI than otherwise comparable non-vegetarians.^{17,18} Research suggests that low meat and non-meat eaters have a lower risk of diabetes, largely because of their lower BMI.¹⁹ However, it should be noted that non-meat eaters generally have healthier lifestyles than meat eaters.

Taken together, the beneficial effects of plant-based diets, including the protection they offer against premature mortality, provide strong evidence for public health guidelines recommending healthful plant-based diets as a means to prevent and control NCDs.^{20,21,22,23,24}

Macro- and micronutrient intake in plant-based diets

There are some concerns about the nutritional adequacy of plant-based diets, particularly vegan diets which exclude all forms of animal foods in their entirety. While the absorption and availability of specific micronutrients (such as iron, vitamin A and zinc) may be lower in plant than animal foods, obtaining recommended levels of these micronutrients can still be achieved with an appropriately planned vegan diet that includes a variety of different plant foods.²⁵ As for other micronutrients such as vitamin D and vitamin B12, which are mostly found in animal sources, vegans may consider the consumption of fortified foods and – in the specific case of vitamin D – adequate sun exposure. Accordingly, individuals who consume a vegan diet should remain aware of potential micronutrient insufficiencies. Vegan diets generally meet protein intake recommendations, though they are usually lower in this respect than less restrictive forms of plant-based diets. However, it should be noted that current research in this area is based on a small number of cohort studies.

According to a systematic review, vegan diets are typically associated with relatively low intakes of vitamins B2, B12, D, iodine, zinc, calcium and selenium.²⁶ Intake of vitamin B12 (important for several bodily functions including a healthy nervous system) was found to be significantly lower in vegans. The review found that vegan diets are characterized by lower consumption of saturated fat and higher consumption of beneficial unsaturated fat. It also found that such diets are not associated with a risk of insufficient intake of vitamins A, B1, B6, B9 (folate), C, E, iron, phosphorus, magnesium or copper in adult populations.

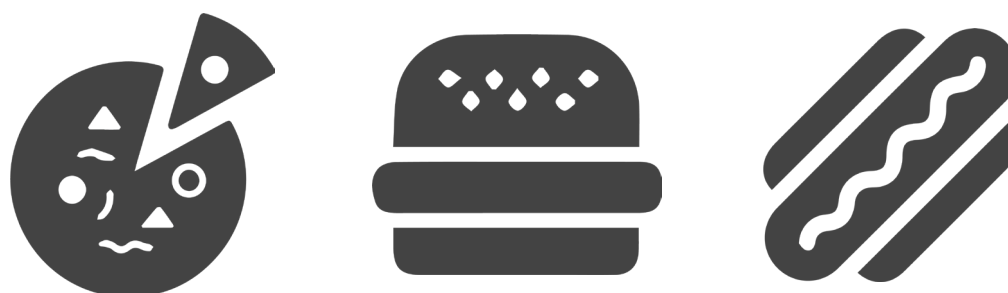


Ultra-processed plant-based foods

Notwithstanding the health benefits of a diet rich in plant-based foods, not all plant-based diets are healthy. While such diets are typically characterized in terms of the proportion of plant-based foods they contain relative to animal foods, little consideration may be given to the types and quality of the plant foods concerned. It is common to associate plant-based diets with healthful, whole and minimally processed plant foods such as whole grains, fruits and vegetables, legumes, nuts and seeds. However, refined grains, and sugar-sweetened beverages, snacks and confectionery are foods that can still be considered “plant-based” as they or their ingredients originate from plants and may be free from animal products.

Modern plant-based diets may also include ultra-processed foods.²⁷ These include imitation processed “meats” (including products marketed as sausages, nuggets and burgers), beverages (for example, almond and oat “milk”), and plant-based “cheese” and “yoghurt”. Ultra-processed foods, as defined by the NOVA classification system, are formulations of substances derived from whole foods, such as starches, sugars, fats and protein isolates, with little, if any, whole food, and often with added flavours, colours, emulsifiers and other cosmetic additives to improve shelf-life, palatability and visual appeal. Consequently, there are significant knowledge gaps in the nutritional composition of such meat and dairy substitutes, while the extent of their contribution to contemporary diets in many countries in the European Region is unclear.²⁷ In addition, further research is needed to investigate the yet-unknown health impacts of the food additives and by-products formed during industrial processing of such plant-based “meats”.

Plant-based foods are increasingly becoming part of the growing out-of-home meal sector in the WHO European Region – a growing sector that includes food and beverage outlets where food and drink can be bought for consumption outside the home. A 2020 study found that plant-based meals produced in the out-of-home sector can contain high amounts of salt.²⁸ There are, however, significant gaps in our understanding of the links between plant-based diets, out-of-home meals and nutritional quality.



Additional benefits of plant-based diets

Plant-based diets have the potential not only to improve human health but also to reduce the environmental impacts associated with high consumption of animal-sourced foods such as meat and dairy products.^{1,29,30} The production of plant foods, such as fruits and vegetables, grains, legumes, nuts and seeds, produces lower greenhouse gas emissions than that of animal foods.³¹ Foods associated with the greatest negative environmental impacts – unprocessed and processed red meat – are consistently associated with the largest increases in disease risk. Shifting towards plant-based diets can also help prevent biodiversity loss.³² This shift in dietary patterns could significantly reduce global land use for agriculture, by reducing the amount of land required for grazing and growing crops.³³ It is encouraging that reducing the consumption of unprocessed and processed red meat has dual benefits for both human and planetary health.^{1,34,35}

Alongside the benefits to human health, the adoption of plant-based diets could translate into savings of billions of euros across Europe in health-care costs.³⁶ Excessive meat consumption places a burden on health-care systems; for example, it has been estimated that in 2020 there were 2.4 million deaths worldwide, and approximately €240 million in health-care costs, attributable to excessive red and processed meat consumption.³⁷



Recommendations and conclusion

For consumers who are new to plant-based diets and those who currently eat animal products frequently, it may be helpful to focus on incremental transitions towards plant-based diets by adopting plant-forward eating, in which meat is not necessarily excluded but is not the central feature of the meal. Gradual reductions in animal products like red meat and poultry may be easier to adopt and adhere to than more restrictive diets which exclude animal products entirely. Gradual shifts and more flexible dietary patterns also allow for religious and culturally appropriate applications of plant-based dietary recommendations.

For individuals who prefer not to consume some or most animal foods, healthful and well-planned plant-based meals can provide adequate levels of micronutrients. For individuals who prefer a more moderate approach, substantial health benefits may be gained even by incremental reductions in animal foods and substitutions with healthful plant foods. Nevertheless, for any plant-based diet, it is prudent to consider the types and quality of plant foods included in the diet. Barring food allergies and clinical contraindications, individuals should preferably choose minimally processed foods and drinks: whole grains over refined grains; whole fruits over fruit juices; unrefined non-tropical vegetable oils (rich in mono- and polyunsaturated fatty acids) such as olive and sunflower oil over coconut oil and partially hydrogenated oils; and unsweetened beverages such as water, coffee or tea over fizzy drinks and other sugar-sweetened beverages.

In conclusion, considerable evidence supports shifting populations towards healthful plant-based diets that reduce or eliminate intake of animal products and maximize favourable “One Health” impacts on human, animal and environmental health.

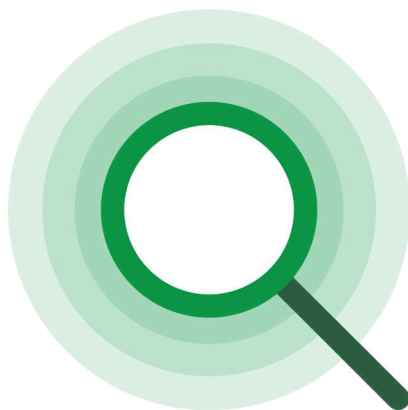


WHO Regional Office for Europe's activities on plant-based diets

The WHO European Office for the Prevention and Control of Noncommunicable Diseases (NCD Office) in Moscow, Russian Federation, is currently carrying out activities in the area of plant-based diets to gather evidence to inform the development of policy guidance in this area. Some of our activities include:

- [a systematic review of the intake and adequacy of vegan diets](#)
- [a commentary piece on ultra-processed plant-based foods](#)
- a multicountry study on the nutritional content of vegan burgers
- a study of the nutritional content and environmental impacts associated with processed plant-based food products from online supermarkets.

To learn more about our areas of work within healthy and sustainable diets, click [here](#).



Acknowledgements

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The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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