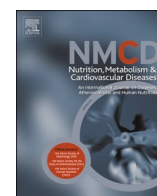




Contents lists available at ScienceDirect

Nutrition, Metabolism and Cardiovascular Diseases

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



Position Paper

Mediterranean diet: Why a new pyramid? An updated representation of the traditional Mediterranean diet by the Italian Society of Human Nutrition (SINU)

Francesco Sofi, Daniela Martini^{*}, Donato Angelino, Giulia Cairella, Angelo Campanozzi, Francesca Danesi, Monica Dinu, Daniela Erba, Licia Iacoviello, Nicoletta Pellegrini, Laura Rossi, Salvatore Vaccaro, Anna Tagliabue, Pasquale Strazzullo

Ad hoc Working Group of the Italian Society of Human Nutrition (SINU), Italy



ARTICLE INFO

Handling editor: Dr. A. Siani

Keywords:

Mediterranean diet
Food pyramid
Human health
Planet health
Sustainable healthy diet

ABSTRACT

In recent decades, an increasing body of research has highlighted significant scientific evidence linking adherence to the Mediterranean diet with a reduced risk of chronic diseases. Simultaneously, concerns about the environmental impact of the food system have intensified, particularly considering projected population growth in the coming years. This work introduces a new graphical representation of the traditional Mediterranean dietary model, developed by a dedicated Working Group of the Italian Society of Human Nutrition (SINU). This new model emphasizes plant-based foods, including fruits, vegetables, whole grains, legumes, and extra-virgin olive oil, at its foundation, reflecting their historical and scientific significance in the Mediterranean diet. Animal products, particularly red and processed meats, are de-emphasized, with dairy, white meats, and eggs recommended for moderate, weekly consumption. The pyramid also advocates limiting added sugars, salt, and alcohol to address their links with chronic diseases. Sustainability principles are woven into the framework, prioritizing local, seasonal, and minimally processed foods while discouraging food waste. The pyramid aligns with global recommendations from FAO and WHO, offering a comprehensive guide to adopting a healthy, sustainable dietary lifestyle while preserving cultural traditions and addressing contemporary nutritional and environmental challenges.

1. Introduction: reasons and criteria for a new SINU pyramid

The first graphical representation of the traditional Mediterranean dietary model, structured as a food pyramid, was presented in 1995 in a landmark article by Walter Willett and a few prestigious co-workers, among which the Italian scientist Anna Ferro-Luzzi, at the time Director of the National Institute of Nutrition [1]. Several modified graphical representations of the Mediterranean diet have been released over the last 30 years prompted by new scientific evidence in the nutritional area and by the growing concern about the contribution of agriculture and food production to the climate changes and, in general, to environmental damage [2–4].

Recently, a new version of the traditional Mediterranean diet pyramid has been produced by an *ad hoc* Working Group of the Italian

Society of Human Nutrition (SINU) as a tool for teaching activities and educational campaigns in favour of a healthy and sustainable diet aimed at the prevention of non-communicable chronic diseases (NCD) including metabolic, cardiovascular and neoplastic disorders (Fig. 1). The decision to undertake an updating of the previous versions of the pyramid was prompted by the impact of novel important scientific evidence concerning the relationship between Mediterranean diet and NCD as well as by the consideration of the FAO-WHO document on sustainable healthy diets and the article by the EAT–Lancet Commission on healthy diets from sustainable food systems [5,6]. These landmark documents stimulated a debate inside the Society on the need to emphasize to a greater extent the orientation towards a plant-based diet, to promote a reduction in the consumption of animal products and to integrate in the pyramid a few lacking messages concerning the contrast

^{*} Corresponding author. Division of Human Nutrition, Department of Food, Environmental and Nutritional Sciences (DeFENS), Università degli Studi di Milano, 20133, Milan, Italy.

E-mail address: daniela.martini@unimi.it (D. Martini).

<https://doi.org/10.1016/j.numecd.2025.103919>

Received 29 November 2024; Received in revised form 7 February 2025; Accepted 17 February 2025

Available online 21 February 2025

0939-4753/© 2025 The Authors. Published by Elsevier B.V. on behalf of The Italian Diabetes Society, the Italian Society for the Study of Atherosclerosis, the Italian Society of Human Nutrition and the Department of Clinical Medicine and Surgery, Federico II University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

to NCD. Two other official Italian documents carefully considered by the Working Group were the Dietary Guidelines for Healthy Eating delivered by the CREA-Food and Nutrition Research Centre [7] and the most recent V Revision of the Dietary Reference Values for the Italian population (LARN) [8].

The production of the pyramid was the result of a research work and an internal debate conducted independently by the *ad hoc* SINU Working Group with no financial support or any other form of sponsorship by either public or private institutions.

The present document is not intended to be a systematic review of the scientific evidence about Mediterranean diet or in general healthy diets but simply a guide to the interpretation of the changes introduced with respect to previous versions of the Mediterranean diet Pyramid.

1.1. The pyramid foundation: daily food choices

The base of the Pyramid is composed of two sections, both containing foods to be consumed on a daily basis. The bottom section includes fruits, vegetables and extra-virgin olive oil (EVOO). The choice of these foods as basic components of the Mediterranean diet is justified by two elements: i) their being the most typical foods of the traditional Mediterranean diet such as described by the pioneering work of Ancel Keys and co-workers [9], and ii) the bulk of convincing evidence of the benefit associated with their habitual consumption in even larger amounts than those reported by the analyses of food consumption carried out in Italy in recent years [10]. In essence, their position in the Pyramid aims at further promoting their consumption in the Italian population, in keeping with the efforts made by the health institutions and by the current National and Regional Prevention Plans [11].

The placement of EVOO in a central position among the bottom-line foods is due to: i) a recognition of olive oil as historical product of the agriculture of all the countries bordering the Mediterranean Sea and almost exclusive condiment of the soups and dishes typical of the Mediterranean populations [9], and ii) the consolidated evidence of its value for the prevention of cardiovascular disease [12,13]. While most

previous models of the pyramid refer to just “olive oil”, the Working group felt that the time has come to highlight the definitely higher impact provided by high-quality “extra-virgin” olive oil on human health, thus encouraging the efforts that more and more modern farmers spend in its production. Accordingly, the consumers are invited to pay careful attention to the choice of the oil to be used in the kitchen and at the table, giving preference to the quality of the product. Educational campaigns should focus on the decisive role for cardiovascular prevention of the anti-oxidant and anti-inflammatory substances contained in EVOO in much higher amounts compared with lower quality ordinary olive oil [14–23]. These considerations are also relevant to the ongoing debate on the choice of a front-of-pack labelling system for food products in Europe, where all the systems so far proposed by the health institutions and agencies of different countries restrict their assessment to the nutrient composition of the products while paying little or no attention to their quality, their content of bioactive substances and their degree of industrial transformation [24].

The upper section of the Pyramid foundation also contains foods to be consumed on a daily basis with a dominant position for wholegrain cereals as a main source of carbohydrates and energy. The consumption of this food group is hinged on the Mediterranean tradition of Southern Italy but in time has gained diffusion all over the country: pasta, rice and bread are essential components of a healthy diet and the new Pyramid emphasizes in particular the consumption of wholegrain cereals in consideration of their provision of dietary fibre, vitamins and bioactive compounds as well as of their beneficial metabolic effects in comparison with refined cereals, first of all, the lower post-prandial blood glucose response [25,26]. Advice is provided in favour of the combination of cereals with vegetables and/or legumes in keeping with ancient Mediterranean culinary traditions and with the large scientific evidence of the nutritional and metabolic benefits thereof [9,27].

The consumption of nuts but also dry fruits (figs and apricots in particular) is also typical of the Mediterranean dietary habits: indeed, bread and figs (fresh or dried, according to the season) have long been a staple food for Southern Italian field workers. The growing scientific



Fig. 1. SINU Mediterranean diet pyramid.

evidence of the beneficial properties of nuts and oilseeds [28] has led to their inclusion in the Guidelines for a healthy diet in numerous countries. The Italian Guidelines recommend the regular use of nuts in consideration of their content of polyunsaturated fatty acids, vitamins, minerals and bioactive substances albeit in moderation (30 g/day) taking into account their energy content [7]. In line with this recommendation, the SINU Working Group's opinion was that the evidence of benefit from regular consumption of this food group typical of the Mediterranean tradition justifies their placement at the foundation aside to cereals.

Special attention was given by the Working Group to the position of dairy products in the new Mediterranean diet Pyramid. From Ancel Keys' description of the Mediterranean diet practiced in Southern Italy by less affluent people in the 1950s it appears that the intake of milk, in particular cow's milk, was not very relevant whereas there was a higher consumption of cheese, in particular hard cheese like "caciocotta", made in general from a mixture of sheep's and goat's milk, also used grated on macaroni (<http://www.isa.cnr.it/prodtip/prodotti/ita/aacm.htm>), but also fresh cheese like ricotta or "mortedda", a fresh spun paste cheese made with cow's milk and preserved in sprigs of myrtle (<http://www.ilcilentano.it/mozzarella-nella-mortella-presidio-slow-food-cilentano>). The Italian Guidelines for healthy eating highlight however that in the average Italian diet cheese represents a major source of salt and saturated fats and recommend the regular consumption of partially skimmed milk and yogurt [7]. They also remind us that some of the saturated fatty acids present in milk and derivatives (those with short or odd chain) do not significantly impact serum cholesterol levels. The presence of lactose in milk promotes the intestinal absorption of calcium and therefore the same Guidelines advise against the use of lactose-free milk unless in the presence of clinically documented severe lactose intolerance. Based on these indications and the overall current scientific evidence, milk and yogurt were assigned a position in the new Pyramid aside to cereals and nuts and recommended for daily consumption whereas cheese was positioned in the central part of the Pyramid for less frequent, weekly consumption, preference being given to fresh as compared with hard and highly seasoned cheese representing a relevant source of salt in the diet.

1.2. The middle tier: weekly food choices

The central part of the Pyramid is also composed of two sections including foods that are sources of plant or animal protein. The two sections correspond to the different advice related to the health promoting role of these food groups. The two major recommended protein sources, legumes and fish, are positioned in the lower section together with the already mentioned fresh dairy products (ricotta, mozzarella, etc.). Legumes are a highly typical Mediterranean food group, consumed either as such or in combination with pasta or vegetables in several traditional dishes of the Mediterranean area [9]. The EAT-Lancet Commission reported that, in controlled feeding studies, legumes reduced serum LDL-cholesterol concentrations as well as blood pressure levels and that, in prospective studies, their consumption was associated with a lower rate of coronary heart disease compared with red meat. A higher consumption of legumes as replacement of foods providing animal proteins is desirable not only for human health but also to reduce the environmental impact of food production [6]: the recommended frequency of consumption of 3–4 times a week reported in the Pyramid aims at ensuring the overall balance of the diet [9] accounting for the presence of all other protein sources, however a more frequent consumption has no substantial side effects.

Furthermore, the consumption of fish is part of the local tradition along the coastal areas of the Mediterranean countries, with larger consumption of fresh products in warm seasons and of preserved products over wintertime. Eating about 2 g/week of omega-3 fatty acids from fish sources may reduce the risk of death from heart disease by more than one third [6]: this amount can be achieved by consuming 150 g of

fatty fish two or three times a week. In the Mediterranean area preference should be given to small local fish ("blue fish") both for nutritional and environmental reasons. A high consumption of fish like tuna or swordfish, that can bioconcentrate mercury being high on the food chain, imposes a significant risk of neurological toxic effects [6]; in addition to that, at global and Mediterranean level, the overfishing of big predatory species is impacting the sea ecosystem by eroding the natural marine resources [29].

The upper section of the central part of the Pyramid includes, together with hard cheeses, other animal protein sources, i.e., white meats and eggs, and an alternative source of carbohydrates, i.e., potatoes.

Although, according to Ancel Keys, the consumption of meat in the traditional Mediterranean diet of Southern Italy was limited [9], its consumption has unfortunately progressively increased and become much more frequent with the improvement of the general economic condition: this includes both fresh and processed meat, the latter from pork and occasionally from wild boar. According to the EAT-Lancet Commission, the replacement of animal protein with protein from plant sources (i.e., legumes but also cereals) is associated with substantially lower mortality rates, a beneficial effect attributed mainly to the high saturated to polyunsaturated fatty acid ratio and the high levels of heat-induced carcinogens and haem iron of red meats [30–32]. Moreover, processed meats contain other elements such as sodium, nitrates, nitrites, etc., added as preservatives, that may further increase cancer risk [33,34]. By contrast, other animal protein rich foods consumed in adults have not been associated with any type of cancer [6]: this is the case of eggs, a source of high-quality proteins and other important nutrients. For long time the consumption of eggs has been an object of concern because of their relatively high cholesterol content, until more recently large prospective studies have shown that even the consumption of one egg a day was not actually associated with increased risk of heart disease, with the possible exception of diabetic patients [35]. It should also be pointed out that the monetary value of egg proteins is much lower compared with other types of high-quality proteins, making them particularly suitable in low-income conditions [36]. Based on these considerations, the consumption of white meats, in particular poultry, as well as eggs is recommended on a weekly basis together with the consumption of cheese, that needs to be considered as a main protein source in the meal rather than an additional course. By contrast, red meat and, in particular, processed meat, that nowadays is often proposed as *hors d'oeuvre* of a meal in Mediterranean countries, are allocated to the apex of the Pyramid and are intended for occasional consumption: this a major step forward in favour of a more definitely plant-based diet compared to previous versions of the Pyramid suggesting regular consumption of red/processed meats on a weekly basis.

In the new Mediterranean diet Pyramid potato consumption has been shifted from the foundation to the middle tier compared to previous versions, i.e., from a daily to a weekly consumption: this was motivated by consumers' behaviours and nutritional reasons. In fact, potatoes are more and more used as side dishes, often replacing vegetables source foods, rather than as the main carbohydrate source of the meal. In terms of nutritional effects, potato consumption on a daily basis has a significant impact on post-prandial glucose levels and risk of weight gain and type 2 diabetes compared with isocaloric amounts of wholemeal cereals [37]. Hence, potatoes cannot be considered an equivalent alternative to wholemeal pasta or rice as a source of energy and carbohydrates and their consumption as a side dish in the same meal with cereals should be avoided. Recommended behaviours are the consumption of potatoes in combination with a reduced portion of cereals or their consumption as a side dish in a meal not containing other quantitatively relevant sources of carbohydrates.

1.3. The apex of the pyramid: foods for occasional consumption

Together with red/processed meats, the top of the Pyramid is

occupied by all the products containing large amounts of added sugars (sweets, sugary beverages, biscuits, most snacks, candies, etc.). According to the LARN [8] and the Italian Guidelines for a healthy eating [7], in a well-balanced diet the content of total sugars should not exceed 15 % of the total energy content, corresponding to 75 g/day in a 2000 kcal diet. This amount is intended as the sum of both the sugars naturally contained in foods to be consumed every day (fruits, milk, vegetables) and those added during food processing at home or at the industrial level. Actually, accomplishing the recommendations for fruits, vegetables and milk consumption, the total intake of sugars would be not far from the threshold of 15 % of the total daily energy, leaving very little space for added sugars. In the Mediterranean tradition the consumption of sweets was generally limited to special occasions, even though dried fruits with high sugar content, e.g., dried figs or apricots, were relevant energy providers among manual hard field workers (e.g., agricultural practices).

1.4. Sugar, salt and alcohol: the less the better

A modern interpretation of healthy Mediterranean-like diet must carefully consider the excess of sugar, salt and alcohol intake, three factors too often disregarded although largely responsible for the onset of major non-communicable chronic diseases. This explains why, in the upper part of the figure, on the left-hand side of the Pyramid, it was decided to call attention on the need for maximum moderation in the use of these components. As a plant-based dietary model with prevalent use of unprocessed or minimally transformed natural foods, the Mediterranean diet should not be expected to involve a high salt intake. However, the time trend to eating more and more processed foods such as highly salted bread and other bakery products, hard cheese and processed meats, and the long-standing habit of adding too much salt while cooking and during meal consumption make the diet currently practiced by the Mediterranean people, including the Italian population and the young generations, definitely too high in salt [38,39]. This habit must be reverted by educating the consumers to reduce the level of “discretionary” salt (always choosing the iodized form) and to recognize the salt hidden in processed foods; moreover, salt benchmarks need to be defined for the food categories most relevant to population salt intake and their implementation should ideally be mandatory after consultation with food producers [40].

Another well recognized lifestyle weakness in the Mediterranean area is given by the drinking habits, characterized by a trend to excessive alcohol intake mainly in the form of red or white wine and less often beer. This popular habit, once more common among men but nowadays widespread also among women and with increasing reasons of worries among adolescents, is still nowadays mistakenly seen with favour for marketing reasons. Moderate drinking has also been endorsed by epidemiologists given the apparent protection provided by a moderate consumption of wine against coronary heart disease [41]. More recently, however, a bulk of scientific evidence has made clear that any possible benefit provided in terms of heart disease is overcome by the negative effects on the risk of cancer [42,43] and of other cardiovascular conditions such as atrial fibrillation [44]. According to WHO, “no safe amount of alcohol consumption for cancers and health can be established” [43]. For these reasons, the opinion of the SINU Working group is that, although a typical characteristic of the Mediterranean eating model, alcohol consumption cannot be recommended as habitual practice: nevertheless, wine and beer, having a lower alcohol content than other alcoholic drinks, are acceptable as products to be consumed consciously and in moderation in special occasions and during the meal, without considering them protective for health and avoiding consumption at empty stomach or high levels of intake on a single occasion. Similar considerations have been made for the use of coffee, ginseng and other beverages having neurotropic effects, whose consumption has been found to be safe and even beneficial for most healthy people [45] but requires caution in children, adolescents and older people as well as in

pregnant women, hypertensive patients, and subjects affected by anxiety and/or sleep disturbances [46].

1.5. Other considerations about lifestyle and environment

Some important aspects of a healthy and sustainable Mediterranean lifestyle are graphically reported in the space below the Pyramid: they include the need for adequate hydration preferably using the public water supply, the value of conviviality and regular physical activity for control of body weight and as health promoting practice, the preference to be given to fresh seasonal products in place of heavily transformed foods, the use of spices and aromatic herbs to flavor foods, the attention to avoid or reduce food waste as much as possible and to make food choices respectful of the nature biodiversity.

Sustainability of a diet according to the FAO/WHO documents [5] includes not only its healthiness for humans but also its impact on the environment and the climate, its compatibility with the local traditions and, last but not least, its economic and social accessibility for everyone. The Working Group believes that the modifications introduced in the Pyramid are compliant with these indications: we are aware that a few of these changes may meet resistance by touching vested interests and will require time to be fully implemented. The food industry, the small-medium enterprises and the public restoration system have the potential to accelerate this process in cooperation with food scientists and health institutions for the sake of our health and in the interest of the future generations.

2. Conclusion

The new Mediterranean diet Pyramid by SINU marks a significant evolution, grounded in cutting-edge scientific evidence and sustainability principles. At its foundation, this updated model places greater emphasis on plant-based foods, particularly fruits, vegetables, and extra-virgin olive oil, while promoting whole grains and legumes as primary sources of nutrients. It advocates for a measured approach to animal products, especially red and processed meats, reflecting a shift towards more sustainable dietary patterns. The Pyramid also underscores the importance of moderation in consuming added sugars, salt, and alcohol, integrating these recommendations seamlessly into its structure. By interweaving environmental and economic considerations, this revised pyramid offers a holistic guide to a modern Mediterranean diet. It not only aims to enhance population health but also preserves cultural food traditions while addressing the nutritional and ecological challenges of our time. In essence, this new Pyramid provides a practical and forward-thinking framework for adopting a sustainable and health-promoting dietary lifestyle in the 21st century.

References

- [1] Willett WC, Sacks F, Trichopoulos A, Drescher G, Ferro-Luzzi A, Helsing E, Trichopoulos D. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr* 1995;61(6 Suppl):1402S–6S.
- [2] Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulos A, Dernini S, et al. Mediterranean Diet Foundation Expert Group. Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr* 2011;14(12A):2274–84. <https://doi.org/10.1017/S1368980011002515>.
- [3] Ruini LF, Ciatì R, Pratesi CA, Marino M, Principato L, Vannuzzi E. Working toward healthy and sustainable diets: the “Double Pyramid Model” developed by the Barilla Center for Food and Nutrition to raise awareness about the environmental and nutritional impact of foods. *Front Nutr* 2015;2:9.
- [4] Serra-Majem L, Tomaino L, Dernini S, Berry EM, Lairon D, Ngo de la Cruz J, et al. Updating the Mediterranean Diet Pyramid towards sustainability: focus on environmental concerns. *Int J Environ Res Public Health* 2020;17(23):8758. <https://doi.org/10.3390/ijerph17238758>.
- [5] FAO and WHO. Sustainable healthy diets – guiding principles. 2019. Rome.
- [6] Willett W, Rockström 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.
- [7] Rossi L, Berni Canani S, Censi L, Gennaro L, Leclercq C, Scognamiglio U, et al. The 2018 revision of Italian dietary Guidelines: development process, novelties, main

- recommendations, and policy implications. *Front Nutr* 2022;9:861526. <https://doi.org/10.3389/fnut.2022.861526>.
- [8] SINU, Società Italiana di Nutrizione Umana. LARN - Livelli di Assunzione di Riferimento di Nutrienti ed energia per la popolazione italiana - V Revisione. Milano: Biomedica; 2024.
 - [9] Keys A, Keys M. How to eat well and stay well the Mediterranean way. Garden City, N.Y.: Doubleday; 1975.
 - [10] Mistura L, Le Donne C, D'Addezio L, Ferrari M, Comendador FJ, Piccinelli R, et al. The National Food Consumption Study IV SCAI: main results in terms of food consumption. *Nutr Metab Cardiovasc Dis* 2025. <https://doi.org/10.1016/j.numecd.2025.103863>.
 - [11] Ministero della Salute. Direzione generale della Prevenzione sanitaria. Piano nazionale della Prevenzione 2020-2025. www.salute.gov.it. C.17_notizie.5029.
 - [12] Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. *Br Med J* 2008;337:a1344. <https://doi.org/10.1136/bmj.a1344>.
 - [13] Karam G, Agarwal A, Sadeghirad B, Jalink M, Hitchcock CL, Ge L, et al. Comparison of seven popular structured dietary programmes and risk of mortality and major cardiovascular events in patients at increased cardiovascular risk: systematic review and network meta-analysis. *Br Med J* 2023;380:e072003. <https://doi.org/10.1136/bmj-2022-072003>.
 - [14] Visioli F, Bellomo G, Montedoro G, Galli C. Low density lipoprotein oxidation is inhibited in vitro by olive oil constituents. *Atherosclerosis* 1995;117:25–32.
 - [15] Ramirez-Tortosa MC, Urbano G, López-Jurado M, Nestares T, Gomez MC, Mir A, et al. Extra-virgin olive oil increases the resistance of LDL to oxidation more than refined olive oil in free-living men with peripheral vascular disease. *J Nutr* 1999;129:2177–83.
 - [16] Owen RW, Mier W, Giacosa A, Hull WE, Spiegelhalter B, Bartsch H. Phenolic compounds and squalene in olive oils: the concentration and antioxidant potential of total phenols, simple phenols, secoiridoids, lignans and squalene. *Food Chem Toxicol* 2000;38:647–59.
 - [17] Owen RW, Giacosa A, Hull WE, Haubner R, Würtele G, Spiegelhalter B, Bartsch H. Olive-oil consumption and health: the possible role of antioxidants. *Lancet Oncol* 2000;1:107–12.
 - [18] Visioli F, Galli C. Antiatherogenic components of olive oil. *Curr Atheroscler Rep* 2001;3:64–7.
 - [19] Pacheco YM, Bemúdez B, López S, Abia R, Villar J, Muriana FJ. Minor compounds of olive oil have postprandial anti-inflammatory effects. *Br J Nutr* 2007;98:260–3.
 - [20] Loru D, Incani A, Deiana M, Corona G, Atzeri A, Melis MP, et al. Protective effect of hydroxytyrosol and tyrosol against oxidative stress in kidney cells. *Toxicol Ind Health* 2009;25:301–10.
 - [21] PREDIMED study investigators. Intake of total polyphenols and some classes of polyphenols is inversely associated with diabetes in elderly people at high cardiovascular disease risk. *J Nutr* 2015;146:767–77.
 - [22] Medina-Remón A, Casas R, Tresserra-Rimbau A, Ros E, Martínez-González MA, Fitó M, et al. Polyphenol intake from a Mediterranean diet decreases inflammatory biomarkers related to atherosclerosis: a substudy of the PREDIMED trial. *Br J Clin Pharmacol* 2017;83:114–28.
 - [23] Da Porto A, Brosolo G, Casarsa V, Bulfone L, Scandolin L, Catena C, Sechi LA. The pivotal role of oleuropein in the anti-diabetic action of the mediterranean diet: a concise review. *Pharmaceutics* 2021;14(1):40. <https://doi.org/10.3390/pharmacutics14010040>.
 - [24] SINU Scientific Board, SINU Scientific Committee. "Front-of-pack" nutrition labelling. *Nutr Metab Cardiovasc Dis* 2021;31:2989–92.
 - [25] Slavin J. Why whole grains are protective: biological mechanisms. *Proc Nutr Soc* 2003;62:129–34.
 - [26] Slavin J. Whole grains and human health. *Nutr Res Rev* 2004;17:99–110.
 - [27] Venn BJ, Mann JI. Cereal grains, legumes and diabetes. *Eur J Clin Nutr* 2004;58:1443–61.
 - [28] Fadnes LT, Balakrishna R. Nuts and seeds - a scoping review for nordic nutrition recommendations 2023. *Food Nutr Res* 2024;68. <https://doi.org/10.29219/fnr.v68.10483>.
 - [29] Zhou S, Smith ADM, Punt AE, Richardson AJ, Gibbs M, Fulton EA, et al. Ecosystem-based fisheries management requires a change to the selective fishing philosophy. *Proc Natl Acad Sci USA* 2010;107:9485–9. <https://doi.org/10.1073/pnas.0912771107>.
 - [30] Sinha R, Cross AJ, Graubard BI, Leitzmann MF, Schatzkin A. Meat intake and mortality: a prospective study of over half a million people. *Arch Intern Med* 2009;169:562–71.
 - [31] Pan A, Sun Q, Bernstein AM, Schulze MB, Manson JE, Stampfer MJ, et al. Red meat consumption and mortality: results from 2 prospective cohort studies. *Arch Intern Med* 2012;172:555–63.
 - [32] Song M, Fung TT, Hu FB, Willett WC, Longo VD, Chan AT, Giovannucci EL. Association of animal and plant protein intake with all-cause and cause-specific mortality. *JAMA Intern Med* 2016;176:1453–63.
 - [33] Bouvard V, Loomis D, Guyton KZ, Grosse Y, El Ghissassi F, Benbrahim-Tallaa L, et al. Carcinogenicity of consumption of red and processed meat. *Lancet Oncol* 2015;16:1599–600.
 - [34] Etemadi A, Sinha R, Ward MH, Graubard BI, Inoue-Choi M, Dawney SM, Abnet CC. Mortality from different causes associated with meat, heme iron, nitrates, and nitrites in the NIH-AARP Diet and Health Study: population based cohort study. *Br Med J* 2017;357:j1957.
 - [35] Rong Y, Chen L, Zhu T, Song Y, Yu M, Shan Z, et al. Egg consumption and risk of coronary heart disease and stroke: dose-response meta-analysis of prospective cohort studies. *Br Med J* 2013;346:e8539.
 - [36] Iannotti LL, Lutter CK, Stewart CP, Gallegos Riofrio CA, Malo C, Reinhart G, et al. Waters W.F. Eggs in early complementary feeding and child growth: a randomized controlled trial. *Pediatrics* 2017;140:e20163459.
 - [37] Muraki I, Rimm EB, Willett WC, Manson JE, Hu FB, Sun Q. Potato consumption and risk of type 2 diabetes: results from three prospective cohort studies. *Diabetes Care* 2016;39:376–84.
 - [38] Donfrancesco C, Lo Noce C, Russo O, Minutoli D, Di Leonardo A, Profumo E, et al. Trend of salt intake measured by 24-h urine collection in the Italian adult population between the 2008 and 2018 CUORE project surveys. *Nutr Metab Cardiovasc Dis* 2021;31:802–13.
 - [39] Campanozzi A, Avallone S, Barbato A, Iacone R, Russo O, De Filippo G, et al. High sodium and low potassium intake among Italian children: relationship with age, body mass and blood pressure. *PLoS One* 2015;10(4):e0121183.
 - [40] Strazzullo P, Cairella G, D'Elia L, Scognamiglio U, Simonetti P, Salt & Health Working Group of the Italian Society of Human Nutrition. Time to define food salt targets in Italy starting with cereal-based products: a safe and practical way to reduce the heavy burden of cardiovascular disease. *Nutr Metab Cardiovasc Dis* 2024;34:294–8.
 - [41] Costanzo S, Di Castelnuovo A, Donati MB, Iacoviello L, de Gaetano G. Wine, beer or spirit drinking in relation to fatal and non-fatal cardiovascular events: a meta-analysis. *Eur J Epidemiol* 2011;26:833–50.
 - [42] Rungay H, Shield K, Charvat H, Ferrari P, Sornpaisarn B, Obot I, et al. Global burden of cancer in 2020 attributable to alcohol consumption: a population-based study. *Lancet Oncol* 2021;22:1071–80.
 - [43] Anderson BO, Berdzuli N, Ilbawi A, Kestel D, Kluge HP, Kreck R, et al. Health and cancer risks associated with low levels of alcohol consumption. *Lancet Public Health* 2023;8(1):e6–7.
 - [44] Di Castelnuovo A, Costanzo S, Bonaccio M, Rago L, De Curtis A, Persichillo M, et al. Moderate alcohol consumption is associated with lower risk for heart failure but not atrial fibrillation. *JACC Heart Fail* 2017;5:837–44.
 - [45] Sonestedt E, Lukic M. Beverages - a scoping review for Nordic Nutrition Recommendations 2023. *Food Nutr Res* 2024;68. <https://doi.org/10.29219/fnr.v68.10458>.
 - [46] EFSA NDA Panel. (EFSA Panel on Dietetic Products, Nutrition and Allergies). Scientific Opinion on the safety of caffeine. *EFSA J* 2015;13(5):120. <https://doi.org/10.2903/j.efsa.2015.4102>.

Update

Nutrition, Metabolism and Cardiovascular Diseases

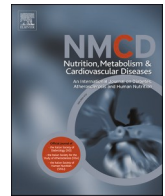
Volume 35, Issue 11, November 2025, Page

DOI: <https://doi.org/10.1016/j.numecd.2025.104263>



Contents lists available at ScienceDirect

Nutrition, Metabolism and Cardiovascular Diseases

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

Corrigendum to Mediterranean Diet: Why a new PYRAMID? An updated representation of the traditional Mediterranean diet by the Italian Society of Human Nutrition (SINU)

Daniela Martini

Division of Human Nutrition, Department of Food, Environmental and Nutritional Sciences (DeFENS), Università degli Studi di Milano, 20133, Milan, Italy

The authors regret to inform that the published Declaration of competing interest should be amended.

FD received grants from Soremartec Italia srl, DE from Casillo Next Gen Food, FS from Barilla G. e R. Fratelli S. p.A. and Cerbios-Pharma S. A., LI from Barilla S. p.A., NP from Associazione Italiana Celiachia, DM, DA and MD from Food Progetti, DM from Parmalat S. p.A., and Ferrero S. p.A.

LR and DM received a payment from Nutrition Foundation of Italy, NP from Associazione Italiana Celiachia, DA from AMPI – Accademia Maestri Pasticceri Italiani, AT from Dr Schar S. p.A. and Nutricia FS from European Laboratory for Non-Linear Spectroscopy, University of Florence.

DM received consulting fees from Ferrero S. p.A. NP received support for attending meetings and/or travel from Food Drink Europe and EFFOST, AT from Dr Schar S. p.A.

DM is a member of the Advisory Board of Fondazione Istituto Danone. FS has an unpaid leadership or fiduciary role in Italian Association of Lactose Intolerance Patients (AILI), NP in formare, AT in the Italian Society of Human Nutrition, PS is an unpaid member of WASSH (World Action on Salt Sugar & Health) and of the SINU Working Groups on Salt & Health and on Mediterranean Diet and is the Scientific Director (unpaid) of the Ancel Keys Association for Mediterranean Diet – Pioppi.

Authors SV, GC and AC declare no conflict of interest.

The authors would like to apologize for any inconvenience caused.

DOI of original article: <https://doi.org/10.1016/j.numecd.2025.103919>.

E-mail address: daniela.martini@unimi.it.

<https://doi.org/10.1016/j.numecd.2025.104263>

Available online 29 August 2025

0939-4753/© 2025 The Author(s). Published by Elsevier B.V. on behalf of The Italian Diabetes Society, the Italian Society for the Study of Atherosclerosis, the Italian Society of Human Nutrition and the Department of Clinical Medicine and Surgery, Federico II University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).