Unique features of the Mediterranean food environment: Implications for the prevention of chronic diseases Rh: Mediterranean food environments

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Published online: 28 November 2018
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Introduction

The rising obesity pandemic is a public health priority worldwide [1]. Obesity is associated with an increased risk for non-communicable diseases (NCDs), including diabetes, cardiovascular disease and cancer [1]. In Spain, the prevalence of obesity in adults nearly doubled between 1987 (8.0%) and 2012 (16.5%) [2]. Historically, strategies to prevent obesity have targeted high-risk individuals, showing poor results or lack of improved outcomes [3]. Therefore, it is essential to shift paradigms around the causes of obesity towards a socio-ecological perspective, in which individual dietary behaviors are embedded within broader contextual determinants [3, 4].

At the population level, diet is driven by upstream determinants including food availability, food accessibility and food affordability, which in turn are influenced by agriculture and production policies, marketing and media, urbanization, or culture and social norms [4, 5]. These population diet determinants differ between countries and cultures [6] and have changed over time [7]. These changes have transformed dietary patterns of Mediterranean countries (e.g. Greece), traditionally adhered to Mediterranean diets (high in legumes, fruits and vegetables, and whole grains), which are gradually moving towards a

‘Westernised/Americanised’ diet [8]. In conclusion, during the last decades demographic, economic and social changes have changed traditional food patterns into Western food patterns [1].

Although these urbanization and economic processes are rapidly changing the food supply and distribution systems, many cultural and social differences still exist between the U.S and Southern-European countries (e.g. Spain) regarding the shape and distribution of the food environment [6, 9]. Despite a growing literature on the influence of different aspects of the food environment on diet in Anglo-Saxon countries, there is little evidence for Mediterranean urban settings [9]. Comprehensive monitoring of the characteristics of Mediterranean food environments related to obesity and NCDs is needed to allow comparisons, and to timely evaluate the impact of initiatives to improve food environments [10].

In this context, the ‘Heart Healthy Hoods’ project (www.hhhproject.eu) is an ongoing study, which studies the association between urban environment characteristics (including the food environment) and cardiovascular outcomes in Madrid, as an example of a Southern-European city [3, 11]. This Perspective article reviews the unique characteristics of Mediterranean food environments highlighting current gaps in the literature, which might help promoting healthier diets and preventing chronic diseases.

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Unique characteristics of Mediterranean food environments

Assessing the retail food environment, the retailing part of a food system, involves measuring: 1) the *community* food environment (number, type and location of food outlets); and 2) the *consumer* nutrition environment (in-store characteristics, such as prices, promotions, or nutritional quality) [5]. We argue that Mediterranean cities have a unique food

Fig. 1 Trends in the proportion of food stores by type from 2012 to 2017 in the city of Madrid, Spain. City of Madrid data was used with permission from Ayuntamiento de Madrid: Datos Abiertos. 2018. <https://datos.madrid.es/> Accessed February 1st, 2018

environment in terms of 1) diversity of types of stores, 2) compactness of urban form, and 3) a unique consumer food environment. What follows is a brief review of these three arguments and the consequences for measuring Mediterranean food environments.

Diversity of food store types

Traditionally, the market share concentration of food retailing activity in Mediterranean countries has been low, as compared to the U.S. and other Anglo-Saxon countries. Mediterranean food environments have a larger proportion of food markets and small specialized stores, as opposed to large retail chains of supermarkets or convenience stores [6, 12, 13]. These small specialized stores include fruit and vegetable store, fishmongers and butchers. Yet, few studies have assessed the role of these specialized food stores as alternative healthy food sources. A previous study, conducted by Pettinger et al [13], highlighted the relevance of small specialized food stores for Mediterranean populations: whereas a larger proportion of English participants (89.9%) used a supermarket at least once a week than those in France (74.5%), preferring to buy everything ‘*under one roof*’, the French used bakers, butchers, fishmongers and fruit and vegetable stores more frequently. These specialized food stores are the primary healthy food source for residents in Madrid, who prefer the closer social relationships with food store owners and the trust that is built with them [14]. These findings occur at the same time that traditional stores are in decline (e.g. in Spain), while supermarkets are becoming dominant due to their competitive prices and wider choices [14, 15]. Moreover, these changes in the retail food environment have been found to vary by type of neighborhood social and economic change [16]. Fig. 1 shows the trends over the last 6 years (2012 to 2017) in

the proportion of food stores of each type. As the figure shows, there’s a monotonic increase in the proportion of supermarkets and other unspecialized stores, and a small decline in the proportion of all types of specialized stores.

Previous studies have suggested to improve availability of supermarkets as a specific strategy to improve healthy food availability [17]. However, labelling ‘supermarkets’ as healthy food sources, neglects the increased availability of cheaper, processed, higher fat, and added-sugar food options available in line supermarkets [17, 18]. In fact, research in Latin American countries has shown how supermarkets worsen population diets, and are rapidly becoming the main source of ultra-processed foods [19].

Moreover, we argue that preserving the diversity of Mediterranean urban food environments could be not only linked to adopting healthier dietary patterns, but also to social behaviors. As recognized in 2010 by UNESCO, the Mediterranean diet is an intangible cultural heritage, not only because of its nutritional aspects, but also for encompassing other aspects (‘eating together’ and ‘socializing among others’) [20]. A previous study examining residents’ perspectives around their local food environment, showed that through grocery shopping, residents socialized with each other [15]. Participants of this study highlighted that these encounters (e.g. at the public market) served as a social protection net against loneliness, and as opportunity structures for socializing [15]. Food environments are a highly complex phenomenon resulting from the interaction between multiple physical and social influences [4, 12], not just healthy food availability of the presence of supermarkets.

Another notable feature of Mediterranean food environments illustrating their diversity are public markets. Defined as ‘*a group of locally owned, primarily private retail businesses leasing space in a shared facility with fresh foods and community services*’, these covered markets are

open year-round. These markets, as farmers' markets do in the US, promote public health in multifaceted aspects: increasing the consumption of fresh foods (e.g. fruit and vegetable) [21], and reducing social isolation (e.g. promoting social interactions with the vendors, or with other customers or residents) [11, 15]. Moreover, public markets represent public spaces characterized by their proximity, personal treatment, and urban architectural patrimony. Yet, the potential influence of markets on healthy food environments has not been fully recognized.

Compactness of Mediterranean food environments

Walkable environments are areas where there is increased availability of destinations (to walk to), a street network that is conducive to walking (with a high degree of connections), and with enough density to guarantee that destinations are not too far apart [22]. The reduced levels of urban sprawl of Mediterranean cities create more compact-retail environments and promote non-motorized (walking or bicycling) accessibility [22, 23].

Partially as a consequence of this increased compactness, the number of food stores per resident is three times higher in Spain, Italy, and Portugal than in the United Kingdom [12]. A study, conducted within the Heart Healthy Hoods project, compared local food environments in two different cultural cities: Madrid (Mediterranean food environment), and Baltimore (Americanized food environment) [6]. This study showed that 77% of the residents in Madrid lived within less than 200 m from a food store with high healthy food availability. However, 95% of Baltimore's residents lived further than 400 m from these stores [6]. As shown in Table 1, the density of food stores was 3.5 times higher in Madrid than in Baltimore. Marquet et al. [23], also highlighted the relevance of proximity for walking trips in the city of Barcelona. These results illustrate the need to preserve well-connected retail food environment in terms of diversity of food store types, which are also highly accessible by walking.

Table 1 Food store density in the cities of Madrid and Baltimore, 2016

City	Madrid (Spain) ^a	Baltimore (United States) ^b
Total population (n)	3141000	621000
Food outlets (n)	16367	1028
Food outlet density (food stores/1000 residents)	5.21	1.65

^aData available at datos.madrid.es for the city of Madrid.

^bData available at <http://mdfoodsystemmap.org/> for the city of Baltimore

Consumer food environment in the Mediterranean context

The *consumer* food environment is assessed through the measurement of food prices and their nutritional quality [5, 10]. Subsequently, characterizing Mediterranean urban food environments requires assessing the actual foods that food stores offer, not just food store types or accessibility.

The 'Nutrition Environment Measurement Surveys in Stores' (NEMS-S), developed by Glanz et al, is one of the most widely observational measures used to assess the consumer food environment [24]. The NEMS-S measure, protocol and training are readily accessible online; and the instrument has shown a high inter-rater reliability, test-retest reliability, and face and criterion validity [24]. In brief, it measures the availability and cost of healthy options compared to less healthy options in food stores over 11 food groups (low-fat or skim milk, fresh fruit, fresh vegetables, lean ground beef, fat-free or reduced-fat hot dogs, reduced-calorie frozen dinners, low-fat baked goods, diet sodas and 100% fruit juices, whole-grain bread, baked chips, and low-sugar cereal), based on a mainstream American diet [24].

Therefore, within the Heart Healthy Hoods study, we adapted the original NEMS-S tool to assess Mediterranean *consumer* food environments. While previous researchers have modified the NEMS-S tool to other urban contexts, to the best of our knowledge, no equivalent adaptation exists for Mediterranean contexts [25]. The adapted NEMS-Med audit tool is depicted in Table 2, and available to readers under request. The NEMS-Med tool includes 11 food groups: 1) fruits; 2) vegetables; 3) nuts; 4) non-alcoholic beverages; 5) bread, cereals and baked goods; 6) milk, dairy products and eggs; 7) oil and butter; 8) rice and pasta; 9) legumes; 10) meat and meat products; and 11) fish (see Table 2). The scoring was based on the NEMS-S scoring protocol [24] and modified to accommodate the Mediterranean dietary pattern [20]. In future research, we will document the distribution of the consumer food environment in a Southern European city (Madrid), and its association with socioeconomic status and nutrition-related outcomes.

Conclusions

Understanding the economic, social and urban processes that have driven the change in traditional dietary patterns during the last decades is a key public health challenge. Mediterranean urban food environments present unique characteristics in terms of diversity and compactness, which can promote healthy food availability and accessibility.

Tackling the undergoing 'Westernization' of Mediterranean urban food environments requires valid and context-specific measures to characterize the *community* and the

Table 2 Food groups, food items, and variables assessed in the Mediterranean Environment Measure Survey in Stores (NEMS-Med)

Food group	Variables	
	Availability	Price
		Absolute Comparative
1) Fresh fruits	X	X
2) Vegetables (fresh/frozen)	X	X
3) Nuts	X	
-Raw versus processed		
4) Non-alcoholic beverages	X	X
- Fruit juice: 100% juice versus juice drinks		
- Soda: diet versus regular		
5) Bread: 100% whole grain	X	X
6) Baked goods	X	
7) Cereals	X	X
-Plain versus > 7 g of sugar per serving		
-White rice versus whole-grain rice		
8) Milk, dairy products and eggs	X	X
-Skim/low-fat versus whole		
-White cheese versus aged cheese		
-Low-fat yoghurts		
-Eggs		
9) Oil and butter	X	X
- Extra virgin olive oil versus sunflower oil		
- Butter versus light butter		
10) Legumes	X	
11) Meat and meat products (red meat and poultry)	X	X
- Red meat versus poultry		
- Processed meat		
12) Fish	X	X
- Fresh fish		
- Unprocessed seafood versus processed seafood		
- Tuna		

consumer food environments. Understanding and protecting Mediterranean food environments may also help preventing the ‘Westernization’ of the Mediterranean diet, improving population diets and reducing chronic diseases burden.

Acknowledgements This article is published as part of a supplement sponsored by the Mediterranean Diet Foundation and the Diputació de Barcelona.

Funding : Julia Díez and Manuel Franco were funded by the European Research Council under the European Union’s Seventh Framework Programme (FP7/2007- 2013/ERC Starting Grant HeartHealthyHoods Agreement n.336893). Usama Bilal was funded by a Johns Hopkins Center for a Livable Future-Lerner Fellowship.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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