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Review Article

The impact of nutrition and lifestyle modification on health

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ABSTRACT

The main recommendations from public health entities include healthy diets and physical activity as the main lifestyle factors impacting the development of chronic diseases such as cardiovascular and metabolic diseases, cancer, and even neurological diseases.

Randomized clinical trials have been designed to demonstrate those lifestyle modifications can change the pattern of chronic diseases development and progression. Among these, nutrition is one of the most impacting factors. Therefore, nutrition and diets were also included in different randomized clinical trials, and most of them showed a favorable impact of nutrition modification on the participant's health. Nevertheless, study designs were considerably different, and future studies are needed to support nutrition modifications further.

The choice of a healthy considered diet, like the Mediterranean diet, was shown to impact chronic diseases, cardiovascular risk, and adult life expectancy mainly due to its anti-inflammatory and antioxidant properties. Furthermore, a high intake of fibers, fruits, and vegetables together with a low intake of fat and energy-dense, processed foods contribute to an inflammation reduction and a more robust immune system leading. Besides these well-known properties, all lifestyle modifications must be personalized according to the availability of foods, geographic localizations, and the healthy status of the patient.

1. Introduction

According to the World Health Organization (WHO), Non-communicable Diseases (NCDs), heart disease, stroke, diabetes, obesity, metabolic syndrome, chronic obstructive pulmonary disease, and some types of cancer represent 63% of annual global deaths. Furthermore, it is estimated that by 2030 NCDs will be responsible for 52 million annual deaths worldwide [1]. Therefore, these diseases are considered major chronic diseases that together are responsible for high mortality rates that are preventable in large part [2].

Several studies provide evidence that regular physical activity, maintaining healthy body weight, not smoking, and following correct nutritional and other health-promoting practices influence health in a decisive way [3]. Thus, different factors from patients' lifestyle contribute to the prevention of chronic diseases, and therefore the concept of Lifestyle Medicine (LM) can be adopted to support the reduction of the risk related to lifestyle factors [2,3]. The focus of this review is to highlight the impact of nutrition on health and clinical outcomes associated with chronic, metabolically active diseases.

2. Lifestyle medicine

According to the definition of the American College of Lifestyle Medicine, the Australian Lifestyle Medicine Association, and the European Lifestyle Medicine Organization, LM is "the research and clinical prevention and treatment of dysfunctions caused by a non-physiological lifestyle accumulating allostatic load (lifestyle-related diseases, LRDs)" and/or "prevention and treatment of LRDs through nutritional, exercise, psychological, social, environmental and pharmaceutical interventions" [4].

Being such an important field, it is interesting to realize that LM concepts are not common subjects as a part of the medical school's curriculum [2,5] For instance, in what concerns nutrition, despite several recommendations to include it in medical student's curriculum, most medical schools in Europe and worldwide do not have adequate training in nutrition nor specialized qualified faculty [6]. A systematic review analyzing several articles and studies about nutrition in medical schools worldwide concluded that graduating medical students are not adequately supported in providing effective nutrition counseling to

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patients [7]. In the United States, nutrition is taught in less than 25% of medical schools [8–10]. This is similar in the United Kingdom, where most physicians do not value nutrition as an essential part of the doctor's responsibility to direct it to other staff members in the health care system [11]. Nevertheless, there are hundreds of clinical studies supporting the positive impact of lifestyle modifications on health. Table 1 includes a summary of the key interventional randomized studies registered at clinical trials.gov, assessing the impact of lifestyle modifications on clinical outcomes [12–17].

Due to the strength of the scientific evidence supporting the impact of lifestyle habits, the recent evidence-based clinical guidelines incorporate lifestyle recommendations to prevent chronic metabolically related diseases [18–30]. In all of them was emphasized that lifestyle habits are critical components for the prevention and adjuvant treatments of chronic diseases. At the same time, modification of harmful lifestyle habits could be an indirect form of reducing the health system costs [31].

3. Lifestyle medicine and nutrition

As part of lifestyle, nutrition is one of the most important key factors in lifestyle habits and practices influencing every chronic NCD disease [32,33].

Since 1975 obesity almost tripled, and in 2016 (34). In 2020 approximately 39 million children under five were overweight or obese, creating a significant public health question since obesity is one of the main risk factors for chronic NCD diseases [34]. On the other hand, changing dietary habits with increased physical activity helps prevent and treat obesity [35]. Furthermore, some studies demonstrated that a weight decrease of about 10% could increase life expectancy by preventing NCD [36,37].

Dietary patterns have changed over time and are a significant factor in the global burden of disease and death [38]. In 2017, a systematic analysis for the Global Burden of Disease Study evaluating the consumption of significant foods and nutrients concluded that 11 million deaths and 255 (Disability-Adjusted-life-years DALYs) were attributable to dietary risk factors [33]. Diets low in whole grains are, in general, the most significant dietary risk factor for deaths and Disability-Adjusted-life-years (DALYs). Other dietary risk factors are diets low in fruits, vegetables, nuts, and seeds and diets high in sodium [33]. Notwithstanding, the current food production is not aligned with planetary health [38]. These facts also highlight the need for interventions to improve not only human but also planetary well-being [38].

Several interventional studies have addressed the impact of diet modifications on clinical outcomes. A summary of the key interventional studies is included in Table 2 [39–55]. From the different studies, with different study designs, we can conclude that, although some of them showed a positive impact of diet modifications on the reported outcomes, further and robust studies are needed to support the actual impact of nutrition in the development and management of chronic diseases.

Nevertheless, various organizations' dietary guidelines and consensus statements have recognized the crucial role of nutrition in the prevention and treatment of chronic diseases [56–60]. Consensus statements and recommendations recommend a dietary pattern higher in fruits and vegetables, whole grains, nonfat dairy, seafood, legumes, and nuts [56–60]. Guidelines also recommend that those who consume alcohol (among adults) do so in moderation. The recommendations also reinforce the need for diets that are lower in red and processed meats, refined grains, sugar-sweetened foods, and saturated and trans fats, emphasizing the importance of adequate caloric intake and also regular physical activity as strategies for maintaining a healthy weight and, thereby, further reducing the risk of chronic diseases [1,29]. Moreover, World Health Organization provides publications to promote and support healthy lifestyles based on "12 steps to healthy eating" recommendations [61]. Included in these foods are vitamins and minerals, which are also vital to boost immunity and healthy development.

An important point to address is the age-related effect of nutrition, namely in disability, since older adults are a growing age group in Europe. High-protein intake was associated with better disability trajectories [62]. In this context, results from the MIND diet were reported, in a cohort study, as reducing in 53% the risk for developing Alzheimer's disease [63] and a slower decline in cognitive function. The highest adherence rates to the MIND diet were associated with a cognitive function equivalent to being 7.5 years younger [64], and even modest adherence to this diet was associated with a 35% risk reduction for Alzheimer's disease versus the lowest adherence group. High adherence to the Mediterranean and DASH diets showed a statistically significant benefit [63] and reduced the risk for cognitive decline [65]. However, there is a need to develop different strategies allowing healthy aging.

3.1. Nutrients and foods versus dietary patterns

The link between dietary patterns, foods, and nutrients is inexorable [66]. Dietary guidance over the past decades has moved from specific

Table 1
Key interventional randomized studies evaluating the impact of lifestyle modification in health outcomes [12–17].

Author (year)	Population	Intervention	Clinical outcome	Main results
Earnest [12]	373 sedentary post menopausal women	Exercise training	Heart rate variability	Moderate intensity exercise training was sufficient to improve HRV.
Verhaeghe [13]	325 individuals with mental disorders	10-week health promotion intervention	Bodyweight, BMI, Waist circumference and fat mass	Minor significant improvements were possible in individuals with mental disorders
Hornnes [14]	254 individuals with stroke or transient ischaemic attack and smoking history	Smoking cessation advice	Smoking cessation	Higher smoking cessation rates were not achieved in the intervention group
Scharhag-Rosenberger [15]	74 sedentary individuals	6-months high-repetition resistance training 3 days/week	Strength, resting metabolic rate, body fat, serum irisin	Preventive resistance training elicited an increase in resting metabolic rate
Suboc [16]	111 sedentary older adults (age $\geq$ 50)	Pedometer-only intervention and a pedometer with an interactive website physical activity.	Endothelial function by brachial flow-mediated dilation, vascular stiffness by tonometry, step-count by a pedometer, and physical activity intensity/distribution by accelerometer	Moderate-intensity physical activity reversed age-related endothelial dysfunction but required to be performed in bouts of $\geq$ 10 duration for $\geq$ 20 min/day.
Sloan [17]	119 Healthy, sedentary, young adults	12 weeks of aerobic exercise training	Lipopolysaccharide, TNF-α, IL-6, toll-like receptor, and aerobic capacity by cardiopulmonary exercise training.	There were no changes in inflammatory markers.

BMI: Body Mass Index; IL-6: interleukin-6; TNF-α: tumor necrosis factor-α

Table 2
Key interventional randomized studies evaluating the impact of diet modifications in health outcomes.

Author (year)	Population	Intervention	Clinical outcome	Main results
Delbridge [40]	Overweight or obese individuals	Very-low-energy diet for 3 months followed by a high-protein or high-carbohydrate diet for 12 months	Weight maintenance and improvement of cardiovascular risk	Protein or carbohydrate content did not affect successful weight-loss maintenance. Both dietary treatments were significant for systolic blood pressure change.
Burrows [41]	159 overweight children aged 5–7 years	Dietary modification program or physical activity or a combination of both	Parental child-feeding practices at 6, 12, and 24 months (Child Feeding Questionnaire)	Specific Child-Feeding domains were modifiable in the context of targeted obesity intervention
Weber [42]	Outpatients over 45 years of age with atherothrombotic cardiovascular disease	Brazilian Cardioprotective Diet Program versus dietary therapy proposed by Brazilian guidelines	Blood pressure, fasting glucose levels and body mass index	Brazilian Cardioprotective Diet Program was more effective
Campbell [43]	Overweight/obese post-menopausal women	Diet or exercise or diet plus exercise	Adipose tissue gene expression	Weight loss was associated with adipose gene expression, namely in steroid hormone metabolism and IGF signalling pathway
Darghosian [44]	190 patients with paroxysmal or persistent atrial fibrillation	High-dose marine omega-3 polyunsaturated fatty acids	Recurrence of atrial fibrillation and markers of inflammation and oxidative stress	omega-3 polyunsaturated fatty acids did not reduce the recurrence of atrial fibrillation nor inflammation and oxidative stress
Ferrara [39]	83 Migraineurs	Low-lipid diet	Headache: number and severity of attacks	Low-lipid diet significantly affected the number and severity of migraine attacks.
Sørensen [45]	693 8–11-year-old Danish children	Healthy school meal	Concentration and school performance	School meals did not affect concentration but improve reading performance
Voon [46]	45 Healthy Malaysian adults	High-protein Malaysian diets with virgin olive oil, palm olein, and coconut oil	Cell adhesion molecules, lipid inflammatory mediators, and thrombogenicity indices	Virgin olive oil diet lowered plasma proinflammatory LTB4, and palm oil diet raised the antiaggregatory plasma PGF1α
Camps [47]	11 Asian men with BMI 17–24 Kg/m^2	Low glycemic index over 24 hours	Glycemic response and postprandial substrate oxidation	Low glycemic index diet promoted fat oxidation over carbohydrate oxidation
Lima [48]	40 overweight and obese adult women	Diet containing folate and hazelnut oil capsule	Methylation level of the ADRB3 gene	Reduction in the methylation levels of ADRB3, increased high-density lipoprotein cholesterol and total antioxidant capacity
Sun [49]	12 healthy Chinese male participants	Dairy and soy milk consumed either before or together with a carbohydrate	Postpandrial blood glucose, insulin, and gastric emptying	Preloading of dairy or soy milk resulted in a more significant reduction in glycemic response
Parsi [50]	54 Patients with cardiac arrythmias	Micronutrient combination	Insulin resistance levels, left ventricular function	Micronutrient combination as add-on improved cardiometabolic health in patients with cardiac arrythmias
Schübel [51]	150 overweight or obese non-smokers, aged 35–65 years	Intermittent calorie restriction and continuous calorie restriction	Weigh change, adipose tissue gene expression, visceral and adipose tissue	Intermittent calorie restriction was equivalent to continuous calorie restriction
Otten [52]	22 overweight and obese subjects with type 2 diabetes mellitus	Paleolithic diet and exercise	Cardiac fat, structure, and function	Exercise training plus Paleolithic diet reduced myocardial triglycerides levels and improved left ventricle remodeling
Corban [53]	89 patients with reactive hyperemia-peripheral arterial tonometry (RH-PAT index $\leq$ 2)	Chardonnay seed polyphenols-rich	RH-PAT indices and endothelial progenitor cells	Chardonnay seeds improved peripheral endothelial function
Ford [54]	Healthy and older women	High protein diet with probiotics and prebiotics	Intestinal microbiota composition and probiotic strain recovery	High protein diet mantained wellness in healthy older women with minor perturbation to the microbiome profile
Galindo Muñoz [55]	209 overweight or obese individuals	Diet adjusted to patient́s chronotype	Weight, Body mass index, and waist circumference	Chronotype-adjusted diet was more effective than the traditional hypocaloric dietary treatment

LTB4: Leukotriene B4; PGF1α: prostaglandin f1α; ADRB3: adrenoreceptor beta 3 RH-PAT: Reactive hyperemia peripheral arterial tonometry

foods and nutrients to a greater emphasis on dietary patterns and the critical aspect of providing practical advice for implementing recommendations [33]. Nevertheless, dietary patterns are easily used in dietary advice since people eat foods and not nutrients. Further nutrient-based research will explain the mechanisms by which specific foods and dietary patterns act [66].

Different educational documents, named Food-based dietary guidelines (FBDGs), are regularly updated, providing scientific information on the general population's food composition and nutritional needs [67]. National scientific and international organizations publish these guidelines. A concise, descriptive global review of this content was recently published, aiming to assess the similarities and critical differences of diets across the countries [68]. Most countries have developed a graphic representation of Food-Based Dietary Guidelines (FBDGs) to illustrate the proportions of different foods with similar characteristics that should be included in a balanced diet, although they may have a list of messages or tips as well [67]. Besides the differences among countries, there are similar key points: consume many fruits, vegetables, and cereals, limiting fat, simple sugars, and salt [67–69].

In Europe, FBDGs have been developed in several countries, being the food pyramid used as a food guide illustration in 23 countries out of 34 and classify foods into five or six groups [69]. This showed that the most popular graphic representation of FBDGs is the pyramid. Foods are classified into five or six groups. The main food groups are grains, vegetables, fruits, and vegetables and fruits together. Most nutritional key points are similar among the different European FBDGs, although there are some differences in geographic conditions and cultural heritage. Some differences include the modality of food classification. The main message is always to consume adequate amounts of grains, vegetables, and fruits with a moderate intake of fats, sugars, meats, caloric beverages, and salt. Other healthy behaviors are frequently indicated [69]. However, FBDGs still seem insufficient regarding ethnic peculiarities, agreement on how to group foods, and subgroup population nutritional requirements [69].

3.2. *Mediterranean diet*

Mediterranean diet is considered an Intangible Cultural Heritage of

Humanity since 2013. It is one of the top 8 most popular diets globally, and it incorporates the traditional healthy living habits of people from countries bordering the Mediterranean Sea. Three different regions can easily be identified for the Mediterranean diet, southern Europe (Portugal, Spain, France, and Italy), eastern Mediterranean (Greece, Turkey, Syria, Lebanon, Palestine, and Egypt), and North Africa (Libya, Algeria, Tunisia, and Morocco). They all use olive oil as the primary source of fat and have some mandatory characteristics: Colour, Flavour, Taste, Variety, and Mixture, although they can have slightly different details which have to do with climate, culture, and geography. The basic principles and the components of the diet are the same, low saturated fatty acids, high amounts of antioxidants, carbohydrates, and fiber, and, above all, high content of monounsaturated fatty acids and *n*-3 PUFAs, mainly derived from olive oil, as alpha-linolenic acid and long-chain PUFAs from fish, particularly in certain areas, closer to the sea [70]. Mediterranean diet comprises dietary and lifestyle, sociocultural, environmental, and health issues [70]. From the diet point of view, the Mediterranean diet comprises

Ancel Keys was the first to draw attention to the reduction in cardiovascular disease risk among populations whose nutritional model was consistent with practices of peoples from the Mediterranean areas [71]. After that, research revealed the Mediterranean diet's beneficial effects on NCDs, glycemic control, and cognitive function [70,72–74].

The most known symbol of the Mediterranean diet pattern is olive oil, used as the primary source of fat. The health benefits attributed to olive oil are related to extra virgin olive oil (EVOO) intake with its high nutritional quality and multiple positive effects on health. Different clinical trials and observational studies showed that consumption of olive oil associated with the Mediterranean diet improves cardiovascular risk, is inversely associated with death with cardiovascular disease and all-cause death [72,75–79]. A study performed in the United States, outside of the Mediterranean diet, involving 61,181 women and 31,797 men demonstrated that with a follow-up of 24 years, the higher olive oil was associated with a low risk of cardiovascular disease and coronary heart disease [80]. One of the essential components of EVOO is phenolic compounds responsible for improving antioxidant capacity [81,82].

The reduction of cardiovascular risk is accompanied by a significant reduction of systemic vascular inflammation markers (IL-6, IL-7, IL-aa18, and hs-CRP) [80,83]. Long- and short-term studies demonstrated that olive oil supplementation was also associated with a significant decrease in inflammatory markers like Thromboxane-B2 (TXB2) and Leukotriene-B4, confirming its anti-thrombotic and anti-inflammatory effects [81]. Moreover, studies on subjects at high cardiovascular risk showed that after EVOO supplementation, the blood pressure values, both systolic and diastolic, decreased [75,84].

Fresh fruits and vegetables are vital sources of phytochemicals, polyphenols, phytosterols, and carotenoids, bioactive compounds believed to confer many health benefits associated with fruit and vegetable consumption [85]. For example, the lower mortality risk associated with fruit and vegetables is plateaued at approximately 5 servings of fruit and vegetables per day [86]. In addition, they have antioxidative properties and a role in regulating nuclear transcription factors, fat metabolism, and inflammatory mediators [87].

The main benefits and limitations of a Mediterranean diet are synthesized in Fig. 1 [88–95]. Although the benefits of the Mediterranean diet seemed to be well established, the limitations are more controversial. For example, the intake of vitamin D is low, nevertheless, in Mediterranean countries, vitamin D is synthesized for several months of years, and therefore the oral intake could not be so important [94]. Concerning iron deficiency, although red meat intake is low in the Mediterranean diet, a study showed that one year in the Mediterranean Diet did not result in a lower iron status [95]. Thus, further studies are needed to address the fundamental limitations associated with Mediterranean Diet.

In this context, the concept of the French paradox was introduced in 1992 when it was noticed that French people have low incidence of coronary heart disease, even though their diet was rich in saturated fats [96]. Wine consumption is the potential explanation for that fact, and at that time, it was associated with the wine's micro-constituents antioxidant capacity [97]. However, it is accepted that besides the antioxidant properties, these compounds also exert an anti-inflammatory and anti-thrombotic action [98]. Thus, as part of the Mediterranean diet, wine contributes to its cardio-protective effect [98].

Few studies have compared the Mediterranean diet and other diets [94,99,100]. Canada's food guide and Mediterranean diet have similarities concerning promoting a diet rich in grains, fruits, and vegetables; however they differ regarding red wine, fat, meat, and meat alternatives. For Canadians, the Mediterranean diet was only preferable if sources of vitamin D are included and limited in wine consumption [94]. Compared with the Nordic Diet, which differs from the Mediterranean diet about the primary source of fat, study results are discrepant, and further studies should be developed [100]. However, a review of the published studies showed an association between both dies and lower risks of chronic disease, disability, and mortality [99]. Furthermore, in

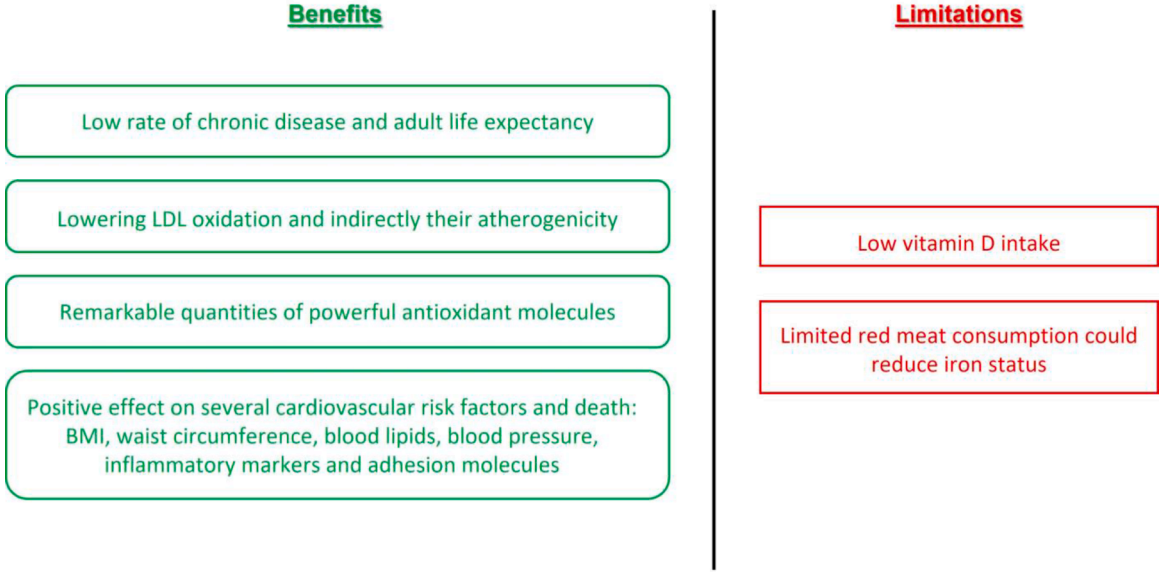

Fig. 1. Main benefits and limitations of the Mediterranean diet [88–95].

the Nordic population, adherence to a Healthy Nordic diet may be protective against disability in the Nordic population [100].

Finally, the Mediterranean diet was considered healthy and sustainable, sharing sociocultural benefits [101].

3.3. Nutrition and the immune system

During our whole life, there are diverse exposures to an endless amount of nutritional and other stressors like processed food, overfeeding, environmental toxins, infectious agents, or drugs which can promote chronic inflammation and the development of metabolic disorders [102].

Moreover, high intake of fat and energy-dense, processed foods, low intake of fibers, fruits, and vegetables changed nutritional patterns in Western societies and triggered the rise of NCDs. This proinflammatory diet is associated with a rising prevalence of asthma, allergies, and autoimmune diseases involving inflammatory mechanisms [103–105]. On the other hand, healthy diets with fiber, vitamins, and minerals in fresh foods act as anti-inflammatory factors [103,104].

Fiber is part of a healthy diet and is very important as it generates short-chain fatty acids (SCFAs) and promotes the proliferation of commensal bacteria, protecting the gut epithelium. Short-chain fatty acids (SCFAs) have anti-inflammatory effects helping epithelial mucus secretion, increasing the protective effect on the intestinal surface, and preserving the barrier function [106,107] (Fig. 2). The impairment of gut microbiota is a significant causal factor for the development of inflammation, mainly influenced by lifestyle [102,108]. Gut dysbiosis was found in several inflammatory pathologies such as obesity, diabetes, cardiovascular and neurodegenerative diseases. This can be connected to the induction of chronic low-grade inflammation since the gut microbiome is closely connected to innate immune responses [109–111]. Vitamins like A, B6, B12, folate, C, D, and E [112–116] and some minerals, mainly zinc, copper, selenium, and iron [117,118], are fundamental for supporting the human immune system and reducing the risk of infections or its complications. Amino acids and fatty acids are also essential, of course.

Essential fatty acids (EFAs) are critical immune regulators. The *n*-6 polyunsaturated fatty acid (PUFA), linoleic acid (LA), is converted in the mammalian body into arachidonic acid (AA) and subsequently may give origin to proinflammatory lipid mediators (eicosanoids). On the contrary, from -linolenic acid (ALA), both *n*-3 PUFA eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are produced and subsequently converted into anti-inflammatory and/or pro-resolving lipid mediators (resolvins and protectins) [119]. Therefore, for the maximum anti-inflammatory effect, it is essential to increase *n*-3 PUFA rather than *n*-6 PUFA. So, the best recommendation for the ratio *n*-6: *n*-3 is "the lower, the better," at least 2:1 as found in the Mediterranean diet. Unfortunately, in Western countries, this ratio can reach 15:1 for some types of diet [120] (Fig. 2).

Concerning immunomodulation and anti-inflammatory properties, olive oil and the Mediterranean diet pattern itself are in the front line. Populations that consume a diet rich in fruits, vegetables, and fibers have lower incidences of inflammatory diseases than Western populations [72–74,121,122]. Overall, the Mediterranean pattern has direct (mono-unsaturated fatty acids (MUFAs), tocopherols, polyphenols) and indirect (low saturated fats, well-balanced linoleic/alpha-linolenic acid) effects on the immune system and inflammatory responses. Olive oil and probably the Mediterranean diet globally have several effects on immune-mediated and inflammatory diseases, such as coronary heart disease/cardiovascular diseases, obesity, type-2 diabetes, cancer, asthma, and allergies [120]. Mediterranean diet also influences gut microbiota because of its content in prebiotics foods like those with wheat bran, fructooligosaccharides, and galactosacharides, and probiotics like fermented milk [123–126] (Fig. 2).

Furthermore, in the presence of a pathogenic agent such as virus and bacteria, for correct and timely activation of the immune system, the

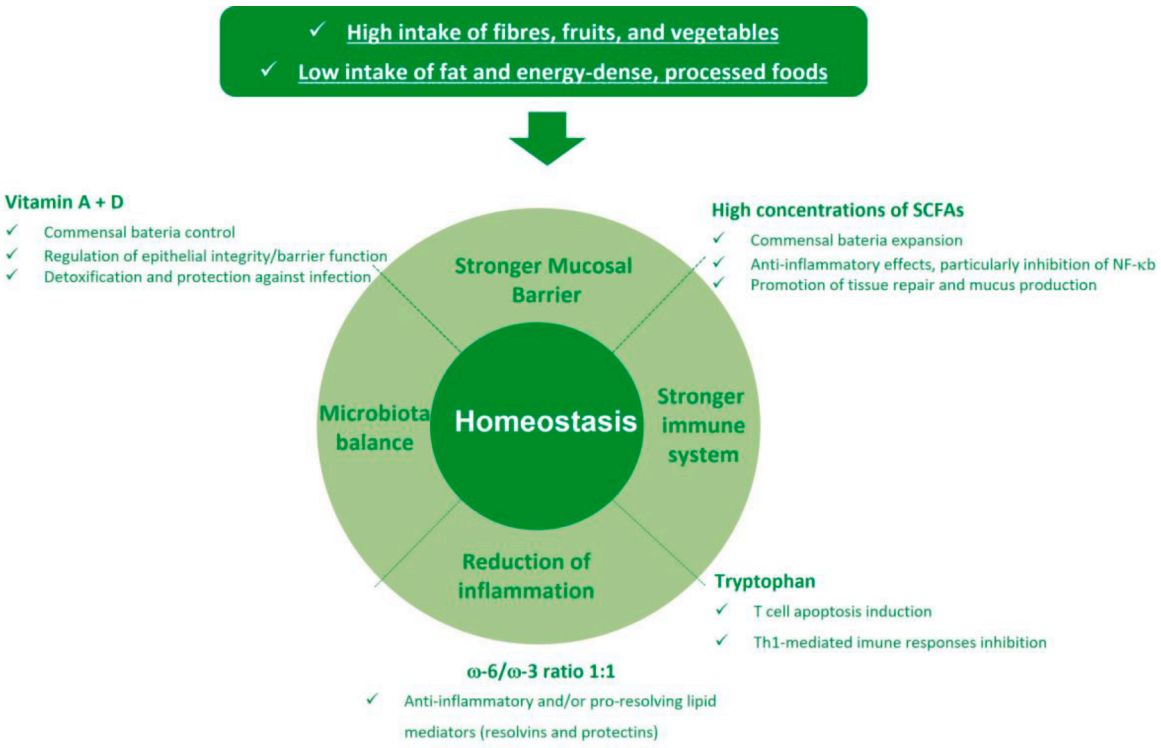

Fig. 2. Nutrition and Immune system [102,104,107]. Diet rich in fibres, fruits, and vegetables and with low intake of fat and energy-dense, processed food contributes to gut homeostasis. Moreover, nutrients absorbed are transported from the gut to the blood, where they can influence bone marrow and may cell types throughout the body: enhance dendritic cells, immune cells, macrophage phagocytic function, and Tregs balance resulting in the control of lung microbiota and efficient mucociliary clearance and inhaled microbes and particles. SCFAs: short-chain fatty acids, such as acetate, propionate, and butyrate.

metabolic rate of immune cells increases requiring energy sources, substrates for biosynthesis, and regulatory molecules, which are almost all derived from the diet [127–130].

4. Recommendations put into practice

Healthy dietary patterns can be described as those that are rich in health-promoting foods, including plant-based foods, fresh fruits and vegetables, antioxidants, nuts, sources of omega-3 fatty acids, low in saturated fats and trans fats, animal-derived proteins, and added/refined sugars [131]. Globally, they are fiber-rich, nutrient-dense, and deficient in proinflammatory foods.

Patterns such as these are naturally occurring in some areas of the world and are based on local or regional traditions and access to food depending on its sources, as is the case for the traditional Mediterranean and Asian diets. Others have been developed or changed according to preparation for studies or their results in terms of health outcomes, like, for instance, the DASH [132] and the MIND [133] diets, which share some common characteristics [131].

Diets must be personalized [134], choices should be made depending on the individual needs, culture, habits, and beliefs, like dietary cholesterol restriction for hypercholesterolemia; gluten-free for grain intolerance; fructose restriction for fructose intolerance; lactose restriction for lactose intolerance; lutein for risk of macular degeneration; carnitine supplementation for poor acyl-carnitine biosynthesis; branched-chain amino acid supplementation for individuals with sarcopenia; ketogenic diets for epilepsy or higher protein diets for later stage insulin resistance [135].

It is recognized [136] that maintaining healthy body weight and preventing abdominal fat accumulation is healthy. So, mainly in this field, many people try to modulate their diet to achieve the best and quickest results. What about extreme modulation of diet?

A Mixed Diet seemed to be healthier than any extreme form of diet and besides the long-term results are still unknown and very hard to keep for a long time.

An excellent example of a modulated diet is caloric restriction [137], which inhibits key nutrient-sensing and inflammatory pathways, promotes proteostasis, genome stability, stress resistance, and stem cell function. With caloric restriction, insulin sensitivity increases, and inflammatory status is reduced. This must be combined with diet quality modifications [138,139] to keep a nutritional balance.

Fasting is one example of an extreme diet. By definition, fasting is a survival mechanism in both animals and humans [140,[141], especially in countries where food conservation is complex [142] . In the rest of the world, fasting has been employed either due to religious convictions or wellness centers. One of the methods used to control severe obesity is the “zero-calorie diet.” Nowadays, people follow several types of fasting with the primary goal of achieving the “ideal” weight.

Much research shows the beneficial effects of fasting on health and different pathological conditions, but people must be aware of malnutrition if the restriction is taken to the extreme.

5. Conclusion

Scientific information is growing regarding the impact of lifestyle modifications, namely from the nutrition point of view. Different diet modification has been studied with demonstrated positive impacts in the management of non-communicable chronic diseases. For example, the Mediterranean diet was considered one of the healthy diets strongly associated with reducing the risk of cardiovascular diseases associated with the antioxidative and anti-inflammatory properties of the main components, namely olive oil, fruits, and vegetables. Nevertheless, it is essential to highlight that modification must be applied in personalized medicine, being environmentally sustainable and more equitable at a national scale.

Declaration of Competing Interest

The author declares no conflict of interest.

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