Aging and Health Research 1 (2021) 100015

Contents lists available at ScienceDirect

Aging and Health Research

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

Healthy aging in the context of the Mediterranean diet–health-environment trilemma

Stefania Maggi[a], Domenico Rogoli[a,b], Fiona Ecarnot[c,d,*]

[a] CNR Aging Branch-NI, Via Giustiniani, 2, 35128 Padua, Italy
[b] Mediterranean Diet Foundation, Ostuni BR, Italy
[c] Department of Cardiology, University Hospital Besancon, 25000 Besancon, France
[d] EA3920, University of Burgundy Franche-Comté, 25000 Besancon, France

ARTICLE INFO

Keywords:
Health
Diet
Environment
Mediterranean diet
Sustainability
Pollution

ABSTRACT

Successful aging results from a lifetime of interaction between a range of factors, including those that are inherited (age, genetics), and those related to lifestyle (diet, exercise). In this brief communication, we examine the role of the Mediterranean-style diet in human health. Diet is one of the major pillars of healthy aging, and accumulating evidence supports the health benefits of the Mediterranean diet. We also discuss the lifelong effect of exposure to environmental pollution. Thus, there is an intricate relationship between health, diet and environment, which together represent a trilemma that must be addressed with a holistic, life-course, population-level approach.

Introduction

Individual health and lifestyle choices may create fertile ground for disease to develop. However, social, environmental and biological factors also jointly influence health. A life-course approach to health involves preventing and controlling diseases at key stages of life, from preconception to adulthood. Non-communicable diseases (NCDs) and disability share common risk factors whose combined presence over the life-course may initiate disease and/or disability in later life, namely poor diet, physical inactivity, environmental pollution, etc. These exposures over the cumulative life-course contribute to an increasing burden of ill health, justifying the need for effective prevention strategies.

The role of the Mediterranean diet in human health

Among the many lifestyle determinants of later health, one of the major pillars of healthy aging is diet. Among the oldest dietary patterns ever described is the Mediterranean diet, an umbrella term that actually encompasses a wide range of diets common to several countries around the Mediterranean basin, which share certain common features but also present wide variety in the actual composition. The whole could more correctly be described as a dietary pattern (DP). The Mediterranean DP is recognized as the healthiest lifestyle by UNESCO and the Council of the European Union, and recommended by the US Department of Health in its *Dietary Guidelines for Americans 2015–2020* [1]. It is of vital importance to implement these recommendations at national level in every country as an investment in the future health of the population, since societal and economical changes have revolutionized our lives in the last few decades, and moved away from traditional family structures and working patterns. This has led to a "westernization" of DPs, with a greater tendency to eat quick meals while working, or looking at a telephone, and less adherence to the traditional model of family dining, with its associated communication and conviviality, resulting in an overall decline in adherence to the Mediterranean dietary pattern [2]. The defining features of the Mediterranean DP are shown in Fig. 1. But there is more to the Mediterranean DP than just the foods that are ingested. The Mediterranean DP also includes socio-cultural aspects such as the conviviality of dining together with friends and family, and local environmental considerations, such as seasonality of foods, use of locally produced goods, and biodiversity in line with local agricultural conditions.

There is an abundant literature attesting to the beneficial effects of a Mediterranean DP on various diseases [3]. In a systematic review, Barbaresko et al. found convincing evidence that meat-based DPs tended to be positively associated with markers of inflammation, while DPs rich in fruit and vegetables showed an inverse relationship [4]. They reported that this finding was particularly well supported by intervention studies investigating the Mediterranean diet, and this is in line with strong evidence that the Mediterranean DP is a powerful tool to counteract inflamm-aging and its consequences [5]. While *ad hoc* adjustments to diet targeting one or several nutrients can be helpful in reducing inflammation, the best evidence indicates that it is the overall DP that is

* Corresponding author at: Department of Cardiology, University Hospital Besancon, 25000 Besancon, France.
E-mail addresses: stefania.maggi@in.cnr.it (S. Maggi), fiona.ecarnot@univ-fcomte.fr (F. Ecarnot).

https://doi.org/10.1016/j.ahr.2021.100015
Received 7 December 2020; Received in revised form 24 April 2021; Accepted 26 April 2021
Available online 2 May 2021

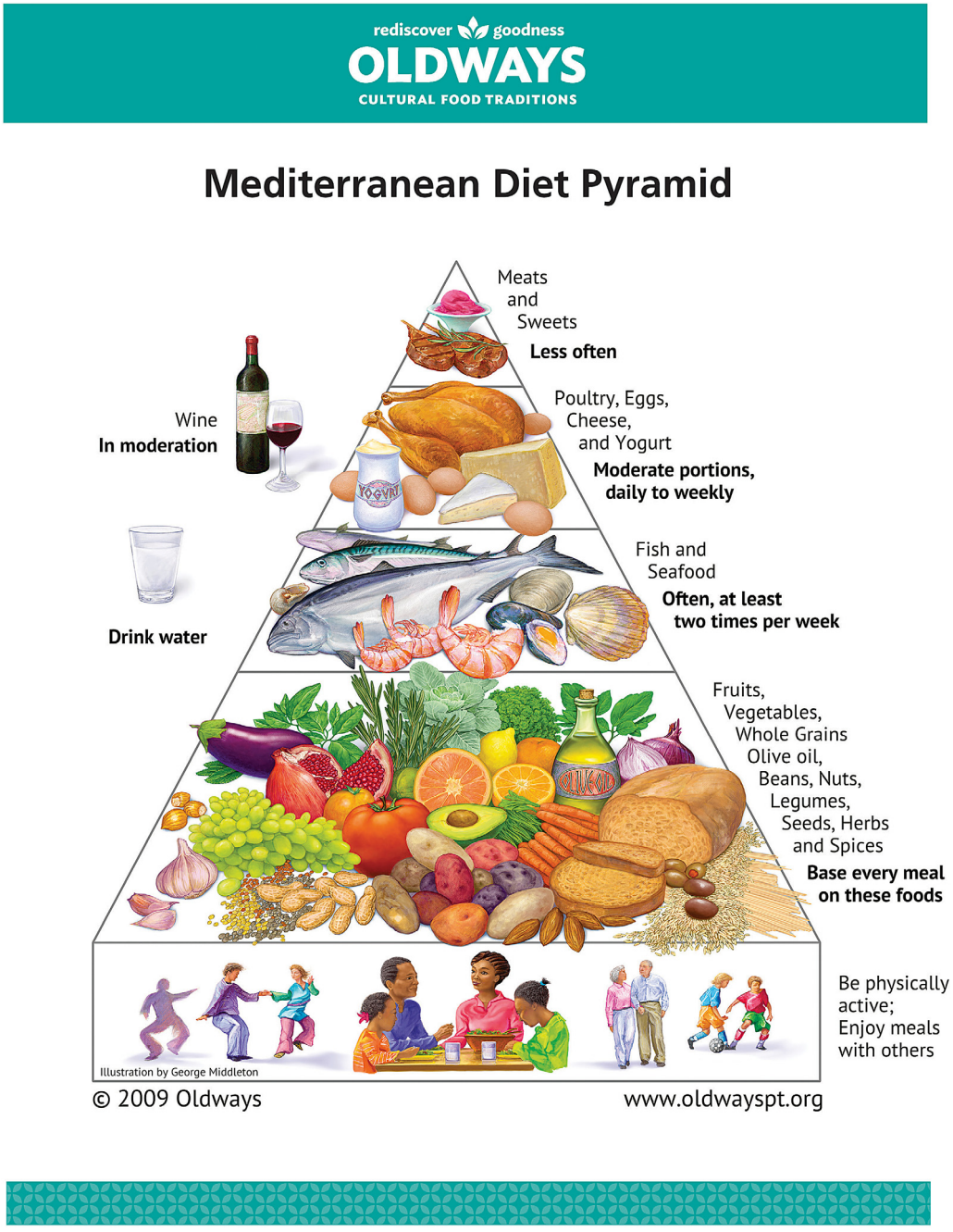

Fig. 1. Defining Features of the Mediterranean Dietary Pattern.
Reproduced with permission from Oldways, www.oldwayspt.org.

most advantageous in achieving lasting benefits, rather than targeting single components [6]. Indeed, it is true that foods are rarely eaten in isolation, and the cumulative and synergistic effects resulting from interactions between all the nutrients in a DP are greater than the sum of the individual effects of each nutrient. On top of the actual foods eaten, regular exercise is another fundamental tenet of the Mediterranean lifestyle, outdoors in the sunshine where possible.

The sustainability of the Mediterranean diet for the environment

The Mediterranean DP is propounded as the most environmentally sustainable diet, i.e. one that is healthier for the environment as well as the consumer. Indeed, diet, health and environment are intricately linked, in a triumvirate known as the diet-health-environment trilemma [7]. A sustainable diet has a low environmental impact, promotes biodiversity, and optimizes human and natural resources with a view to preserving them for future generations. The intense industrialization of agricultural practices in recent decades, combined with increasing affluence and urbanization has generated exponential rises in demand for animal-source foods, and led to dietary shifts towards less healthy and less sustainable dietary patterns. The production of meat from ruminants produces greenhouse gas emissions between 2000% and 10,000% higher than those produced by plant-based foods, per kilocalorie of food produced [7]. From a health perspective, these dietary shifts are at the root of substantial increases in the prevalence and incidence rates of diet-related diseases, particularly obesity, diabetes, and heart disease [7]. Paradoxically, under-nutrition is also a persistent problem, with over nine million people under-nourished in the Southern Mediter-

ranean in 2001–2003 [8]. From an environmental point of view, current dietary trends are harmful for the environment, with increases in greenhouse gas emissions, fertilizer use, pollution of freshwater and marine ecosystems and reduced air quality [7]. Society and culture also play a major role in dietary trends, with general economic repercussions.

The Mediterranean DP is considered to have a low environmental impact, and therefore be more sustainable, thanks to its emphasis on plant-based foods, consumption of locally produced goods, and preference for products in season, thus reducing the overall carbon footprint of the diet. The development of sustainable diet models at a population or global scale requires awareness among consumers, producers, and governments that agriculture, food, nutrition, health, culture and environment are strongly interdependent. A global modelling analysis reported that a public health approach focused on changing towards plant-based diets could reduce environmental pressures, redress nutrient deficiencies and reduce diet-related mortality [9]. Diets that follow the best evidence on healthy eating would meet sustainability criteria in most regions of the world, would substantially improve population health, and would also have a substantial impact on diet-related environmental pollution [9]. The current COVID-19 pandemic has raised awareness in many countries around the world of the need to be able to guarantee food security using short supply circuits (i.e. locally produced food), as it became painfully clear that heavy reliance on foreign imports can quickly become an untenable position.

Environmental pollution negatively impacts on human health and aging but can be reduced by wider use of the Mediterranean DP

The impact of the environment on human health is well established. Yet, human activity across the world continues to harm the environment day in, and day out, through water, soil and air pollution. Water is the primary purveyor of human health risks [10]. Chronic exposure to air pollution is another environmental factor whose cumulative lifelong effect can lead to unsuccessful aging, chronic disease and frailty [11]. Frail elderly populations are particularly vulnerable, since frailty is characterized by a reduced capacity to respond to environmental stressors. Greater adherence to the tenets of the Mediterranean DP at international level could yield substantial advantages for the environment, due to the sustainability associated with Mediterranean dietary practices. Any benefits for the environment, even small, would accumulate to represent a significant benefit at a planetary level that would in turn have repercussions on human health, on top of the benefits of Mediterranean-type nutrition. With over 400 studies investigating the Mediterranean diet currently registered in ClinicalTrials.gov, future research will undoubtedly provide sound evidence of the benefits of this DP on human health, also through innovative production systems for sustainable agriculture to produce healthy and safe food, in respect of the environment.

Conclusions

In conclusion, the probability of successful aging can be substantially enhanced by adopting good lifestyle behaviours throughout the life-course, notably a Mediterranean DP. This is true not only at the individual level, but also at the population level. In addition, this type of DP, when based on the consumption of locally produced goods, respecting biodiversity and natural and human resources, is most environmentally sustainable, and will enable us to bequeath both good health and a healthy planet on future generations.

Funding

This work received no funding. All authors should confirm that they had full access to all the data and accept responsibility to submit for publication.

Author contributions

Conception: SM; literature review: SM, FE; drafting of the manuscript: SM, DR, FE;

Critical revision of the manuscript: SM, DR, FE; final approval for submission: SM, DR, FE.

Declaration of Competing Interest

No author has any conflict of interest to declare.

References

[1] 2015–2020 dietary guidelines for Americans. 8th Edition. U.S. Department of Health and Human Services and U.S. Department of Agriculture; 2015. Available at http://health.gov/dietaryguidelines/2015/guidelines/ [*Access date*: 29 *September* 2020].
[2] da Silva R, Bach-Faig A, Raido Quintana B, Buckland G, Vaz de Almeida MD, Serra–Majem L. Worldwide variation of adherence to the Mediterranean diet, in 1961-1965 and 2000-2003. Public Health Nutr 2009;12(9A):1676–84.
[3] Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. Am J Clin Nutr 2010;92(5):1189–96.
[4] Barbaresko J, Koch M, Schulze MB, Nothlings U. Dietary pattern analysis and biomarkers of low-grade inflammation: a systematic literature review. Nutr Rev 2013;71(8):511–27.
[5] Martucci M, Ostan R, Biondi F, et al. Mediterranean diet and inflammaging within the hormesis paradigm. Nutr Rev 2017;75(6):442–55.
[6] Romagnolo DF, Selmin OI. Mediterranean diet and prevention of chronic diseases. Nutr Today 2017;52(5):208–22.
[7] Clark M, Hill J, Tilman D. The diet, health, and environment trilemma. Ann Rev Environ Resour 2018;43:109–34.
[8] Dernini S, Berry EM. Mediterranean diet: from a healthy diet to a sustainable dietary pattern. Front Nutr 2015;2:15.
[9] Springmann M, Wiebe K, Mason-D'Croz D, Sulser TB, Rayner M, Scarborough P. Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. Lancet Planet Health 2018;2(10):e451–ee61.
[10] Li P, Wu J. Drinking water quality and public health. Expo Health 2019;11(2):73–9.
[11] Cohen G, Gerber Y. Air pollution and successful aging: recent evidence and new perspectives. Curr Environ Health Rep 2017;4(1):1–11.