

## ANALYSIS OF RELATIONSHIP BETWEEN CONSUMER BEHAVIOR AND EFFECTIVENESS OF HEART MEDICINES

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**Abstract:** Nowadays many research dealing with the food consumer behavior and its relationship with health status of population, thus the demand of pharmaceutical market. It is well known that cardiovascular diseases such as ischaemic heart diseases are the most common cause of the early and suddenly mortality. The higher level of pharmaceutical preventive technologies may result partly that fewer people need to consume heart medicines due to the healthy diet, on the other hand that the therapies can keep low the heart mortality rate inside of all mortality. Effectiveness of medicine treating heart diseases is not same in the examined OECD countries, which can also be traced back to different food consumption due to the same forms of treatment and the risks of the disease between regions. The examined OECD countries were selected based on consumer data availability. The target of analysis is to research the relationship between the „ineffectiveness” of heart medicine consumption (via the heart mortality data) and the health awareness in food consumption that also shows the subjective utility of preventive health services. During the examination of preventive services market it could be consider only costumer decisions those motivate effort to realize and maximize health utility that can obtain by reducing the objective likelihood of later illness (prevention defined by the reduction of influenced risk factors). For this it has to be eliminated the impact of all factors in consumption those are not associated with health consciousness – calculation of price and income flexibility serve it. Every nutritional culture considered unhealthy or incorrect, which exceeds the critical values expressed in dietetics recommendations. The data described in a 2 dimensional diagrams, and between diagrams the distances from reference country data to data of another country examine with correlation coefficient. It can conclude there is a strongest connection between the carbohydrate/fat consumer rates and the effect of medical treatments than between the latter and fat or fat/protein consumer rates. Basically, my research is empirical and quantitative.

**Keywords:** price flexibility, health, consumption, prevention, nutrition, heart diseases

**JEL classification:** I15

### 1. Generally Introduction

Nowadays many research dealing with the food consumption based on health awareness and its connection with health status of population, so the demand of pharmaceutical market. According to KEARNEY (2010) the nutrition transitions associated with rising rates of obesity and chronic diseases such as cardiovascular disease and cancer. Since “the health budget expenditures have increased dramatically over the world, due to the increasing cost pressure” (FRANK, 2007), it can save several type of expenditures in public health sector with following health conscious nutrition. Overall, in Europe “cardiovascular diseases result mostly the inability of work and raising costs in health care, furthermore classify as the most frequent causes of early sudden death” (KÉKES, 2009). “The obesity, smoking, stress-filled environment, excessive alcohol consumption and lack of physical activity constitutes a group of lifestyle-related risk factors, which responsible for at least 40% of total mortality in the developing countries, while 75% of total mortality in the

industrialize countries" (GÁRDOS, 2001). In contrast, a statistical study based on narrow sample contained by young people clearly concludes that knowledge of risk factors itself has not contributed to live healthier (BARANYAI et al., 2006.). For example in Hungary „the level of health awareness is considered stable, the majority eat completely normally or foods those taste good" (KOZÁK, 2009). According to the World Health Statistics by WHO (2014) „the preponderance of noncommunicable diseases (NCDs) such as ischaemic heart disease and cerebrovascular disease in cause of death rankings is therefore potentially misleading and may not appropriately reflect the impact of premature mortality". „Of the leading 15 causes of YLL, ischaemic heart disease and stroke were two of the three causes for which YLL increased between 2000 and 2012. Such changes also have implications for overall rankings as ischaemic heart disease overtook lower respiratory infections as the leading cause of YLL in the world" (WHO, 2014).

## **2. Material and methods**

The higher level of pharmaceutical preventive technologies may result partly that fewer people need to consume heart medicines due to the healthy diet, on the other hand that the therapies can keep low the heart mortality rate inside of the all mortality. Accordingly, during the analysis the author illustrate the the former reasons in a diagram that have 2 dimensions: the average drug consumption per 1000 people between 2000 and 2011 and the disease specific mortality rate in the same period (in this case for the ischaemic heart diseases). In the food consumption "depending on the developmental standard of the economy, structural change proceeds along the following dimensions: assortment-, convenience-, health- and environmental trends and transparency of the market" (LEHOTA, 2004). Despite of this the author limited reasons of food consumption decisions only for three factors: the impact of real income changes (including food prices and the incomes of customers), the change of food supply composition and attributed specifics (role in nutritional culture, nutrient content, experienced sense of satisfaction after previous tasting, marketing impact, ability reducing hunger), and the diet awareness which include the health awareness too. During the examination of preventive services market it could be consider only costumer decisions those motivate effort to realize and maximize medical utility that can obtain by reducing the objective likelihood of later illness (prevention defined by the reduction of influenced risk factors). For this it has to be eliminated the impact of all factors those are not associated with health consciousness. It can be distinguished three food types: fats, proteins and carbohydrates – from these types a food basket could assemble. The consumer's own decision that whether worth for it drawn up the former basket in accordance with the prescribed rate in order to maintain his health. The extent of deviation from the desirable consumer basket gives one of dimensions of analysis: due to the three different types and its presumed effects the former extent has to show separately in terms of the energy arise from fat in kcal, the rate of fat/protein, the rate of carbohydrate/fat, vegetable oils and fish consumption, those have polyunsaturated fats.

The author evaluates deviation in terms of the development of ischemic heart diseases: every nutritional culture considered unhealthy or incorrect, which exceeds the critical values expressed in dietetics recommendations. Taken into account the exchange rates used for nutritional science: fat of 9.2 kcal/g, protein of 4.2 kcal/g, and carbohydrate of 4.1 kcal/g. Moreover, based the newest studies, prescribe rate of the energy arise from fat is 30% of daily energy intake, the fat/protein is nearly 1.5, the carbohydrate/fat is approximately 1.66.

The other one of dimensions is the reason of consumption of the given diet composition, which measured by the sum of price and income flexibility: since lower flexibility essentially means greater diet awareness, so the author measures the latter factor as reciprocal of sum of flexibility rates, while the change of food supply composition considered unchanged. The price and income flexibility calculated by the formula (1).

$$\varepsilon = \frac{\partial D(p_0)}{\partial p} * \frac{p_0}{D(p_0)} + \frac{\partial D(I_0)}{\partial I} * \frac{I_0}{D(I_0)} \quad (1)$$

In this case the food consumer decisions motivating health awareness can be detected clearly in the 2 dimensions model if the nutritional consumption, those are nearly to the prescribed diet compositions, have high diet awareness (so low price and income flexibility). From considering preventive nature of nutrition follows that for the consumers it will only be worth it to give up the unhealthier diet, which can have higher utility in order to a healthier one if the utility of prevention, namely the estimated probability of chronic disease within 10 years next to the absence of prevention, compared to the estimated probability next to prevention, would evaluate to higher significantly. However, if diets followed by consumers result utility permanently within the required criteria, than diet with preventive specifics integrate into the consumer customs, for this reason man prefers these foods without the utility of prevention, so in motivation behind consumption the border between the prevention aim and following of nutritional customs disappear, but since the latter finally also based on the health awareness, the author identify the impact of nutritional culture with this. The data described in a 2 dimensional diagram examine with correlation coefficient ( $r$ ) of relative distances ( $s$ ) from reference country data to data of another countries.

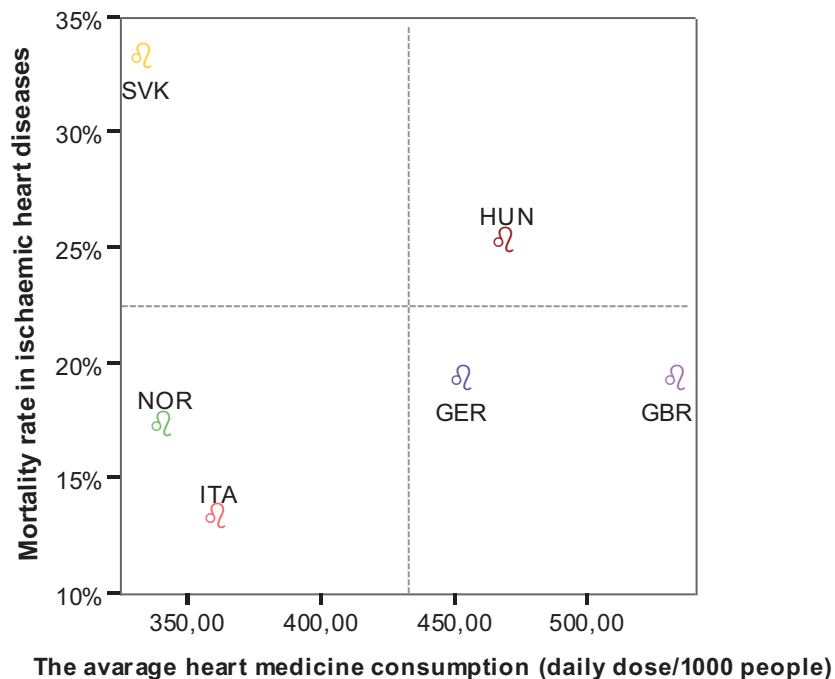
$$s_n = \sqrt{\Delta x_n^2 + \Delta y_n^2}$$

$$r = \frac{\sum (s_1 - \bar{s})(s_2 - \bar{s})}{\sqrt{\sum (s_1 - \bar{s})^2 \sum (s_2 - \bar{s})^2}}$$

When setting up the model, the author assume that the pharmacological treatment begin at the same time with disease emergence (or cessation of symptom control), furthermore sudden premature mortality (before life expectancy) explained by the failure of medication. The starting assumption of the model is that all members of examined populations feed as average (the annual sum of price and income flexibility data between 1996 and 2011 characterized by quadratic average of those, which is suitable for handle the different sign variations) based on the OECD Statistics and FAO data services. Owing to the data availability the examined countries are OECD members: Hungary, Slovakia, Germany, Italy, United Kingdom and Norway.

### 3. Results and discussion

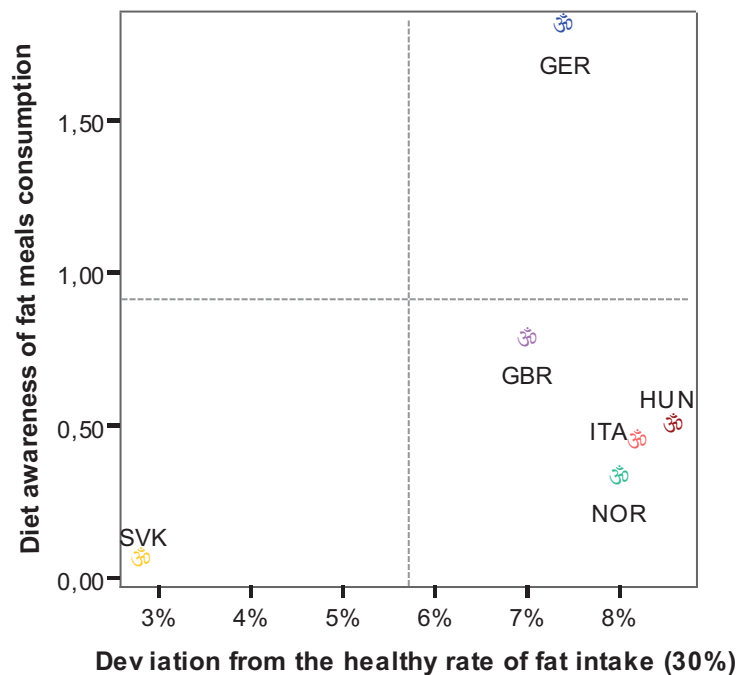
If the effectiveness of heart medicine examined only in the paper, it will not appear so differences between countries, which would explain by another reason than health care system or distinct health status of population. Compared this to the food consumption, the differences between country data can also explain in terms of different nutritional cultures.



**Figure 1:** The effectiveness of heart medicine consumption (2000-2012). Source: own editing based on OECD Health Statistics.

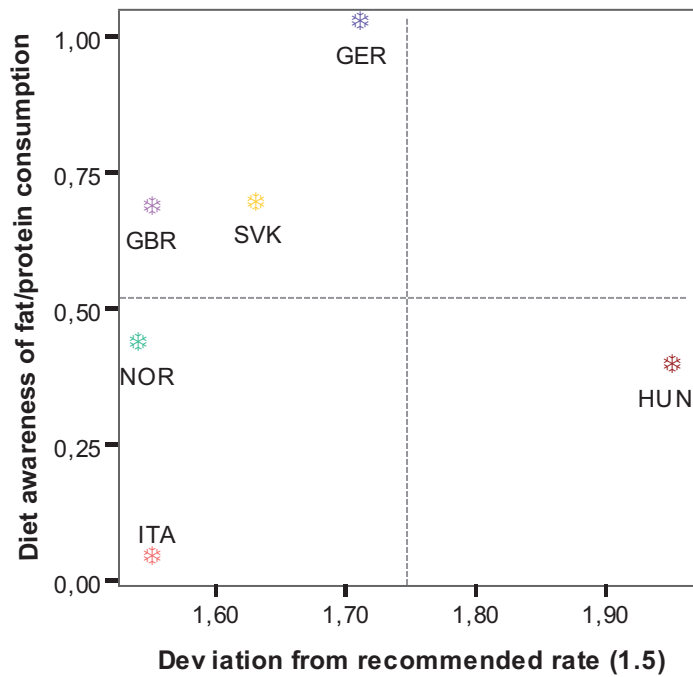
Based on Figure 1 it can be diagnosed that between Slovakia and Norway, furthermore Germany and Hungary appear much greater difference in mortality rate in ischaemic heart disease than only differences in heart (blood pressure and cholesterol lowering) medicines consumption would justify. Moreover, in the UK next to relatively higher drug consumption the disease-specific mortality rate is the same as the data of Germany (19%). In relation to each other of six examined countries Slovakia is in the least favourable situation, since relative to the low heart medicine consumption, disease-specific mortality rate is high (33%), so in Slovakia the average effectiveness of medicinal treatment is extremely wrong compared to other countries. However, it can be explained by the lower medical availability, but that cannot be said for Hungary, where the mortality is the second highest, next to the highest medicine consumption following the UK. Those countries are in the best position, where beside to lower medicine demand, there is also lower mortality rate in ischaemic heart diseases compared to all mortality, such as Norway and Italy.

In terms of the fat intake the best, upper left quarter of coordinate-system in Figure 2, includes no one country – Slovakia is the only one where – however fat consumption is the lowest, the latter have the highest price and income flexibility too. Despite to Slovakia, Germany stands out in that relatively higher fat consumption rate influenced by diet awareness, which can be explained by different in standard of living. However, it is the worst situation too, since the high fat intake rate arises from the dietary culture followed by vast majority of Germans, which can be formed only longer term. The majority of examined countries has low fat intake rate, but the price flexibility of consumption is higher, so in this respect those are closer to the most unfavorable case. The dispersion of medicinal data cannot be explained by the difference of fat meals consumption: the latter is higher in Slovakia compared to Norway despite of the fact that in Norway there is a greater fat intake rate by 5% at the same diet awareness as in Slovakia. Moreover, the larger mortality rate in Hungary can be less attributed to different fat intake, while the latter is considered to be more diet conscious in Germany.

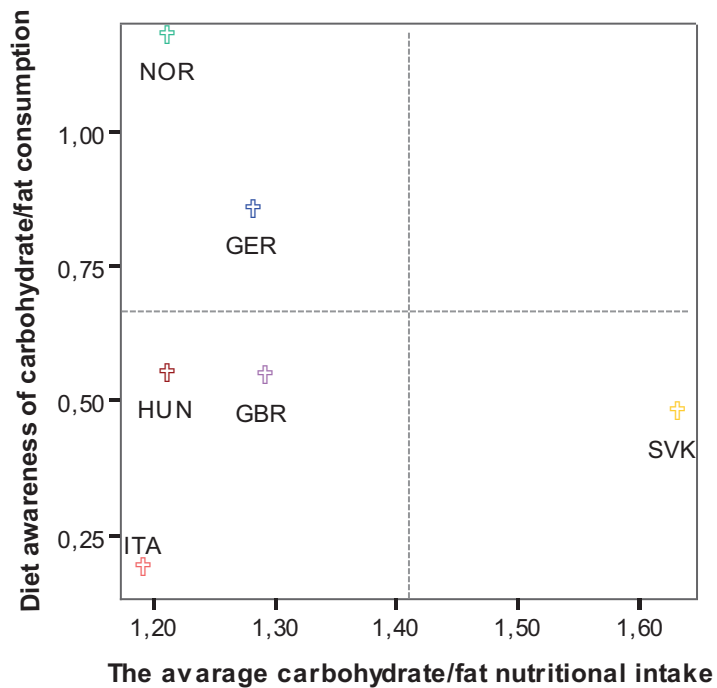


**Figure 2:** The average fat consumption (1996-2011) in six OECD countries. Source: own editing based on FAO Statistics.

According to the literature the lipoproteins (lipid-protein complexes) play an extremely role in causing ischaemic heart diseases by inducing atherosclerosis. According to its composition there are two types of lipoprotein: high density lipoproteins (HDLs) is the protective cholesterol, which the LDLs that deposited in vessel wall transported back to the liver where it is degraded, so if HDL level is low, the risk of arteriosclerosis, heart attack and stroke will increase – the low density lipoproteins (LDLs) increasing risk of disease would occur strongly next to nutritional culture that can characterized by high fat content eating compared proteins. So inadequate fat/protein ratio enhances the number of wrong cholesterol, which already not compensated by the level of protective cholesterol, increasing the chance of occurrence of hyperlipidemia and hypertension (high blood pressure), thus these connect with the less effectiveness of medicinal treatment healing ischaemic heart diseases. Based on data illustrated in Figure 3, Italy, Norway and United Kingdom have the most favorable fat/protein ratio, however, those extend could not explain the least by high diet awareness in Italy. The worst rate can be detected in Hungary, but the price and income relations are more decisive in food consumption than diet consciousness. Compared this with the average consumption of blood pressure lowering medicine, it can consequence that the medicine utilization determined rather by an awareness of consumption of healthier diet (Germany) than a less healthy fat/protein rate, that consume less consciously (Hungary).



**Figure 3:** The average fat/protein nutritional intake rate (1996-2011) in six OECD countries. Source: based on FAO Statistics own editing.



**Figure 4:** The average carbohydrate/fat nutritional intake rate (1996-2011) in six OECD countries. Source: own editing based on FAO Statistics.

Due to high glycemic-index carbohydrate intake, the sugar concentration develops in the blood causing persistently higher level of insulin. It causes that insulin can connect more

weakly to the insulin receptors of cells, so those become resistant to the presence of insulin, and production of those. The brain sensing increased blood glucose level, instructs beta cells to produce further insulin, which exhaust due to the resistance of cells and continued high glucose level, thus insulin deficiency or diabetes develops, followed by obesity and cardiovascular diseases. In terms of carbohydrate/fat nutritional intake, Slovakia is the worst position, while Norway, Hungary and Italy have rate regarded as the best – however the diet awareness remains typical mostly for Norway and the least for Italy. Comparing this to the data of fat/protein intake rates, it is concluded that the medicine utilization determined rather by the carbohydrate/fat intake rate than the fat/protein rate.

**Table 1:** The average consumption of vegetable oils and fishes in six OECD countries

Consumption		Germany	Hungary	Italy	Norway	Slovakia	Great-Britain
Oils	Rate	2,1%	2,1%	2,6%	1,8%	1,8%	2,1%
	Awareness	1,16	10,79	1,44	14,46	26,32	3,64
Fishes	Rate	1,4%	0,5%	2,1%	5,3%	1,0%	2,0%
	Awareness	2,39	16,66	1,56	1,76	104,81	1,52

Source: own editing based on FAO Statistics.

In respect of secondary prevention of ischemic heart diseases relevant to consider the consumption ratio of food containing polyunsaturated fatty acids - vegetable oils and fish contain polyunsaturated fatty acids in the largest proportion. The consumption of vegetable oils, shown in Figure 5, is around 2% of the total food consumption in all examined countries. From this Italian rate deviates a little with its 2.5%, while diet awareness is surprisingly low in Norway.

Alternatively, values for fish consumption can be already detected in a wider interval: while in the most of countries fish meals are eaten in 2% or less compared to total food (among others in the lowest proportion in Hungary), the diet of Norwegians determined by more than 5% the consumption of seafood. However, it considers that, in Italy – despite of the results in the fat intake rates – the nutritional consciousness of vegetable oils and fishes is extremely high. Thus the effect of following Mediterranean diet to food consumption manifests not primarily in control of nutrition intake rates relation to each others, but also insistence for certain types of food, regardless of its content, which refers to less health-conscious food consumption. The correlation coefficients of deviations described in Table 2.

**Table 2:** Correlation between nutritional culture and medical treatment

	Medical treatment	Fat	Fat/Protein	Carbo-hydrate/fat	Vegetable oils	Fishes
Correlation coefficient	1	0,396	-0,575	-0,856	-0,04	-0,23

Source: own editing.

Since in this analysis the presages consider as irrelevant, there is a strongest connection between the carbohydrate/fat consumption and the medical treatment.



#### 4. Conclusions and Summary

In conclusion, firstly, effectiveness of medicine treating heart diseases is not same in the six examined OECD countries, which can also be traced back to different food consumption due to the same forms of treatment and the risks of the disease between regions. The latter, however, may be assessed according to several criteria (nutrient intake by itself and in relation to each other, and consumption of foods containing less frequent nutrients), those indicate not the same results concerning effectiveness of medical treatment. It is concluded that the medicine utilization determined rather by the carbohydrate/fat intake rate or fish diets than the fat/protein rate or fat consumption.

During the analysis starting relative results of the six countries, in respect of diet awareness depending on level of development, fat intake can explain less, fish consumption may explain the most the differences in effectiveness of medical treatment, other factors have not explanatory effect.

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