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"Planeterranean" diet: the new proposal for the Mediterranean-based food pyramid for Asia

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Abstract

Background and objectives The Mediterranean Diet (MD) has been recognized for its benefits for human health and sustainability for the planet, but it has considered not easy to reproduce in other populations. The United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair on Health Education and Sustainable Development is fostering a research project (Planeterranea), aiming to identify a healthy dietary pattern based on local foods with the same MD features. The aim of our study is to develop a MD-based food pyramid for Asian populations.

Methods Asia was stratified into six areas according to pedo-climatic conditions. For each region a comprehensive scoping review of local crops and typical foods was conducted on several databases such as the US Department of Agriculture (USDA)'s database, the Food and Agriculture Organization of the United Nations (FAO) website, and PubMed, focusing on both plant-based and animal-based foods. Narrative review was then conducted on the identified foods to determine their nutritional composition and planetary health impact. Finally, the collected information was used to build up the Asian food pyramid with details for each respective region.

Results We proposed a food pyramid for Asian countries, guaranteeing the same nutritional intake and health benefits as MD, by considering dietary habits and typical foods of this population. From the bottom to the top, Asian fruits and vegetables present similar nutritional profile as those in MD. Whole grains (barley) may represent valid alternative to white rice. Sesame oil represents a source of unsaturated fats and an alternative to olive oil. Legumes (soybean), edible insects, mushrooms and algae, guarantee an adequate intake of plant-based proteins with a complete amino-acid profile and a low environmental impact with respect to animal-based ones.

Conclusions This work is a new insight of healthy and sustainable local food system based on MD principles for the Asian population.

Keywords Mediterranean diet, Healthy diet, Sustainable diet, Planetary health, Food Pyramid, Planeterranea, Asia

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Introduction

The Mediterranean diet (MD), recognized as an Intangible Cultural Heritage of Humanity by United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2010, stands as a paradigm of healthful and sustainable eating practices. Rooted in the culinary traditions and dietary patterns of the Mediterranean basin long-living population [1], the MD has garnered global attention for its association with reduced risk of non-communicable diseases (NCDs), such as diabetes, cardiovascular diseases, and certain types of tumors [2]. Furthermore, its environmentally friendly features contribute to its acclaim as a model for sustainable food consumption [3]. Achieving a consensus on the definition of the MD required extensive deliberations among representatives from various countries, facing on Mediterranean basin (i.e. Italy, France, Greece, Morocco, Israel, Lebanon, Spain, etcetera) [4].

The MD is depicted through a food pyramid that symbolizes its dietary principles. At the bottom of the pyramid there are those foods, which should be consumed at every main meal: fresh vegetables, fruits, and cereals (preferably whole or partly refined grains). At the second step those which should be consumed daily, such as olive, nuts, oilseeds, herbs and spices, in order to limit added salt), and small quantity of legumes, as main source of proteins. Dairy food (especially milk, yogurt and low-fat cheese), being rich in protein, calcium and micronutrients, should also be consumed daily in a moderate amount. Going through, there are those foods which should be consumed on a weekly basis, such as fish and seafood, poultry, and eggs, as source of animal proteins for which two to four portions for week are recommended. These are to be preferred respect to red and processed meat, which should be limited to a maximum of two weekly portions. Finally, at the top there are sweets and processed foods. Olive oil should be considered the main source of fat, both for cooking and dressing [5, 6]. Some underrated aspects of a traditional Mediterranean diet include foods choice, preferring local production, promoting the seasonality and the biodiversity, minimally processing and preservation with natural methods (i.e. fermentation), the use of slow cooking methods (rather simple and yet extremely varied) and the preservation of culinary heritage [6].

The positive environmental MD implications are: (i) the low land and water use, and gas emissions greenhouse, triggered by the high consumption of plant-based food, even if these foods may have negative or mixed effects on different environmental pillars; (ii) the seasonality, resulting in a better ecological fingerprint of the supply and transport chains; (iii) the maintenance of biodiversity through the use of different seedings and crop rotation.

However, the above benefits, the MD adoption remains limited even within Mediterranean countries, and faces much more challenges in other regions. Just think to the unavailability of many raw materials and the high cost of imported products, beyond to culinary traditions of different countries and to cultural and social aspects strictly related to nutritionRecognizing this gap, within the frame of the UNESCO Chair on "Health Education and Sustainable Development", aimed at fostering the transfer of knowledge on Health and Sustainability, we proposed a new healthy and sustainable dietary model, based on the MD features, called *Planeterranea*, [7] in which we will build up food pyramids for each continent by using typical crops and local foods, with similar nutritional profile to those of the Mediterranean diet.

Herein, we started by Asia, because it already encompasses some region (i.e. West Asia), which includes countries, that are part of the Mediterranean basin. Moreover, Asia burgeoning population and rapid economic development present unique challenges in ensuring food security, addressing malnutrition, and combating the rising tide of NCDs. China, for example, has made significant steps in addressing food security challenges in alignment with the Sustainable Development Goals (SDGs). The nation has implemented comprehensive agricultural policies to enhance food production, diversify crop varieties, and improve rural infrastructure. Efforts include investment in agricultural technology, promotion of sustainable farming practices, and development of resilient food systems. China has also focused on reducing food waste and improving food distribution networks to ensure equitable access to nutritious food. These measures contribute to the global goal of ending hunger, achieving food security, and promoting sustainable agriculture by 2030.

Against this background, this study aimed to summarize the local food produced and consumed in the different Asian regions and to develop a food pyramid for the Asian populations, that reflects the dietary traditions and local foods with the same profile of MD.

Methods

Identification of main geographical Asian areas

To better identify the local foods, Asia was divided into the following six areas, according to pedo-climatic conditions, which are known to influence cultivation and breeding: Central, East, North, South-East, South, and West Asia. The main geographic characteristics and areas are summarized in Table 1.

Scoping review for food identification, according to the six Asian selected areas

The search strategy for Asian typical foods was set up for plant-based and for animal-based foods, separately.

Table 1 The six Asian areas and countries with relative pedo-climatic conditions

Asian areas	Countries	Geographical and climatic characteristics
Central Asia (CA)	Kazakistan Kirghizistan Tagikistan Turkmenistan Uzbekistan	Characterized from large mountain systems Central Asia has a distinctive continental arid and semi-arid climate with hot, cloudless, dry summers and moist, relatively warm winters in the south (Kazakistan) and cold winters with severe frosts in the north (Kirghizistan, Tagikistan, Turkmenistan, Uzbekistan)
East Asia (EA)	China Hong Kong Japan Macao Mongolia North Korea South Korea	Humid subtropical climate and very rainy tropical climate. Developed both agriculture (rice, wheat, tea, cotton, wheat, corn) and livestock (cattle, sheep, goats, pigs) Mongolia can be divided into different steppe zones: the mountain forest steppe, the arid steppe, and the desert steppe
North Asia (NA)	Russia Siberia	Russia's climate ranges from steppes in the south through humid continental in much of European Russia, and subarctic in Siberia to tundra climate in the polar north. Winters vary from cool along the Black Sea coast to frigid in Siberia. Summers vary from warm in the steppes to cool along the Arctic coast Russia is among the top five countries with the most fertile agricultural land
South-East Asia (SEA)	Burma Brunei Cambodia Indonesia Laos Malaysia Philippines Singapore Thailand East Timor Vietnam	The climate is predominantly tropical and subtropical and characterized by monsoons, receiving considerable annual precipitation. It is the kingdom of the rainforest Mineral-rich volcanic material that has broken down over the centuries has left rich, fertile soil, making Southeast Asia's islands highly productive agricultural areas
South Asia (SA)	Afghanistan Bangladesh Bhutan India Iran Maldives Nepal Pakistan Sri Lanka	Divided into two large peninsulas (Indian Peninsula and Indochinese Peninsula). Extremely heterogeneous, the climate of Indochina depends above all on two factors: on the position of the territory in latitude and on the alternating expiration of the monsoon winds
West Asia (WA)	Saudi Arabia Armenia Azerbaijan Bahrain United Arab Emirates Georgia Iraq Israel Jordan Kuwait Lebanon Oman Qatar Syria Yemen	Including the Arabian Peninsula, an almost arid area Three climatic zones, however, characterize West Asia: a continental climate in the northern regions (Georgia, Armenia, Azerbaijan, Syria, Cyprus, Lebanon); a dry zone, except where northerly winds bring moisture to the mountains, to the south (Yemen, Saudi Arabia, Oman, United Arab, Qatar); and a Mediterranean climate along the western edges (Israel, Jordan, Bahrain, Kuwait)

Firstly, the search was targeted the US Department of Agriculture (USDA)'s database (https://ipad.fas.usda.gov/ogamaps/cropproductionmaps.aspx) and the Food and Agriculture Organization of the United Nations (FAO) institutional website (www.fao.org) to identify the Asian food production and consumption. Secondly, additional searches were conducted on PubMed and Google Scholar using combinations of keywords specific to each category of food.

For plant-based food, keywords such as "local crop", "fruit OR vegetables", "edible plants", "plant-based foods OR food plants", "indigenous plant species", "edible algae OR mushrooms", "aromatic herbs OR spices", "whole grains", "nuts OR oilseeds", "legumes OR pulses" were

used to capture a diverse range of edible plant species commonly consumed in Asian countries.

Similarly, for animal-based food, keywords, such as "fish OR seafood products", "meat OR cattle OR animal husbandry OR poultry meat", "milk OR cheese OR dairy products", "farm animals OR animal source food", "edible insects", "eggs" were employed to identify relevant sources.

The search strings were launched between December 2022 and September 2023, setting English language, and the last 10 years, as limits to ensure currency and relevance.

The article records, selected by two independent reviewers (FO and FC), were fulfilled in two Excel datasheets, with each entry documenting the food item, its association with a specific Asian area, the source link, and any additional notes deemed relevant by the reviewers.

Narrative review for the assessment of nutritional properties of foods and their health impact

For foods identified in point 2.2, a narrative review was conducted, focusing on its nutritional composition and its impact on human health, environment sustainability, and overall planetary health (Supplementary Tables S3-S13).

The new proposal for the Mediterranean-based food pyramid for Asia

Based on nutritional profile of local foods identified in points 2.2 and 2.3, we selected some of them in order to build up our proposal for Mediterranean-based food pyramid for Asia.

Results

Plant-based food

The Mediterranean diet, known for its health-promoting properties, emphasizes a rich variety of plant-based foods that are central to its culinary traditions. Fruits, vegetables, whole grains, legumes, nuts, and olive oil constitute the cornerstone of this dietary pattern, offering a diverse array of nutrients and phytochemicals, other than essential vitamins, minerals, and fibers.

Fruits and vegetables

Fruits and vegetables are the most important sources of phenolic compounds (especially flavonoids), minerals, vitamins, and dietary fibers in the MD, which are associated with lower risk of many NCDs [8]. Acknowledging the importance of vegetables and fruits, the World Health Organization (WHO) recommends to consume at least 5 portions daily [9]. From our literature review, we found some common vegetables species, such as carrots, tomatoes, cucumber, spinach, and radish, and some peculiar ones, such as Okra (*Okro Abelmoschus esculentus*), Japanese radish (*Raphanus Sativus*), Bamboo shoots (*Phyllostachys edulis*), Indian spinach (*Basella Alba*), Calabash or Bottle gourd (*Lagenaria siceraria*), and Purslane (*Portulaca oleracea*) (table S3).

As for fruits, we found some common fruits, such as apple, pomegranate, watermelon, orange. However, despite differences in specific levels of micronutrients (e.g. Kiwifruit and Sea Bucktorn are richer of vitamin C than other fruits), the nutritional value of typical Asian fruits is comparable *] + + + + + of many other Mediterranean and/or commercial fruits. Hawtorn or Crataegus (*Crataegus pinnatifida*), Kiwifruit (*Actidinia arguta*) from East Asia (EA), Jackfruit (*Artocarpus heterophyllus*) from South Asia (SA), Lychee (*Lichi chinensis*), Dragon fruit or Pytaya (*Selenicereus undatus*) from South-East Asia (SEA), Date (*Phoenix dactylifera*) from West Asia (WA), Sea buckthorn or Siberian pineapple (*Hippophae rhamnoides* L.) from North Asia (NA) are all native of Asian continent (table S4). Dates, because of the high kilocalories amount and percentage of sugars, could be considered as a substitute of a dessert and then eaten less frequently than other fruits.

Whole grains

Both cereals and pseudo cereals, especially whole grains, are a healthy source of carbohydrates, fibers and bioactive peptides with anticancer, antioxidant, and antithrombotic effects [10]. In traditional MD, they provide up to 55–60% of daily caloric intake and are posed at the bottom of the food pyramid. Whole grains, which contain all the parts of the grain (bran, germ and endosperm), should be preferred. Their advantages are related to the low glycemic index, great content of fibers, essential fatty acids, vitamin-B complex, vitamin E, Iron, Potassium, Magnesium, Zinc, Selenium and other bioactive components [11]. Although different varieties consumed across countries, white rice (*Oryza sativa*) is the main contributor to carbohydrate intake in Asia [4], but its consumption should be reduced both for nutritional and environmental reasons. Indeed, the worldwide production of this cereal accounts for more greenhouse gas emissions (GHG), and it requires more water than that of any other plant-based food [12].

Wheat (*Triticum*), barley (*Hordeum vulgare*), maize (*Zea Mais*), oat (*Avena sativa*), millet (*Panicum miliaceum*), sorghum (*Sorghum vulgare*) were consumed in several Asian countries, such as India, which is one of the main grain-producing countries in the world (table S5).

Aromatic herbs and spices

Aromatic herbs are essential ingredients of MD, used as food additives and condiments, and as herbal teas [13]. Herbs are rich in many phytochemical components with bioactive effects, with resulting benefits for human health, in addition to the fact that they add flavour and colour to all types of everyday meals, and they can be a pleasant and healthier substitute for salt in cooking. Some herbs used in Asia were Ginger (*Zingiber officinale*), Coriander (*Coriandrum sativum*), Tarragon (*Artemisia dracunculus*), and Saffron (*Crocus sativus* L.) (table S6).

Nuts and oilseeds

Nuts (tree nuts and peanuts) and edible seeds are nutrient-dense content foods, providing around 230–300 kcal per serving, being a typical serving equivalent to about 5 g of fats (45 kcal). These foods boast a healthy nutritional profile, rich in mono and polyunsaturated fats that have been associated with a reduced risk of cardiometabolic disorders, such as dyslipidemia, obesity, and insulin resistance [14]. Nuts selected from Asia included Pistachio (*Pistacia vera*), Peanut (*Arachis hypogaea*), Indian almond (*Terminalia catappa*), and Chinese chestnut (*Castanea mollissima*) (see table S7). Peanuts belong to the legume category, making them richer in proteins, and more nutritionally complete than other tree nuts, similar to chickpeas and soybeans [15]. Chinese chestnuts, unlike other nuts and seeds, are relatively low in calories and fats, making them suitable for use in flour and sweet preparations.

Oilseeds, on the other hand, are characterized by high lipid, protein, and fiber contents, and low levels of digestible carbohydrates. These attributes have been associated with decreased glucose and insulin peaks, low glycemic index, and high satiety [16]. Among seeds, sesame (*Sesamum indicum*) is the most frequently consumed in all Asians countries and used to produce sesame oil (see table S7). According to the Chinese Food Composition Table (2015), sesame oil has an average content of unsaturated fatty acids of 74.59%, which is comparable to that of olive oil (80%). It's important to note that olive oil is praised not only for its unsaturated fatty acids content but also for its high monounsaturated fatty acid (MUFA) content, ranging between 70 to 80%, while that of sesame oil is around 40 to 50%. Anyway, sesame oil is richer in flavor substances compared to olive oil, aligning well with the traditional dietary habits of Chinese consumers. Moreover, sesame oil is commercially available at a lower price than olive oil, enhancing its cost-effectiveness [17]. Finally, Gold of pleasure (*Camelina sativa*), cultivated in West Asia, is a promising Brassicaceae oil crop due to its excellent resistance and tolerance characteristics (see table S7). The promotion of nut consumption within the MD is supported by its lower greenhouse gas emissions compared to livestock farming, although recent research has highlighted their highest amount of water required [18]. Similarly, olive oil, a staple of the MD, presents environmental challenges despite being plant-based. The cultivation and processing of olives for oil production can have significant environmental impacts, including water usage and land degradation.

Legumes or pulses

Legumes or pulses, members of the Fabaceae family, play a pivotal role in daily dietary intake, offering a wealth of essential nutrients and health benefits. Not only they are low in fat, but they are also abundant sources of proteins, starches, minerals, vitamins, and fibers [19]. Crucially, legumes provide a rich source of essential amino acids, including lysine and leucine, which, when combined with cereals and other sulphur-containing amino acids foods, constitute primary source of nutritional and functional proteins. Moreover, legumes boast an impressive array of micronutrients such as calcium, iron, phosphorus, potassium, chromium, copper, selenium, zinc, magnesium, and folic acid, each contributing to various aspects of health and well-being. The low glycemic index of legumes, coupled with their abundance of non-nutrient phytochemicals such as saponins, phytosterols, lectins, phytoestrogens, phytates, and amylase and trypsin inhibitors, confers additional protective effects against cancer, free radicals-induced damage, cardiovascular diseases, and hypercholesteremia [20].

Importantly, the adoption of plant-source proteins from legumes offers environmental advantages by reducing land occupation and greenhouse gas (GHG) emissions compared to animal-source proteins, thereby achieving a more favorable balance between nutritional needs and environmental protection [21]. Furthermore, legumes harbor symbiotic nitrogen-fixing bacteria in their root nodules, obviating the need for nitrogen fertilizers additions and promoting sustainable agriculture practices such as crop rotations [22].

Among Asian pulses, soy stands out as the most prominent, with soy foods and their isoflavones garnering attention for their potential roles in cancer and osteoporosis prevention and treatment [23]. Other notable Asian pulses include Bitter bean or Petai (*Parkia Speciose*), Blackgram (*Vigna mungo*), Chickpea (*Cicer arietinum*), Jengkol (*Archidendron pauciflorum*), Mung bean (*Vigna radiata*), and Pigeon pea (*Cajanus cajan*) (see table S8).

Mushrooms and algae

The consumption of mushrooms and green algae is very common in Asia, especially in the Eastern. Mushrooms

and algae are important dietary sources of bioactive compounds, including dietary fibers, minerals, polysaccharides (e.g., β-glucans, chitin), vitamins, and antioxidants [24]. For this reason, mushrooms have a wide range of therapeutic effects: they boost immune system, lower inflammation, act as anticarcinogenic, support healthy digestion. Moreover, they have been used medicinally for antibacterial and antiviral, antioxidant, and hypoglycemic applications [25]. Their consumption can also reduce the risk of depression [26]. Edible mushrooms represent a viable option for obtaining high quality proteins, since most of them have a complete essential amino acid profile [27], and their production is usually faster and cheaper than that of animal and plant proteins. Another great advantage is its ease of growing on various substrates, generally waste from the wood, paper and agricultural industries, so its cultivation is eco-friendly [28]. We reported in table S9 the following mushrooms: Shiitake (*Lentinula edodes*), Button mushroom (*Agaricus bisporus*), and Morels (*Morchella spp.*)

The high protein content of most algae and their amino acid composition make them suitable for human and animal nutrition (table S10). Microalgae have recently attracted considerable interest worldwide, due to their extensive applications in the renewable energy. There is substantial evidence for algae as nutritional and functional foods, yet still remain considerable challenges in quantifying these benefits, and in assessing potential adverse effects. Studies have indicated that blue-green algae have antiviral, antitumor, antioxidant, anti-inflammatory, antiallergic, antidiabetic, and antibacterial properties as well as lipid-lowering effects. In particular, their effects on hyperlipidemia, inflammation, and oxidative stress can contribute to the prevention of the development of CVD and non-alcoholic fatty liver disease [29]. As biofuels, they are a perfect substitute to liquid fossil fuels with respect to cost, renewability, and environmental concerns. Notably, they account for more than 40% of the global carbon fixation. However, the cultivation of algae does not harm the natural environment due to the lack of the need to use pesticides and other synthetic chemical compounds, leading to disturbance of the ecosystem balance, including the extinction of species and the accumulation of xenobiotics in soil and water [30].

Animal-based food

Fish, insects, buffalo and cattle meat, poultry, eggs and diary product are an important protein source for anyone who have an omnivorous diet, and for many Asian countries (Table S2).

Chicken, duck, fish, pork, beef, mutton, and eggs are consumed by all communities in Asia except by the majority of vegetarian Hindu and a few Buddhist communities due to religion taboo.

Fish

Fish is an important nutrient source, that provide high quality proteins, vitamins and essential fatty acid that improve human health, and in MD is one of the most preferred protein and unsatured fat source. Fish exerts antioxidant and anti-inflammatory effects, and has neuroprotective, cardioprotective and hepatoprotective properties [31]. According to the MD, fish should be consumed at least three times a week, preferably wild-caught rather than farmed.

Culturally, fish is the main dish for people residing near sea coasts, rivers, streams, lakes, and ponds. Traditionally, preserved fish products are largely confined to East and Southeast Asia. Fermentation, salting, drying, and smoking are the principal methods of perishable fish preservation innovated by the ethnic people of Asia to enrich their diets. Fish fermentation technology is a home-based traditional technique where varieties of fermented fish products, mostly fish sauce, are prepared and used as staple foods, side dishes, and condiments in Asia. The types of fish consumed in Asia are the most diverse according to the macro-area, and it depends on access and availability, culture habits and fish habitat (Table S11).

Edible insects

Edible insects represent a healthy and sustainable alternative protein source both for humans and animals. From a nutritional point of view, they have high amount of vitamin B12, iron, zinc, fiber, essential amino acids, omega-3 and omega-6 fatty acids, and antioxidants [32], making them good candidates for improving prevention and management of chronic diseases, like diabetes, cancer, and cardiovascular disease, and enhancing immune function. From an environmental point of view, land use, water footprint, and greenhouse gas emissions were 40–60% lower for the feed and food of edible insects than for traditional animal livestock, thereby diminishing their carbon footprint [33]. Selected insects have been studied further, such as House cricket (*Acheta domesticus*), Mealworm (*Tenebrio Molitor*), and Pulmuchi (*Locusta Migratoria*) (table S12).

Eggs and dairy products

Being a nutrient, rich in protein, cheap, and easily available food, eggs are consumed everywhere in Asia. Besides chicken eggs, eggs of other poultry species are consumed in Asian countries, such as those of duck in Mongolia and of bird in Macao, while the quail and turkey ostrich eggs in China [34].

Regarding dairy foods, there is no historical record of any ethnic fermented milk product in Japan, Korea, and many Southeast Asian countries; however, production of fermented milk products has been reported in ancient China. The consumption of milk and dairy products is very different between urban and rural centers. Cow's, goat and sheep milk are the most common all-over Asian countries, while in Kazakhstan horse and mare's milk and relative dairy products are consumed.

Eggs and soft (low-fat) cheeses are protein foods that can also be consumed as a substitute for meat by vegetarians. In the MD model, the ideal rule is to consume no more than 2 eggs a week, while mature cheese should rarely be consumed because it is rich in fat and cholesterol [35].

In Table S13 we summarized eggs and dairy products we found in Asian countries.

Poultry and meat

Consumption of animal-based foods, in particular meat, in Asia is mostly influenced by religions, dietary laws, such as taboos imposed on consumptions, availability of animal sources, geographical location, and environmental factors.

With three of the world's four most populous countries included in Asia and growing demand for animal proteins, the region already consumes 40% of global chicken production and intakes continue to grow, especially in South-East Asia (SEA), where the production 9.2 million metric tonnes in 2018. It is expected to reach 12.3 million metric tonnes by 2028 [36]. In SEA, duck meat is the second most consumed poultry meat after chicken meat.

Concerning the red meat, the two-humped camel is widely distributed in the arid and semi-arid areas of East and Central Asia, including China, Mongolia, Russia, and Kazakhstan, while the dromedary, or one-humped camel, is common in the desert and semi-desert regions of the Middle East (EA) and South Asia (SA).

Asia contributes the largest percentage to global sheep population and China is the leading sheep producing country and China also dominates in terms of sheep consumption followed by India. Unlike Europe, traditionally fermented meats, sausages, hams, and bacons are uncommon in Asia, except for a few in Thailand, China, India, and Bhutan.

According to the MD, white meat should be consumed 2–3 times a week, while the consumption of red or processed meat should be limited to a maximum of once a week, both for human and planet concerns. Indeed, the EAT-Lancet Commission has raised an important environmental concern linked to the excessive consumption of meat in the diet: intensive farming is attributable to the highest CO2 emissions as well as the reduction of biodiversity, and the excessive use of soil and water [12].

The new proposal of a Mediterranean food pyramid in Asia

In Fig. 1 we firstly propose a food pyramid of the MD, adapting it to Asia and its countries, by considering dietary habits linked to the specific cultural and religious beliefs, the typical foods, the tastes, and flavors, with the final goal to guarantee the same nutritional intake and health benefits for humans and the planet.

At the base of the pyramid, Asian fruits and vegetables present similar nutritional profile as those in the MD. The consumption of whole grains should be present in everyday meals and should be promoted with respect to white rice. Sesame oil, obtained both from toasted seeds and from the cold pressing of raw seeds, represents a source of unsaturated fats and an ideal alternative to olive oil, both as a condiment and for cooking foods. Legumes, in particular soybean, along with mushrooms and algae, if appropriately alternated and consumed in the right quantities (100 gr/150 gr consumed twice or three times per week), guarantee an adequate intake of plant-based proteins with a complete amino-acid profile and a better carbon footprint, to be preferred to those of animal origin. Among the latter, edible insects may represent a typical food with optimal nutritional profile and a low environmental impact.

Discussion

The present article has provided a comprehensive overview of Asian local foods and beverages, that might recreate the MD nutritional profile. In addition, our approach has shown the feasibility of adapted Mediterranean-based dietary patterns, that rely on geographical, environmental, and ethnic characteristics, while respecting the basic healthy MD principles. The MD, as plant-based dietary pattern, has been appointed as a healthy diet that respect planetary boundaries. However, the adherence to MD is decreasing even in Mediterranean countries, for several reasons. First of all, the adoption of Western-style processed foods high in salt, sugar, and fat is increasing, due to their higher availability and affordability, that are particularly evident in people with lower socio-economic status and in the younger generations [37]. On the other hand, targeted nutrition public health policies (i.e. the reduction of sodium in bread, the taxation of sugar-sweetened beverages, and the change in the availability of unhealthy foods at schools and public spaces) have been prompted in several European countries, providing promising results [38]. Moreover, the MD has been long lasting considered challenging to be replicated in other non-Mediterranean countries, mainly due to several barriers. Firstly, the adoption of MD might

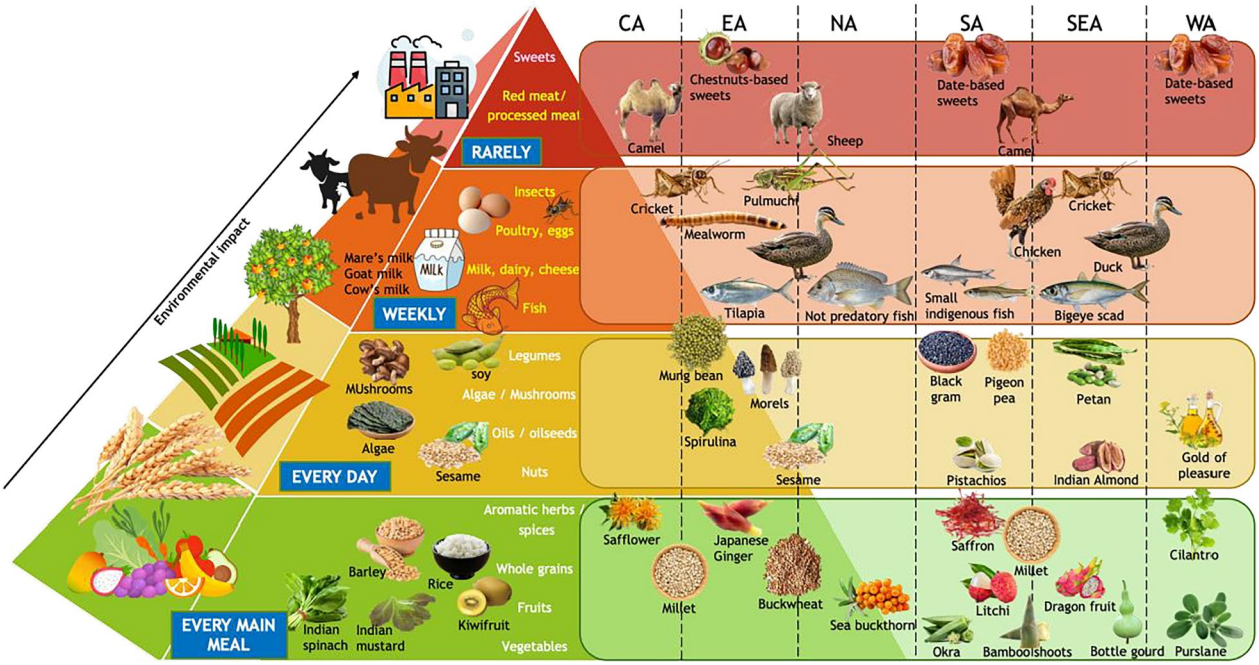

Fig. 1 The new proposal for a Mediterranean-based food pyramid in Asia, according to six geographical areas with similar pedo-climatic characteristics

be linked to huge modifications in eating behavior [37]. Local diets rely on cultural identity and inherent traditions as well as on diverse climate, geographic, and economic issues, contributing to food production systems and food choices of a given region. In addition, for sustainable diets, local foods should be advocated since they have reduced footprints. Consuming mainly plant-based local crops would be associated with large reductions in environmental resource use and pollution, with a reduction of greenhouse gas emissions, that are usually related to intensive farming and globalization [12].

Furthermore, one of the main issues related to poor compliance with MD is the affordability of foodstuffs, that is linked to high costs for transportation and commercialization [39, 40]. In addition, many individuals are not aware of the potential health benefits of the foods available in the local markets as well as the best methods to consume them (cooking methods, recipes, etcetera).

Planeterranea approach can help different populations to discover healthy food and beverages that are available in their countries. Accordingly, biodiversity could be protected thus preserving planetary health. Indeed, it has been reported that maintaining crop diversity can be beneficial for natural systems, agrobiodiversity, soil health, and can prevent native crop losses and potentially reduce pesticide use [41].

Therefore, the shift toward a healthier dietary pattern based on MD principles can have a pivotal role in the improvement of the nutritional profile in Asian populations, while contributing to preserve the planet health. This would be in line with the "One Health" approach proposed by WHO, that advocates the strict interplay between human, animal, and planet health [42].

In this context, the Planeterranea approach facilitates a transition towards healthier dietary patterns by addressing various Sustainable Development Goals (SDGs) outlined in the 2030 Agenda. By integrating local biodiversity, sociocultural dimensions, and economic considerations, our approach provides valuable insights to inform stakeholders and governance policies in the selected countries.

Limitations

Although the present study offers useful recommendations for tailoring the Mediterranean dietary pattern to the Asian contexts, it is also associated with some limitations. Firstly, even if the utilized databases reported food information with high degree of completeness, some gaps or inaccuracies could not be excluded, i.e. for non-popular and endemic foods. Secondly, nutritional profiles of some foods and their impact on human and environmental health could not be available in the literature. Finally, eating the Mediterranean diet in the Asian regions is connected to numerous cultural, geographic, and economic factors that were not fully considered by the current study.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12967-024-05491-2.

Additional file 1.

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Author contributions
CF, IA, CV conceptualised and designed the study. CF, FO, IA, CV drafted the manuscript. FO, FC made the review of the literature. All authors critically revised the manuscript, read the final version of the manuscript, and agreed upon submission for publication. All authors had full access to the data upon signing a confidentiality agreement.

Availability of data and materials
Not applicable.

Declarations

Competing interests
None.

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