

# Nutritional Habits of Croatian Island Populations – Recent Insights

Saša Missoni

Institute for Anthropological Research, Zagreb, Croatia

## ABSTRACT

*Although Croatia is divided into continental and insular subpopulation which practice different dietary habits, a general shift in nutritional habits has been observed in the direction of globalization, including considerably higher intake of red meat, saturated fatty acids, milk, dairies etc. and accompanied by a decrease in physical activity. These relatively abrupt changes have had an especially significant impact on the insular populations, known for their traditional Mediterranean diet and have led to the increased prevalence of hypertension, metabolic syndrome, diabetes mellitus, coronary heart diseases etc. on Croatian islands. Since the expression of genes responsible for the occurrence of complex diseases can be enhanced in isolated populations due to the effect of evolutionary forces, genetic-epidemiological research in population isolates is of great importance, giving us insight into the interplay between intrinsic (genes) and extrinsic risk factors (diet) for disease development.*

**Key words:** nutrition, islands, intrinsic and extrinsic factors, complex diseases, evolution

## Diet in Croatia

Republic of Croatia can be divided into two basic regions regarding dietary habits; continental and Mediterranean one. Such division is geographic and therefore also climatic. Continental Croatia is characterized by a shorter vegetation period and that is the main reason for a reduced intake of fresh fruits and vegetables throughout the year, when compared to the Mediterranean part of the country. There, in line with the considerably longer vegetation period, the intake of such fresh products is more constant. The most significant difference in dietary habits between the regions is in the proportion of saturated and unsaturated fatty acids in the diet and in the general calorie intake. Higher intake of saturated fatty acids of animal origin is more common in continental Croatia, together with consumption of smoked products. Also, typical preparation of food there is by roasting or deep-fat frying. Diet of farmers in the coastal part of the country can be seen as a variant of the Mediterranean diet characterized mostly by the consumption of brown bread, olive oil, red wine, fruits and vegetables. In line with recent research of dietary habits in Croatia, a notable influence of »global« diet has been noticed in the Mediterranean region, i. e. high intake of red meat, poultry, industrially processed food and fast food<sup>1-5</sup>. Such di-

vergence of dietary habits in one population is potentially interesting for studying the influence of diet on phenotypic traits in a population. This kind of research has mostly been conducted in the 70ies, as a part of The Seven Countries Study<sup>6</sup>.

## Dietary Habits of Middle Dalmatian Islands

Research conducted in the 90ies on the island of Hvar showed a tendency towards change in dietary habits of the contemporary population, including higher intake of meat, pasta, cakes and coffee<sup>7</sup>. In the last ten years, results of research performed on island of Vis have shown similar trends. Although the diet on the islands is predominantly Mediterranean, a significant increase in the consumption of red meat, poultry, milk, dairy products, sugar and industrial products and decreased consumption of fish, fruits and vegetables has been observed. This has had a significant effect on the balance between saturated and unsaturated fatty acids, increasing the levels of saturated ones due to intake of red meat and industrial products<sup>4</sup>. Intake of red meat and poultry, fruits and vegetables is in line with the national average, while the

consumption of other meat is 2–3 times *per week*. This is also in line with the national average and the region with the highest intake of meat is the Požeško-slavonska County, where 28.9% of inhabitants eat meat every day. Considering vegetable consumption, the islands hang behind regions such as Istria and Međimurje (northern Croatia), but are in line with the rest of the region, the Splitsko-Dalmatinska county. Intake of fish is higher than the national average, but still lower than in other Mediterranean countries. Inhabitants of the island of Vis eat fish 2–3 times *per week*, which is considerable when compared to the rest of the country. However, given that Vis is an island with a long fishing tradition, fishery potential is not used to its fullest.

Considerable number of studies has in the last years been focused on studying the influence of changes in dietary habits and lifestyle on the development of obesity and metabolic syndrome. The study conducted by Kolčić et al. (2006)<sup>8</sup> is worth mentioning, since it has established a high prevalence of such conditions on Croatian island isolates. The highest prevalence of metabolic syndrome has been observed on the island of Mljet, according to WHO (53%), while the prevalence on the island of Vis, in places Komiža nad Vis, was 33% and 34%, respectively. The effect of inbreeding on the prevalence has not been established in this study. A study by Deka et al. (2012)<sup>9</sup> has indicated a high prevalence of the syndrome on the island of Hvar – 25% according to NCEP and 38% according to IDF<sup>9</sup>. One of the highest prevalence of obesity in Croatia has been recorded on the island of Vis, according to all three measures for obesity detection (body mass index, waist circumference and waist-to-hip circumference ratio). The average body mass index (BMI) of 27.47 (kg/m<sup>2</sup>) is an indication of general overweight of the island's inhabitants. Also, high results have been obtained for hypertension (69%), metabolic syndrome (47.2% according to NCEP), diabetes mellitus (8.1%) coronary heart diseases (94%) and cerebral stroke (3.9%) on Vis<sup>4</sup>.

### Different Perspectives on Dietary Change

Dietary changes observed in the last few decades can be explained from several perspectives:

#### *The globalization trend*

Processes of globalization and industrialization worldwide have led to changes in dietary habits and lifestyle. Hard physical labour is being increasingly replaced with mechanisation and traditional agriculture and fishery with a physically less demanding tourism (e.g. current wine-growing economy amounts for only 8% of the same economy before WWII). The explanation for dietary habit changes can be found in the neglected agriculture and the appearance of supermarkets, together with more easily accessible cheap groceries. The problem with diet on the islands is also socioeconomic – Croatia belongs to countries with an unfavourable economic situation, directing people towards consumption of cheaper and more

easily accessible, but nutrient-poor food. Such diet has considerable effect on the development and distribution of obesity and metabolic syndrome. The globalization trend is the main cause of widespread availability of nutrient-poor food products. Populations today eat more high-energy food, which includes more saturated fatty acids, cholesterol and simple carbohydrates and not enough fruits and vegetables, fibres, vitamins, minerals etc. Lifestyle changes, leading towards less physical activity, also have to be highlighted. Our insular populations fit nicely within the global trends with increased intake of high-energy products, according to the WHO report.

#### *Socio-cultural aspect*

In the past, fish and brown bread have always been symbols of poverty, while red meat and white bread were considered elite food. Nowadays, when these »elite-products« are equally available, people turn to them more often. Accordingly, studies have shown that wealthier people tend to consume more red meat, poultry and refined sugar.

#### *Evolutionary adaptive aspect*

Sudden and swift shift in dietary habits on the islands can be observed as a strong trigger for development of diverse pathogenic changes, general obesity trend, and occurrence of metabolic syndrome, diabetes mellitus and coronary heart diseases. As far as is known, changes in dietary habits and lifestyle in general have never been introduced in human populations so fast. We can therefore propose a thesis that populations have not yet adapted to the new habits and food products that are produced and processed in a different way. Although it is still not scientifically proven, we cannot neglect the existence of new and complex chemical compounds that are affecting the products of our ecosystem (their growth and processing) and whose effect on human health is questionable.

### Intrinsic and Extrinsic Risk Factors in Genetic Isolates

Middle and South Dalmatian islands are considered to be genetic isolates and it is certain that genes act as intrinsic factors affecting complex traits, as has already been shown in many studies conducted on Croatian insular populations<sup>10</sup>. Islands as genetic isolates are also powerful tools that offer insight into the interaction between genes and environment, i.e. the decreased genetic diversity and influence of environmental factors on the development of complex diseases. Explanation for the high prevalence of diabetes mellitus in some isolated populations should be sought in the fact that it has always taken a considerable period of time for populations to adjust to certain dietary changes. That is why the current sudden and radical shift towards less physical activity and high intake of saturated fatty acids, red meat, refined sugar etc. can be observed as a strong extrinsic im-

pulse. This impulse affects the genetic structure resulting in higher frequency and expression of certain candidate genes in small, isolated populations, which is consequently responsible for the development of complex diseases. Good examples for this are the Pima Indians<sup>11</sup>. We can conclude that the current changes in dietary habits and lifestyle are occurring faster than ever before and the adaptation power of one generation cannot keep track with them, resulting often in development of pathogenic conditions.

## Future Research

Research on the islands of Hvar and Vis are to be continued, but it would be of great significance if other Croatian genetic isolates (such as islands of Korčula, Brač, Rab, Lastovo, Mljet, Elafits etc.) also become targets of genetic-epidemiological research. Another interesting perspective would be studying people that originate from the islands, but live in other parts of the country. We would then have one population that has been exposed to different extrinsic factors, such as different dietary habits, which could offer interesting insights.

A more detailed study on the island of Hvar would be desirable, since the island has a strong east-west difference in the population structure and we could investigate the influence of similar environmental factors on two different subpopulations<sup>12</sup>. Such studies are important, because they can tell us more about the interplay between intrinsic (genes) and extrinsic factors (diet) in an isolated population.

## REFERENCES

1. TUREK S, RUDAN I, SMOLEJ-NARANČIĆ N, SZIROVICZA L, ČUBRILO-TUREK M, ŽERJAVIĆ-HRABAK V, RAK-KAIĆ A, VRHOVSKI-HEBRANG D, PREBEG Z, LJUBIČIĆ M, JANIČIJEVIĆ B, RUDAN P, Coll Antropol, 25 (2001) 77. — 2. KAIĆ-RAK A, PUCARIN-CVETKOVIĆ J, KULIER, Acta Med Croatica, 61 (2007) 259. — 3. MISSONI S, Coll Antropol, 30(3) (2006) 673. — 4. MISSONI S, Coll Antropol, 33(4) (2009) 1273. — 5. MISSONI S, SAHAY R, RUDAN P, DURAKOVIĆ Z, SINDIK J, COUCH S, DEKA R (2012) Shift in dietary patterns in an Adriatic island population, 18th EAA congress, Ankara. — 6. KEYS A, ARAVANIS C, VAN BUCHEM FSP, BLACKBURN H, BUZINA R, DJORDJEVIĆ BS, DONTAS AS, FIDANZA F, KARVONEN MJ, KIMURA N, MENOTTI A, NEDELJKOVIĆ A, PUDDU V, PUNSAR S, TAYLOR HL, Lancet, 8 (1981) 58. — 7. SMOLEJ-NARANČIĆ N (2000) Physical and lifestyle in Mediterranean setting. 5th International Congress on Physiological Anthropology, Seoul, Korea, Proceedings: 299. — 8. KOLČIĆ I, VORKO-JO-

VIĆ A, SALZER B, SMOLJANOVIĆ M, KERN J, VULETIĆ S, Croat Med J, 47 (2006) 585. — 9. DEKA R, DURAKOVIĆ Z, NIU N, ZHANG G, KARNS R, SMOLEJ NARANČIĆ N, MISSONI S, CARIĆ D, CARIĆ T, RUDAN D, SALZER B, CHAKRABORTY R, RUDAN P, Ann Hum Biol, 39(1) (2012) 46. DOI: 10.3109/03014460.2011.637512 — 10. RUDAN I, RUDAN D, CAMPBELL H, CAROTHERS A, WRIGHT A, SMOLEJ-NARANČIĆ N, JANIČIJEVIĆ B, JIN L, CHAKRABORTY R, DEKA R, RUDAN P, J Med Genet, 40(12) (2003) 925. DOI: 10.1136/jmg.40.12.925 — 11. SCHULZ LO, BENNETT PH, RAVUSSIN E, KIDD JR, KIDD KK, ESPARZA J, AND VALENCIA ME, Diabetes CareM, 29 (2006) 1866. — 12. DEKA R, NARANČIĆ NS, XIP H, TUREK S, ČUBRILO-TUREK M, VRHOVSKI-HEBRANG D, JANIČIJEVIĆ B, TOMLJENOVIĆ A, SZIROVICZA L, JIN L, CHAKRABORTY R, RUDAN P, Coll Antropol, 32(1) (2008) 85.

Longitudinal research conducted on children and adolescents would also be of special importance, since it would enable us to study development of obesity and metabolic syndrome and give us a possibility to detect possible triggers for the onset of such diseases and ways to prevent them. That is the reason why genetic-epidemiological research can be seen as great contribution to the improvement of public health system. Concerning the questionable health status and high prevalence of obesity and metabolic syndrome on Croatian islands, systematic education in schools and medical centres should be a priority.

## Acknowledgements

In general, an interdisciplinary approach to such matters is crucial in future research – that is interaction of sociocultural, sociological and biomedical aspects of research. However, an evolutionary perspective and studying the ways in which tradition changes in different populations and in different times should also not be neglected.

This research was supported by the Ministry of Science, Education and Sports of the Republic of Croatia (project no. 196-1962766-2751 under the direction of Academician Pavao Rudan) and was presented at the international workshop on the island of Hvar, in September 2012. The workshop was realized with the financial support of The Wenner-Gren Foundation, New York, USA and I would like to thank them for their collaboration and support.

S. Missoni

*Institute for Anthropological Research, Gajeva 32, 10 000 Zagreb, Croatia*  
e-mail: *sasa.missoni@inantro.hr*

## **PREHRAMBENE NAVIKE HRVATSKIH OTOČNIH IZOLATA – NOVE SPOZNAJE**

### **S A Ž E T A K**

Iako se prehrambene navike stanovništva u kontinentalnom dijelu Hrvatske i na otocima razlikuju, zamijećen je opći trend promjene prehrambenih navika u smjeru globalizacije, što uključuje znatno veći unos crvenog mesa, zasićenih masnih kiselina, mlijeka i mliječnih proizvoda itd. te smanjenu fizičku aktivnost. Ove relativno nagle promjene imale su osobito velik utjecaj na zdravlje stanovništva hrvatskih otoka, inače poznatih po mediteranskoj prehrani te je kod njih utvrđena povišena prevalencija za visok krvni tlak, metabolički sindrom, šećernu bolest, srčana oboljenja itd. Ekspresija gena odgovornih za razvoj navedenih kompleksnih bolesti pojačana je u takvim izoliranim populacijama zbog utjecaja evolucijskih sila pa su genetičko-epidemiološka istraživanja populacijskih izolata poput hrvatskih otoka od velikog značaja, jer nam omogućavaju uvid u međudjelovanje unutarnjih (gena) i vanjskih faktora rizika (prehrana) za oboljenje od kompleksnih bolesti.