



CONSENSUS STATEMENT

Executive summary: Updates to the dietary treatment of prediabetes and type 2 diabetes mellitus[☆]V. Pascual Fuster^a, A. Pérez Pérez^b, J. Carretero Gómez^c, A. Caixàs Pedragós^d, R. Gómez-Huelgas^e, P. Pérez-Martínez^{f,*}^a Centro de Salud Palleteer, Universidad CEU-Cardenal Herrera, Castellón, Grupo de Trabajo Nutrición y Estilo de Vida, Sociedad Española de Arteriosclerosis (SEA), Spain^b Servicio de Endocrinología y Nutrición, Hospital de la Santa Creu i Sant Pau, Institut d'Investigació Biomèdica Sant Pau, Universitat Autònoma de Barcelona, Barcelona, Centro de Investigación Biomédica en Red de Diabetes y Enfermedades Metabólicas Asociadas (CIBERDEM), Sociedad Española de Diabetes (SED), Spain^c Servicio de Medicina Interna, Hospital Comarcal de Zafra, Grupo de Diabetes, Obesidad y Nutrición, Sociedad Española de Medicina Interna (SEMI), Zafra, Badajoz, Spain^d Servicio de Endocrinología y Nutrición, Departament de Medicina, Hospital Universitari Parc Taulí, Universitat Autònoma de Barcelona, Institut d'Investigació i Innovació Parc Taulí (I3PT), Sabadell, Barcelona, Sociedad Española de Diabetes (SED), Spain^e Servicio de Medicina Interna, Hospital Regional Universitario de Málaga, Instituto de Investigación Biomédica de Málaga (IBIMA), Universidad de Málaga, Málaga, Centro de Investigación Biomédica en Red de Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Instituto de Salud Carlos III, Grupo de Diabetes, Obesidad y Nutrición, Sociedad Española de Medicina Interna (SEMI), Spain^f Unidad de Lípidos y Arterioesclerosis, Instituto Maimónides de Investigación Biomédica de Córdoba (IMIBIC), Hospital Universitario Reina Sofía, Universidad de Córdoba, Centro de Investigación Biomédica en Red de Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Instituto de Salud Carlos III, Grupo de Trabajo Nutrición y Estilo de Vida, Sociedad Española de Arteriosclerosis (SEA), Grupo de Diabetes, Obesidad y Nutrición, Sociedad Española de Medicina Interna (SEMI), Grupo de Educación para la Salud, Sociedad Española de Medicina Interna (SEMI), Spain

Received 17 September 2020; accepted 24 November 2020

KEYWORDS

Prediabetes;
Diabetes;
Diet;
Carbohydrates;
Obesity;
Caloric content**Abstract** Adequate lifestyle changes significantly reduce the cardiovascular risk factors associated with prediabetes and type 2 diabetes mellitus. Therefore, healthy eating habits, regular physical activity, abstaining from using tobacco, and good sleep hygiene are recommended for managing these conditions. There is solid evidence that diets that are plant-based; low in saturated fatty acids, cholesterol, and sodium; and high in fiber, potassium, and unsaturated fatty acids are beneficial and reduce the expression of cardiovascular risk factors in these subjects. In view of the foregoing, the Mediterranean diet, the DASH diet, a low-carbohydrateDOI of original article: <https://doi.org/10.1016/j.arteri.2020.11.005>[☆] Please cite this article as: Pascual Fuster V, Pérez Pérez A, Carretero Gómez J, Caixàs Pedragós A, Gómez-Huelgas R, Pérez-Martínez P. Resumen ejecutivo: actualización en el tratamiento dietético de la prediabetes y la diabetes mellitus tipo 2. Clin Investig Arterioscler. 2021;33:73–84.

* Corresponding author.

E-mail address: pabloperrez@uco.es (P. Pérez-Martínez).

PALABRAS CLAVE

Prediabetes;
Diabetes;
Dieta;
Hidratos de carbono;
Obesidad;
Contenido calórico

diet, and a vegan-vegetarian diet are of note. Additionally, the relationship between nutrition and these metabolic pathologies is fundamental in targeting efforts to prevent weight gain, reducing excess weight in the case of individuals with overweight or obesity, and personalizing treatment to promote patient empowerment.

This document is the executive summary of an updated review that includes the main recommendations for improving dietary nutritional quality in people with prediabetes or type 2 diabetes mellitus. The full review is available on the webpages of the Spanish Society of Arteriosclerosis, the Spanish Diabetes Society, and the Spanish Society of Internal Medicine.

© 2021 Published by Elsevier España, S.L.U. on behalf of Sociedad Española de Arteriosclerosis.

Resumen ejecutivo: actualización en el tratamiento dietético de la prediabetes y la diabetes mellitus tipo 2

Resumen Los cambios adecuados del estilo de vida reducen significativamente los factores de riesgo cardiovascular asociados a la prediabetes y la diabetes mellitus tipo 2, por lo que en su manejo se debe recomendar un patrón saludable de alimentación, actividad física regular, no consumir tabaco, y una buena higiene del sueño. Hay una sólida evidencia de que los patrones alimentarios de base vegetal, bajos en ácidos grasos saturados, colesterol y sodio, con un alto contenido en fibra, potasio y ácidos grasos insaturados, son beneficiosos y reducen la expresión de los factores de riesgo cardiovascular en estos sujetos. En este contexto destacan la dieta mediterránea, la dieta DASH, la dieta baja en hidratos de carbono y la dieta vegano-vegetariana. Adicionalmente, en la relación entre nutrición y estas enfermedades metabólicas es fundamental dirigir los esfuerzos a prevenir la ganancia de peso o a reducir su exceso en caso de sobrepeso u obesidad, y personalizar el tratamiento para favorecer el empoderamiento del paciente.

Este documento es un resumen ejecutivo de una revisión actualizada que incluye las principales recomendaciones para mejorar la calidad nutricional de la alimentación en las personas con prediabetes o diabetes mellitus tipo 2, disponible en las páginas web de la Sociedad Española de Arteriosclerosis, la Sociedad Española de Diabetes y la Sociedad Española de Medicina Interna.

© 2021 Publicado por Elsevier España, S.L.U. en nombre de Sociedad Española de Arteriosclerosis.

Introduction

Prediabetes and type 2 diabetes mellitus (DM2) are illnesses whose growing increase in the population has become a serious public health problem. From the clinical point of view, controlling these metabolic alterations directly affects cardiovascular morbidity and mortality, which makes it necessary to provide effective strategies for prevention and treatment.

Adequate changes in lifestyle significantly reduce cardiovascular risk (CVR) factors associated with prediabetes and DM2. Consequently, it is necessary to recommend a healthy diet, regular physical activity, abstention from smoking and good sleep hygiene in managing these 2 illnesses.¹

There is solid evidence that following eating patterns based on vegetables, low in saturated fatty acids, cholesterol and sodium, with high fibre, potassium and unsaturated fatty acid content, is beneficial and reduces the expression of CVR factors in these individuals.² In this context, the Mediterranean diet,³ the low carbohydrate (CH) diet⁴ and the vegan-vegetarian diet⁵ stand out.

In addition, in the relationship between nutrition and these metabolic illnesses, it is crucial to attempt to pre-

vent weight gain or reduce excess weight if individuals are overweight or obese. It is also fundamental to individualise the treatment to favour patient empowerment.

In this paper, we present an up-dated review that provides useful evidence and hierarchical recommendations by levels. We use evidence from clinical trials (when available), observational studies on clinical evidence or substitution markers and expert consensus. Based on the preceding, 3 types of recommendations are given: (1) strong, based on clinical trials and meta-analyses incorporating criteria of quality; (2) moderate, supported by prospective cohort studies and by studies of cases and controls; and (3) weak, justified by consensus and expert opinions or based on extensive clinical practice.

In short, there is evidence revealing that a high rate of adults present prediabetes or DM2, with the consequent short- and medium-term increase in CVR. Lifestyle, especially the diet, constitutes the basis of treatment to improve blood pressure, lipid and blood glucose control, and to reduce the elevated cardiovascular morbidity and mortality that appear in these individuals.¹

This document is an executive summary of an updated review that includes the principal recommendations for

improving the nutritional quality of the dietary intake of individuals with prediabetes or DM2. It is available at the websites of the Spanish Arteriosclerosis Society [*Sociedad Española de Arteriosclerosis*] (<https://www.se-arteriosclerosis.org/guias-documentos-consenso>), the Spanish Diabetes Society [*Sociedad Española de Diabetes*] (https://www.sediabetes.org/grid/?tipo=cursos_formacion&categoria=consensos-guias-y-recomendaciones) and the Spanish Internal Medicine Society [*Sociedad Española de Medicina Interna*] (<https://www.fesemi.org/actualizacion-en-el-tratamiento-de-la-prediabetes-y-la-diabetes-tipo-2-consenso-semi-sed-y-sea>).

Objectives of the diet in the population with prediabetes or type 2 diabetes

The general objective of dietary treatment for individuals with prediabetes or DM2 is to help them to modify nutritional habits to prevent and/or delay the illness, to improve their metabolic control, to treat the complications and the associated processes or comorbidities, and to maintain or improve their quality of life. Within this general objective, there are specific objectives that are applicable to the majority of people with DM2 or at risk of developing it, objectives that are backed by solid information.^{1,6–8}

The specific dietary objectives for the population with prediabetes or DM2 are as follows:

- Prevent and/or delay the progression to DM2 for individuals with prediabetes. Programmes that combine healthy diets and physical activity are effective in reducing the incidence of DM2 and improving CVR factors, with the most intensive programmes being the most effective.⁸ (**Strong evidence**).
- Achieve and maintain the objective of individualised blood glucose control. Different nutritional interventions for individuals with DM2, including the reduction of energy intake, make it possible to achieve absolute decreases in glycosylated haemoglobin (HbA_{1c}) of .3%–2.0% at 3–6 months, and this can be maintained or improved at > 12 months. This improvement is better in those with a recent diagnosis and/or more elevated initial levels of HbA_{1c}. Likewise, decreasing the dose and/or quantity of antidiabetic drugs is also possible.⁸ (**Strong evidence**).
- Reach and maintain the personalised weight objective. In adults with DM2, nutritional therapy makes it possible to reduce weight (2.4–6.2 kg), or it does not modify it.⁸ (**Moderate evidence**).
- Achieve and maintain the personalised objectives for control of lipids and blood pressure. Nutritional interventions with individuals with normal or near-normal values improve or do not modify the lipid profile and blood pressure.⁸ (**Moderate evidence**).
- Maintain or improve quality of life. For individuals with DM2, implementing nutritional therapy significantly improves the self-perception of the state of health, increases knowledge and motivation, and reduces emotional stress.⁸ (**Strong evidence**).

Dietary characteristics

Calories content

The objective of the calories provided by the diet is to achieve and maintain a reasonable body weight (understanding reasonable to mean a more realistic weight than the ideal, one that can be reached and maintained in the short and long term).¹

The majority (approximately 80%) of the people with DM2 are obese, so weight reduction is initially the main therapeutic objective. Obesity, particularly abdominal, constitutes the principal factor for the development of DM2 in genetically-predisposed subjects, and preventing obesity represents the principal course of action in reducing the incidence of DM2. There is solid evidence on the effectiveness of a moderate weight loss (5%–10%) in preventing or delaying the progression from prediabetes to DM2.^{9,10}

Moderate calorie reduction (≥ 500 kcal/day), together with physical exercise, modification of dietary habits and provision of psychological support, are the most used effective measures to obtain and maintain a gradual, moderate weight loss. However, the clinical benefits of weight loss are progressive and increase as greater weight loss reductions are achieved.^{11,12}

An alternative for people with DM2 and obesity who cannot achieve weight loss in a structured programme, and for specific selected individuals, is the very low calorie diet (<800 kcal/day), generally a diet of liquids, for short periods (<3 months) and with progressive reintroduction of foods. This very low calorie diet achieves a marked loss of weight and the remission of DM2 at the end of a year in 50% of the subjects.¹²

Healthy dietary models for the treatment of diabetes

There are several models or patterns of diet considered to be healthy.¹³ The best known models are the Mediterranean diet, the Dietary Approaches to Stop Hypertension (DASH) diet, the low CH diet and the vegetarian diet.

- The **Mediterranean diet** is based on the consumption of vegetables, fruits, legumes, nuts and seeds, whole grains; moderate to high consumption of olive oil (as the main source of fat); low to moderate consumption of dairy, fish and poultry; and low consumption of red meat.

This diet has been shown to be effective in improving both glycaemic control and CVR factors.¹⁴ Compared with the diet based on the recommendations of the American Diabetes Association, both the traditional Mediterranean diet and the low-CH Mediterranean diet reduce HbA_{1c} and triglyceridemia, while only the low-CH Mediterranean diet improves plasma levels of cholesterol associated with low-density and high-density lipoproteins in subjects with overweight and DM2 after a year of treatment.¹⁵

In a systematic review, the low-CH diet was more effective than the low-fat diet in reducing HbA_{1c} in the short term, but not at 2 years.¹⁶ In the randomised multicentre study carried out in Spain, *Prevención con la dieta*

Table 1 Initial distribution of carbohydrates based on diabetes treatment.

Treatment	Number of intakes/day
<i>Diet alone or diet and non-insulin glucose-lowering medication</i>	3 main meals
<i>Diet and basal insulin (glargine or detemir or degludec)</i>	3 main meals
<i>Diet and 1 or 2 doses of intermediate or premixed insulin (biphasic insulins)</i>	
1 dose at night	3 main meals + supplement at bedtime
1 dose in the morning	3 main meals + mid-morning supplement
2 doses	3 main meals + mid-morning and bedtime supplements
<i>Diet and insulin in a basal-bolus regimen with injections or insulin pump</i>	3 main meals/flexible with carbohydrate counting

mediterránea (Predimed) [Prevention with the Mediterranean diet], with individuals at high CVR, almost half of the subjects diagnosed with DM2 at the beginning of the study showed benefits in the reduction of cardiovascular events with the Mediterranean diet supplemented with extra-virgin olive oil or varied nuts and seeds, in comparison with another fat-limited diet recommended by the American Heart Association.¹⁷

- The **DASH diet**, discussed in the 2020 recommendations of the American Diabetes Association,¹ emphasises the consumption of fruits, vegetables, non-fat dairy products, whole grain products, poultry, fish and nuts and seeds. The recommendations also include reducing the intake of saturated fat, red meat, sugar and sugar-sweetened drinks, as well as reducing sodium. However, only 1 short-term (8 weeks) study,¹⁸ randomised and controlled, of those that the American Diabetes Association mentions, is carried out on patients with DM2; it shows a significant improvement in weight, basal blood glucose, blood pressure, cholesterol associated with high- and low-density lipoproteins and HbA_{1c}. A systematic review and meta-analysis of prospective cohort studies that included individuals with DM2 showed that following the DASH diet was associated with a reduction in cardiovascular events.¹⁹
- The model of **vegetarian diet** includes the lacto-ovo-vegetarian, lacto-vegetarian, ovo-vegetarian and vegan diets. Observational studies find lower prevalence of DM2 in vegetarian subjects than in the general population, while intervention studies on people with DM2 observe that vegetarian diets lead to a greater reduction in weight, basal blood glucose and HbA_{1c} and better lipid control than a conventional hypocaloric diet, with less need for antidiabetic medicines.²⁰ Another systematic review of controlled randomised studies shows that vegetarian and vegan diets improve HbA_{1c} and basal blood glucose in DM2.²¹

Carbohydrate distribution for treatment of diabetes

The studies that have attempted to determine the effects of meal frequency on health do not offer conclusive evidence, independently of energy and nutrient intake.²² However, other more recent studies would be in agreement with reducing intake frequency.

In a randomised, crossover study in patients with DM2 treated with oral glucose-lowering medication, distributing the food into 2 bigger meals a day (breakfast and supper) offers benefits in terms of weight and blood glucose control compared with distributing the food into 6 daily meals.²³ Focusing on people with DM2 treated with insulin in a non-defined regime, Jakubowicz et al.,²⁴ in their randomised study comparing the use of a 3-meal and 6-meal isocaloric diets, show that the diet with 3 meals/day offers benefits in weight loss, lowered HbA_{1c} and glycaemia in general, and also in reduced appetite and insulin need.

Based on the evidence available, we consider that the distribution of the CHs should depend on the type of glucose-lowering pharmacological treatment, the glycaemic profile and the patient's habits and, after that, on adjustments arising from the results of blood glucose control monitoring. In [Table 1](#), an example of meal distribution depending on DM2 treatment is proposed.²⁵

[Fig. 1](#) shows the distribution of the CHs throughout the day, according to the guidelines and the profile of insulin action. [Table 2](#) presents recommendations about dietary treatment of prediabetes and DM2, with the level of evidence on which they are based.

Foods in the prevention and treatment of prediabetes and type 2 diabetes

[Table 3](#) presents a summary of the recommendations for the intake of different foods in the prevention and treatment of prediabetes and DM2, with the level of evidence existing for them.

Adhering to the diet: implementing strategies to improve adherence

Dietary adherence of individuals with DM2 is very low. In general, just as for pharmacological treatment, the factors that contribute most to the lack of adherence are the lack of education about health, the perception of the illness itself, the complexity of the treatment, economic limitations, psychological factors and the lack of social support. In [Table 4](#), we summarise the main factors that make following a diet difficult for people with DM2.

There are 2 types of interventions that permit greater dietary adherence among individuals with DM2⁷²: ones in which the health professionals take the cultural beliefs, the family and the social environment of the patient into consideration, and multifactor interventions that include various elements related to knowledge and perception of the illness and the diet, along with support and follow-up. [Table 5](#) presents the strategies that must be considered to improve dietary adherence and the level of evidence on which they are grounded.^{1,7,26}

The future of foods. Conclusions

There is currently solid evidence that eating patterns based on vegetables (fundamentally the Mediterranean diet, the vegan–vegetarian diet, the DASH diet and the low-CH diet) constitute the substantive basis for treatments to improve control of risk factors and to reduce the elevated cardiovascular morbidity and mortality of individuals with prediabetes or DM2.

Over the last few years, there have been proposals considering the urgent need to transform the food system, adopting a new model that, in addition to the traditional concept, would be healthy for the human population and

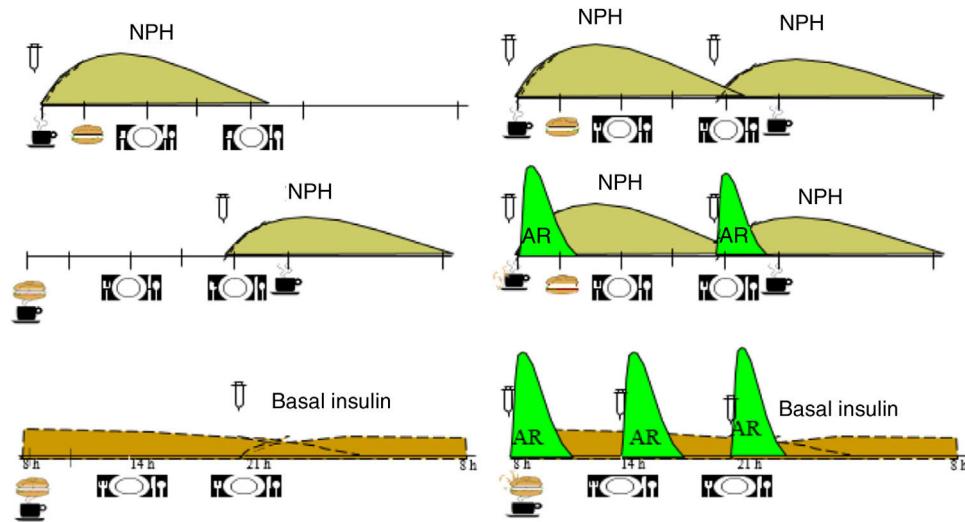


Figure 1 Carbohydrate distribution over 24h based on the guideline and insulin action profile. Basal insulin: glargine U100, glargine U300, degludec, detemir; NPH: neutral protamine Hagedorn; RA: rapid-acting insulin analogue.

Table 2 Dietary treatment of prediabetes and type 2 diabetes. Recommendations.

1. For individuals with prediabetes or with DM2 and obesity or overweight, a nutritionally balanced low-calorie diet is recommended to keep a lower, healthier weight (**strong evidence**)
2. Dietary models to consider for patients with DM2, in agreement with their preferences:
 - a. The Mediterranean diet para to reduce cardiovascular events (**strong evidence**) and improve blood glucose control (**moderate evidence**)
 - b. The DASH diet to improve blood glucose control (**weak evidence**), blood pressure in patients with diabetes (**weak evidence**) and LDL cholesterol (**moderate evidence**), and reduce cardiovascular events (**moderate evidence**)
 - c. The vegan or vegetarian diet to improve blood glucose control (**moderate evidence**), weight (**weak evidence**) and lipid profile, including LDL cholesterol (**moderate evidence**), and reduce the risk of myocardial infarction (**moderate evidence**)
3. People with DM2 should keep regular mealtime hours and time between meals to optimise blood glucose control (**weak evidence**)
4. In individuals with DM2 who use fixed insulin dosages, a constant pattern of CH intake with respect to meal schedules and amounts (adapted to the insulin action profile) can improve glycaemia and reduce the risk of hypoglycaemia (**moderate evidence**)

also for the planet itself. Willet et al., in line with the recommendations from many corporations and backed scientifically by the *Lancet Commission*, have proposed a model of «healthy planetary eating» capable of conserving the planetary ecosystem and reducing non-transmissible diseases, with DM2 among them.³⁴ Such a diet would be flexi-vegetarian, based on foods of vegetable origin, with fruits, varied vegetables, legumes, whole grains, nuts and seeds and only small amounts of animal protein. Red meat and its derivatives contribute considerably to global warming, land overuse and water consumption. Likewise, ultra-processed foods (whether meat-based or not) and almost all precooked foods contain products such as added sugar or trans fats

and they have to be kept from our diet. For that reason, they must be avoided, and the consumption of foods rich in vegetable proteins must be increased.

The contribution of foods to global warming depends as much on their production as their transportation. Consequently, we must eat local foods that are in season, avoiding ones from farther away. Your lifestyle (which includes regular, maintained physical activity and a diet that follows recommended guidelines) constitutes the main therapeutic tool that there is for improving the control of blood glucose, lipids and blood pressure and reducing the elevated cardiovascular morbidity and mortality in people with prediabetes and DM2.

Table 3 Food recommendations in the prevention and treatment of prediabetes and type 2 diabetes.**Edible fats**

Substitute unsaturated fat food sources for saturated fats to improve the lipid profile, blood glucose control and insulin resistance²⁶

Moderate evidence

The Mediterranean dietary regimen shows that it can reduce basal and postprandial glycaemia, improve metabolic control and body weight, as well as prevent cardiovascular disease^{27,28}

Moderate evidence

The most recommendable fat for salad dressing and cooking purposes is virgin olive oil^{13,17}

Moderate evidence

At high temperatures, soybean, corn and sunflower oils undergo oxidative phenomena, producing free radicals and other pro-inflammatory molecules, so they should not be used for frying foods²⁹

Weak evidence**Meats**

Eating meat (no more than 4 servings a week) does not appear to be prejudicial for CVR and DM2.^{30–33} However, to improve dietary sustainability, it is a good idea for the world population to reduce consumption of meat and increase that of vegetables.³⁴ It is better to choose lean pieces and remove the skin and visible fat before cooking

Weak evidence

Eating processed meat is linked to the risk of cardiovascular events, colorectal cancer, DM2 and mortality from any cause.^{30–33} Consumption of sausages and other processed meats is not recommended

Moderate evidence**Eggs**

Consuming eggs is not prejudicial and can be part of a healthy diet. There do not seem to be sufficient grounds to restrict their consumption in order to reduce CVR or improve metabolic control.^{35–38} However, some series limit their intake to a maximum of 3 eggs a week¹³

Weak evidence**Fish**

Greater consumption of fish has positive cardiovascular effects. Eating fish or shellfish at least 3 times a week is recommendable (2 of these consumptions should be in the form of oily fish such as salmon and trout)^{39,40}

Moderate evidence**Dairy products**

Consumption of cheese is not linked with increased CVR^{41,42}

Moderate evidence

Consumption of dairy products shows a reduction of the risk of DM2,^{43–45} especially yogurt^{41,46}

Moderate evidence

Consuming dairy products, no matter their fat content, does not increase CVR.^{41,42} It does not seem appropriate to limit the consumption of full-fat dairy products in order to reduce the incidence of DM2 or cardiovascular events. Consuming at least 2 daily servings of whole or skimmed dairy products is recommendable, although the intake of dairy products with added sugar is not recommended. If reducing the calorie content of the diet is a goal, low-fat or non-fat dairy products should be chosen preferentially

Moderate evidence**Grains**

The consumption of whole grains reduces the risk of DM2 and of cardiovascular mortality.^{47–49} Consuming whole grains instead of refined grains is recommended

Moderate evidence

Eating white or brown rice is not associated with higher CVR^{50,51} or with an increased risk of DM2, although it is linked to a greater risk of metabolic syndrome⁵¹

Weak evidence**Legumes**

In the context of the Mediterranean diet, greater intake of legumes (especially lentils) seems to be associated with a lower risk of DM2⁵²

Weak evidence

Eating legumes is associated with a lower total CVR and ischemic cardiopathology risk.⁵³ Eating a serving of legumes at least 4 times a week is recommended¹³

Table 3 (Continued)

Moderate evidence*Root vegetables*

Moderate consumption of root vegetables, from 2 to 4 servings a week (preferably baked or boiled), is recommended; the intake of commercially-processed potatoes or those with added salt should be limited to very occasional servings.¹³ Daily consumption of potatoes (especially if they are fried) may cause an increased risk of DM2^{54,55}

Moderate evidence*Nuts and seeds*

Eating nuts and seeds in moderate amounts (30 g/day) has been associated with lower cardiovascular mortality and morbidity.^{17,56} In people with DM2, regular intake of nuts and seeds reduces the risk of cardiovascular mortality and total mortality⁵⁷

Habitual intake of nuts and seeds can be recommended for the general population and for people with hypercholesterolemia or high blood pressure, obesity and/or DM2.¹³ Eating a handful of raw nuts or seeds (equivalent to approximately 30 g) frequently (every day or at least 3 times a week) is recommended, although they should not be salted

Strong evidence*Fruits y vegetables*

Consuming more fruits and vegetables is a habit that helps to prevent cardiovascular events⁵⁸

Eating at least 5 servings a day of vegetables and fruits is recommended. Intake should be varied, avoiding preparations that contain added sugars or fats

Moderate evidence*Chocolate and cocoa*

Eating dark chocolate with $\geq 70\%$ cocoa is associated with a reduced risk of myocardial infarction, stroke, DM2 and mortality from cardiovascular events^{59,60}

The majority of the products derived from cocoa that are found on the market have sugar and other fats added, and are not recommended

Dark chocolate with $\geq 70\%$ cocoa can be consumed in moderate amounts (up to 30 g/day)

Weak evidence*Processed foods*

Eating ultra-processed foods is associated with a greater risk of DM2, total cardiovascular, coronary and cerebrovascular disease, and mortality from any cause⁶¹⁻⁶³

The intake of ultra-processed foods in the diet should be avoided. Instead, consumption of fresh food products (unprocessed or minimally processed) should be encouraged

Moderate evidence*Salt*

The intake of excess sodium is associated with the presence of chronic renal disease, obesity, high blood pressure and cardiovascular mortality⁶⁴

The consumption of up to 2.3 g a day of sodium is recommended.⁶ An alternative to salt is lemon juice, herbs, spices or garlic for use in cooking. It is necessary to limit the intake of precooked foods, tinned foods, cured or salted products, carbonated drinks, sausages and deli meats, which all normally have a high sodium content

Moderate evidence*Coffee y tea*

Regular consumption of up to 5 cups a day of coffee (filtered or instant, normal or decaffeinated) or tea (green or black) is beneficial for cardiovascular health^{65,66} and the consumption of coffee is inversely associated with the risk of DM2⁶⁷

The intake of coffee or tea with added sugar has to be limited as much as possible

Moderate evidence*Alcoholic drinks*

In comparison with abstinence or excessive consumption of alcoholic drinks, moderate intake is associated with a reduction of CVR and of DM2^{68,69}

Moderate evidence

The maximum acceptable intake is up to 1 fermented drink a day for women and up to 2 for men (with the unit being equivalent to a 330-ml beer or a 150-ml glass of wine)¹

Weak evidence

Drinking alcohol should not be encouraged in people who do not normally drink, and any consumption is prohibited for people who present a history of illnesses that contraindicate alcohol intake (liver disease, hypertriglyceridemia, history of addictions, etc.)⁷⁰

Table 3 (Continued)

Moderate evidence*Beverages with added sugar and artificial sweeteners*

Frequent intake of beverages with added sugar is associated with an increase in the risk of obesity, metabolic syndrome, prediabetes and DM2⁷¹

Strong evidence

Substituting water or sugarless herb tea for beverages with added sugar reduces energy consumption and the risk of obesity, metabolic syndrome, prediabetes and DM2^{1,13,70}

Moderate evidence*Herbal, vitamin or mineral supplements*

There is insufficient evidence for recommending the use of herbal, vitamin or mineral supplements by patients with DM2 that have no associated deficit⁶

Weak evidence**Table 4** Factors that make it more difficult to follow a diet.*Related with diet design and prescription*

Using recommendations whose usefulness has not be established; for example, glycaemic indexes, diets «in fashion», etc.
Using standard diets that are strict, monotonous and not adapted to the patient's characteristics
Proposing unrealistic objectives
Neglecting to implicate the patient in designing the diet and not including individual preferences

Related with the health professionals

Prescribing by professionals that are not involved or connected with the diabetes team
Having a lack of knowledge and, above all, convictions about the importance and the feasibility of the diet
Giving insufficient instructions to the patient about the importance, goals and management of the diet

Related with the patient and the social environment (emotional aspects)

Having a habit of using food to face problems
Resisting temptations in relation to social engagements and special meals
Finding it hard to control amounts and ingredients
Lacking the desire to follow the diet
Feeling unable to eat in the same way as people who do not have diabetes
Being tempted to abandon the diet temporarily (taking a vacation)
Putting other aspects that the patient considers of higher priority above the diet
Feeling a lack of support/understanding from the family and friends
Having a lack of information

Table 5 Strategies to improve adherence to the diet.*Steps to improve diet design and prescription (weak evidence)*

Simplify the diet. Consider only firmly-established recommendations in order to avoid confusion and contradictions between different prescriptions
Design the diet individually, based on the characteristics of the patient, of the diabetes and its treatment and on the capabilities and possibilities of the patient
Make a formal prescription, similar to the pharmacological treatment and integrated with the rest of the therapeutic measures
Select the dietary system or model to transmit the recommendations based on the patient's characteristics, learning skills, diabetes treatment, clinical objectives, etc.

Nutritional education (strong evidence)

The process of patient education has to be personalised and carried out (at least partially) individually by the nursing staff diabetes educator or the by a dietitian trained in diabetes treatment and integrated into the team
The implementation should be handled in 3–6 sessions over the first 6 months; after that, assess the need for additional sessions

Table 5 (Continued)

Behavioural strategies (weak evidence)

- Demonstrate conviction to the patient about the importance of the diet. Do not disparage the diet with respect to the other therapeutic measures, and ask about the patient's eating habits in each visit
- Set accessible short-range objectives, which are flexible and have great possibilities of being achieved
- Avoid talking about failure and concentrate on what can be done to achieve the objectives
- Value changes in dietary habits, even though glycaemic control, body weight or lipid concentration has not been modified to the expected extent
- Praise the patient for having reached the desired objectives or, simply, having made favourable changes
- Evaluate any possible obstacles to following the diet and get the patient's commitment to look for solutions and resolve the problem
- Encourage participation by the patient's partner and relatives, especially those who prepare the meals

Permanent evaluation and counselling (weak evidence)

- Nutritional therapy in DM2 is a continuing process that requires periodic evaluation and support
- In the follow-up, evaluate the patient's adherence to the recommendations and the need to adapt them to changes in the diabetes or in the patient's life

Funding

None.

Conflict of interests

The authors declare that they have no conflicts of interest with respect to the content of this work.

References

1. American Diabetes Association. 5. Facilitating behavior change and well-being to improve health outcomes: standards of medical care in diabetes—2020. *Diabetes Care*. 2020;43 Suppl 1:S48–65.
2. Rinaldi S, Campbell EE, Fournier J, O'Connor C, Madill J. A comprehensive review of the literature supporting recommendations from the Canadian Diabetes Association for the use of a plant-based diet for management of type 2 diabetes. *Can J Diabetes*. 2016;40:471–7.
3. Boucher JL. Mediterranean eating pattern. *Diabetes Spectr*. 2017;30:72–6.
4. Huntriss R, Campbell M, Bedwell C. The interpretation and effect of a low-carbohydrate diet in the management of type 2 diabetes: a systematic review and meta-analysis of randomised controlled trials. *Eur J Clin Nutr*. 2018;72:311–25.
5. Pawlak R. Vegetarian diets in the prevention and management of diabetes and its complications. *Diabetes Spectr*. 2017;30:82–8.
6. Evert AB, Dennison M, Gardner CD, Garvey WT, Lau KHK, MacLeod J, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. *Diabetes Care*. 2019;42:731–54.
7. Briggs Early K, Stanley K. Position of the Academy of Nutrition and Dietetics: the role of medical nutrition therapy and registered dietitian nutritionists in the prevention and treatment of prediabetes and type 2 diabetes. *J Acad Nutr Diet*. 2018;118:343–53.
8. Franz MJ, MacLeod J, Evert A, Brown C, Gradwell E, Handu D, et al. Academy of Nutrition and Dietetics nutrition practice guideline for type 1 and type 2 diabetes in adults: systematic review of evidence for medical nutrition therapy effectiveness and recommendations for integration into the nutrition care process. *J Acad Nutr Diet*. 2017;117:1659–79.
9. Tuomilehto J, Lindström J, Eriksson JG, Valle TT, Hämäläinen H, Ilanne-Parikka P, et al. Finnish Diabetes Prevention Study Group. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med*. 2001;344:1343–50.
10. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346:393–403.
11. Franz MJ, Boucher JL, Rutten-Ramos S, VanWormer JJ. Lifestyle weight-loss intervention outcomes in overweight and obese adults with type 2 diabetes: a systematic review and meta-analysis of randomized clinical trials. *J Acad Nutr Diet*. 2015;115:1447–63.
12. Lean ME, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, et al. Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. *Lancet*. 2018;391:541–51.
13. Pérez-Jiménez F, Pascual V, Meco JF, Pérez-Martínez P, Delgado Lista J, Domenech M, et al. Documento de recomendaciones de la SEA 2018. El estilo de vida en la prevención cardiovascular. *Clin Invest Arterioscler*. 2018;30:280–310.
14. Hallberg SJ, Dockter NE, Kushner JA, Athinarayanan SJ. Improving the scientific rigour of nutritional recommendations for adults with type 2 diabetes: a comprehensive review of the American Diabetes Association guideline-recommended eating patterns. *Diabetes Obes Metab*. 2019;21:1769–79.
15. Elhayany A, Lustman A, Abel R, Attal-Singer J, Vinker S. A low carbohydrate Mediterranean diet improves cardiovascular risk factors and diabetes control among overweight patients with type 2 diabetes mellitus: a 1-year prospective randomized intervention study. *Diabetes Obes Metab*. 2010;12:204–9.
16. Van Zuuren EJ, Fedorowicz Z, Kuijpers T, Pijl H. Effects of low-carbohydrate- compared with low-fat-diet interventions on metabolic control in people with type 2 diabetes: a systematic review including GRADE assessments. *Am J Clin Nutr*. 2018;108:300–31.
17. Estruch R, Ros E, Salas-Salvadó J, Covas MI, Corella D, Arós F, et al. Primary prevention of cardiovascular disease with a Mediterranean diet supplemented with extra-virgin olive oil or nuts. *N Engl J Med*. 2018;378:e34.

18. Azadbakht L, Fard NR, Karimi M, Baghaei MH, Surkan PJ, Rahimi M, et al. Effects of the Dietary Approaches to Stop Hypertension (DASH) eating plan on cardiovascular risks among type 2 diabetic patients: a randomized crossover clinical trial. *Diabetes Care*. 2011;34:55–7.
19. Schwingshackl L, Bogensberger B, Hoffmann G. Diet quality as assessed by the Healthy Eating Index, alternate Healthy Eating Index, Dietary Approaches to Stop Hypertension score, and health outcomes: an updated systematic review and meta-analysis of cohort studies. *J Acad Nutr Diet*. 2018;118, 74–100.e11.
20. Kahleova H, Pelikanova T. Vegetarian diets in the prevention and treatment of type 2 diabetes. *J Am Coll Nutr*. 2015;34:448–58.
21. Viglioniouk E, Kendall CW, Kahleová H, Rahelić D, Salas-Salvadó J, Choo VL, et al. Effect of vegetarian dietary patterns on cardiometabolic risk factors in diabetes: a systematic review and meta-analysis of randomized controlled trials. *Clin Nutr*. 2019;38:1133–45.
22. Mattson MP. The need for controlled studies of the effects of meal frequency on health. *Lancet*. 2005;365:1978–80.
23. Kahleova H, Belinova L, Malinska H, Oliyarnyk O, Trnovska J, Skop V, et al. Eating two larger meals a day (breakfast and lunch) is more effective than six smaller meals in a reduced-energy regimen for patients with type 2 diabetes: a randomised crossover study. *Diabetologia*. 2014;57:1552–60.
24. Jakubowicz D, Landau Z, Tsameret S, Wainstein J, Raz I, Ahren B, et al. Reduction in glycated hemoglobin and daily insulin dose alongside circadian clock upregulation in patients with type 2 diabetes consuming a three-meal diet: a randomized clinical trial. *Diabetes Care*. 2019;42:2171–80.
25. Pérez A, Caixàs A, Couto Y. Dieta en la diabetes. In: Salas-Salvadó J, Bonada A, Trallero R, Saló ME, Burgos R, editors. *Nutrición y dietética clínica*. Barcelona: Elsevier Masson; 2019. p. 267–89.
26. Imamura F, Micha R, Wu JH, de Oliveira Otto MC, Otite FO, Abioye AI, et al. Effects of saturated fat, polyunsaturated fat, monounsaturated fat, and carbohydrate on glucose-insulin homeostasis: a systematic review and meta-analysis of randomised controlled feeding trials. *PLoS Med*. 2016;13:e1002087.
27. Huo R, Du T, Xu Y, Xu W, Chen X, Sun K, et al. Effects of Mediterranean-style diet on glycemic control, weightloss and cardiovascular risk factors among type 2 diabetes individuals: a meta-analysis. *Eur J Clin Nutr*. 2015;69:1200–8.
28. Becerra-Tomas N, Blanco Mejia S, Viglioniouk E, Khan T, Kendall CWC, Kahleova H, et al. Mediterranean diet, cardiovascular disease and mortality in diabetes: a systematic review and meta-analysis of prospective cohort studies and randomized clinical trials. *Crit Rev Food Sci Nutr*. 2020;60:1207–27.
29. Dobarganes C, Márquez-Ruiz G. Possible adverse effects of frying with vegetable oils. *Br J Nutr*. 2015;113 Suppl 2:S49–57.
30. Micha R, Wallace SK, Mozaffarian D. Red and processed meat consumption and risk of incident coronary heart disease, stroke, and diabetes mellitus: a systematic review and meta-analysis. *Circulation*. 2010;121:2271–83.
31. Rohrmann S, Overvad K, Bueno de Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality—results from the European Prospective Investigation into Cancer and Nutrition. *BMC Med*. 2013;11:63.
32. Wang X, Lin X, Ouyang YY, Liu J, Zhao G, Pan A, et al. Red and processed meat consumption and mortality: dose–response meta-analysis of prospective cohort studies. *Public Health Nutr*. 2016;19:893–905.
33. Fretts AM, Howard BV, McKnight B, Duncan GE, Beresford SA, Mete M, et al. Associations of processed meat and unprocessed red meat intake with incident diabetes: The Strong Heart Family Study. *Am J Clin Nutr*. 2012;95:752–8.
34. Willett W, Rockstrom J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *Lancet*. 2019;393:447–92.
35. Blesso CN, Fernandez ML. Dietary cholesterol, serum lipids, and heart disease: are eggs working for or against You? *Nutrients*. 2018;10:426.
36. Fuller NR, Caterson ID, Sainsbury A, Denyer G, Fong M, Gerofi J, et al. The effect of a high-egg diet on cardiovascular risk factors in people with type 2 diabetes: The Diabetes and Egg (DIABEGG) study—a 3-mo randomized controlled trial. *Am J Clin Nutr*. 2015;101:705–13.
37. Díez-Espino J, Basterra-Gortari FJ, Salas-Salvadó J, Buil-Cosiales P, Corella D, Schröder H, et al. Egg consumption and cardiovascular disease according to diabetic status: The PREDIMED study. *Clin Nutr*. 2017;36:1015–21.
38. Djoussé L, Khawaja OA, Gaziano JM. Egg consumption and risk of type 2 diabetes: a meta-analysis of prospective studies. *Am J Clin Nutr*. 2016;103:474–80.
39. Rimm EB, Appel LJ, Chiuve SE, Djoussé L, Engler MB, Kris-Etherton PM, et al. American Heart Association Nutrition Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Epidemiology and Prevention; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology Seafood long-chain n-3 polyunsaturated fatty acids and cardiovascular disease: a science advisory from the American Heart Association. *Circulation*. 2018;138:e35–47.
40. Deng A, Pattanaik S, Bhattacharya A, Yin J, Ross L, Liu C, et al. Fish consumption is associated with a decreased risk of death among adults with diabetes: 18-year follow-up of a national cohort. *Nutr Metab Cardiovasc Dis*. 2018;28:1012–20.
41. Drouin-Chartier JP, Brassard D, Tessier-Grenier M, Côté JA, Labonté ME, Desroches S, et al. Systematic review of the association between dairy product consumption and risk of cardiovascular-related clinical outcomes. *Adv Nutr*. 2016;7:1026–40.
42. Alexander DD, Bylsma LC, Vargas AJ, Cohen SS, Doucette A, Mohamed M, et al. Dairy consumption and CVD: a systematic review and meta-analysis. *Br J Nutr*. 2016;115:737–50.
43. Aune D, Norat T, Romundstad P, Vatten LJ. Dairy products and the risk of type 2 diabetes: a systematic review and dose–response meta-analysis of cohort studies. *Am J Clin Nutr*. 2013;98:1066–83.
44. Gijsbers L, Ding EL, Malik VS, de Goede J, Geleijnse JM, Soedamah-Muthu SS. Consumption of dairy foods and diabetes incidence: a dose–response meta-analysis of observational studies. *Am J Clin Nutr*. 2016;103:1111–24.
45. Alvarez-Bueno C, Cervero-Redondo I, Martínez-Vizcaino V, Sotos-Prieto M, Ruiz JR, Gil A. Effects of milk and dairy product consumption on type 2 diabetes: overview of systematic reviews and meta-analyses. *Adv Nutr*. 2019;10 Suppl 2:S154–63.
46. Salas-Salvadó J, Guasch-Ferré M, Díaz-López A, Babio N. Yogurt and diabetes: overview of recent observational studies. *J Nutr*. 2017;147:1452S–61S.
47. Zhang B, Zhao Q, Guo W, Bao W, Wang X. Association of whole grain intake with all-cause, cardiovascular, and cancer mortality: a systematic review and dose-response meta-analysis from prospective cohort studies. *Eur J Clin Nutr*. 2018;72:57–65.
48. Kyrø C, Tjønneland A, Overvad K, Olsen A, Landberg R. Higher whole-grain intake is associated with lower risk of type 2 diabetes among middle-aged men and women: The Danish Diet, Cancer, and Health Cohort. *J Nutr*. 2018;148:1434–44.
49. Chanson-Rolle A, Meynier A, Aubin F, Lappi J, Poutanen K, Vinoy S, et al. Systematic review and meta-analysis of human studies to support a quantitative recommendation for whole grain intake in relation to type 2 diabetes. *PLoS One*. 2015;10:e0131377.
50. Muraki I, Wu H, Imamura F, Laden F, Rimm EB, Hu FB, et al. Rice consumption and risk of cardiovascular disease: results

- from a pooled analysis of 3 U.S. cohorts. *Am J Clin Nutr*. 2015;101:164–72.
51. Krittanawong C, Tunhasirwet A, Zhang H, Prokop LJ, Chirapongsathorn S, Sun T, et al. Is white rice consumption a risk for metabolic and cardiovascular outcomes? A systematic review and meta-analysis. *Heart Asia*. 2017;9:e010909.
52. Becerra-Tomás N, Díaz-López A, Rosique-Esteban N, Ros E, Buil-Cosiales P, Corella D, et al. PREDIMED Study Investigators Legume consumption is inversely associated with type 2 diabetes incidence in adults: a prospective assessment from the PREDIMED study. *Clin Nutr*. 2018;37:906–13.
53. Marventano S, Izquierdo Pulido M, Sánchez-González C, Godos J, Speciani A, Galvano F, et al. Legume consumption and CVD risk: a systematic review and meta-analysis. *Public Health Nutr*. 2017;20:245–54.
54. Bidel Z, Teymoori F, Davari SJ, Nazarzadeh M. Potato consumption and risk of type 2 diabetes: a dose–response meta-analysis of cohort studies. *Clin Nutr ESPEN*. 2018;27:86–91.
55. Borch D, Juul-Hindsgaul N, Veller M, Astrup A, Jaskolowski J, Raben A. Potatoes and risk of obesity, type 2 diabetes, and cardiovascular disease in apparently healthy adults: a systematic review of clinical intervention and observational studies. *Am J Clin Nutr*. 2016;104:489–98.
56. Becerra-Tomás N, Paz-Graniel I, Kendall C, Kahleova H, Rahelić D, Sievenpiper JL, et al. Nut consumption and incidence of cardiovascular diseases and cardiovascular disease mortality: a meta-analysis of prospective cohort studies. *Nutr Rev*. 2019;77:691–709.
57. Liu G, Guasch-Ferré M, Hu Y, Li Y, Hu F, Rimm E, et al. Nut consumption in relation to cardiovascular disease incidence and mortality among patients with diabetes mellitus. *Circ Res*. 2019;124:920–9.
58. Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all cause mortality—a systematic review and dose response meta-analysis of prospective studies. *Int J Epidemiol*. 2017;46:1029–56.
59. Morze J, Schwedhelm C, Bencic A, Hoffmann G, Boeing H, Przybyłowicz K, et al. Chocolate and risk of chronic disease: a systematic review and dose-response meta-analysis. *Eur J Nutr*. 2020;59:389–97.
60. Yuan S, Li X, Jin Y, Lu J. Chocolate consumption and risk of coronary heart disease, stroke, and diabetes: a meta-analysis of prospective studies. *Nutrients*. 2017;9:688.
61. Srouf B, Fezeu LK, Kesse-Guyot E, Allès B, Méjean C, Andrianasolo RM, et al. Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study (NutriNet-Santé). *BMJ*. 2019;365:l1451.
62. Schnabel L, Kesse-Guyot E, Allès B, Touvier M, Srouf B, Hercberg S, et al. Association between ultraprocessed food consumption and risk of mortality among middle-aged adults in France. *JAMA Intern Med*. 2019;179:490–8.
63. Srouf B, Fezeu LK, Kesse-Guyot E, Allès B, Méjean C, Andrianasolo RM, et al. Ultraprocessed food consumption and risk of type 2 diabetes among participants of the NutriNet-Santé prospective cohort. *JAMA Intern Med*. 2020;180:283–91.
64. O'Donnell M, Mann JF, Schutte AE, Staessen JA, Lopez-Jaramillo P, Thomas M, et al. Dietary sodium and cardiovascular disease risk. *N Engl J Med*. 2016;375:2404–6.
65. Kim Y, Je Y, Giovannucci E. Coffee consumption and all-cause and cause-specific mortality: a meta-analysis by potential modifiers. *Eur J Epidemiol*. 2019;34:731–52.
66. Zhang C, Qin YY, Wei X, Yu FF, Zhou YH, He J. Tea consumption and risk of cardiovascular outcomes and total mortality: a systematic review and meta-analysis of prospective observational studies. *Eur J Epidemiol*. 2015;30:103–13.
67. Carlström M, Larsson SC. Coffee consumption and reduced risk of developing type 2 diabetes: a systematic review with meta-analysis. *Nutr Rev*. 2018;76:395–417.
68. Xi B, Veeranki SP, Zhao M, Ma C, Yan Y, Mi J. Relationship of alcohol consumption to all-cause cardiovascular, and cancer-related mortality in U.S. adults. *J Am Coll Cardiol*. 2017;70:913–22.
69. Polsky S, Akturk HK. Alcohol consumption diabetes risk, and cardiovascular disease within diabetes. *Curr Diab Rep*. 2017;17:136.
70. Pascual V, Pérez-Martínez P, Fernández JM, Solá R, Pallarés V, Romero-Secín A, et al. Documento de consenso SEA/SEMERGEN 2019. Recomendaciones dietéticas en la prevención cardiovascular. *Clin Investig Arterioscler*. 2019;31:186–201.
71. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: Systematic review and dose–response meta-analysis of prospective studies. *Br J Nutr*. 2014;112:725–34.
72. Gupta L, Khandelwal D, Lal PR, Gupta Y, Kalra S, Dutta D. Factors determining the success of therapeutic lifestyle interventions in diabetes — role of partner and family support. *Eur Endocrinol*. 2019;15:18–24.