Is the Mediterranean Diet for all? An analysis of socioeconomic inequalities and food consumption in Italy

Abstract

Purpose: The goal of this paper is twofold. Firstly, to investigate the role of the main socioeconomic and demographic factors in affecting the consumption frequency of specific food categories with a view to highlighting differences across population segments. Secondly, to analyse whether socioeconomic status is ultimately related to the overall level of adherence to the Mediterranean Diet (MD) of the Italian population.

Approach: Data were obtained from the Italian Household Survey covering about 36.000 individuals (18-year-old and older). The Household Survey includes questions aimed at eliciting the consumption frequency of the main food items of the MD pyramid. Moreover, to assess the degree of adherence to the MD we constructed an index (MDI) aimed at reflecting how much individuals follow the MD pyramid recommendations.

Findings: The results show that both socioeconomic and demographic factors play a relevant role in affecting consumption frequency of the main food categories of the MD pyramid. More affluent people consume fish, fruit and vegetables, wine, and beer more frequently than their poorer counterparts. Moreover, higher income is associated with lower consumption of meat and eggs, dairy products, cereals and starchy vegetables as well as legumes.

Originality: The results foster the debate on how to guarantee healthy food accessibility to all population segments, thus having relevant implications in terms of food and health policies. The issue of MD adherence in Italy and its relationship with socioeconomic status (SES) has been previously investigated on the basis of regional data, which make it difficult to extend the results to larger contexts, particularly in a country like Italy with remarkable socioeconomic differences between northern and southern regions.

Keywords: Mediterranean Diet; food consumption; socioeconomic status; adult population

1. INTRODUCTION

The Mediterranean Diet (MD) is widely acknowledged as an optimal diet for preserving good health due to its preventive power against several communicable and noncommunicable diseases. This diet, which is characterized by both a low consumption of red meat and processed foods, and a high consumption of fresh fruits and vegetables with olive oil as a main source of fat, is indeed associated with a reduced risk of cardiovascular disease, cancer, diabetes, overweight and obesity, neurodegenerative diseases and, more generally, all-cause mortality (Sofi et al., 2010; Bonaccio et al., 2012a; Tektonidis et al., 2015; Schwingshackl and Hoffmann, 2016). The value of the MD is not only limited to its proven positive effects on health, but is also related to its traditional and cultural significance, to the point that in 2013 it has been listed by UNESCO in the Representative List of the Intangible Cultural Heritage of Humanity. According to UNESCO, the MD is not just a specific dietary model, but includes a set of traditional practices that have been passed on over different generations, so that it can be regarded as '*the foundation of the cultural identity and continuity of communities throughout the Mediterranean basin'*.

Despite its cultural value and its widely acknowledged benefits, the societies of the Mediterranean countries are rapidly withdrawing from this eating pattern. This trend can be traced back to some decades ago, but the most significant drop in MD adherence has been observed in more recent years, when the global economic crisis has probably contributed to accelerate the change in dietary habits (Bonaccio et al., 2014). This phenomenon has been observed in all the main Mediterranean countries, namely Spain, Italy and Greece, above all (but not exclusively) among adolescents and young adults (Lopez et al., 2009; Schröder et al., 2016; Santomauro et al., 2014; Grosso and Galvano 2016). Societies of the Mediterranean basin are experiencing a gradual but significant shift from the MD plant-based model, to the so called 'Westernized' dietary patterns characterized by high consumption of refined grains and sugars, animal fats, processed meat, and low intake of legumes, whole grains, fruits and vegetables (Trichopoulos and Lagiou, 2004; Lopez et al., 2009; Bonaccio et al., 2012a; León-Muñoz et al., 2012; Bonaccio et al., 2014).

The reasons why individuals keep on shifting from the traditional MD model to less healthy dietary habits are multiple. Some researchers have attributed this trend to food globalization, which has contributed to the spread of the Westernized diet in the Mediterranean areas. The increased presence of the fast-food industry across EU countries has facilitated access to this new dietary model, which has become more and more popular over the last years (Lopez et al., 2009; Bonaccio et al., 2012a). Other studies have explored the role of taste, convenience, as well as the role of food prices (French, 2003). This latter factor seems to play a key role in the decline of adherence to the MD. In fact, there is consistent evidence in the literature that high quality diets, including the MD, are associated with higher monetary daily diet costs, contrary to Western diets which are typically

less expensive (Schröder et al., 2006; Lopez et al., 2009; Schröder et al., 2016). The higher costs associated with healthy diets partially explain why it is more frequent to observe low adherence to the MD among the more disadvantaged population segments (Schröder et al., 2006; Darmon and Drewnowski, 2008; Lopez et al., 2009; Pampel et al., 2010; Schröder et al., 2016; Cavaliere et al., 2018). Some studies found that the consumption of the main food items of the MD pyramid is unevenly distributed across adults by socioeconomic status (SES). High SES groups tend to consume more whole grains, lean meats, fish, low-fat dairy products, fresh fruit and vegetables in line with the MD pyramid recommendations, whilst individuals with lower SES tend to show Western-type dietary patterns characterized by energy-dense and nutrient-poor foods (see Darmon and Drewnowski, 2008 for an extensive review).

In this context, this paper aims at extending current evidence on the relationship between SES and food consumption, focusing on the Italian population. In detail, the goal of this paper is twofold. Firstly, the study investigates the role of the main socioeconomic factors (i.e., SES) in affecting the mean consumption frequency of specific food categories with a view to highlighting differences across SES strata. Secondly, the paper investigates whether SES is ultimately related to the overall level of adherence to the MD of the Italian population. If so, the results will contribute to foster the debate on how to effectively guarantee healthy food accessibility to all population segments, thus having relevant implications in terms of food and health policies.

The issue of MD adherence in Italy and its relationship with SES has been previously investigated (Bonaccio et al., 2012a; Bonaccio et al., 2012b; Bonaccio et al., 2014; Bonaccio et al., 2017; Grosso et al., 2014; Grosso and Galvano, 2016; Santomauro et al., 2014; Roccaldo et al., 2014). However, to the best of our knowledge, all these works are based on regional data, which make it difficult to extend the results to larger contexts, particularly in a country like Italy with remarkable socioeconomic differences between northern and southern regions. This paper is geared at deepening previous evidence by considering nationwide data collected through the Italian Household Survey by the Italian Central Institute of Statistics (Istat, 2016), which includes observations on a representative sample of about 36.000 Italians from all regions in the country. The analysis allows to verify whether the results obtained at a regional level concur with nationwide ones, extending research in the field and providing additional insights on the topic.

This paper is organized as follows: Section 2 describes the sample population and explains the approach to the analysis and methodology applied; Section 3 describes the main results providing the related discussion; and Section 4 reports the conclusions.

2. METHODS

2.1 Study population

The analysis is based on the most recent available data collected by the Italian Institute of Statistics (Istat) through the Italian Household Survey. The data are related to the 2016 wave and involve a representative sample of the Italian population, constructed by interviewing about 20.000 households and providing observations on 43.360 individuals (18-year-old and older). The sample is selected by Istat following a multistage random sampling procedure based on the population census. The Italian cities of all regions are stratified on the basis of their demographic dimension and other criteria. A few days before the interview, all sampled households are informed about the details of the survey through a letter from Istat. The interviews are conducted in the presence of an expert interviewer. The anonymous questionnaire is aimed at collecting data on both people's lifestyle and habits (including food habits), and their socio-demographic and socio-economic variables. For the the purposes of this analysis, which is focused on adult population, only individuals older than 18 years old were considered, what resulted in a final sample of 36.032 Italians.

2.2 Study variables

2.2.1 Food Categories

The Household Survey includes 19 questions aimed at eliciting the consumption frequency of the main food items of the MD pyramid. In order to explore differences across population segments by SES the single questions were grouped to form 10 main food categories, as illustrated in Table 1.

[Please insert Table 1 about here - Proposed Food categories measures]

The first food category (comprising 5 items) is related to meat and eggs consumption frequency; the second to fish consumption frequency (single item); the third to dairy products (2 items); the fourth to cereals and starchy vegetables (2 items); the fifth to legums (single item); the sixth to fruit and vegetables (3 items); and the seventh concerns snacks consumption (single item). Response alternatives to these consumption frequency questions ranged from 1 (=never) to 5 (=more than once a day). As for the remaining three food categories, respectively related to soft drinks (single item), alcoholic beverages (2 items) and water (single item), the response alternatives could take values from 1 (=no consumption) to 6 (=more than one L a day).

2.2.2 Socio-economic and demographic variables

To explore the relationship of SES with both the consumption frequency of specific food categories and the overall adherence to the MD the analysis takes into account the main socioeconomic indicators (Krieger et al., 1997), namely, education and income, age, gender, household size and marital status. As for income, the Household Survey does not include any question that explicitly elicits income level, even though the questionnaire is anonymous. For this reason, income levels have been assumed to be related to individuals' jobs. Specifically, income level 1 (=low income) has been assigned to unemployed individuals, level 2 to people with odd jobs, level 3 to workmen, level 4 to office workers, and level 5 (=high income) to managers. All socioeconomic indicators with related mean and SD are reported in Table 2.

[Please insert Table 2 about here - Socio-demographic and economic variables]

2.2.3 Mediterranean Diet Index

To assess the degree of adherence to the MD we constructed an index (MDI) aimed at reflecting how much individuals follow the MD pyramid recommendations. The index is based on the same 19 questions used to create the 10 food categories described in section 2.2.1. As in Cavaliere et al. (2018) the rationale behind the construction of the MDI is based on the validated Mediterranean-Diet scale developed by Trichopoulou et al. (2003). This latter scale, which was further adopted in other studies such as Drichoutis et al. (2009), is constructed assigning a value of 0 or 1 to the consumption of different food items based on the use of the sex-specific median as the cutoff. More in detail, for beneficial components persons whose consumption is below the median are assigned a value of 0, while 1 was assigned to individuals whose consumption is at or above the median. For the food items that are presumed to be potentially harmful if consumed in high quantities value 0 is assigned to consumption below or at the median, and 1 otherwise.

In this paper, scores to the self-reported consumption frequency of the food items were assigned based on the MD pyramid guidelines for the adult population, instead of the sex-specific median. This allows constructing an index that reflects compliance with the MD dietary guidelines independently from the median values of the population.

As for the classification of food items, the scores assigned to each consumption frequency are illustrated in Table 3. In line with the rationale of Trichopoulou et al. (2003), scores were assigned as follows: for beneficial components (cereals, vegetables, fruit, legumes, fish, other seafood, and nuts), value 0 was assigned to individuals with consumption below the recommended intake, value 1 to individuals with consumption corresponding to the recommended intake, while value 2 to consumption above the recommended intake. For processed meat, red meat/beef, pork meat, and

salty snacks, value 2 was assigned to consumption corresponding to the recommended intake, value 1 to consumption slightly above, and value 0 to consumption below the recommendation.

[Please insert Table 3 about here - Proposed Food items measures]

With regard to the items related to drinks and beverages, the scoring is illustrated in Table 4.

[Please insert Table 4 about here - Proposed Food drink measures]

For water intake, value 2 was assigned when the response alternative corresponded to 'More than one L a day', value 1 to '0.5 L to 1 L a day', and 0 otherwise. As for soft drinks and alcoholic beverages, namely wine and beer, the MD pyramid guidelines are quite generic and do not provide specific recommended intakes. For his reason, as in Cavaliere et al. (2018), the scores were given on the basis of the guidelines for healthy diet formulated by the Center for Research in Agricultural Economics for the Italian adult population. Accordingly, for wine and beer value 2 was assigned when 'Rarely' was the chosen response alternative, value 1 was assigned to '1–2 glasses a day', and value 0 otherwise. With regard to soft drinks, value 2 was assigned to 'Zero consumption', 1 to 'Seasonal consumption', and 0 otherwise. The final individual MDI could take values from 0 (=minimum adherence to the MD) to 38 (maximum adherence to the MD).
Differently from Trichopoulou et al. (2003) we used three scoring levels (0 to 2) instead of just two (0, 1) in order to have a more thorough description of the population in terms of their level of adherence to the MD.

2.3 Statistical analysis

In line with the objectives of the paper the analysis was conducted following a stepwise approach. Firstly, a set of OLS regressions was performed to examine how socioeconomic indicators are related to the consumption frequency of the 10 food categories described in section 2.2.1. Each OLS included all sociodemographic indicators as regressors, while the mean consumption frequency of the single items comprised in each food category were used as dependent variables. The resulting 10 dependent variables are described in Table 5 with related means and SD.

[Please insert Table 5 about here - Food categories variables description]

As for food categories 1 to 7 (i.e., meat and eggs, fish, dairy products, cereals and starchy vegetables, legumes, fruit and vegetables, and snacks), the dependent variables could take values between 1 (= never) and 5 (= more than once a day). As regards the remaining three food categories

(that is, soft drinks, alcoholic beverages, and water), the mean values could be comprised between 1 (=no consumption) and 6 (=more than one L a day).

It is worth observing that the mean consumption frequency of fruit and vegetables is remarkably lower than that recommended by the MD pyramid. Indeed, the mean value is comprised between 'sometimes in a week' and 'once a day', while people should eat 5 portions a day (comprehensive of fruit and vegetables). The single item values highlight that the most worrisome data is related to scarce vegetable consumption, while fruit is consumed relatively more often. Also water consumption is far lower than the recommended intake, with people drinking on average only less than one liter a day.

As a second step in the analysis a further OLS model was performed to investigate whether SES is ultimately related to the overall level of adherence to the MD of the Italian population. In this case, the MDI was used as dependent variable, while keeping all sociodemographic indicators as regressors.

3. RESULTS AND DISCUSSION

3.1 Socioeconomic characteristics of the sample

Given the large sample size of the household survey, the socioeconomic indicators illustrated in Table 6 correspond to those of the Italian population. While age, gender, household size and marital status are quite evenly distributed across the population, specific comments need to be made with regard to education and income. The data show that most of the population have a high school diploma, which can be considered a medium education level. However, only a very small percentage of Italians have a bachelor/master degree or higher education, whereas the number of people with only primary school diploma is much higher. This denotes the existence of a strong educational gradient in the Italian population. Similarly, when looking at income levels data reveal significant disparities in the prevalence of income classes. The majority of the population has a medium level of income, but there is a remarkable difference with regard to the extreme values: 20.05% of the population belongs to the low income segment, while only 7.47% falls in the high income one. Given that explicit income data were not available, some bias may have occurred due to the way in which the income variable has been constructed. For instance, according to the criterion used to assign individuals to the different income classes, an unemployed person may be wealthy but follow in the lowest income category. However, these are generally quite rare exceptions.

[Please insert Table 6 about here - Socio-demographic and economic characteristics of the sample]

3.2 Consumption frequency of the main food categories and its relationship with SES indicators

The coefficient estimates for all the OLS models performed using the mean frequency intake of the 10 food categories are reported in Table 7.

[Please insert Table 7 about here - Model estimation]

Looking at the results, the first insight emerging from this analysis is that all SES variables play a significant role in predicting consumption frequency of the main food categories of the MD pyramid, what is in line with previous evidence (Darmon and Drewnowski 2008; Bonaccio et al 2012; Bonaccio et al., 2014; Bonaccio et al., 2017; Cavaliere et al., 2018).

More in detail, education is significant in all models, with the only exception of legumes and snacks. Highly educated people eat significantly more fruit and vegetables compared to individuals with lower education levels and drink more water as well as wine and beer. Educated people show lower consumption of soft drinks, meat, dairy products, cereals and starchy vegetables with respect to individuals with lower educational levels. Contrary to the general evidence (Bonaccio et al., 2017) and quite unexpectedly, the regression results reveal that fish consumption is lower among the highly educated. One possible explanation may be related to the fact that higher education is positively related to nutritional knowledge and increased nutritional awareness. As such, educated people may have reduced fish consumption after some food scandals, above all the one related to the presence of mercury in fish, a piece of news which attracted a lot of attention in Italy in the last years, being frequently discussed in the newspapers (Wiener, 2013). However, further analyses are need to better understand this finding[1].

Also income, the second main SES indicator, is significant in all models, except for snacks and soft drinks. Specifically, the coefficient estimates reveal that more affluent people consume fish, fruit and vegetables, wine, beer, and water more frequently than their counterparts. Higher income is instead associated with lower consumption of meat and eggs, dairy products, cereals and starchy vegetables as well as legumes. This indicates that people with greater economic means tend to consume more often food items that are associated with higher daily food costs (Darmon and Drewnowski, 2015) as compared to less expensive foods.

[1] To better interpret this result we checked for differences across geographical areas, namely Northern, Central and Southern Italy and found no significant differences. Unfortunately, the data do not provide province-based information, so that we were unable to specifically identify coastal areas from hinterland.

Overall, these results suggest that education and income seem to exert a similar effect on the mean consumption frequencies of the main food items, with higher SES being associated to a better diet quality (Darmon and Drewnowski 2008; Bonaccio et al 2012; Bonaccio et al., 2014; Bonaccio et al., 2017). The main exception, at least in our case, is represented by fish, whose consumption has a negative relationship with the former indicator and a positive one with the latter. This result, although unexpected, finds support in previous studies demonstrating that both these SES variables influence consumption, but independently of one another (Darmon and Drewnowski 2008; Bonaccio et al., 2012).

Particularly important is the role of both these socioeconomic indicators in positively affecting fruit and vegetable consumption, which are widely recognized as two of the most important foods in terms of their contribution to health. Interestingly enough, both high education and income are also associated with increased consumption water, whose intake was found to be on average quite low in the Italian population, as already highlighted in previous studies (Mistura et al., 2016). As well as fruit and vegetables, water intake plays a crucial role in the maintenance of a good health condition, positively affecting physical and mental functions (Lieberman, 2007). Taken together these results stress that diet quality follows a socio-economic gradient.

Another interesting result is related to the role of age. Younger people consume meat, fish, snacks, soft drinks, alcoholic beverages and water more than older segments of the population. This is consistent with previous evidence showing that the shift from the traditional MD in favor of Westernized dietary patterns is more marked among the younger generations. Indeed, Western diets are characterized by the substitution of cereals with proteins of animal origin and increased intake of simple carbohydrates mainly deriving from soft drinks and snacks (León-Muñoz et al., 2012).

3.3 Relationship between adherence to Mediterranean Diet and SES indicators

In line with the second objective of the paper a further OLS model was performed to investigate the relationship between the main SES indicators and the level of adherence to MD.

To better contextualize the results, we firstly explored the distribution of the MDI in the sampled population, finding that about 70% of the sample scored values of the MDI between 20 and 30, while only 12% reached high adherence to MD, obtaining scores higher than 30 as illustrated in Figure 1.

[Please insert Figure 1 about here - The distribution of the Adherence to the Mediterranean Diet of the sample]

Given that Italy is one of the Mediterranean countries in which the MD originated, one might have expected higher values of the MDI. Instead, this descriptive analysis seems to be in line with the gradual decline in MD adherence.

When moving to the OLS results, it is possible to notice that the strong influence of SES on MD adherence found in previous studies is generally supported. All socioeconomic indicators are significant, with the only exception of household size (Table 8).

[Please insert Table 8 about here - MD and socio-demographic and economic characteristics]

More in detail, it is possible to observe that education is positively related to higher MDI scores This relationship between MD adherence and education also emerges when looking at graphs in Figure 2 illustrating the MDI score distribution by education classes. When comparing the lower education classes (primary, secondary school, and high school) with the highest education class (bachelor degree and higher) it is possible to notice that in the latter class the MDI scores are much less dispersed around the mean. Differently from individuals with low education people in this class do not show MDI scores lower than ten and a remarkably higher percentage of this sub-group scores higher than thirty.

[Please insert Figure 2 about here - The Adherence to the Mediterranean Diet by education classes]

This result has been consistently motivated in the literature by considering the mediating role of nutritional knowledge. Indeed, as shown in previous papers, the longer the education the higher the nutritional knowledge and the individual awareness concerning food related issues. This may lead individuals to better comply with the MD pyramid recommendations (Bonaccio et al., 2012; Bonaccio et al., 2013; Cavaliere et al., 2018).

As for income, the results reveal that more affluent people are more likely to show high adherence to MD with respect to individuals with lower income levels-Looking at the MDI distribution across income categories (Figure 3) it can be observed that the mean MDI score gradually shifts to higher values from the lowest income class to the highest.[Please insert Figure 3 about here - The Adherence to the Mediterranean Diet across income categories]

This result seems to be supported by the evidence that the MD is associated with increased daily food costs, when compared, for instance, with Westernized diets (Schröder et al., 2006; Lopez et al., 2009; Schröder et al., 2016). This implies that following the MD recommendations may ultimately be a matter of wealth.

Furthermore, the OLS estimates indicate that MD adherence is higher in elderly than in younger segments of the population. On the one hand, this may be attributed to the fact that elderly people

are generally more strictly linked to traditional values and habits, what may contribute to their higher adherence to the typical diet of the Mediterranean basin (Leon-Munoz et al., 2012). On the other hand, this result may be due to the abandonment of the MD by the younger population.
In fact, when observing the MDI score distribution by age, it is possible to notice that those aged 18-24 have the lowest scores relative to the other age classes (Figure 4).

[Please insert Figure 4 about here - The Adherence to the Mediterranean Diet by age classes]

4. CONCLUSIONS Taken together these results confirm previous studies that provided evidence of the key role of SES in determining the degree of adherence to MD. In detail, indeed, more affluent and educated people show superior diet quality with respect to lower SES classes. These findings contribute to enrich this field of research at least in two main ways. Firstly, being based on nationwide data the results provide evidence that are independent from any regional socioeconomic and cultural disparity. Secondly, by separately analyzing the relationship between SES, consumption frequencies of the main food categories and MD adherence they extend previous knowledge on Italians' food habits, thus contributing to a better understanding of how consumption patterns evolve over time. Unfortunately, given the nature of the available data, it was not possible to conduct a more detailed analysis of food consumption and MD adherence, for example including condiments or accounting for gender-specific differences. Furthermore, to consider culture and tradition as complementary to the dietary model would offer a broader understanding of the topic and of the main causes of the MD gradual abandonment. However, despite these limitations, these findings may have important implications for future policies geared at fostering the MD as a healthy dietary model, proven to prevent a number of communicable and non-communicable diseases. In this sense, policy makers should consider acting on socioeconomic disparities, rather than only on nutritional education. In other words, given that diet quality seems to follow a socio economic gradient, future policy intervention should consider facilitating availability and affordability of healthy food items in order to make the MD appealing for all segments of the population.

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Fig. 1 The distribution of the Adherence to the Mediterranean Diet of the sample

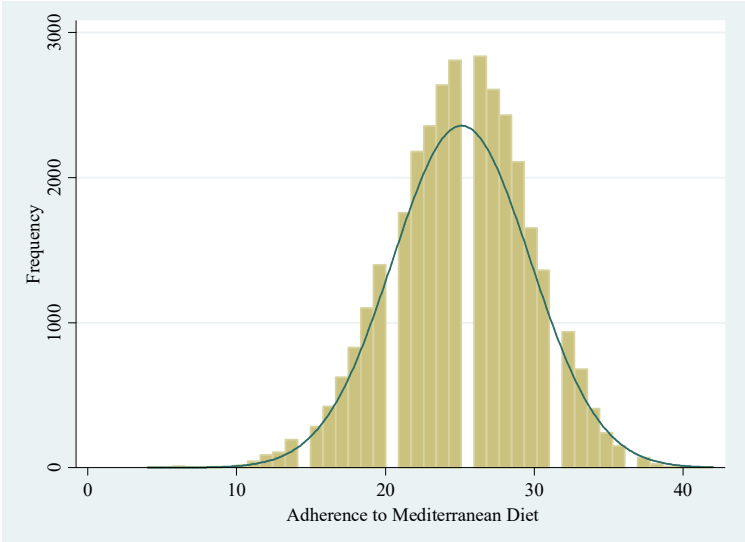
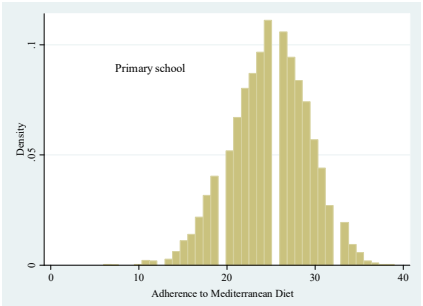
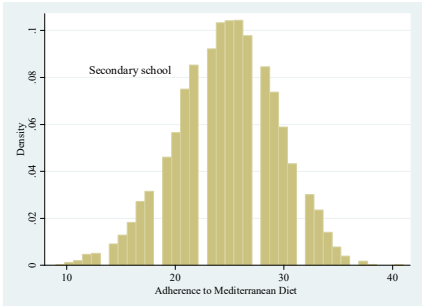
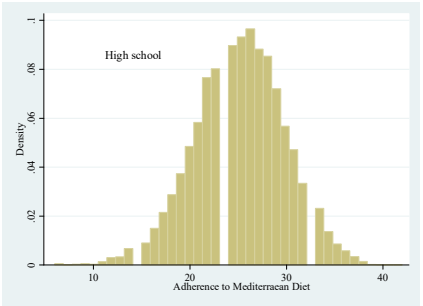


Fig. 2 The Adherence to the Mediterranean Diet by education classes







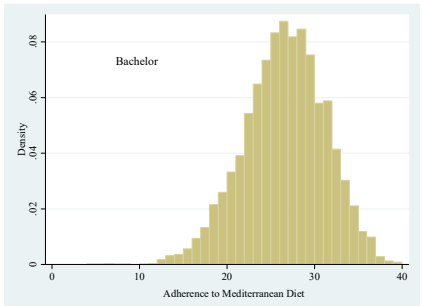


Fig. 3 The Adherence to the Mediterranean Diet across income categories

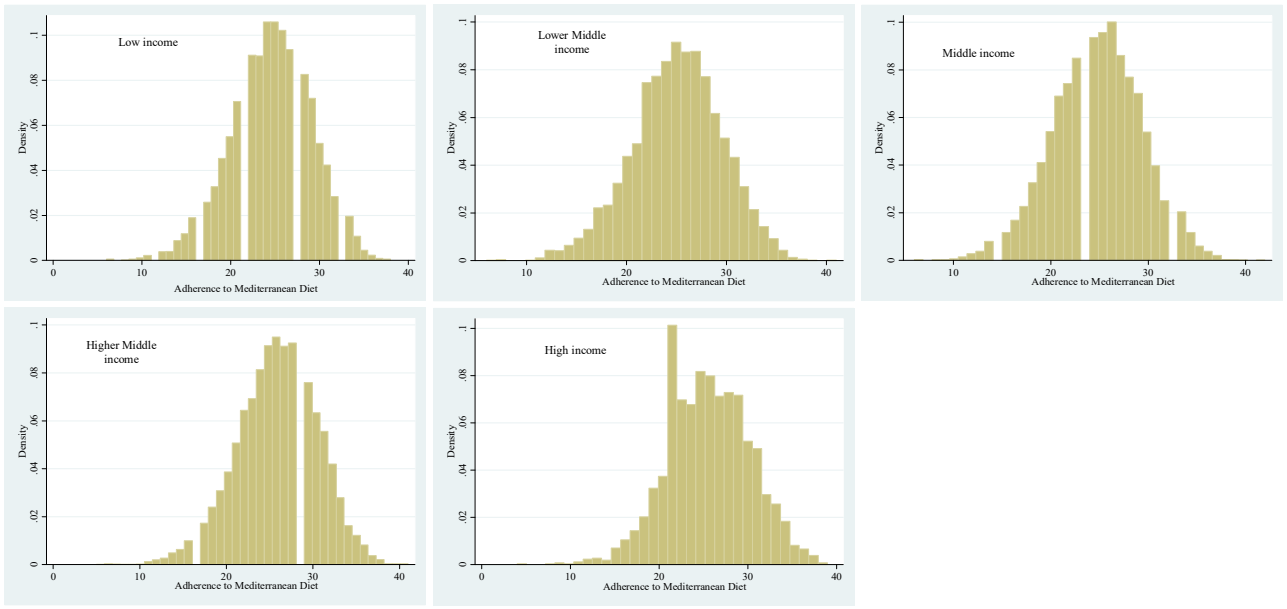
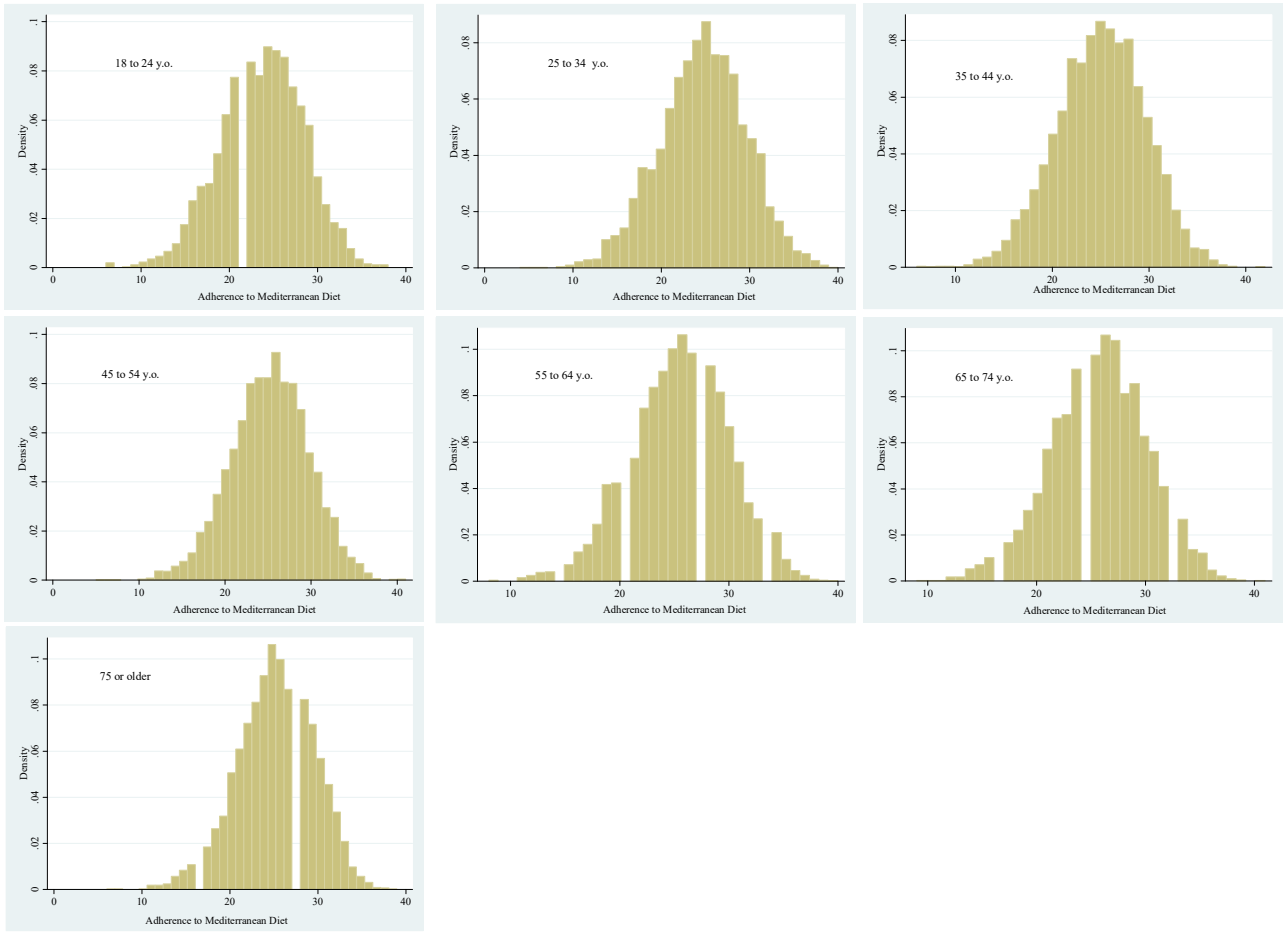


Fig. 4 The Adherence to the Mediterranean Diet by age classes



Tab 1. Proposed Food categories measures

	Response Alternative	Assigned Score
Category 1- Meat and eggs		
White meat (turkey, chicken, rabbit, veal, etc.)		
Processed meat		
Red meat (beef)		
Pork meat		
Eggs		
Category 2- Fish		
Fish		
Category 3- Dairy products		
Milk	Never,	1
Dairy products and cheeses	Less than once a week,	2
Category 4- Cereals and starchy vegetables	Sometimes in a week,	3
Potatoes	Once a day,	4
Cereals (rice, pasta, bread, etc.)	More than once a day	5
Category 5- Legumes		
Legumes		
Category 6- Fruit and vegetables		
Leaf vegetables cooked and raw (spinach, salad, etc.)		
Other vegetables (fennel, tomato, pepper, artichokes, etc.)		
Fruit		
Category 7-Snacks		
Snacks		
Category 8-Soft drinks		
Soft drinks	No consumption,	1
Category 9- Alcoholic beverages	Seasonal consumption,	2
Wine	Rarely,	3
Beer	1–2 glasses a day,	4
Category 10- Water	0.5 L to 1 L a day,	5
Water	More than 1 L a day	6

Tab 2. Socio-demographic and economic variables

	N	Mean	SD	Min	Max
Education	36032	2.46	0.96	1	4
Income	36032	2.87	1.22	1	5
Age	36032	4.22	1.82	1	7
Gender	36032	1.52	0.50	1	2
Household size	36032	2.17	0.86	1	3
Marital status	36032	1.53	0.50	1	2

Tab. 3 Proposed Food items measures

Food Items	Recommended Intake	Scoring Criterion	
		Response Alternative	Assigned Score
		Never	0
Cereals (rice, pasta, bread, etc.)	1–2 portion(s) every main meal	Less than once a week	0
Leaf vegetables cooked and raw (spinach, salad, etc.)	≥2 portions every main meal	Sometimes in a week	0
Other vegetables (fennel, tomato, pepper, artichokes, etc.)	≥2 portions every main meal	Once a day	1
Fruit	1–2 portion(s) every main meal	More than once a day	2
		Never	0
Legumes	≥2 portions weekly	Less than once a week	0
		Sometimes in a week	2
		Once a day	1
Potatoes	≤3 portions weekly	More than once a day	0
		Never	0
		Less than once a week	1
Fish	≥2 portions weekly	Sometimes in a week	2
		Once a day	0
		More than once a day	0
Processed meat	≤1 portions weekly	Never	0
Red meat (beef)	<2 portions weekly	Less than once a week	2
Pork meat	<2 portions weekly	Sometimes in a week	1
Salty snacks	<2 portions weekly	Once a day	0
		More than once a day	0
		Never	0
White meat (turkey, chicken, rabbit, veal, etc.)	2 portions weekly	Less than once a week	1
		Sometimes in a week	2
		Once a day	0
Eggs	2–4 portions weekly	More than once a day	0
		Never	0
		Less than once a week	0
Milk	2 portions daily	Sometimes in a week	0
		Once a day	2
Dairy products and cheeses	2 portions daily	More than once a day	1

Tab. 4 Proposed Food drink measures

Food Drink	Recommended Consumption	Scoring Criterion	
		Response Alternative	Assigned Score
Soft drinks	Low consumption	No consumption	2
		Seasonal consumption	1
		Rarely	0
		1–2 glasses a day	0
		0.5 L to 1 L a day	0
		More than 1 L a day	0
Wine	1–2 glasses a day	No consumption	0
		Seasonal consumption	0
		Rarely	2
		1–2 glasses a day	1
		0.5 L to 1 L a day	0
		More than 1 L a day	0
Beer	Low consumption	No consumption	0
		Seasonal consumption	1
		Rarely	2
		1–2 glasses a day	0
		0.5 L to 1 L a day	0
		More than 1 L a day	0
Water	More than 1 L a day	No consumption	0
		Seasonal consumption	0
		Rarely	0
		1–2 glasses a day	0
		0.5 L to 1 L a day	1
		More than 1 L a day	2

Tab. 5 Food categories variables description

Dependent variable	Items	N	Mean	SD	Min	Max
Category 1- Meat and eggs		*34751*	*2.59*	*0.47*	*1*	*5*
	Processed meat	35331	2.57	0.82	1	5
	White meat (turkey, chicken, rabbit, veal, etc.)	35861	2.88	0.65	1	5
	Red meat (beef)	35711	2.60	0.71	1	5
	Pork meat	35549	2.33	0.77	1	5
	Eggs	35826	2.59	0.66	1	5
Category 2- Fish		*35845*	*3.41*	*0.69*	*1*	*5*
	Fish	35845	3.41	0.69	1	5
Category 3- Dairy products		*35462*	*3.01*	*0.89*	*1*	*5*
	Milk	35637	3.04	1.35	1	5
	Dairy products and cheeses	35761	2.98	0.82	1	5
Category 4- Cereals and starchy vegetables		*35613*	*3.39*	*0.51*	*1*	*5*
	Cereals (rice, pasta, bread, etc.)	35947	4.06	0.76	1	5
	Potatoes	35683	2.72	0.60	1	5
Category 5- Legumes		*35692*	*2.47*	*0.76*	*1*	*5*
	Legumes	35692	2.47	0.76	1	5
Category 6- Fruit and vegetables		*35205*	*3.76*	*0.75*	*1*	*5*
	Leaf vegetables cooked and raw (spinach, salad, etc.)	35843	3.63	0.94	1	5
	Other vegetables (fennel, tomato, pepper, artichokes, etc.)	35752	3.53	0.86	1	5
	Fruit	35530	4.11	0.96	1	5
Category 7-Snacks		*35545*	*1.84*	*0.85*	*1*	*5*
	Snacks	35545	1.84	0.85	1	5
Category 8-Soft drinks		*35043*	*2.18*	*1.18*	*1*	*6*
	Soft drinks	35043	2.18	1.18	1	6
Category 9- Alcoholic beverages		*35257*	*2.13*	*0.99*	*1*	*6*
	Beer	35327	1.95	1.03	1	6
	Wine	35565	2.32	1.28	1	6
Category 10- Water		*35840*	*4.86*	*1.56*	*1*	*6*
	Water	35840	4.86	1.56	1	6

Tab. 6 Socio-demographic and economic characteristics of the sample

	% of total		% of total
Education			
Primary school	19.82	*Gender*	
Secondary school	28.6	Male	47.65
High school	37.56	Female	52.35
Bachelor/master/higher education	14.03	*Household size*	
Income		Single/widowed	30.21
Low income	20.05	Family without children	22.84
Lower middle income	13.94	Family with children	46.95
Middle income	32.08	*Marital status*	
Higher middle income	26.46	Single/separated/widowed	47.17
High income	7.47	Married/ Living with partner	52.83
Age			
18 to 24	8.16		
25 to 34	11.88		
35 to 44	16.3		
45 to 54	19.6		
55 to 64	15.74		
65 to 74	14.03		
75 or older	14.28		

Tab. 7 Model estimation

	Meat and eggs	Fish	Dairy products	Cereals and starchy vegetables	Legumes	Fruit and vegetables	Snacks	Soft drinks	Alcoholic beverages	Water
Education	-0.041 ***	-0.064 ***	-0.024 ***	-0.042 ***	-0.002	0.064 ***	0.000	-0.031 ***	0.080 ***	0.035 ***
	(0.003)	*(0.005)*	*(0.006)*	*(0.004)*	*(0.005)*	*(0.005)*	*(0.005)*	*(0.008)*	*(0.006)*	*(0.011)*
Income	-0.007 ***	0.010 ***	-0.018 ***	-0.012 ***	-0.026 ***	0.014 ***	0.001	0.004	0.080 ***	0.057 ***
	(0.002)	*(0.003)*	*(0.004)*	*(0.003)*	*(0.004)*	*(0.004)*	*(0.004)*	*(0.005)*	*(0.004)*	*(0.008)*
Age	-0.033 ***	-0.020 ***	0.020 ***	0.000	0.000	0.062 ***	-0.175 ***	-0.199 ***	-0.013 ***	-0.092 ***
	(0.002)	*(0.003)*	*(0.004)*	*(0.002)*	*(0.003)*	*(0.003)*	*(0.003)*	*(0.004)*	*(0.004)*	*(0.006)*
Gender (female)	-0.122 ***	-0.002	0.111 ***	-0.095 ***	-0.006	0.204 ***	-0.107 ***	-0.249 ***	-0.700 ***	-0.027
	(0.005)	*(0.007)*	*(0.010)*	*(0.005)*	*(0.008)*	*(0.008)*	*(0.008)*	*(0.012)*	*(0.010)*	*(0.017)*
Household size	0.020 ***	-0.002	0.006	0.020 ***	-0.007	-0.016 *	0.044 ***	0.042 ***	0.001	0.000
	(0.004)	*(0.006)*	*(0.008)*	*(0.005)*	*(0.007)*	*(0.007)*	*(0.007)*	*(0.010)*	*(0.008)*	*(0.013)*
Marital status	0.019 **	-0.065 ***	0.004	0.020 *	0.078 ***	0.105 ***	-0.037 **	-0.033 *	0.081 ***	0.041
	(0.007)	*(0.010)*	*(0.013)*	*(0.008)*	*(0.012)*	*(0.011)*	*(0.012)*	*(0.017)*	*(0.014)*	*(0.023)*
const	2.841 ***	3.723 ***	2.954 ***	3.502 ***	2.453 ***	3.067 ***	2.585 ***	3.833 ***	2.000 ***	4.948 ***
	(0.015)	*(0.022)*	*(0.028)*	*(0.016)*	*(0.024)*	*(0.024)*	*(0.026)*	*(0.036)*	*(0.030)*	*(0.048)*
Observations	34751	35845	35462	35613	35692	35205	35545	35043	35257	35840
F	219.83	51.6	54.1	107.04	21.78	287.28	1230.8	789.45	1266.5	93.59
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.037	0.084	0.088	0.018	0.036	0.050	0.166	0.114	0.164	0.016
Root MSE	0.462	0.684	0.883	0.506	0.756	0.726	0.773	1.108	0.908	1.547

Note: Robust standard error in parentheses, significance at p<0.05*, p<0.01**,p<0.001 ***. Gender (male) Removed for estimation purpose

1 **Tab. 8 MD and socio-demographic and economic characteristics**

	Adherence to Mediterranean Diet	
Education	0.621	***
	(0.033)	
Income	0.081	***
	(0.024)	
Age	0.294	***
	(0.019)	
Gender (female)	0.205	***
	(0.052)	
Household size	0.004	
	(0.043)	
Marital status	0.786	***
	(0.073)	
const	20.794	***
	(0.153)	
Observations	32407	
F	169.26	
Prob > F	0.000	
R-squared	0.031	
Root MSE	4.557	

Note: Robust standard error in parentheses, significance at p<0.05*, p<0.01**,p<0.001 ***
Gender (male) Removed for estimation purpose

2