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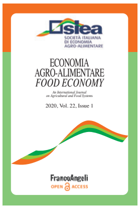

Examining the Prevalence of Obesity in Croatia: The Story of the Mediterranean Diet

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Abstract

The objective of this study is to establish a causal relationship between the Mediterranean diet (MD) and various measures of overweightness using the Croatian Adult Health Survey 2003 data. Our results show that among three measures of obesity (body mass index, waist-to-hip ratio (WHR) and obesity (BMI ≥ 30), we found statistically the most convincing relationship between the BMI and the MD. Our results show that an increase in the Mediterranean diet aggregate index by 10% reduces the BMI by about 0.9%. When the MD10 index is replaced with the set of its ten constituent food groups, as a group, these food variables are jointly statistically significant, most of them have expected (negative) signs, and some of them are also individually significant. For the other two overweight measurements (WHR and obesity) we found that the impact of MD aggregate index is insignificant but when the index is replaced by its ten constituent food elements, these are jointly statistically significant in explaining the variation in the obesity measures.

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Introduction

Obesity has risen throughout much of the world in the past several decades. In United States, the prevalence of obesity defined using body mass index (BMI) rose slowly from 13.3% in 1960-1962 to 15.1% in 1976-1980, then rose dramatically to 23.3% in 1988-1994 and to 35.3% in 2007-2010. Among the OECD countries, the U.S. has the highest prevalence of adult obesity, followed by Mexico (32.4%), New Zealand (31.3%), Hungary (28.5%), Australia (28.3%), Canada (25.4%), Chile (25.1%), U.K. (24.7%) and Ireland (23.0%). East Asian countries such as Japan (3.6%) and Korea (4.6%) have the lowest prevalence, whereas for some of the small Pacific island nations like Nauru, Tonga and Samoa, the prevalence is even higher than in the U.S. and exceeds 50%; see Cawley (2015) and references therein.

An important and unanswered question about obesity is why it varies so much across countries and various race, ethnic and other groups. In the U.S. National Health and Nutrition Examination Survey (NHANES) data for 2011-2012, the prevalence of obesity was 10.8% among Asian-Americans, 32.6% among non-Hispanic whites, 42.5% among Hispanics and 47.8% among non-Hispanic blacks (Ogden *et al.*, 2014). Similarly, based on the second round of the European Health Interview Survey (EHIS), the data indicate that substantial inequalities exist in the EU concerning the proportion of adults who are overweight or obese (Eurostat). For example, in the EU-28 the proportion of adults (aged 18 years and over) who were considered to be overweight varied in 2014 between 36.1% in Italy and 55.2% in Malta for women and between 53.6% in the Netherlands and 67.5% in Croatia for men. Differences in obesity among countries are even more striking. Between Romania and Malta there was a 19.0 percentage points difference in the proportion of obese men and a 14.2 percentage points difference in the proportion of obese women. For the population 18 years and over, the lowest proportions of obese women in 2014 are in Romania (9.7%), Italy (10.3%), Cyprus (12.9%) and Austria (13.4%), and obese men in Romania (9.1%), Italy (11.3%), Netherlands (11.6%) and Sweden (13.6%). The highest proportions of women who were obese are in Malta (23.9%), Latvia (23.3%), Estonia (21.5%) and the United Kingdom (20.4%), and of men in Malta (28.1%), Hungary (22.0%), Slovenia (21.0%) and Croatia (20.7%).

Given the direct association between eating and body weight, obesity is easily explained using simple physics. According to the first law of thermodynamics, in a closed system, energy can be neither created nor destroyed but only transformed. This implies that calories consumed must be either expended, excreted or stored as fat. Rearranging this energy balance equation indicates that obesity must be due to either an increase in calories consumed or a decrease in calories burned. Rather limited data on calories consumed and expended that do exist, seem to suggest that the observed rise in obesity was more likely due to an increase in calories consumed than a decrease in calories burned (e.g. Swinburn, Sacks and Ravussin, 2009). However, thermodynamics is of no use when trying to understand the rapid and continuous increase in obesity in modern times and significant differences in obesity rates across countries and ethnic groups.

To what extent can the standard microeconomic theory model explain these phenomena? Economists typically emphasize reductions in food prices and higher costs of expanding calories as explanations for obesity (e.g., Cutler, Glaeser and Shapiro, 2003). The problem with this is that: (a) food prices declined substantially from early-1970s to mid-1980s, when obesity began to rise, but changed little thereafter while body weight continued to grow, and (b) employment-related calorie expenditures have fallen as the economy shifted to more sedentary jobs but this long-run trend was largely complete by mid-1970s before obesity took off (Ruhm, 2012). In fact, what we frequently observe are eating patterns that look like ex-post economic mistakes rather than the outcomes of rational decisions. This is because rational consumers should generally be at or near their utility maximizing weight to begin with and should not subsequently require large expenditures to reach desired levels. However, the fact that the U.S. weight loss industry in 2009 exceeded $50 billion (MarketData Enterprises, 2009) and that 200,000 people receive bariatric bypass surgery annually (National Institute of Diabetes and Digestive and Kidney Diseases, 2008) are telling examples that rational economic agent model does not work very well.

The alternative approaches to studying the prevalence of obesity include micro-theory models with added features such as habit formation, social norms, etc., see Cawley (2015) for a review. For example, Atkin (2013), for the purposes of investigating regional food consumption differences in India, introduces habit formation into an overlapping-generation general equilibrium model. In his model, households develop tastes for locally abundant foods that they were fed as children. That way, regional differences in preferences and consumption patterns arise endogenously over generations. He concludes that an interaction between preferences and economic environment is needed to explain the observed regional differences. Similarly, Dubois, Griffith and Nevo (2014) found that the prices and food attributes can have large impact on food purchases and the nutritional composition of consumption but economic factors do not tell the whole story. The differences in preferences and eating habits are also very important and in some cases can offset the influences of prices and attributes. For example, they found that UK households purchase healthier foods than US households, despite the prices and product offerings they face and not because of them. Secondly, recent work in behavioral economics (e.g., Ruhm, 2012) emphasizes the importance of systematic errors. The key insight is that many decisions are the results of the brain interaction of a utility-max deliberative system and affective system, dominated by semi-automatic (but potentially learned) responses. There is vast body of psychological research examining conflict resolution between the two systems in decision-making (e.g., Kahneman, 2011) which is very difficult to fully incorporate into an economic model.

In this paper we look at the Mediterranean diet (MD) as a possible explanation for the observed regional differences in the prevalence of obesity in Croatia. Three main reasons motivated this research. First, as emphasized later in the text, the empirical literature on benefits of MD provides a rather compelling evidence of the beneficial effects of the MD on obesity prevention. Second, Croatia is an excellent candidate for studying regional differences in the prevalence of obesity because it consists of two distinct geographical regions: the continental part and the Mediterranean coast. If people of the Mediterranean region predominantly eat MD and people in the continental region do not, then the observed differences in the obesity rates between the two regions should be, *ceteris paribus*, attributable to the differences in diets. Finally, the research into obesity differences across various groups within a country is comparatively easier than international comparisons, because of the common social policies, regulatory and general macro-economic environment and the similarity of wages and prices.

An earlier study of the regional differences in the prevalence of obesity among adult population in Croatia is Music-Milanovic *et al.* (2009). The authors found a significant Mediterranean-continental difference in obesity prevalence among women but not men. The study looked at the relationship between obesity and small group of demographic and behavioral factors such as age, binge drinking, smoking, and regular leisure exercise and did not specifically address the impact of Mediterranean diet on obesity short of looking at the importance of the consumption of fats (vegetable versus animal). They found that in the continental part of Croatia the odds of being obese increases significantly with age and among non-smokers in both men and women and no relationship between any of analyzed behavioral factors and obesity in men and women in the Mediterranean part. Another related paper is Costa-Font, Fabbri and Gil (2010) who tried to explain the differences in levels of obesity and overweight between Italy and Spain. These two countries share the same Mediterranean diet and have similar GDP per capita but have markedly different patterns of obesity. Their decomposition results indicate that the model covariates (eating habits and education) explain about 27-42% of the obesity and overweight gaps between two countries. However, when controls for social environment are included, the model explains 76-92% of the cross-country gap.

The objective of this study is to try to establish a causal relationship between the MD and different measures of overweightness using the single-period cross-sectional data from the 2003 Croatian Adult Health Survey (CAHS). We use a heuristic approach to modeling the relationship between obesity and eating. After experimenting with several obvious model specifications, we venture into a somewhat unchartered territory by augmenting our model with two features. First, we hypothesize that eating habits could also depend on information that is socially learned from mimicking others, i.e., from the existing social norms or peer pressure. Therefore, it is possible that the decision what to eat is not exclusively made at the individual consumer's or the household's level, but rather within a specific community of people, and therefore depends on the local culture and tradition. Second, we also realize that, conceptually, obesity is a stock measure that is impacted not just by current eating (and exercise), but by the cumulative addition of caloric intake and expenditure over the lifetime. Hence, in this sense, the fact that we are using a single-period survey data, forces us to think about the MD measures not so much as a current consumption of foods but more as a proxy for current as well as past habits. If, however, there has been some erosion of adherence to MD due to changes in tastes or culture (for example caused by *Westernization*), then this would show up in cohort differences.

1. Mediterranean diet and Obesity

In 2013 the Mediterranean diets of Cyprus, Croatia, Spain, Greece, Italy, Morocco and Portugal have been inscribed on the Representative List of the Intangible Cultural Heritage of Humanity. According to UNESCO website: "The Mediterranean diet involves a set of skills, knowledge, rituals, symbols and traditions concerning crops, harvesting, fishing, animal husbandry, conservation, processing, cooking, and particularly the sharing and consumption of food. Eating together is the foundation of the cultural identity and continuity of communities throughout the Mediterranean basin. It is a moment of social exchange and communication, an affirmation and renewal of family, group or community identity. The Mediterranean diet emphasizes values of hospitality, neighbourliness, intercultural dialogue and creativity, and a way of life guided by respect for diversity. It plays a vital role in cultural spaces, festivals and celebrations, bringing together people of all ages, conditions and social classes. It includes the craftsmanship and production of traditional receptacles for the transport, preservation and consumption of food, including ceramic plates and glasses. Women play an important role in transmitting knowledge of the Mediterranean diet: they safeguard its techniques, respect seasonal rhythms and festive events, and transmit the values of the element to new generations. Markets also play a key role as spaces for cultivating and transmitting the Mediterranean diet during the daily practice of exchange, agreement and mutual respect”[1].

Epidemiological studies have found increased longevity and reduced morbidity in Mediterranean countries compared to USA or Northern Europe. These health benefits were mainly attributable to the dietary patterns found in these countries in the early 1960s, before their westernization (Keys *et al.*, 1986). Although there are variations in the components of the traditional MD between and within the Mediterranean countries, the common characteristics are: (a) high consumption of plant-based foods (fruits, vegetables, legumes, nuts and seeds and wholegrain cereals); (b) the consumption of seasonally fresh and local foods; (c) olive oil as the main source of dietary lipids; (d) a frequent but moderate intake of wine (especially red) with meals; (e) consumption of fresh fish and seafood; (f) a moderate consumption of dairy products, poultry and eggs; and (g) low frequency and amounts of red and processed meats (Buckland, Bach and Serra-Majem, 2008).

There is also a substantial body of research on the relationship between the MD and low prevalence of obesity. Interestingly enough, the aforementioned globally increased trends in obesity did not completely bypass the Mediterranean countries. As documented in Costa-Font, Fabbri and Gil (2010), the prevalence of obesity in Italy and Spain was between 6% and 7% in 1990 and the gap was not statistically significant, by 2003 the obesity in Italy remained at 8% but grew to 14% in Spain. There has been a decrease in adherence to the MD in Southern European countries through the similar period as well as the tendency to lead more sedentary lifestyles, but it is not clear to what extent the changing dietary patterns account for the increases in obesity (Serra-Majem and Helsing, 1993).

Studies dealing with the association between the MD and obesity belong to three groups: cohort studies, cross-sectional studies and intervention studies. In a systematic review of these studies, Buckland, Bach and Serra-Majem (2008) found that one out of three cohort studies provided evidence of a significant protective effect of the MD against obesity, four out of seven cross-sectional studies found that a higher adherence to MD had a significantly negative association with overweight/obesity and eight out of eleven intervention studies found that the adherence to MD significantly decreased weight/BMI. The cross-studies comparison of results is difficult because of the variations in definitions and evaluation of the MD, control diets and additional non-dietary interventions and statistical methodologies.

1. https://ich.unesco.org/en/RL/mediterranean-diet-00884.

However, while the empirical results are far from unanimous, these studies provide rather compelling evidence of the beneficial effects of the MD on obesity prevention.

2. Data

The data used in this study comes from the Croatian Health Survey (CHS), which was conducted in 2003 by interviewing 9,070 adult individuals aged 18 years and more. The CHS aims to collect health information primarily to support the national campaign for cardiovascular disease prevention but also to support other public health initiatives (Vuletic *et al.*, 2009). The survey was carried out by public health nurses in face-to-face interviews in the respondents' houses, which is the reason for rather high response rate of 84%. The design of the CHS intended to provide a representative sample of adult population for the entire country. Five years later there was a follow-up survey (Croatian Adult Health Cohort Study – CroHort) whose aim was to contact and re-interview the original respondents of the CHS 2003 survey. However, various logistical problems contributed to a significantly lower response rate in 2008 (3,229 respondents) and potential selection problems are making the second survey essentially unusable; for details see Uhernik *et al.* (2012).

The survey contains information coming from physical measurements (height, weight, waist and hip circumference, blood pressure and pulse) and answers to questions on the health perception, the use of health care, chronic diseases, the use of medication and lifestyle (physical activity, smoking, dietary habits, alcohol consumption). Main information on socio-economic characteristic of the individual and the household are also provided. As depicted in Figure 1, geographically Croatia is comprised of two regions: the Mediterranean and the continental region. Because of the large immigration flows from the periphery of country and from the neighboring state of Bosnia and Herzegovina into the capital city of Zagreb during the Croatian War of Independence 1991-1995, we decided to extract the City and County of Zagreb from the rest of the continental region[2]. We believe that the

2. These two regions are formed for analytical purposes of this study. They are not official administrative units of Croatia. Mediterranean region is defined as covering the following 6 counties (zupanija): Dubrovacko-neretvanska, Istarska, Primorsko-goranska (without municipality of Vrbovsko), Sibensko-kninska, Splitsko-dalmatinska and Zadarska. All of them are influenced by the mediterranean climate and have access to the Adriatic Sea. The remaining 13 counties (not counting the city and county of Zagreb) form the continental region. One of those 13 counties (Licko-Senjska) has also access to the sea, yet it was clasiffied into the continental region because all survey respondents of that county were from its continental section.

metropolitan area is too diverse to reflect any discernable attributes of either continental or Mediterranean eating patterns and hence we treat Zagreb as a separate region.

Figure 1 - Regional Map of Croatia

As a measure of obesity/overweight, we use the standard definition of BMI, constructed by dividing an individual's weight (in kilograms) by the square of the height (in meters). The four main BMI categories are: underweight (BMI < 18.5), normal weight (BMI ≥ 18.5 and BMI < 25), overweight (BMI ≥ 25 and BMI < 30) and obese (BMI ≥ 30). The waist-to-hip ratio (WHR) is another way of assessing abdominal obesity. WHR has been shown to be more reflective of visceral fat and central adiposity, as well as a better predictor of obesity related disorders, such as stroke, myocardial infarction, or cardiovascular death, than BMI (WHO, 2008). In women, the ratio should be 80% or less, and in men, it should be 100% or less.

Table 1 presents the raw survey data on BMI, the percentage shares of obese people and the WHR for both men and women in the two regions of the country, Zagreb metropolitan area, and the country as a whole. The data indicates that in all three types of measurements, the Mediterranean region has significantly lower numbers than the continental region whereas Zagreb metropolitan area tracks closely the averages for the entire country. The biggest difference between the Mediterranean and the continental region is in the percentage of the obese people. There are 16.8% of obese people in the Mediterranean part and 25.4% in the continental part. Another interesting result is that the regional differences in obesity are almost completely attributable to the differences in obesity measures among women. The average BMI for women is lower by 1.39 points, the average WHR is lower by 2.21% and the prevalence of obesity in the Mediterranean region is lower by more than 12 percentage points than in the continental part. The differences in all three obesity measures between regions are statistically insignificant among men.

Table 1 - Regional Prevalence of Obesity in Croatia

	Mediterranean Region	**Continental Region**	**Zagreb Region**	**Croatia Total**	**Diff. (Mediterranean-Continental)**
Total					
Average BMI	26.15	27.08	26.66	26.72	-0.93***
Obese (% of pop.)	16.79	25.44	22.27	22.25	-8.64***
Average WHR (%)	86.48	88.08	87.08	87.39	-1.60***
No. of observations	2,483	4,242	2,034	8,759	
Women					
Average BMI	25.70	27.09	26.37	26.52	-1.39***
Obese (% of pop.)	15.09	27.13	22.46	22.60	-12.04***
Average WHR	83.20	85.41	83.96	84.44	-2.21***
No. of observations	1,690	2,846	1,416	5,952	
Men					
Average BMI	27.10	27.05	27.33	27.12	0.05
Obese (% of pop.)	20.42	21.99	21.84	21.52	-1.56
Average WHR	93.49	93.52	94.20	93.66	-0.03
No. of observations	793	1,396	618	2,807	

Notes: *** p<0.01, ** p<0.05, * p<0.1 of two-sample t-test for unpaired data with unequal variances.
Number of observations are for BMI and obesity; for WHR there are 11 observations less.

The initial dataset containing valid measures of height and weight that has been converted into the BMI values consists of 9,040 observations. While cleaning the dataset, we excluded 281 observations due to missing data for some of the explanatory variables. The working data set consists of 8,759 observations, 11 of those do not have valid measures of waist and hips. The dataset is unbalanced in the sense that it has more than double the number of observations for women than for men, whereas in the 2001 Census, in the age group of 18 and older, there are only 11% more women than men. This is not necessarily a problem because, as we said earlier, the main drivers of the regional obesity differences are women. When it comes to the regional distribution of survey respondents, the data set is more balanced with 2,483 observations (28.4%) in the Mediterranean part, 4,242 in the continental part (48.4%) and 2.034 (23.2%) in the Zagreb metropolitan area.

In order to explain the individual BMIs, WHRs or obesity incidences by MD, we use ten food variables: (i) type of fat/oil used for cooking, (ii) consumption of bread, (iii) fruits, (iv) various salads (excluding potato and mayonnaise dressing), (v) cabbage, broccoli, cauliflower and similar, (vi) legumes, (vii) root vegetables, (viii) leafy vegetables, (ix) smoked/processed meats and (x) wine. Given the constraints imposed by the availability of the survey data, we chose our food variables trying to reconstruct the basic features of the MD as closely as possible to the common characteristics of the MD spelled out in Buckland, Bach and Serra-Majem (2008). It is worth mentioning that, for unknown reasons, CHS 2003 does not contain questions on fresh meat and fish consumption, hence our Mediterranean diet lacks these components[3]. Next, we use this ten food variables to construct a MD10 index. As seen from Table 2, each of the 10 food items are coded as dummy variables such that the value of 1 indicates a beneficial potential effect on obesity (lowering BMI) and 0 otherwise. By summing up all these food dummies, our MD10 food index has the maximum value of 10, which indicates the highest exposure to MD and the minimum value of 0 that indicates no exposure to MD.

To accommodate the idea that the observed eating patterns and obesity could also depend on the persistent effects beyond the current time period while our data set is a single period cross-section, we use two more variables measuring person's geographical origin and regional peer effects. To identify

3. As suggested by one of the referees, the fact that we do not have all food categories that typically comprise the Mediterranean diet could potentially raise some concerns about the appropriateness of using the term "Mediterranean diet". However, following the UNESCO definition by which the Mediterranean diet consists of not only food items but in fact describes a way of life, and given our empirical approach to explaining the differences in obesity between Croatian regions, we believe that the use of the terminology is appropriate.

Table 2 - Definition of variables

Name	Type	Description/Calculation
BMI index	Number	Body Mass Index (BMI) weight (kg) /height squared (m^2)
Obese	Binary	Obesity (1 if BMI>=30)
WHR (Waist-to-hip ratio)	Number	Waist-to-Hip Ratio Waist (cm) /hip (cm) (×100)
Age	Number	Age at time of survey (Year of birth from BKI_1)
Household size	Number	Household size HOU_02a+HOU_02b+HOU_02c
Urban	Binary	Urban residence (1 if HOU_06=1 or HOU_06=2)
Female	Binary	Female (1 if BKI_02=2)
Married or cohabitate	Binary	Married (1 if BKI_03=1)
College education	Binary	College education (1 if BKI_07=4 or BKI_07=5)
High income	Binary	High income (1 if person belongs to top quartile of HOU_04/ hhsize (income at midpoint of interval)
MD10	Number	Mediterranean diet score (Sum of 10 food binary variables)
Vegetable oil	Binary	Vegetable oil or no fat at all (1 if FHA_02=1 or FHA_02=3)
Bread low	Binary	Bread: max 3 slices per day (1 if FHA_10=1 or FHA_10=2)
Salads often	Binary	Often eat salads (1 if FHA_13=3 or if FHA_13=4)
Cabbage often	Binary	Often eat cabbage, broccoli, cauliflower (1 if FHA_15=3 or if FHA_15=4)
Legumes often	Binary	Often eat legumes (1 if FHA_16=3 or if FHA_16=4)
Carrots often	Binary	Often eat carrots, turnip, parley (1 if FHA_17=3 or if FHA_17=4)
Spinach often	Binary	Often eat spinach, chard and similar (1 if FHA_18=3 or if FHA_18=4)

Table 2 - continued

Name	Type	Description/Calculation
Fruits often	Binary	Often eat fruit (1 if FHA_12=3 or FHA_12=4)
Smoked meat	Binary	Rarely eat smoked meat (1 if FHA_19=1 or FHA_19=2)
Wine often	Binary	Often drink wine (1 if FHA_25=5 or FHA_25=6)
Non-smoker	Binary	Nonsmoker (1 if SMO_05=1)
Walk/Bike to work	Binary	Walks or ride a bike to work (1 if PHA_01=3 or PHA_01=4 or PHA_01=5)
Med-origin	Binary	Mediterranean origin (1 if county of residence in 1991 Census was in Mediterranean region)
Peer pressure	Number	Peer pressure effects (Mode of silhouette from PHM_13 for each reference group determined by: 6 food clusters*, gender (M/F) and age (18-29; 30-49; 50-65; 65+)

* *Northern Adriatic*: Istarska and Primorkso-Goranska counties; *Dalmatia*: Zadarska, Sibensko-Kninska, Splitsko-Dalmatinska, Dubrovacko-Neretvanska; *Slavonia*: Brodsko-Posavska, Vukovarsko-Srijemska, Osjecko-Baranjska, Pozesko-Slavonska; *North-Western Croatia*: Krapinsko-Zagorska, Medjimurska, Varazdinska, Viroviticko-Podravska, Koprivnicko-Krizevacka; *Central Croatia*: Bjelovarsko-Bilogorska, Karlovacka, Sisacko-Moslavacka, Licko-Senjska; *Zagreb*: City and Zagreb county.

the person's geographical origin, we use the survey question asking people which county they lived in during the 1991 Census. The variable is coded as equal to 1 if on March 31, 1991 the person lived in one of the Mediterranean counties and 0 elsewhere. The presumption here is that, other things being equal, somebody who lived in the Mediterranean region in 1991, is likely to have been exposed to the MD longer than the person who did not.

The second variable in this group is what we term peer effects. To construct this variable we start by defining food clusters. Excluding Zagreb metropolitan area, there are 6 counties (zupanija) in the Mediterranean region and 13 counties in the continental region. We consolidated these self-governing political units into 2 food clusters in the Mediterranean region (Northern Adriatic and Dalmatia) and 3 food clusters in the continental region of the country (North-Western Croatia, Slavonia and Central Croatia) plus Zagreb metropolitan area. These areas are supposed to reflect the geographical and cultural diversity of Croatia revealing the fact that Mediterranean and continental regions are not internally homogeneous. For example, within the Mediterranean region, Istria (Istarska zupanija) in the north (bordering Slovenia) that very much resembles Tuscany or Dordogne-Perigord region in France, with abundance of truffles and amazing olive oils is very different from Dubrovnik region (Dubrovacko-Neretvanska zupanija) in the south with tangerine groves in the river Neretva delta and zinfandel-

Table 3 - Regional averages of main socio-demographic and dietary variables

	Mediterranean Region	**Continental Region**	**Zagreb Region**
Socio-demographic indicators			
BMI index	26.1	27.1	26.7
Obese (%)	16.8	25.4	22.3
WHR: Waist-to-hip ratio (avg.)	86.5	88.1	87.1
Age (years)	54.6	53.8	53.4
Female (%)	68.1	67.1	69.6
Married or cohabitate (%)	64.7	61.5	59.3
Household size (members)	305.4	317.0	311.7
Urban (%)	81.1	50.2	79.7
College education (%)	15.8	8.7	21.6
High income (%)	27.5	15.9	37.5
Lifestyle			
Non-smoker (%)	72.9	75.0	71.6
Walk/Bike to work (%)	10.9	9.2	6.5
Diet			
MD10 (avg.)	6.1	5.1	5.6
Bread low (%)	66.4	71.0	73.5
Salads often (%)	30.7	31.1	34.7
Cabbage often (%)	64.7	59.3	65.3
Legumes often (%)	52.3	62.0	55.4
Carrots often (%)	77.1	81.7	76.3
Spinach often (%)	73.4	32.1	46.4
Fruits often (%)	58.8	50.5	59.8
Smoked meat rarely (%)	62.0	50.6	53.1
Wine often (%)	27.7	12.7	16.6
Other			
Mediterranean origin (%)	69.7	3.1	0.9
Peer pressure (avg.)	4.8	4.8	4.9

type red wines on the Peljesac peninsula. Similarly in the continental region, Medjimurska zupanija (in the north, bordering Slovenija and Hungary), known for its hot spas and excellent white wines is very different from Vukovarsko-Srijemska zupanija (in the east, bordering Serbia), known for its wildlife preserves and famous fresh-water fish stews. Next we form reference groups in terms of region (5+1 food clusters), gender (male, female) and age (18-29; 30-49; 50-65; 65+) and then to each individual in the data set we assign his or her reference group's mode (highest frequency) of the silhouette match from PHM_13 question of the survey. Notice from the Appendix, that the survey instruction ask the person to circle a number next to the silhouette sketch which is mostly similar to the silhouette of the respondent. The positive coefficient associated with this variable will indicate that people conform to social norms and peer pressures and align their eating patterns with what is considered socially acceptable.

Finally, as is customary in these kinds of studies, we also use individual socio-economic and demographic characteristics (age, gender, marital status, household size, education, income and urban/rural residency) and lifestyle variables (smoking and walking or riding bicycle to work). The definitions of all variables used in the econometric analyses are given in Table 2 and their summary statistics in Table 3. All relevant (used) survey questions from the CHS 2003 survey are listed in the Appendix.

3. A Heuristic Model of Obesity

In order to organize ideas, we propose a heuristic relationship between some measure of obesity and a set of explanatory variables: $\Omega_{ij} = \beta_0 + \beta_2^k \mathbf{F}_i^k + \beta_3^m \mathbf{Z}_i^m + \beta_4^n \mathbf{X}^n + \varepsilon_i$ where Ω_i identifies the obesity measure of individual i that can be measured as a continuous value of the BMI and WHR or a discrete variable identifying obesity. $\mathbf{F}_i^k$ is a vector of *k* food categories consumed by an individual *i*, $\mathbf{Z}_i^m$ is an individual *i's* vector of socio-economic and lifestyle characteristics, $\mathbf{X}^n$ is a vector of other variables meant to capture the persistent effects of MD beyond the current period and ε_i is an error term. In order to learn something about the nature of the proposed relationship we need to estimate β coefficients.

Before presenting the estimation results of the above model, two characteristics of our empirical approach are worth mentioning. The first thing to notice about the suggested model is the absence of prices. This represents a departure with the traditional economic approach to explaining obesity by increased affordability of food via decreasing relative prices. The main and obvious reason for this is the lack of food prices in the health survey data that we are using. However, the problem appears to be unimportant because the review of the regional prices (unit values) for various food items computed using the 2003 Croatian Household Budget Survey (HBS) reveal the fact that prices do not vary substantially across households of similar characteristics. As a result, prices are unlikely to have significant explanatory power when it comes to understanding the observed regional differences within the country.

Secondly, a more careful inspection of the survey instrument in the Appendix reveals the fact that consumed quantities were not precisely measured in standardized units like pounds, servings, cups, etc. The survey questions typically ask respondents, how many times a week did they eat a certain food item but did not ask them about the actual quantity consumed. As a result, we have no information on the exact daily or weekly caloric intakes of various food items for the survey respondents. This unfortunate feature of our data set is quite common in many of the previously cited observational and cohort studies which attempt to explain the relationship between the MD and the prevalence of obesity, e.g., Costa-Font, Fabbri and Gil (2010).

We follow the estimation strategy similar in spirit to the one employed by Levinson (2016) by starting with the simple model that contains only the MD and age and sex variables and then subsequently adding groups of socio-demographic, lifestyle and other variables of interest. The idea is to see how the signs and significance of the MD variables, which are of principal interest, change from one specification to the next. We always estimate three versions of various model specifications: two OLS models with the continuous BMI or WHR dependent variables and the linear probability model with discretely defined obesity (if BMI≥30) variable[4]. We present the results in Tables 4a, 4b and 4c.

4. We use linear probability model for obesity for the ease of interpreting coefficients. Probit results are qualitatively indistinguishable and are not presented to economize on space but are available upon request.

Table 4a - OLS regressions results for BMI

	Model					
	(1)	(2)	(3)	(4)	(5)	(6)
MD10	-0.076***	-0.033	-0.011	-0.232***	-0.240***	
Vegetable oil †						-0.992**
Bread low †						-0.594*
Salads often †						0.491
Cabbage often †						-0.056
Legumes often †						-0.122
Carrots often †						-0.197
Spinach often †						0.259
Fruits often †						-0.843**
Smoked meat rarely †						-0.736**
Wine often †						1.405***
Age	0.458***	0.455***	0.425***	0.411***	0.418***	0.403***
Age^2	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
Female	-0.407***	-0.573***	-0.467***	-0.456***	-0.226*	-0.220
Married		0.215*	0.230**	0.240**	0.244*	0.263*
Household size		0.081**	0.082**	0.082**	0.090**	0.086**
High education		-1.397***	-1.401***	-1.387***	-1.413***	-1.391***
High income		0.098	0.093	0.095	0.023	0.009
Urban		-0.367***	-0.268**	-0.283***	-0.293**	-0.334***
Non-smoker		1.156***	1.139***	1.140***	1.285***	1.270***
Walk/Bike to work		-0.678***	-0.670***	-0.659***	-0.866***	-0.849***
Med-origin			-0.678***	-0.469	-0.262	-0.022
Peer pressure			0.260***	0.245***	0.309***	0.300***
MD10*Age †				0.004***	0.005***	incl.
MD10*Med-origin †				-0.035	-0.023	incl.
Mediterranean					1.788	1.996*
Mediterranean*Age					-0.050	-0.054
Mediterranean*Age^2					0.001	0.001
Mediterranean*Female					-0.849***	-0.920***
Mediterranean*Married					0.014	0.020
Mediterranean*Hh size					-0.038	-0.039
Mediterranean*High educ.					0.071	0.119
Mediterranean*High inc.					0.195	0.155
Mediterranean*Urban					0.316	0.265
Mediterranean*Nonsmoker					-0.581**	-0.535**
Mediterranean*Walk					0.743**	0.760**
Mediterranean*Med-origin					0.241	0.317
Mediterranean*Peer press.					-0.151	-0.193
Constant	14.412***	13.844***	13.560***	14.555***	13.987***	14.623***
Number of obs.	8,759	8,759	8,759	8,759	8,759	8,759
Adj. R-squared	0.117	0.143	0.147	0.148	0.151	0.154

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: $F(30, 8703) = 2.51$; Prob.>F = 0.0000.

Table 4b - OLS regressions results for WHR

	Model					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
MD10	-0.257***	-0.143***	-0.116**	-0.044	-0.060	
Vegetable oil †						-0.885
Bread low †						-1.122*
Salads often †						0.917
Cabbage often †						0.111
Legumes often †						0.536
Carrots often †						-1.232*
Spinach often †						1.056
Fruits often †						-0.352
Smoked meat rarely †						-0.639
Wine often †						1.595*
Age	0.413***	0.397***	0.366***	0.370***	0.365***	0.350***
Age^2	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
Female	-8.911***	-9.032***	-8.929***	-8.936***	-8.614***	-8.510***
Married		0.522**	0.539***	0.538***	0.617**	0.711***
Household size		-0.001	0.001	0.001	0.053	0.060
High education		-1.716***	-1.724***	-1.728***	-1.923***	-1.853***
High income		-0.455**	-0.461**	-0.465**	-0.442	-0.416
Urban		-1.180***	-1.063***	-1.062***	-1.225***	-1.245***
Non-smoker		0.562***	0.543***	0.546***	0.654***	0.664***
Walk/Bike to work		-0.831***	-0.824***	-0.823***	-0.775**	-0.741*
Med-origin			-0.817***	-0.485	2.072**	1.906*
Peer pressure			0.259*	0.263*	0.369*	0.349*
MD10*Age †				-0.001	-0.001	incl.
MD10*Med-origin †				-0.055	-0.034	incl.
Mediterranean					1.987	1.814
Mediterranean*Age					-0.021	-0.017
Mediterranean*Age^2					0.000	0.000
Mediterranean*Female					-1.104**	-1.302***
Mediterranean*Married					-0.262	-0.349
Mediterranean*HH size					-0.180	-0.175
Mediterranean*High educ.					0.549	0.569
Mediterranean*High inc.					-0.036	-0.005
Mediterranean*Urban					1.019**	0.989**
Mediterranean*Nonsmoker					-0.489	-0.419
Mediterranean*Walk					0.008	0.003
Mediterranean*Med-origin					-2.423***	-1.964**
Mediterranean*Peer press.					-0.195	-0.226
Constant	80.054***	80.666***	80.384***	80.046***	79.315***	80.286***
Number of obs.	8,748	8,748	8,748	8,748	8,748	8,748
Adj. R-squared	0.289	0.300	0.301	0.301	0.303	0.305

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: F (30, 8692) = 1.53; Prob.>F = 0.0315.

Table 4c - Linear probability model regressions results for Obesity

	Model					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
MD10	-0.007***	-0.003	-0.001	-0.006	-0.008	
Vegetable oil †						-0.034
Bread low †						-0.027
Salads often †						0.053*
Cabbage often †						-0.049
Legumes often †						0.012
Carrots often †						-0.027
Spinach often †						0.047
Fruits often †						-0.037
Smoked meat rarely †						-0.011
Wine often †						0.081*
Age	0.024***	0.024***	0.023***	0.023***	0.023***	0.022***
Age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
Female	0.022**	0.009	0.013	0.013	0.039***	0.037***
Married		-0.004	-0.003	-0.002	0.004	0.005
Household size		0.007**	0.007**	0.007**	0.009**	0.009**
High education		-0.104***	-0.105***	-0.105***	-0.112***	-0.112***
High income		0.015	0.014	0.014	0.017	0.017
Urban		-0.032***	-0.022**	-0.023**	-0.028**	-0.033***
Non-smoker		0.071***	0.070***	0.070***	0.081***	0.082***
Walk/Bike to work		-0.044***	-0.044***	-0.044***	-0.069***	-0.067***
Med-origin			-0.070***	-0.024	-0.020	-0.001
Peer pressure			0.010	0.010	0.023**	0.022**
MD10*Age †				0.000	0.000	incl.
MD10*Med-origin †				-0.008	-0.006	incl.
Mediterranean					0.239**	0.243**
Mediterranean*Age					-0.003	-0.004
Mediterranean*Age^2					0.000	0.000
Mediterranean*Female					-0.091***	-0.093***
Mediterranean*Married					-0.018	-0.016
Mediterranean*HH size					-0.008	-0.009
Mediterranean*High educ.					0.019	0.023
Mediterranean*High inc.					-0.014	-0.016
Mediterranean*Urban					0.047**	0.047*
Mediterranean*Nonsmoker					-0.046**	-0.044*
Mediterranean*Walk					0.089***	0.088***
Mediterranean*Med-origin					0.038	0.050
Mediterranean*Peer press.					-0.032**	-0.035**
Constant	-0.418***	-0.463***	-0.474***	-0.452***	-0.523***	-0.493***
Number of obs.	8,759	8,759	8,759	8,759	8,759	8,759
Adj. R-squared	0.038	0.054	0.059	0.059	0.063	0.065

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.
† Joint test for all food variables and interactions with age and Med-origin: $F(30, 8703) = 1.38$; Prob.>F = 0.0830.

4. Results and Discussion

We start with the simple model that contains only the MD10 food index, age, age squared, and gender variables (and the intercept term). We see that in all three version of the model (BMI, WHR and obesity), the MD10 variable has the expected (negative) sign and is statistically significant at 1% level. The results also show that, *ceteris paribus*, women have on average lower BMI and lower WHR than men but higher probability of being obese. All three measures of obesity increase with age but at the decreasing rate.

Next, we add the set of socio-economic and lifestyle variables. Somewhat unexpectedly, the significance of the MD10 drops in the BMI and the obesity model but not in the WHR model where it is still significant at 1% level. Among the newly included variables in the WHR model, whether a person is married or not and the household size are insignificant, education coefficient is negative (and significant) indicating that people with more education tend to have lower WHR. The same is true for urban residents and people with higher incomes. Finally, people that walk or bike to work have lower WHR and people who do not smoke have higher WHR.

In the Model 3 we introduce additional two variables for which we believe can address the problem that the relationship between the diet and obesity is not only contemporaneous and direct but also depends on the host of other factors whose influences are more prolonged, sometimes even permanent. The motivation behind including this group of variables is the presumption that, of course, peoples' decisions about what they eat are based on the relative prices and income, but their preferences and the choice sets they face are determined by cultural factors such as tradition, collective memory and habits. First, borrowing from Atkin (2013), who claims that households develop tastes for locally abundant foods they were fed as children, we submit that a person's geographical origin could be exploited to explain the rigidities in eating patterns. As it turns out, the Mediterranean origin appears to be important in explaining obesity in all three models. Survey respondents that lived in the Mediterranean region in 1991, exhibit the tendency of having the lower BMI, lower WHR and lower probability of being obese. In all models, these coefficients are highly statistically significant.

The second variable in this group is what we term as peer effects. Peer effects are guided by social norms regarding peoples' beliefs about what is considered aesthetically acceptable or pleasing regarding how people look. We interpret social norms as a behavioral regularity that can be measured by the behavior of a reference group, such that any deviation from the established norms results in a cost (Akerlof and Kranton, 2000). The coefficient associated with the peer effects variable have the expected sign (positive) in all three models and are statistically significant in the BMI and WHR models. Recall the variable has been constructed by assigning the most frequently observed silhouette in a given reference group to the person belonging to that reference group. As an illustration, this means that if most of the people whom I associate with, i.e. my peers, are little bit on the chubby side, it is perfectly acceptable for me to be chubby as well, hence the expected sign of this coefficient is positive. The results show that increasing the most observed (mode) silhouette in the reference group by 1 (one position to the right), the BMI of the person belonging to that reference group would increase by 0.26 points and his or her WHR would increase 0.26 percent.

As a group, these two variables performed reasonably well in explaining the prevalence of obesity in Croatia. Their inclusion in the model did not affect the significance of the MD10 variable which continued to be insignificant in the BMI and obesity models and significant in the WHR model.

The notion that obesity is not a flow but rather a stock variable is captured by the idea that the duration of exposure to particular set of habits matter for obesity. In other words, the longer one eats MD, the more pronounced will be its impact on obesity. Similarly, to the extent that there has been some differences in the adherence to or the composition of MD due to changes in tastes or culture, this should show up in age cohort differences. In all these cases, there should be some interaction effect between age cohorts and eating a MD. To harness this idea, in Model 4 we include two more variables. The expected sign of the interaction effect MD10*age is negative, reflective of the idea that, *ceteris paribus*, the older the person is, the longer should be his exposure to MD and hence the more pronounced its impact on obesity prevention and hence lower the obesity measure. Notice that the interpretation of this coefficient is somewhat complicated by the fact that the model contains age variables as well, which show that the obesity is increasing with age but at a decreasing rate. Therefore, combined with natural biological aging effect on obesity, the expected negative sign of the interaction between age and MD means that the negative effect of aging on obesity should be mitigated (slowed down) by eating MD. The estimation results show that in the WHR and obesity models this interaction effect is effectively zero, whereas in the BMI model we got an unusual result of the positive effect, which turns out to be very small, albeit statistically significant.

A similar effect can be also captured by introducing the interaction between MD10 and Mediterranean origin dummy. The expected sign of this coefficient is also negative because people of any age with the Mediterranean background should have had longer exposure to MD and this effect should intensify for older folks, of course controlling for the natural effect of aging on obesity. The estimation results for all three models show that this tendency is detectable in the data in the sense that all estimated coefficients are in fact negative. However, none of the coefficients are statistically significant.

The inclusion of these two variables had an opposite effect on the significance of the MD10 variable in the BMI and WHR models. In the BMI model, previously insignificant effect of the Mediterranean diet on the BMI score is now significant at the 1% level, whereas the previously significant coefficient of MD10 in the WHR model is now insignificant. The inclusion of these two variables did nothing to the significance of the MD10 variable in the obesity model, which continues to be statistically insignificant. One has to be careful when interpreting these results. We are reluctant to conclude that the history of eating patterns do not matter for obesity. We are more inclined to accept our earlier premise that the single-period survey data serve as good proxies for current consumption as well as past habits.

Another question of interest is how much of the observed variation in three different obesity measures is explained by our last model? Because we are primarily interested to measure the effect of the Mediterranean diet, an obvious thing to ask is whether the Mediterranean region is somehow different from the rest of the country in addition to the fact that people residing there are likely to have higher exposure to MD than the rest of the country. For example, the fact that people, especially women, are thinner in the coastal area could be attributable to the proximity of the ocean (beaches), better air quality, higher proportion of sunny days during the year, or who knows what. Another possibility could be the stronger presence of the short food supply chains in all its configurations, such as farmers' markets, farm shops, community-supported agriculture and solidarity purchase groups in the Mediterranean region relative to other regions[5]. An obvious way to obtain an answer to this question is to saturate the model with the full set of Mediterranean dummy variables except for the interaction with the food variable MD10. We do this in Model 5.

In case of the BMI model, the results show that all estimated coefficients, and their t-statistics, stayed very close to their previously estimated values and that the single Mediterranean dummy and most of the interactions are statistically insignificant. The exceptions are the interaction of regional dummy with the female variable, which is negative showing that women in the Mediterranean region have lower BMI than women in the rest of the country for reasons unaccounted for by our model. The other two examples are interactions with smoking and walking to work. For unknown reason, nonsmokers have lower BMI in the Mediterranean region then their nonsmoking counterparts in the rest of the country, and people who walk to work have higher BMI than their counterparts in the rest of the country. These results lend support to the conclusion that the Mediterranean diet based

5. The benefits of short food supply chains on the reduction of BMI scores in the group of adult Italians are documented in Bimbo *et al.* (2015).

model explains the BMI variation in Croatia reasonably well. The MD10 coefficient shows that an increase in index by 1 point reduces the BMI score by 0.24 points. Given that the average BMI for the country as a whole is 26.7, this means that an increase in Mediterranean diet exposure by 10% reduces the BMI by about 0.9%.The effect is modest but statistically significant.

The introduction of the full set of Mediterranean region dummy variables into the model did not improve the statistical significance of the MD10 index in the WHR and the obesity models. Clearly, the within country variations in these two obesity measures are not very well explained by one summary index of Mediterranean diet. This is also seen from the estimation results that show more interactions between the Mediterranean region dummy variable and other covariates are being statistically significant than in the BMI model.

Finally, we want to look at the impact of the individual components of the MD10 index on various measures of obesity. In Model 6 we replace the MD10 variable with the set of its ten constituent food groups. As mentioned before, the way these food variables are coded, the negative coefficient means beneficial effect of the food group on the BMI, WHR or obesity reduction. Starting with the BMI model, from the last column in Table 4a we see that most but not all food groups have expected (negative) sign and some of them are statistically significant. Testing for the joint significance of all food variables and their interactions with age and the Mediterranean origin variables show that F statistics with 30 and 8703 degrees of freedom equals 2.52 which indicates that the Mediterranean diet is statistically significant in explaining the variation in the BMI at 1% level. The results show that consuming olive oil, low amounts of bread, large amounts of fruits and rarely eating smoked meat, all have statistically significant beneficial effects on the reduction of the BMI. For example, a person eating fruits very often or every day has a lower BMI by 0.84 points than a person who does not eat fruit at all or eats fruit only occasionally. Our results also show that wine consumption increases the BMI. In particular, we show that a person who drinks wine 2-3 times a week or every day has higher BMI by 1.4 points than a person who drinks wine once a week or less[6]. This result is interesting as it raises question of what moderate consumption of wine, or alcohol in general, really means.

Moving on to two other models for the WHR and obesity, we find the results pretty much in line with our earlier findings. In both of those models,

6. These findings are somewhat contrary to the extant literature in the field. In general, recent prospective studies show that light-to-moderate alcohol intake is not associated with adiposity gain while heavy drinking is more consistently related to weight gain. Experimental evidence is also mixed and suggests that moderate intake of alcohol does not lead to weight gain over short follow-up periods, see Traversy and Chaput (2015).

the number of individual food items constituting the MD that have the expected (negative) signs and statistical significance is lower than in the BMI model. However, testing the statistical significance of the entire MD complex of variables with an F-test indicates that they are jointly significantly different from zero. Related to Mediterranean region and diet, we found two statistically significant results that are consistent across all three overweight measurement models. First, drinking wine two to three times a week or more definitively increases BMI, WHR and obesity. Second, for reasons not attributable to Mediterranean diet and other model covariates, women in the Mediterranean region are thinner than in the rest of the country. The Mediterranean women have 0.92 points lower BMI score, 1.3% lower WFR and are 9.3 percent less likely to be obese than women in the rest of the country.

5. Conclusions and Policy Implications

Obesity has risen throughout much of the world in the past several decades. An important and unanswered question about obesity is why does it vary so much across countries and various race, ethnic and other groups. Whereas the conclusions in the literature are not unanimous, numerous empirical studies provide a rather compelling evidence of the beneficial effects of the Mediterranean diet on obesity prevention. In this paper, we investigate the effects of Mediterranean diet on the prevalence of obesity in Croatia. The country is a good candidate for studying regional differences in the prevalence of obesity because it consists of two distinct geographical regions: Mediterranean and continental part. Whereas it is reasonable to assume that people in the Mediterranean region are more exposed to the MD, the question remains whether the observed differences in obesity between the two regions are solely explicable by the differences in what people eat or are there other significant factors that play an important role.

In this study, we seek to establish a causal relationship between the MD and three different measures of overweightness using the single-period cross-sectional data from the 2003 Croatian Adult Health Survey (CAHS). We hypothesize that people conform to social norms and peer pressures and try to match the way they look and behave with what is considered socially acceptable. We found strong support for this hypothesis in all our regression models. We also explicitly acknowledge that fact that obesity is not a flow but rather a stock variable that is impacted not just by current eating, but by the cumulative effect of overeating during the lifetime. The fact that we are using a single-period survey data motivated the search for ways to incorporate the idea that the duration to exposure to a particular diet matters for obesity into the regression analysis. We discovered that differential cohort effects are largely insignificant and concluded that the reported contemporaneous consumption of foods is a good proxy for current as well as past dietary habits.

Among three measures of obesity, we found statistically the most convincing relationship between the BMI and the MD. Our results show that an increase in the Mediterranean diet aggregate index by 10% reduces the BMI by about 0.9%. The effect is modest but statistically significant. When we replaced the MD10 index with the set of its ten constituent food groups, we found that, as a group, these food variables are jointly statistically significant, most of them have expected (negative) signs, and some of them are also individually significant. The results show that consuming olive oil, low amounts of bread, large amounts of fruits and rarely eating smoked meat, all have statistically significant beneficial effects on the reduction of the BMI. However, contrary to the literature that claims the beneficial effect of moderate consumption of red wine on obesity control, our results show that wine consumption of more than two-to-three times per week increases the BMI significantly.

Our findings are in line with the most recent evidence of significant health benefits associated with the MD. According to the just published Global Burden of Disease study by the Institute of Health Metrics and Evaluation (see Afshin *et al.*, 2019), unhealthy diets are responsible for 11 million preventable deaths globally per year, more than any other factor, even smoking tobacco. The study suggest that the leading dietary risk factors are high intake of sodium and low intake of healthy foods, such as vegetables, whole grains, legumes, fruit, nuts and seeds. Other risk factors considered were consuming high levels of red and processed meat and sugary drinks and low milk and fiber consumption. Heart attacks and strokes are the main diet-related causes of death, followed by cancers and type 2 diabetes. The study also found that countries that have a mainly Mediterranean diet (e.g., Lebanon, Israel and Iran) eat more fruit, vegetables, nuts and legumes and are among the better performers. But no country has an optimal level of consumption of all the health foods. Even in countries that have a Mediterranean diet, the current intake of many other dietary factors is not optimal. Therefore, while perhaps the relationship between different obesity measures and the Mediterranean diet is somewhat tenuous, the health benefits of the MD seem indisputable.

Our results have a couple of important policy implications. First, relevant to countries with high wine consumption, we showed that as a standard element of the MD, moderate wine consumption is an exception in that it does not provide positive effect on obesity prevention. For example, Croatia has either the largest or the second largest consumption of wine per capita in Europe. According to 2014 Wine Institute data, Croatians consume 44 liters of wine per capita, Slovenians consume the same amount and France is third with 43 liters. According to WHO 2010 data (published in 2014) for the population of 15 and older and assuming 13% alcohol content in wine, Croatia consumed on average 42 liters per capita, Slovenia has the same consumption, but France has the consumption of 53 liters per capita per year[7]. Given the fact that the average BMI for the entire country of 26.72 is in the overweight category and close to a quarter (22.25%) of the population is obese, perhaps a sound public policy proposal would be to increase the consumption tax on wine or introduce some other measure to deter over-consumption.

Secondly, our results could be helpful in formulating new and enforcing old national nutritional guidelines. In Croatia, and in the EU, prevention of obesity with early intervention in school lunch programs has been the target of numerous public health initiatives. The National Guidelines for Nutrition in Primary Schools was lunched by the Croatian Ministry of Health in 2013 aiming at prescribing groups of normative menus of balanced diet in terms of daily nutrition and energy intakes as well as food selections. All these prescriptions have a lot in common with the Mediterranean diet as commonly understood. In 2017, Croatia adopted the National Strategy for Implementation of the School Scheme for Food, Vegetables and Diary Products with the intention to increase the consumption of these products by children. The Strategy was a part of the European Union program to support the supply of fruit and vegetables, bananas and milk in educational establishments, as requested by the European Parliament regulation No. 1308/2013. Despite the fact that our analysis does not pertain to children, our results showing benefits of eating Mediterranean type diet, reach in fruits and vegetables, could be extrapolated to give credence to school lunch and other nutritional programs targeting children and young adults.

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7. The data taken from https://jakubmarian.com/wine-consumption-in-europe-by-country-per-year-per-capita/.

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Appendix

CHS 2003: CROATIAN HEALTH SURVEY
(Selected questions from the questionnaire by sections)

HOUSEHOLD

HOU_01
In which county do you live?
23 possible choices (21 counties of Croatia, country from ex-Yugoslavia, and other country)

HOU_02a
Household size – under 18 years old?

HOU_02b
Household size – 19-64 years old?

HOU_02c
Household size – 65 years old and above?

HOU_04
Monthly household income (in average)?
1 - Less than 1000 kuna
2 - Between 1000 and 2000 kuna
3 - Between 2000 and 3000 kuna
4 - Between 3000 and 4000 kuna
5 - Between 4000 and 5000 kuna
6 - Between 5000 and 6000 kuna
7 - Between 6000 and 10000 kuna
8 - More than 10000 kuna

HOU_06
Level of urbanization
1 - Urban settlement
2 - Suburban settlement
3 - Village settlement
4 - Isolated house

MIG_01
In which county did you live during the census in 1991 (March, 31)?
23 possible choices (21 counties of Croatia, country from ex-Yugoslavia, and other country)

EATING HABITS

FHA_02
What kind of fat do you mostly use for food preparation at home?
1 - Vegetable oil, vegetable oil or margarine

2 - Butter, pork lard or any kind animal fat
3 - Does not eat fat at all

FHA_10
How many slices of bread do you usually eat per day?
1 - None
2 - Not more than 3 slices
3 - 4 slices and more

FHA_12
How often do you usually eat fruit?
1 - Does not eat fruits
2 - Occasionally
3 - Very often
4 - Every day

FHA_13
How often do you usually eat salads (green, tomato, cabbage, beetroot, carrot and similar)?
1 - Does not eat salads
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_15
How often do you usually eat cabbage, broccoli, cauliflower and similar?
1 - Does not eat cabbage, broccoli, cauliflower and similar
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_16
How often do you usually eat legumes (pod, bean, peas, soya bean and similar)?
1 - Does not eat legumes
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_17
How often do you usually eat root vegetables (carrot, turnip, parsley and similar)?
1 - Does not eat root vegetables
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_18
How often do you usually eat spinach, chard and similar vegetables?
1 - Does not eat spinach, chard and similar vegetables
2 - Very rarely (several times a month)

3 - Twice a week
4 - Every day or almost every day

FHA_19
How often do you usually eat smoked meat, sausage-meat, ham, bacon and similar?
1 - Does not eat smoked meat, sausage-meat, ham, bacon and similar
2 - Very rarely (several times a month)
3 - Twice a week
4 - Every day or almost every day

FHA_25
How often do you usually have wine?
1 - Never
2 - A few times a year
3 - 2 to 3 times a month
4 - Once a week
5 - 2 to 3 times a week
6 - Every day

SMOKING

SMO_05
Do you smoke at the present time (cigarettes, cigars, pipe)?
1 - Not at all
2 - Occasionally
3 - Yes, every day

PHYSICAL ACTIVITY

PHA_01
How many minutes a day do you spend walking or riding bicycle to and from work? (combine time spent both ways)
1 - Does not work at all or works at home
2 - Goes to work by car, public transportation or similar
3 - Walks (ride a bike) less than 15 minutes a day
4 - Walks (ride a bike) between 15 to 30 minutes a day
5 - Walks (ride a bike) for more than 30 minutes a day

BACKGROUND INFORMATION

BKI_01
Year of birth?

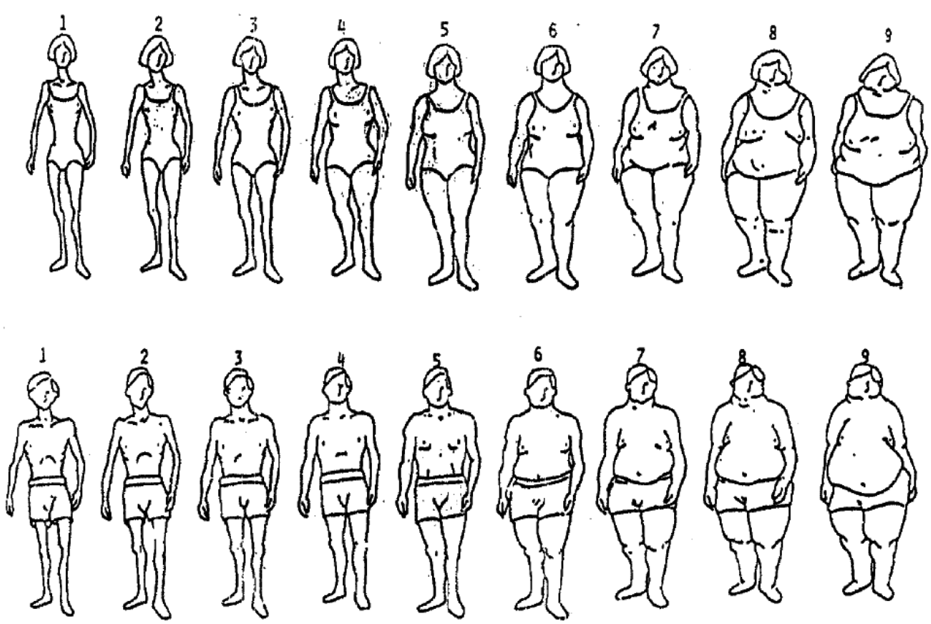
BKI_02

Sex
1 - Male
2 - Female

BKI_03
Marital status
1 - Married or living in partnership
2 - Single
3 - Separated or divorced
4 - Widowed

BKI_07
Education
1 - Unfinished primary school
2 - Primary school
3 - High school or similar school
4 - College
5 - University
6 - Unknown

PHM_13
Silhouette
(circle a number next to the silhouette which is most similar to the silhouette of the respondent)



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