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Review Article

From Mediterranean diet to Mediterranean lifestyle: a narrative review

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Abstract
Objective: To summarize the recent scientific evidence regarding the wellness-promoting capacity of the Mediterranean lifestyle (ML), with a special focus on physical, social and environmental wellness.
Design: Narrative review of English-language publications in PubMed, Scopus and Embase, from 1 January 2010 to 31 October 2018.
Setting: Prospective cohort studies, interventional studies, meta-analyses and reviews of those investigating the effect of at least one component of the ML on wellness parameters.
Participants: General population.
Results: Although an explicit definition of ML is missing, compliance with various combinations of its components improves metabolic health and protects against or ameliorates disease state. However, there is heterogeneity in the healthy behaviours that the ML-focused studies include in their design and the way these are assessed. Also, despite that features of the ML could contribute to other wellness dimensions, there are no studies exploring the effect this healthy lifestyle could confer to them.
Conclusions: Chronic lifestyle diseases are of multifactorial aetiology and they warrant multifaceted approaches targeting the general way of living. ML, if thoroughly evaluated, can provide a valuable tool to holistically promote health and wellness.

Keywords
Mediterranean lifestyle
Mediterranean diet
Healthy lifestyle
Lifestyle medicine
Wellness
Non-communicable diseases
Narrative review

Wellness is conceived as the most favourable health status aiming at the achievement of optimal performance both at the personal and interpersonal level[1]. This is in accordance with the updated definition of health dictating that it is not just the absence of illness, but that it also incorporates a positive component consisting of the maintenance of physical, mental and social well-being[2]. Out of the several features of wellness, the one that has received the most attention, and has been extensively studied, is that of physical wellness. Over the last decades, the diseases modern Westernized societies suffer from have shifted from communicable to non-communicable diseases, with the WHO reporting that the global annual contribution of non-communicable diseases to total mortality has reached approximately 70 %[3]. Modifiable risk factors, such as active and second-hand smoking, sedentary lifestyle, unhealthy dietary habits and excessive alcohol intake, stand at the forefront of chronic disease prevention[3]. However, adherence to low-risk lifestyle behaviours has declined, substantiating the concern about the future prevalence of lifestyle diseases[4].

Although a great bulk of research has revolved around dietary habits and their impact on health outcomes, diet alone cannot explain the heterogeneity and complexity of chronic degenerative diseases. Since lifestyle diseases are of multifactorial aetiology and robustly associated with personal lifestyle habits, their prevention and treatment warrant multifactorial and sophisticated approaches focusing on the overall way of life. However, adopting a dietary pattern that has been developed in a specific geographic

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region means that its composition has been determined by the special environmental and cultural parameters of this place. This leads to the consumption of a diet designated by the unique lifestyle factors of this region and not based on health-promoting guidelines, but on spontaneous consumption due to the naturally present circumstances dictating such a consumption and way of consumption.

Several decades have passed since Ancel Keys' groundbreaking Seven Countries Study demonstrating that the Mediterranean diet (MD) holds the potential to prevent CHD mortality by attenuating plasma cholesterol concentrations[5]. Since then, the traditional MD has been presented as a healthy dietary pattern with numerous health benefits and its cultural contributions have been acknowledged as 'Intangible Cultural Heritage of Humanity' by the United Nations Educational, Scientific and Cultural Organization[6]. It is of importance that the way MD is described there reveals information about the overall Mediterranean lifestyle (ML) and how this has affected dietary habits[6]. Intriguingly, the updated Mediterranean pyramid, published in 2010, incorporates not only information about the frequency and the serving size of the several food groups typical of the MD, but also some lifestyle dimensions deeply embedded into the traditional Mediterranean way of life[7]. These newly added components comprise the element of frugality and moderation that governs the whole pattern of consumption, the choice of locally grown, biodiverse, seasonal and traditional products, preserving in this way a sustainable and eco-friendly diet, personal involvement in food preparation and culinary activities, conviviality during meal consumption, regular convivial physical activity in open spaces, adequate hydration, rest and relaxation[7]. Notably, these lifestyle parameters compose the framework within which the MD functions properly, with the updated representation of the Mediterranean pyramid signalling the shift from diet-focused research to the overall lifestyle characterizing the countries bordering the Mediterranean Sea and the potential health benefits it incurs.

Therefore, the purpose of the current narrative review was to summarize the recent scientific evidence regarding the health-promoting potential of complying with the ML and its emergence as a holistic way to promote overall health and wellness, with a special focus on physical, social and environmental wellness dimensions.

Methods

Search methodology

A literature search of PubMed, Scopus and Embase was conducted from January 2010 through October 2018. Searches were performed using keywords related to the ML and its relevant components, as they were depicted in the updated representation of the Mediterranean pyramid by Bach-Faig *et al.*[7] in 2010. These keywords included the following terms: 'Mediterranean lifestyle', 'Mediterranean diet', 'Mediterranean pyramid', 'low-risk health behaviours', 'lifestyle behaviours', 'sustainable lifestyle', 'conviviality', 'commensality', 'communal meals', 'cooking skills', 'home food preparation', 'physical activity', 'leisure-time physical activity', 'sleep pattern', 'siesta', 'socialisation' and 'social interaction'. These keywords were searched in various combinations with keywords relevant to wellness dimensions, such as 'wellness', 'physical wellness', 'non-communicable diseases', 'chronic diseases', 'lifestyle diseases', 'health outcomes', 'health promotion', 'social wellness', 'environmental wellness', 'intellectual wellness', 'spiritual wellness', 'emotional wellness', 'occupational wellness' and 'financial wellness'. Further filters were applied during the search of literature databases including, apart from the publication dates mentioned above, limitations regarding the article types, the text availability and the species studied. More precisely, with respect to article types, only clinical trials, controlled clinical trials, meta-analyses, prospective studies, randomized controlled trials, reviews and systematic reviews were included in the present work. Additionally, only free full texts and studies conducted in human subjects were reviewed. Another limitation was the publication language, since only English-language publications were reviewed. The primary outcome of the reviewed literature was focused on the effect of at least one component of the ML on wellness parameters and more specifically on physical, social and environmental dimensions of wellness.

Inclusion criteria

The reviewed publications were eligible for inclusion in the present narrative review if: (i) they assessed at least one component of ML in their design with respect to wellness parameters and mainly physical, social and environmental wellness; (ii) they evaluated adherence to the Mediterranean dietary pattern using a validated *a priori* index in the case of prospective cohort studies; (iii) they assessed ML by using a combination of its components and explicitly mentioned the elements studied; and (iv) they had as primary outcome any dimension of wellness, with a special focus on physical, social and environmental wellness.

Results

Mediterranean diet and its health impact

The MD is so unique because its composition is not the result of dietary guidelines. Instead, the food choices defining this diet accrued from the regional availability of food resources which, in turn, dictated their spontaneous consumption in the countries of the Mediterranean basin. Hence, the MD was not constructed to serve health-promoting beliefs. On the contrary, the evidence-based

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beneficial effect of this diet on various chronic diseases led to the establishment of the dietary guidelines Mediterranean people are advised to adhere to. Notwithstanding, compliance with the MD has been proved to be effective even among non-Mediterranean populations[8–11], in terms of chronic disease prevention. As a case in point, in their recent review Mocciaro *et al.*[12] proposed that higher degree of adherence to the MD from populations outside the Mediterranean region holds the potential to ameliorate some cardiometabolic parameters, although the inconsistent MD definition and the lack of a sufficient number of studies in non-Mediterranean populations do not allow for conclusive results, necessitating further research. In line with this are findings derived from racial/ethnic minority groups demonstrating that compliance with the MD can confer cardiometabolic benefits, given the incorporation of certain cultural adaptations to enhance feasibility and, thus, adherence among non-white, non-Mediterranean populations[13]. Since the Mediterranean-style dietary pattern is promoted as one of the healthiest dietary patterns on a global scale, as its inclusion in the 2015–2020 Dietary Guidelines for Americans reveals[14], it is of imperative importance to conduct further research in order to confirm its efficacy in non-Mediterranean populations and implement cultural adaptations that might facilitate compliance.

It is noteworthy that there is no one MD, but as many as the number of countries bordering the Mediterranean Sea, with each variant mirroring the sociocultural differences and food variations present in each region. Despite the variations of the Mediterranean-type dietary patterns, though, there are some commonalities shared by all of them that characterize, in general, this healthy dietary pattern. The Mediterranean-style diet is often described as a plant-based dietary pattern, focusing on the intake of whole grains, fruits, vegetables, legumes, nuts and seeds. The intake of fish and seafood, and of dairy products in the form of cheese and yoghurt, is moderate, while the ingestion of poultry, red meat, refined grains and sugars is quite limited, giving it a low saturated fat content. Also, at the core of the Mediterranean pyramid stands olive oil, constituting the main added culinary fat, and alcohol, mainly in the form of wine, which is consumed in moderate amounts during meals[7].

Adherence to the principles of the MD has been linked to enhanced mental and physical health[15], living longer without adverse health implications[16] and decreased mobility deterioration among the elderly[17]. Also, adoption of the MD can reduce all-cause[18–22] and specific mortality risk[22]. Moreover, epidemiological evidence suggests that higher compliance with the MD leads to better weight regulation[23–25]. With respect to CVD prevention, higher conformity to the MD can diminish arterial stiffness, whereas it has also been positively associated with beneficial impact on peripheral artery disease, coronary artery disease and chronic heart disease[26]. Besides, increased MD adherence is efficient in attenuating arrhythmias and, thus, preventing sudden cardiac death[26]. Also, it has been shown that, among premenopausal women free of CVD at baseline, those adhering the most to the MD were less likely to be obese and have low ankle-brachial index, which is indicative of peripheral artery disease. The antioxidant content of foods typical of the MD was shown to sturdily contribute to this protective effect and predict reduced occurrence of asymptomatic atherosclerosis[27]. The recent 18-year follow-up of the Seguimiento Universidad de Navarra (SUN) cohort yielded results that are in agreement with previous epidemiological studies as it was demonstrated that greater degree of adherence to the MD protects against all-cause mortality, CVD events, type 2 diabetes mellitus (T2DM), weight gain, metabolic syndrome (MetS), depression, cognitive failure and the development of kidney stones, whereas it might be positively associated with fertility[28]. It is of note that those complying the most with the principles of the MD had lower heart rate and were protected against CVD and T2DM even in the presence of overweight/obese state[28]. These findings have been corroborated by interventional studies demonstrating that increased adoption of the MD effectively attenuates BMI measures[29,30] and prevents central adiposity[31]. Further, greater adherence to the MD protects against CVD[18–21,32–34], even in the presence of well-documented CVD risk factors[18,19]. A recent meta-analysis of observational studies has demonstrated that people with the highest conformity to the MD are protected against CVD events and mortality by 24 %, whereas protection against incident CHD, myocardial infarction and stroke reaches 28, 33 and 34 %, respectively[34]. Intriguingly, it was shown that the consumption of olive oil, legumes, fruits and vegetables decisively contributed to these protective trends, and the protective impact was even greater when findings from clinical trials were included in the analysis[34]. Also, regarding MetS, another well-established cardiometabolic risk factor, compliance with the MD has been shown to improve the abnormalities typical of this intricate entirety, leading to substantial remission of the syndrome[25]. Additionally, people following the MD have reduced likelihood to develop T2DM when in a prediabetic state or they can ameliorate features of the disease, including MetS remission, body weight and lipid profile[25,35], and they show improved glycaemic regulation[25,36,37]. Additionally, greater degree of adherence to the MD has been shown to protect against total cancer mortality and incidence of several malignancies[38]. More precisely, in their meta-analysis, Schwingshackl and Hoffmann[38] have indicated that those adhering the most to the MD had decreased possibility to die from any malignancy by 13 %, whereas protection against colorectal, breast, gastric, prostate, liver, head and neck, pancreatic and respiratory cancer reached 17, 7, 27, 4, 42, 60, 52 and 90 %, respectively.

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Another prominent feature deeply embedded in the entirety of the traditional Mediterranean dietary pattern is that of alcohol intake, primarily in the form of red wine, which is consumed in moderate amounts, translated into 1 glass for women and 2 glasses for men, always accompanying meals[7]. Interestingly, red wine is conceived to be one of the three pillars of the MD along with bread and olive oil. This alcohol drinking pattern has long been associated with favourable health outcomes, with the J-shaped relationship between moderate alcohol intake and mortality risk, indicated firstly from Di Castelnuovo *et al.*[39], paving the way for future studies corroborating the beneficial impact of modest alcohol consumption on health. Specifically, moderate alcohol intake ameliorates biomarkers related to CHD[40], but also several CVD-associated outcomes, such as CVD and CHD mortality, and incident CHD, with light-to-moderate drinkers having lower risk relative to non-drinkers[41]. Additionally, it has been shown that moderate red wine intake can reduce the LDL-cholesterol:HDL-cholesterol ratio among patients with carotid atherosclerosis receiving statins by 13 %, independent of other lifestyle changes including adherence to MD and physical activity[42].

Although meta-analytic findings have challenged the protective effect of sensible alcohol intake, suggesting that light alcohol intake does not protect against CVD mortality relative to lifetime abstinence or occasional drinking[43], more recent studies do not corroborate these findings. For instance, among non-drinkers with well-controlled T2DM who followed a MD, those assigned to drink 150 ml of wine during dinner for 2 years had similar visceral and subcutaneous adiposity measurements to their counterparts who had mineral water instead of wine[44]. Interestingly, the modest reduction in abdominal adiposity was correlated with a reduction in the value of glycated Hb, implying that some dietary components of the MD might affect visceral fat distribution[44]. In the context of the same cohort, another sub-study using the same intervention showed that after 6 months of daily moderate wine intake, previous non-drinkers with well-controlled T2DM had similar 24 h blood pressure measurements to their controls receiving mineral water[45]. However, further analyses revealed that those participants being homozygous for the variant of alcohol dehydrogenase enzyme that characterizes fast ethanol metabolizers had reduced systolic blood pressure and pulse pressure, in comparison with those being heterozygous or homozygous for the variant characterizing slow ethanol metabolizers[45], implying that genetic background might be involved in the effect of alcohol intake on health status. Further, data stemming from a recent nutrigenomic trial demonstrated that daily moderate intake of red wine alone or in combination with either a Mediterranean or a high-fat meal can improve oxidative and inflammatory state, inextricably intertwined with the non-communicable disease epidemic, by upregulating genes with antioxidative and anti-inflammatory capacity, namely catalase, superoxide dismutase 2 and glutathione peroxidase 1, or by attenuating oxidized LDL concentration and, thus, providing protection against atherosclerosis[46].

The lifestyle dimension of the Mediterranean diet and its health-related implications

Moderation and frugality

Moderate, frugal and sensible consumption of various foods constitutes the cornerstone of the traditional MD, playing a critical role in the health benefits this diet is considered to bear. Nevertheless, portion size is not explicitly defined, but it is believed that it should be adjusted to the special needs of each Mediterranean population or individual[7]. Notwithstanding, the updated Mediterranean pyramid provides combined information about the frequency and the recommended number of servings consumed per food group[7], with the rationale behind the emphasis on moderate and frugal consumption being especially stressed due to the epidemic dimensions of obesity[7]. Generally, the food groups occupying the lowest levels of the pyramid are recommended to be consumed more frequently and in higher amounts, compared with the foods at the upper levels of the pyramid. This pictorial representation serves another scope; foods that are suggested to be consumed frequently are those providing modest amounts of energy, while offering enhanced feeling of satiety. Contrariwise, foods located at the upper layers of the pyramid and suggested to be consumed rarely are more energy-dense[7]. Interestingly, in the spirit of the updated Mediterranean pyramid, a new serving score has been developed, namely the Mediterranean Dietary Serving Score (MDSS), to evaluate the adherence to the MD on the grounds of the proposed food servings and food groups intake per meal, day and week, and its validation has revealed its potential to effectively discriminate between adherents and non-adherents, with age greater than 60 years, low BMI and no snack consumption in between meals emerging as strong predictors of MD compliance[47].

Conviviality

Meal consumption is a special occasion for Mediterranean people featured by the element of warmth, friendliness and the general sense of belonging that picture the convivial character of food intake and render it a matter of social and cultural identity. The joy shared meals offer is of prominence within the ML and constitutes a feature that is not emphasized in other dietary patterns, no matter how healthy they are considered.

It has been demonstrated that shared meals with family members are robustly associated with the maintenance of a healthy weight, better eating habits and dietary choices, as well as fewer possibilities to report eating disorders among children and adolescents[48]. The first meal-focused randomized controlled trial, the HOME Plus study, examined the impact of family meals on excess weight gain among 8–12-year-old children[49]. It was demonstrated that sharing

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meals in the presence of family members did not significantly affect the BMI *Z*-scores of the children allocated to the intervention group, compared with their counterparts who did not have family meals. None the less, albeit the moderate decrease of excess weight gain reported post-intervention, this was maintained 21 months later, at the follow-up[49]. Fulkerson *et al.*[49] estimated that the effect of their intervention on excess weight gain could be translated into 0·18 and 0·22 kg less than the predicted average weight gain for a normal-weight and overweight 9-year-old child, respectively. Interestingly, in the case of an overweight child of that age, the decrease in excess weight gain would result in a normal weight post-intervention. Likewise, the corresponding decreases for a normal-weight and overweight 11-year-old child could be translated into 0·24 and 0·30 kg less than the predicted average weight gain post-intervention. Additionally, *post hoc* analysis based on pubertal onset revealed that the BMI *Z*-scores were significantly decreased only among the prepubescent children[49].

Culinary activities

Personal involvement in cooking practices comprises one of the lifestyle dimensions accompanying consumption of the MD. This dietary behaviour is of major importance and holds significant health-promoting potential, especially among children, since it has been shown that the involvement of children in their meal preparation can increase not only their vegetable intake, but also feelings of valence and dominance[50]. Likewise, a 12-week intervention in children combining promotion of cooking skills with nutrition and gardening revealed that, compared with the control group, children attending the programme increased their fibre intake and decreased their diastolic blood pressure, whereas the overweight participants in the intervention group gained less weight, relative to their control counterparts[51]. A 10-week cooking skills programme in adults reduced weekly fast-food consumption and increased home-based convivial meals, cooking satisfaction and the skill to prepare meals using low-cost basic ingredients in short time[52].

A decline in engagement in culinary activities has been reported, partly attributed to time limitations and other lifestyle duties, as well as culinary illiteracy, financial constraints and insufficient proximity to sound food choices[53]. It is of note, though, that perceptions about what cooking actually is differ widely and range from cooking from scratch, to any homemade food, including partly or fully pre-prepared meals, but also just heating a microwaveable package[54]. However, albeit convenience foods are highly used, there is unanimity regarding the superiority of the cooking-from-scratch practice[54].

Traditionality, locality, seasonality, biodiversity and eco-friendliness

In the traditional ML, respect to natural resources and their seasonal rotation is of major importance. Opting for seasonal products can boost the local economy, since their purchase is promoted given their lower cost, compared with the imported ones, which have additional travel and storage costs. Also, imported products need to undergo long storage to be suitable for distribution all year round and, given that fresh products are susceptible to rotting, imported and long-stored produce is processed to remain acceptable to consumers[7]. However, both transport and storage affect negatively the nutrient content of foods. In addition, locally grown products are delivered to local markets shortly after their harvest and sold within a few hours. This results in top-notch quality products, which preserve their freshness and flavour. Accordingly, the adoption of traditional agricultural practices that are congruous with seasonality principles maintains special characteristics of local species and preserves the biodiversity of both plant- and animal-derived species. Therefore, compliance with seasonality standards is robustly and positively correlated with the attribute of eco-friendliness. Moreover, dietary patterns emphasizing mainly plant-derived foods are considered to have low carbon footprint and, thus, contributing to environmental conservation. Finally, the preference for locally grown products reinforces biodiversity due to the fact that farmers aiming to sell their produce locally pay more attention to palatability and diversity, rather than to durability or loading efficiency[7]. This lifestyle trait of the MD is congruent with the environmental feature of wellness embracing the harmonic coexistence of man and the natural environment.

Physical activity in the Mediterranean lifestyle

Another component of the ML notably stressed is that of physical activity, highlighted mainly as a feature of daily life which is not necessarily structured. Special attention is given to the domains of physical activity related to active transportation, leisure-time physical activity, and activities performed both in the house and at the workplace, i.e. lifestyle tasks[7]. Additionally, physical activity is performed in open places in the presence of other people, giving in this way the quality of conviviality and positive socialization to this key lifestyle feature. None the less, albeit the human body is structured to move, inactivity is a real concern; the WHO reports that in 2008 about one-third of the global population older than 15 years did not perform adequate levels of physical activity, highlighting physical inactivity as the fourth mortality risk factor worldwide[55].

Several studies have demonstrated the health benefits related to lifestyle physical activity in terms of premature total mortality, CVD, stroke, hypertension, T2DM, cancers of the colon and breast, but also osteoporosis[56]. Epidemiological evidence pinpoints that people engaged in outdoor recreational activity have decreased 13-year CVD mortality risk, compared with those who are not engaged in outdoor leisure-time physical activity, independent of 25-hydroxyvitamin D levels, which are positively associated with sun exposure[57]. Increasing frequency of

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outdoor recreational activity was associated with greater reductions in CVD mortality risk, with those accumulating 1–4 times, 5–12 times, 13–30 times and ≥30 times of involvement in a number of leisure-time physical activities on a monthly basis having 28, 36, 30 and 37 % abated CVD mortality risk, respectively[57]. According to the American College of Sports Medicine and the American Heart Association, adults free of disease are advised to engage in aerobic physical activity of moderate or vigorous intensity for at least 30 min on 5 d/week or at least 20 min on 3 d/week, respectively[58]. Engagement in leisure-time physical activity, even in amounts smaller than the recommended, has been shown to decrease 14-year mortality risk by 20 %, whereas the protective effect reaches 31 % for the recommended minimum[59]. Interestingly, there seems to be an upper limit for mortality benefit at performing leisure-time physical activity equal to 3–5 times the recommended minimum, i.e. 39 %[59]. Additionally, regardless of BMI categorization, increasing engagement in leisure-time physical activity has been linked to increasing life expectancy among middle-aged adults, compared with those who do not participate in leisure-time physical activity[60]. Notably, when a normal BMI was combined with a moderate amount of leisure-time physical activity and compared with no leisure-time physical activity and obese status, it was shown that years of life gained climbed to 7·2[60]. Furthermore, increased moderate-to-vigorous leisure-time physical activity has been proved effective in decreasing the likelihood of MetS incidence by 23·5 % and it has been associated with MetS remission by approximately 30 %[61]. Also, increased total amount of leisure-time physical activity has been related to improvements in several MetS components, namely hyperglycaemia, hypertriacylglycerolaemia and low HDL-cholesterol[61]. Moreover, the effective impact of moderate-to-vigorous leisure-time physical activity has been evident on the mitigated incidence of several cancers, such as colon, rectal and liver cancer, among others[62].

Adequate rest and the Mediterranean sleep pattern

Sleep has emerged as a crucial contributor to good health and wellness and Mediterranean countries have a special tradition revolving around adequate rest. In the context of ML, sleep pattern is translated into adequate rest both in the form of nocturnal sleep and short daytime naps, mainly after lunch[7,63].

Although there is a great volume of research referring to the health outcomes of short or long sleep duration, there is a scarcity of studies focused on sleep patterns including both night and daytime sleep. Epidemiological data reveal that sleeping more than suggested by guidelines was strongly correlated with greater possibility of mortality, compared with normal amount of sleep[64,65]. Also, it was demonstrated that, among habitual midday nappers, those who slept longer at night-time had 38·5 % increased risk of all-cause mortality, whereas shorter nocturnal sleep tended to display a protective effect against overall death events[64]. However, for the non-habitual daytime sleepers, inadequate sleeping duration during the night emerged as a risk factor for total mortality reaching 51 %[64]. A recent meta-analysis demonstrated that both short and long sleepers have increased risk of overall death events by 7 and 33 %, respectively, whereas long sleepers are 43 % more likely to die from CVD implications, compared with those sleeping normal hours[66].

Concerning solely the health impact of siesta, within an Anglo-Saxon population free of disease at baseline, it was observed that those sleeping during daytime were more likely to die from any cause, with the risk being stronger for respiratory diseases-related mortality and aggravated when the duration of napping exceeded an hour[67]. Furthermore, regarding midday nappers, the meta-analysis of da Silva *et al.*[66] showed that those sleeping at least half an hour per day had 27 % increased probability to die from any cause, relative to those not engaged in the practice of siesta. However, no such association was detected for those sleeping at least 2 h during the daytime.

Regarding obesity, findings from the SUN cohort study have revealed that, in a population free of disease at baseline, a decrease in habitual sleep increased the incidence of obesity by 94 %, compared with sufficient sleeping hours[63]. Importantly, this correlation appeared to be even more robust among male individuals and those who had weight gain problems in the past. On the other hand, the practice of midday napping lasting half an hour on a daily basis was associated with decreased likelihood of obesity onset by 33 %, relative to no siesta[63]. Moreover, there is epidemiological evidence indicating that those being engaged frequently in the siesta practice are more likely to develop T2DM by 86 %. However, the magnitude of this trend was attenuated and lost statistical significance when adjusted for BMI, implying that the link between habitual daytime sleep and incident T2DM is mediated by obese status[68].

Therefore, it is important to assess the total number of sleeping hours throughout the day and not only the separate effect of night-time or daytime sleep when investigating the impact of sleep on health outcomes[64]. Additionally, age- and ethnicity-related differences, but also sleep disturbances should be considered in studies aiming at deciphering the impact of sleep and sleep patterns on human health. Nevertheless, given the inconsistency of available literature regarding the health impact of midday napping, more research is needed to draw conclusive inferences.

Health benefits of social involvement

Another highly representative feature of ML is the vivid participation in collective activities and the establishment of intimate social relationships. Possibly because of the favourable weather conditions and the extended exposure to sunlight, people in the Mediterranean region tend to gather more

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Table 1 Main findings regarding Mediterranean lifestyle (ML) research and wellness

ML lifestyle could be described as a healthy way of living focused on a plant-based diet characterized by moderation, seasonality, participation in culinary activities and commensality, but also daily physical activity, adequate rest and active social involvement
Greater compliance with the principles of the MD predicts improved physical wellness by mitigating the risk of incident CVD, even in the presence of overweight/obesity, and all-cause mortality
Higher conformity to the MD can protect against other chronic conditions that constitute CVD risk factors, such as body weight increase, T2DM, MetS and heart rate
Typical foods of the MD, such as fruits and nuts, appear to mediate this protective effect
Lifestyle dimensions of food consumption, such as commensality and personal involvement in meal preparation, have been linked to better dietary habits and anthropometric measurements
Convivial leisure-time physical activity, like that promoted in the ML, can boost physical and possibly social wellness
Sleep pattern is emerging as a critical component of overall health affecting cardiometabolic factors, anthropometric indices, glycaemia and mortality risk
Understudied elements of the ML lifestyle are those of eco-friendliness and social life that could add to the overall protection against lifestyle chronic diseases, but also to other aspects of wellness, such as environmental, social, intellectual and emotional wellness
Wellness components such as spiritual, intellectual, emotional, occupational and financial wellness are hard to assess and are constantly neglected across lifestyle studies
ML-focused studies are inconsistent regarding the lifestyle features they include and the way these are assessed
ML, if explicitly defined and appraised, could provide a targeted and holistic approach to address chronic diseases and promote wellness

MD, Mediterranean diet; T2DM, type 2 diabetes mellitus; MetS, metabolic syndrome.

often away from home and be engaged in outside activities. Provided that social ties have been associated with the risk of morbid state and death rate, it has been speculated that a possible mechanism responsible for this is the way a positive or negative social interaction affects CVD responsiveness. Intriguingly, Carlisle *et al.*[69] have shown that even when interaction with adverse social partners is about to begin, diastolic blood pressure increases; furthermore, feelings of threat and loss of control increase because of the imminent stressor, whereas stress-induced heart rate and respiratory disturbances are aggravated.

Studies on the effect of the Mediterranean lifestyle on human health

Albeit substantial evidence exists on the effect of individual components of the ML (e.g. physical activity, nutrition) or combinations of them on human health, studies assessing the ML in a holistic way are limited.

Epidemiological findings demonstrate that compliance with a group of ML components is associated with a significant protective effect against 20-year overall mortality rate among younger and older adults, reaching 56 and 73 % for adoption of two and three low-risk factors, respectively[70]. It is noteworthy that this healthy lifestyle appeared to be efficient even among a US population in terms of all-cause mortality prevention, with those following it to a greater extent displaying 73 % decreased risk of dying from any cause, relative to those refraining from all the relevant healthy habits[8]. It is of alarming significance that in this population about one-third of the recorded deaths could have been prevented if compliance with the ML had been achieved[8]. Also, all-cause mortality has been shown to be delayed by 8·4 years in men and 15·1 years in women complying with the elements of the ML, when compared with the non-compliants[11]. Moreover, adherence to a combination of ML behaviours has been associated with at least 2 years of prolonged survival while maintaining an optimum health status, compared with non-adherents[10]. Finally, evidence derived from the MORGEN prospective study has confirmed the efficacy of a ML in the primary prevention of an amalgamation of CVD outcomes, both fatal (67 %) and non-fatal (57 %)[9]. When the variable of adequate sleeping hours was incorporated into the entirety of the ML, the protection against fatal and non-fatal CVD events reached 83 and 65 %, respectively, among compliants, relative to non-compliants[9]. These findings are of great value, since that study was the first to embody in the ML entity the feature of sleep, which is a significant risk factor for morbidity and mortality and is usually neglected in ML studies. Additionally, adherents to all the low-risk factors composing the ML are less likely to experience a recurrence of CHD or mortality by 62 and 59 %, respectively, compared with the non-adherents[71]. A new population-based study is under way, namely the Mediterranean healthy Eating, Ageing, and Lifestyle (MEAL) study, which is focused on a constellation of lifestyle behaviours, such as eating patterns, tobacco use, physical activity, behaviours revolving around food consumption, sleep pattern, exposure to sunlight, social ties and perceived stress[72]. Findings derived from the MEAL study will help enrich our current knowledge and understanding about how adherence to multiple features of the Mediterranean way of living or even the divergence from them can affect health status and wellness[72].

Main findings regarding ML lifestyle research and wellness are summarized in Table 1.

Discussion

Chronic diseases are of multifactorial aetiology and strongly affected by the general lifestyle, necessitating multifactorial approaches for their treatment. Additionally, since high-risk

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factors tend to congregate in the population[73], multifaceted interventions aiming at a host of different lifestyle behaviours are warranted. Besides, there is unanimity regarding the enhanced protective effect observed when several low-risk lifestyle habits are combined[4,8,9,70,71,74]. A holistic way that could be employed to address such a challenge is the healthy ML that, although not explicitly and consistently defined, could be viewed as a healthy way of living, focused on a plant-based diet, daily physical activity, a sleep pattern that allows for adequate rest, active social participation, as well as practices revolving around food consumption featuring the preference for seasonal and eco-friendly products, but also moderation, personal involvement in meal preparation and commensality.

The special features of ML distinguishing it from other healthy lifestyles are mainly the predominance of olive oil as the main added culinary fat, in an otherwise plant-based diet, conviviality, high social interaction and the pattern of sleep. Research findings assert the protective role of the ML against all-cause and specific mortality, but also morbidity. Van den Brandt[11] has shown that conformity to the ML may be more advantageous to women, compared with men, in terms of all-cause mortality prevention, suggesting a gender-specific response to a healthy way of living. Furthermore, regarding disease-specific mortality, living a ML has been associated with decreased risk of CVD mortality by 59–67 %[9,71]. In the MORGEN study, when adequate sleep was added to the four traditional low-risk lifestyle factors (i.e. sufficient physical activity, sound dietary habits, sensible alcohol intake, no tobacco use), the protective effect against CVD mortality climbed to 83 %, compared with 67 %[9].

Notwithstanding, there are certain limitations in the lifestyle studies already conducted centred on the Mediterranean way of living. Albeit relatively limited in number, the studies that have been performed so far differ in their design regarding the features they encompass to control conformity to this lifestyle. Hence, studies present a great degree of heterogeneity with each other, since they investigate various combinations of lifestyle components[8–11,70,71]. Except for the component of MD which is omnipresent in all ML studies, the majority of them have two more features in common, namely regular physical activity and no tobacco use[8–11,70,71]. However, this is not a representative depiction of this healthy lifestyle. Even among studies that include the same lifestyle parameters, the way these parameters are defined and assessed varies significantly. For instance, there is great variation in the tools used to assess adherence to the MD. Further, although physical activity engagement is traditionally conceived as the kind of physical movement performed during leisure time, in some studies it has the character of a planned, structured and repetitive exercise workout, or the amount and type of exercise suggested by health and sports-related organizations[8,9]. Another concern is that a considerable volume of studies incorporates anthropometric measures in the host of features delineating the compliance with the ML[8,10,11,71]. However, a favourable or no anthropometric measure cannot be viewed as part of a healthy lifestyle; instead, it could be regarded as an outcome of adhering to such a lifestyle. Therefore, this inconsistency across the literature does not allow for an efficient and accurate comparison of the available evidence.

Additionally, the feature of sleep, which plays a crucial role in the maintenance of health, is neglected, with only one ML-based study accounting for it in its design[9]. Intriguingly, the fact that the addition of sleep measures to other lifestyle factors showed an enhanced protection against CVD incidence[9] highlights the necessity to incorporate sleep in lifestyle studies. However, the potential beneficial impact of adequate sleep on health has also been demonstrated in the HUNT study, showing that those sleeping neither too much nor too little were less likely to die from any cause by 13·8 %[74]. These findings pinpoint the significance of sleep duration in maintaining and achieving wellness by preventing both mortality and morbidity and are in line with the current trends in lifestyle-focused research supporting that the inclusion of sleep improves the predictive potential of lifestyle indices[73].

Other lifestyle factors inextricably linked to everyday life that are highly omitted from the design of such studies are social involvement and the number of sitting hours. None the less, the advantageous health impact of social interaction has been indicated in the HUNT study, where social engagement emerged as a crucial risk factor, with those reporting poor social interaction being 41·4 % more likely to die from any cause[74]. Moreover, while the factor of physical activity is included in every lifestyle study, Mediterranean or other, only one of them has accounted for the number of sitting hours spent during the day. Again, in the frame of the HUNT study, increased number of sitting hours was positively associated with all-cause mortality by 38·7 %[74].

Additionally, cultural elements which have contributed significantly to the configuration of the ML are systematically neglected and either underestimated or hardly assessed and, thus, omitted from ML studies. These special cultural signatures include the convivial character of meal consumption, personal involvement in meal preparation, and the combination of seasonality, traditionality, locality and, hence, eco-friendliness of the MD, which decisively confer to a sustainable lifestyle and could further corroborate any health benefits demonstrated heretofore if added to the other well-established protective lifestyle behaviours.

The major strength of the present narrative review is the attempt to summarize the most recent literature, conducted during the last nine years, regarding the impact of all features of the ML on wellness, with a special focus on its physical, social and environmental dimensions. To the best of our knowledge, there is no other review aiming at gathering evidence on the efficacy of all possible aspects of the

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Fig. 1 Impact of Mediterranean lifestyle (ML) adherence on several wellness parameters. Solid arrows show that there is well-founded scientific evidence regarding the beneficial effect of adhering to at least one feature of the ML and the respective wellness dimension. Dashed arrows show that evidence is completely missing, or it is scarce, warranting further research to reach conclusions

ML in wellness achievement. Another strength of the narrative review is the type of publications included, since only prospective cohort studies, interventional studies, meta-analyses and reviews of those were reviewed. However, some of the strengths of the present review have also served as limitations. More specifically, the exclusion of studies conducted earlier than 2010 and those of cross-sectional design limited the extent of the reviewed literature regarding some elements, such as socialization and lifestyle dimensions of food consumption. Additionally, since there is no single or clear definition of what the ML is comprised of, it is communicated and evaluated in various ways across the literature making it difficult to reach conclusive results regarding its potential benefits in overall well-being. Besides this, not all wellness parameters have been equally investigated so far with respect to their association with the adoption of a healthy lifestyle. The ones that have been mostly studied are those of physical, social and environmental wellness, leaving emotional, spiritual, intellectual, financial and occupational wellness poorly addressed (Fig. 1). None the less, these factors are critical to overall well-being and the impact of lifestyle behaviours on them cannot be neglected. Therefore, new tools evaluating these wellness components should be developed and incorporated in future ML-centred studies to enrich our current knowledge in the field and help leverage new approaches to combat modern lifestyle diseases.

Conclusion

In conclusion, ML could emerge as a tool of critical value to holistically address non-communicable diseases and premature mortality. However, to assess its potential to effectively prevent or delay such health-related outcomes, it has to be defined and evaluated in a systematic way across literature. The manner ML is communicated in current studies does not differ from that of a generally accepted healthy lifestyle and so do the health benefits accrued from its adoption. However, traditionally conceived low-risk factors, such as compliance with a healthy diet, frequent engagement in physical activity, moderate alcohol intake and smoking abstinence, are not enough to compose a comprehensive and holistic way of living, capable of promoting wellness. ML, if thoroughly and accurately evaluated, can provide a more targeted and undoubtedly holistic perspective to achieve wellness, primarily with respect to its physical, social and environmental dimensions.

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