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SUMMARY
SCIENTIFIC UPDATE
ON PLANT-BASED EATING AND CARDIOMETABOLIC HEALTH

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GLOBAL HEALTH BURDEN OF CARDIOMETABOLIC DISEASE

Cardiovascular disease (CVD) continues to be the leading cause of death and is associated with a high burden of disease worldwide, contributing to 31% of all global deaths. Important behavioural factors associated with cardiometabolic disease risk include unhealthy diet, physical inactivity, tobacco use, and excessive alcohol use. **Diet can be attributed to about 45.4% of all premature deaths from CVD.** The good news, however, is that 80% of premature heart attacks and strokes are preventable. Non-alcoholic fatty liver disease (NAFLD), a disease closely related to CVD, has as only recommended treatment the change of lifestyle (diet and physical exercise). It is therefore of great importance to assess which dietary patterns can majorly improve these diseases.

TYPES OF PLANT-BASED DIETARY PATTERNS

Certain food patterns have established benefits to cardiometabolic health. They all emphasize plant-based foods. There is a spectrum of plant-based eating, varying in the proportion of animal products incorporated into the diet. Plant-based eating does not automatically exclude all animal products but puts plant-based foods at the core.
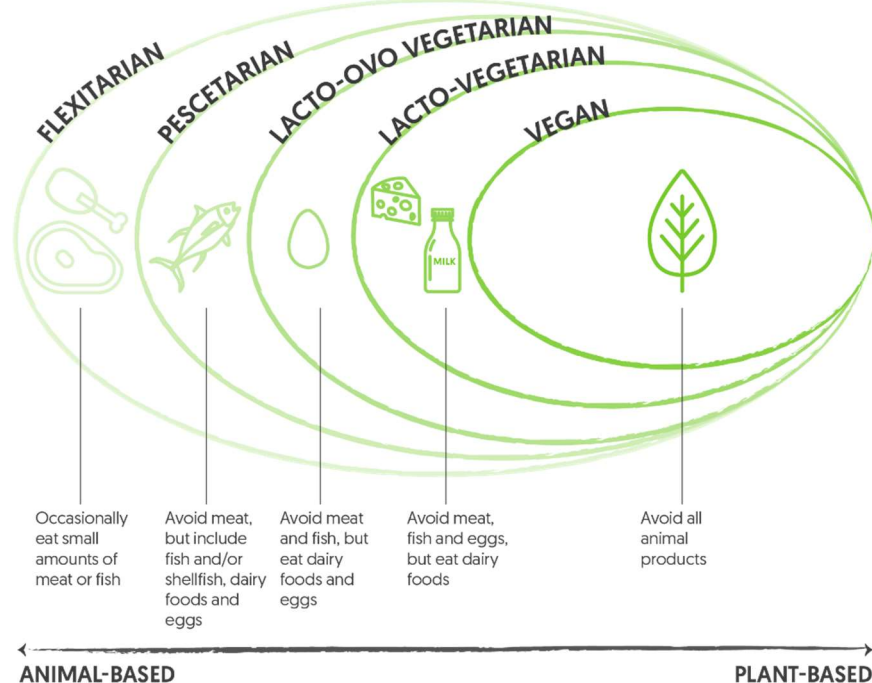

FIGURE 1. SPECTRUM OF PLANT-BASED EATING, varying in the proportion of animal products incorporated into the diet. Plant-based eating does not automatically exclude all animal products but puts plant-based foods such as fruits, vegetables, legumes, wholegrains, nuts, seeds, vegetable oils and plant-based alternatives to meat and dairy at the core of the diet.

Plant-based diets have several characteristics that may contribute to their role in cardiometabolic health. These include high fibre content, low caloric density, lower saturated fat, beneficial fatty acid composition (higher in unsaturated fats) and anti-inflammatory compounds. Examples of such dietary patterns are the Mediterranean diet, Nordic diet, Portfolio diet, DASH diet, and vegetarian and vegan diets.

The **Mediterranean** diet (MedDiet) encourages vegetables, fruits, grains, legumes (incl. soy), nuts, and olive oil, with low to moderate consumption of fish. It limits consumption of red and processed meat, cream and sugar-sweetened beverages. MedDiet is strongly associated with a lower risk (10 – 30%) of developing total CVD and CVD mortality, as shown by several studies and meta-analyses. The biggest intervention study performed to date is the PREDIMED-study, which also demonstrated a 30% lower risk of CVD in elder individuals at high CVD risk. Next to beneficial effects for CVD, it has also been shown to offer benefits for diabetic patients, metabolic syndrome and NAFLD.

The **Nordic diet** is a plant-based diet that is traditional in Nordic countries. It emphasizes the consumption of local, seasonal, and nutritious foods such as whole grains, berries, cabbages, legumes, rapeseed oil, fatty fish, shellfish, seaweed, but will restrict the use of saturated fat. Multiple meta-analyses have shown a significant reduction in total and LDL cholesterol and a lowered systolic and diastolic blood pressure with the Nordic Diet. A positive effect on the components of metabolic syndrome was shown (blood pressure, dyslipidaemia, improvement in insulin resistance and HbA1c and reduced waist circumference). Despite these strong results on risk factors, studies on the Nordic diet show mixed results on cardiometabolic outcome and T2D.

The **Portfolio diet** is a plant-based diet that focuses on cholesterol-lowering foods. To follow the Portfolio diet, one should consume about 45 g of nuts, 50 g of protein from soy or other legumes, at least 20 g of viscous, soluble fibre and 2 g plant sterol. Meta-analysis shows that such a diet reduces LDL by ~17%, and 10-year CHD risk by 13%. Updated studies continue to show that each component can lower LDL-C by 5-10%. This has been substantiated by approved health claims for the reduction of cholesterol by the Food and Drug Administration (FDA), Health Canada or the European Food Safety Authority (EFSA). There is now an established international consensus that LDL-C is causal in the pathogenesis of atherosclerotic CVD, however need for more research on harder CV outcomes after following the Portfolio diet remains.

Vegetarian diets emphasize the consumption of vegetables, fruits, soy, legumes, nuts and whole grains. Vegetarian diets exclude all meat, while **vegan diets** exclude all animal-derived products. These dietary patterns improve cardiometabolic risk factors and reduce mortality from CHD by 22%. In studies, systematic reviews and meta-analyses, vegetarian and vegan diets have been shown to reduce the risk of CVD. A vegan diet centred on whole plant-based foods may even lead to reversal of heart disease, as evidenced by reduced size of atherosclerotic plaques in coronary arteries. Next to CVD risk factor improvements (lower blood pressure, lower CRP levels), vegetarian and vegan diets lead to reductions in haemoglobin A1c and fasting blood glucose levels showing potential benefits both in the prevention and treatment of T2D.

Finally, the **DASH** diet (Dietary Approaches to Stop Hypertension) was modelled after vegetarian diets showed beneficial effects on blood pressure. It encourages the consumption of fruits, vegetables, whole grains, nuts and legumes (incl. soy), and allows for some fish, poultry, free/low-fat dairy. It limits saturated fat, cholesterol, red and processed meats, sweets and sugar-sweetened beverages. Meta-analysis shows a reduction of systolic blood pressure by ~5 points, with the DASH diet and a reduced risk of CVD and coronary artery disease.

CARDIOMETABOLIC RISK FACTORS

Various risk factors influence cardiometabolic diseases. The previously discussed plant-based diets can have a beneficial effect on these risk factors. For example, researchers observed **lower blood pressure with increasing plant-based food consumption**. This is relevant because a blood pressure drop of 5 mmHg could reduce overall mortality by 14%, with a 9% reduction in the risk of death from heart disease.

Another risk factor is lipid profile. Globally, high blood cholesterol is estimated to be responsible for 2.6 million deaths. **Plant-rich diets are helpful in both the prevention and treatment of hyperlipidaemia, or high cholesterol**. For example, the Portfolio diet, vegetarian and Mediterranean diet are all associated with beneficial lipid effects.

Inflammation, commonly measured as C-Reactive Protein (CRP), is the preceding factor to all steps of plaque formation and chronically elevated levels can predict future cardiovascular events. Plant-based diets are associated with lower CRP levels and endothelial health can be maintained and even improved with a plant-based diet.

Overweight, obesity and adiposity increase the risk of all cardiometabolic risk factors and excess fat stores can also lead to low-grade inflammation. Unfortunately, the prevalence of overweight and obesity has tripled globally since 1975 and was at 39% in 2016. Plant-based diets have shown to be an effective tool in weight control: in the BROAD study and many others, researchers demonstrated impressive weight loss results with a low-fat plant-based diet. Storing fat around the abdomen poses increased cardiovascular mortality, even in individuals with a normal BMI. Whole-grain intake is associated with less visceral adipose tissue, as demonstrated in a subset study of the Framingham Heart Study.
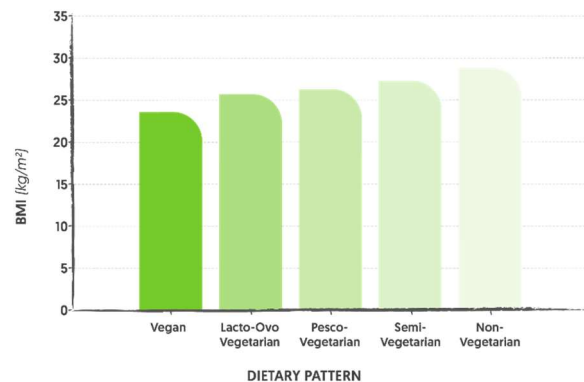

FIGURE 2. BMI AND DIETARY PATTERNS.

Adapted from: Tonstad S et al. Diabetes Care. 2009;32(5):791-796.

Impaired glucose metabolism is another risk factor of cardiometabolic disease. The incidence of T2D, marked by impaired glucose metabolism, is lowest in vegans and highest in omnivores. As recognized by the American Diabetes Association, a meta-analysis confirmed improved glucose control with DASH, Mediterranean, and vegetarian diets, which can be due to the protective effects of more unsaturated fatty acids, found in plant-based foods. The European Association of the study of Diabetes (EASD) encourages the consumption of whole grains and adequate fibre. They additionally recommend reducing saturated fat intake in favour of polyunsaturated fats.

The last risk factor is **NAFLD**. NAFLD is defined as the accumulation of fat in the liver in people who do not consume excessive amounts of alcohol. NAFLD is closely associated with obesity and is the hepatic manifestation of metabolic syndrome. Plant-based diets have been shown to be particularly effective for NAFLD: vegetarian diets are associated with a 21% lower risk of NAFLD compared with non-vegetarian diets, even after adjustment for BMI. Plant-based diets low in saturated fat, high in fibre and unsaturated fatty acids, may have a positive impact on NAFLD even in the absence of weight loss.

PLANT COMPONENTS AND FOOD GROUPS

NUTS

Due to their nutritional profile (high unsaturated fatty acids, low carbohydrates, rich in fibre, minerals, vitamins and other bioactive compounds such as polyphenols)**, nuts possess a wide range of benefits on CVD** (reduced the risk of CVD by 30%, and the risk of peripheral artery disease by 52%) and high nut-consumption is associated with lower prevalence of T2D. They also **modulate related risk factors, such as lipid metabolism, oxidative stress, and inflammation, without affecting body weight.** In large epidemiologic studies and meta-analyses, the frequency of nut consumption was consistently related to lower rates of CHD, incidence and mortality from CVD, and total death. An inverse association between nut intake and risk of weight gain, obesity, and metabolic syndrome was also shown.

SOY

Soybeans are part of the legumes, however they are quite unique as they are a source of high-quality protein and oil (predominantly unsaturated fat including PUFA omega 3 and 6) whereas other legumes contain mostly starch and are lower in protein.

An advantage of incorporating soy foods in the diet is that they can help to reduce blood cholesterol through direct and indirect mechanisms.

- Direct: Soy protein directly lowers LDL-C by approximately 3 to 5%.
- Indirect: When soy foods replace common sources of animal protein in Western diets, which are typically high in saturated fat, the favourable change in fatty acid intake will lower LDL-C.

Beyond the effects on lipids, soy foods may also lower blood pressure (systolic and diastolic) by approximately 2.5 and 1.5 mmHg. Reducing systolic blood pressure by just 2–5 mmHg may reduce stroke and CHD disease by 6%–14% and 5%–9%, respectively. It is, therefore, a valuable and versatile food that contributes high quality protein (contains all essential amino acids and is highly digestible) to the plant-based diet, while at the same time reducing important risk factors for CVD.

LEGUMES

Legumes include alfalfa, broad beans, clover, lupine, soybeans, peanuts, green/dry beans and peas, chickpeas, and lentils. They are a good source of fibre and carbohydrates, and are considered a **low-glycaemic-index food**. This means glycemia increases gradually, without spiking, as legumes are broken down slowly after consumption. Legumes are also rich in some vitamins, minerals (including magnesium and potassium) and polyphenols.

The nutritional profile of legumes and synergy between its different components, endows them with a wide range of potentially beneficial cardiometabolic health properties. Their consumption, within a balanced plant-based diet, is therefore recommended by multiple international health organizations. Legumes **protect against cardiometabolic diseases such as CVD, CHD and hypertension**.

WHOLE GRAINS AND FIBER

Systematic reviews and meta-analyses of randomized controlled trials (RCTs) have shown that **whole grain interventions improve lipids**, including triglycerides and the established therapeutic target LDL-C, **as well as having a positive effect on glycaemic control.** Especially the sources of whole

grains that contain the viscous soluble fibre beta-glucan, such as oats and barley and their isolated fibres, show evidence of benefit (improvements in lipids, fasting glucose and HbA1c). Other important physiological benefits such as contribution to stool bulking and laxation, have been observed in RCTs for whole wheat and wheat bran. These distinctions between sources of whole grains are not apparent in the epidemiology and a protective association with the incidence of CHD is seen. This was also demonstrated in the significant reductions of cardiometabolic risk factors and events in the large multicentre randomized PREDIMED trial, irrespective of source of whole grains. Systematic reviews and meta-analyses of prospective cohort studies that show that **adherence to diets containing whole grains is associated with reduced incidence of diabetes and CVD** and improved glycaemic control, blood pressure and lipids.

FRUITS AND VEGETABLES

International dietary guidelines and clinical practice guidelines for diabetes and heart health are universal in their recommendation to consume fruits and vegetables (at least 400g per day). In addition to providing essential vitamins and minerals and important bioactives, fruits and vegetables have shown many cardiometabolic advantages.

Improvements in risk factors such as HbA1c, lipids, LDL-cholesterol, and blood pressure have all been linked to fruit intake. This was also confirmed by several RCTs. Fruits and vegetables have shown positive effects on blood pressure, reduction in diabetes incidence, CHD incidence and mortality, stroke incidence and mortality, CVD incidence and mortality and all-cause mortality.

The concern that fruit may contribute to excess intake of sugars and so fail to achieve the intended benefits has been refuted by RCTs showing a protective association from fruit (up to 3 servings a day) with diabetes and cardiovascular outcomes.

LINK BETWEEN DIET AND MICROBIOME DIVERSITY

Microbiome diversity, i.e. having a wide variety of different species in the gut is important for good health and loss of diversity is common in patients with various diseases. Increasing number of studies suggest that an effective way of increasing microbial diversity is to consume plant-based diets. Fibre, plant protein, polyunsaturated and monounsaturated fat and polyphenols all increase the diversity of the gut microbiome. **Especially fibres which cannot be digested but are metabolized by the gut microbiota are most relevant.**

IN CONCLUSION

PLANT-BASED FOOD PATTERNS HAVE POSITIVE EFFECTS ON CARDIOMETABOLIC DISEASES AND THEIR RISK FACTORS

In conclusion, the present findings demonstrate that the Mediterranean, DASH, Portfolio, Nordic, and vegetarian or vegan diets may have positive effects on the incidence of and mortality from various CVD outcomes. These diets can help to improve several cardiometabolic risk factors. Emphasizing the consumption of vegetables, fruits, soy, legumes, nuts, seeds and whole grains, these plant-based diets may be recommended for cardiometabolic health.
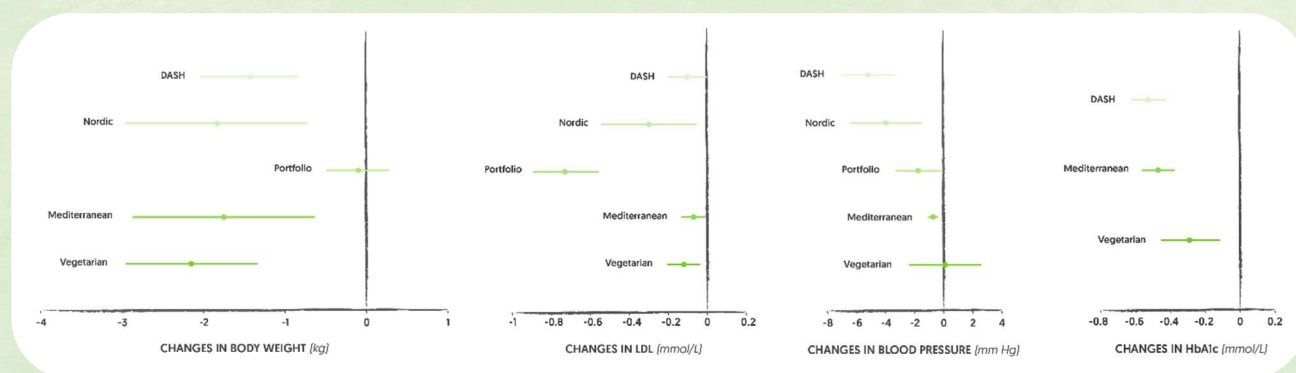

FIGURE 3. CHANGES IN BODY WEIGHT, LDL CHOLESTEROL, SYSTOLIC BLOOD PRESSURE AND HbA1c.

Abbreviations: LDL, low-density lipoprotein; HbA1c, glycosylated haemoglobin A1c. *Adapted from: Kahleova H et al. Nutrients. 2019;11[9].*

ENVIRONMENTAL BENEFITS

On top of the health benefits, a plant-based diet is also at the core of more sustainable diets. To stay within the planetary boundaries, a combination of major dietary change to more plant-based foods, improved food production, and reduced food waste during all steps of the food chain will be needed. Several food-based dietary guidelines emphasize plant-based foods not only for health but also for environmental considerations. [for more info see Alpro Foundations scientific update 'More plant-based eating for the planet' [2019]].

For a complete list of the references, please consult Alpro Foundations full scientific report 'Scientific update on plant-based eating and cardiometabolic health ' [2020] .

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