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THE MAIN CORRELATIONS OF THE HUNGARIAN'S HEALTH STATUS AND FOOD CONSUMPTION

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It is a general socio-political objective of the mid- and long term food industry development strategy of Hungary to promote healthy food production and consumption. The realization of the strategy of the domestic food industry increasingly promotes healthy eating, for example consuming natural, domestic, fresh ingredients, prepared foods, in order to improve the overall health of the population (EFS, 2014–2020). Our study presents the regional tendencies of staple food consumption in Hungarian regions and the changes in indicators reflecting the health status of the population. Furthermore, our hypothesis states that there is a statistically provable correlation between the annual food consumption of Hungarian households per capita and the health status, on regional level.

Keywords: food development strategy, health status, eating habits, life expectancy

Introduction

During the 20th century the production levels of the Hungarian agriculture were sufficient to sustain the domestic population with adequate quantities and qualities of food. At the beginning of the previous century, food consumption levels were significantly lower than in the late 1900s, when food production increased. The food selection and the modernisation of food consumption principles were cardinal in the process, in which consumption levels could grow. The structure of food consumption was influenced by the increasing average life expectancy as well. The spreading of modern eating habits is halted not only by the traditional mentality, but also by the fact that the price of healthier food products is much higher, than cereals and products with high fat content (Kollega Tarsoly, 1997). There is a significant correlation between income levels and the quality of food consumed by the population. There has been a great dispersion between the consumption habits of population segments with different income levels. From the 1960s, the rapidly expanding food production enabled a similarly rapid increase in consumption, which could even exceed the average of European countries. However, the structure of consumption was not ideal at this time, either. After 1990, agricultural production decreased and food prices rose. The food consumption levels fell back below the levels of the 1980s. On the other hand, the Hungarian consumption levels of meat products and egg rose to Western-European levels. The volume of growth of meat (especially poultry) and egg consumption was particularly high compared to the first half of the last century. Significant growth in dairy product consumption occurred not earlier than in the 1980s. Unfortunately, annual fish consumption, although it had grown significantly over 50 years, remained below 3 kg per capita. The role of fruits and vegetables stopped growing in the past fifteen years (Kollega Tarsoly, 1997).

Hungary is capable of a 120% self-sustainment from the basic food stuffs currently. This level could be increased to 150%, which judging by the well-observed rising of the global demand for food can become a significant advantage for the national economy. The endowment of Hungary actually allows domestic agriculture not only to sustain its own population, but also to further increase food export. Food economy is also important for rural employment and in encouraging rural population not to leave to larger cities, because:

- Hungarian food industry is the second largest employer among the processing industries,
- this sector has a large role in preserving rural workplaces,
- it plays an especially important role in providing jobs in rural areas, supporting family enterprises, small-scale farmers, SMEs,
- small-scale farmers provide food to satisfy local demand by processing their own products (Nemzeti Vidékstratégia, 2012–2020).

Social policies focus on supporting food industry as well, because it is an important factor of Hungarian and European food production, and a stable, competitive part of the Hungarian agriculture. Therefore, it significantly contributes to rural welfare and to supplying the Hungarian population with safe and quality food products. However, this objective can only be achieved by exploiting the comparative advantages of the Hungarian agricultural economy.

- to provide safe and reliable food to the population as much from domestic sources as possible;
- to produce the highest possible value added domestically by optimising the food chain, and to improve the situation of the national economy by exporting the surplus food products;
- to preserve the self-sustaining ability and job opportunities of the rural areas by increasing the ration of domestic food processing and by developing sustainable food production systems (ÉFS, 2014–2020).

Agreeing with Tóth and Káposzta (2014), we believe that it is cardinal in the Hungarian food production system to prefer local resources, thus ensuring that the capital invested in them stays in that specific area, and that it could be "reutilised". Several studies have proven the positive effects of local food stuffs on the regional development. Káposzta et al. (2015), during the investigation of the spatial role of Hungarian local foods, observed, that local products have direct and indirect positive impacts on the actors of the product chain and on the regions. This kind of strategies could have an important impact on the regional cohesion. We agree with the statement of Nagy et. al. (2011), who emphasized that policies aiming to improve the competitiveness of the territories must take into consideration the development needs and potentials of the given territory as well as the strategic objectives of the Union.

It is also the interest of the national economy to increase the health level of the population, which can be highly affected by supplying quality food and by promoting healthy consumption habits. Inadequate nutrition and inactivity together result in obesity and cardiovascular diseases, which

are sadly more and more common in our society. Based on the dataset of the Hungarian Central Statistical Office (KSH), three million people die all around the world annually from diseases related to obesity. The Hungarian situation is also worrying; 36% of the population above 15 has overweight, and 20% is obese (KSH, 2010).

Material and methods

We present the regional level changes, the main tendencies of the Hungarian food consumption patterns and the changes in the indicators reflecting to the health-state, by using secondary data. Our hypothesis, which says that there is a statistically provable correlation between the annual food consumption of Hungarian households per capita and the health status, on regional level, was analysed using mathematical-statistical methods. During the investigation we used the freshest data available. The regional data collected from the KSH are from 2014. When choosing the indicators reflecting the health status of the population, we followed the theoretical findings of Kollányi and Imecs (2007) and the calculations of Fogel (1994), Barro (1996) and Bloom, Canning and Sevilla (2001). We chose those staple food products, which, based on empirical experience, affect the health status significantly. The analysed indicators were as follows:

- Average life expectancy for women, years.
- Average life expectancy for men, years.
- Number of live births, number.
- Number of deaths, number.
- Annual cereal consumption of households per capita, kg.
- Annual meat consumption of households per capita, kg.
- Annual fat consumption of households per capita, kg.
- Annual fruit consumption of households per capita, kg.
- Annual vegetable consumption of households per capita, kg.
- Annual sugar consumption of households per capita, kg.

The correlation and regression analyses were conducted by SPSS statistical programme package. The existence, direction and strength of the correlation between the variables were investigated by the Pearson's linear correlation coefficient. This method does not differentiate between dependent and independent variables; therefore, the correlations were tested by the Partial Correlation Coefficient. This method analyses the strength between two variables by filtering out the effects of one or more variables. To establish the type of correlations, two variable regressions were used (Sajtos and Mitev, 2007).

Formula for the Pearson correlation coefficient:

$$r = \frac{\sum XZ - \frac{\left(\sum X\right)\left(\sum Y\right)}{n}}{\sqrt{\sum X^2 - \frac{\left(\sum X\right)^2}{n}\sum Y^2 - \frac{\left(\sum Y\right)^2}{n}}}$$

Interpretation of the Pearson correlation coefficient:

- $r > 0$ denote positive linear correlation,
- $r < 0$ denote negative linear correlation,
- $r = 0$ denote no linear correlation,
- the closer the value r is to 1 or -1, the stronger the linear correlation.

Significance test for the Pearson correlation (ρ):

- $\rho <= 0.05 \rightarrow$ there is correlation in the population,
- $\rho > 0.05 \rightarrow$ there is no correlation in the population.

Formula for the general linear model:

$$Y = \beta 0 + \beta 1X + \varepsilon$$

where:

Y and X – represent the scores for individuali on the criterion and predictor variable respectively

$\beta 0$ and $\beta 1$ – are constants describing the functional relationship in the population

- the value of $\beta 1$ identifies the change along the Y scale expected for every unit changed in fixed values of X (represents the slope or degree of steepness)
- the values of $\beta 0$ identifies an adjustment constant due to scale differences in measuring X and Y (the intercept or the place on the Y axis through which the straight line passes. It is the value of Y when $X = 0$)

ε – represents an error component for each individual. The portion of Y score that cannot be accounted for by its systematic relationship with values of X (Maher, n.d.)

Results and discussion

Tendencies of Hungarian food consumption

Fogarassy et al. (2004) found out that the demand for food products changes much more in long term than in short term. Some very important factors that change the demand for these products are the number and distribution of population (based on age, settlement type, sex, income levels), and the changes in consumer income levels and distribution. The prices of the product and the substitute product, the availability of substitute (direct) products, the changes in consumer taste and preferences also affect the demand of a product, on a long term.

The annual income per capita is higher in more developed regions than in the lagging behind ones. This is partly the reason why food consumption can be characterised by more quality food in these areas. It can also be established that healthier, premium category food products are preferred by the population segment with higher purchasing power (Nagy et al., 2016).

The main problem of the low income segments of the population is to acquire sufficient amounts of food; on the other hand, the ones with higher income show stronger demand towards healthier food products with more value added.

The weight of food products is quite significant in Hungarian consumer brackets; it is almost one quarter of the consumers' spending. The price of food products has gradually increased in the past 45 years. However, due to the weak consumption levels and the unfavourable changes in agricultural prices, the consumer prices decreased by 0.4% in 2014. Compared to this annual decrease of price, there was a bigger drop in the prices of sugar (16%), flour and potatoes (14%), eggs (3.4%), and bread (2.2%). On the other hand, there was a rise in prices of cheese (6.6%), milk (6.5%), canteen services (2.4%), and school and kindergarten meals (2.2% and 1.9%) (KSH, 2015).

Table 1 shows the changes in spending on staple food per capita on regional and settlement levels, between 2010 and 2014. The base ratios reflect the regional differences of food spending well. The spending per capita typically increased in every region. Spending on vegetables decreased only in the Southern Great Plain and the Central Hungary (by 4 and 7 percent). The demand for milk, eggs, cheese and fruits grew significantly in the Central Transdanubia, Western Transdanubia and in the Northern Hungary. Spending on meat increased in the Southern Transdanubia, Northern Hungary and

Table 1 Changes in food spending per capita, based on region and settlement types, 2014 (%)

Name of region	Total cereals	Total meat	Total milk, cheese, egg	Total oils and fats	Total fruits	Total vegetables and potatoes
	2010 = 100%					
Hungary	118	122	120	115	125	109
Central Hungary	111	113	109	105	109	93
Central Transdanubia	129	120	135	116	137	123
Western Transdanubia	128	127	131	117	156	135
Southern Transdanubia	128	141	123	123	141	135
Northern Hungary	119	133	130	130	132	105
Northern Great Plain	124	132	126	124	127	125
Southern Great Plain	104	108	108	106	118	96
Budapest	123	121	119	110	118	100
Cities with county rights, larger rural towns	126	121	119	116	125	113
Other towns	116	119	117	110	114	100
Villages	113	125	123	122	143	122

Source: The authors' own editing based on data from the KSH

in the Northern Great Plain. People buy increasing amounts of fruits and vegetables in the Western Transdanubia and the Southern Transdanubia, and generally, in countryside.

The consumption of cereals is still very significant on a country level, while there is a positive tendency observed regarding the vegetables. Fruit consumption is lower than it would be desirable, and it is also unfortunate from a food-health perspective that sugar and fat consumption per capita is higher than the recommended amount.

We can observe the amount of food consumption of households per capita in different regions and settlements in Table 2. The direction of changes of consumption levels between 2010 and 2014 was indicated by different colours. The consumption levels changed minimally on country- and regional levels. The fact that in certain regions the consumption of fruits and vegetables increased, while cereal and fat consumption dropped, indicates that the health-awareness of the population is changing positively.

In the case of Table 3 we investigated the average life expectancy for men and women, on regional, national and EU levels. The investigated time periods are the years 2001, 2012 and 2014. By analysing the regional data we can see that we cannot find significant differences compared to the national results.

For men, the life expectancy at birth in the year 2001 was the highest in the Central Hungary region (69.1 years), while the lowest value was found in the Northern Hungary. In 2012, the situation was similar, because the Central Hungary region had the highest value in this sense (72.9 years). In 2014 this region maintained the first position (73.5 years). For women, unlike in the case of men, in 2001 the highest life expectancy at birth was measured in

Table 2 The amount of food consumption of households per capita in different regions and settlements (2010, 2014), (kg capita^{-1})

Name of region	Total cereals		Total meat		Total milk, cheese, egg		Total oils and fats		Total fruits		Total vegetables and potatoes	
	2010	2014	2010	2014	2010	2014	2010	2014	2010	2014	2010	2014
	kg capita^{-1}											
Hungary	85	78	53	54	17	16	38	39	77	75	14	14
Central Hungary	74	64	48	46	16	13	42	36	79	65	12	10
Central Transdanubia	82	75	52	52	17	15	33	39	69	71	15	14
Western Transdanubia	87	74	50	49	17	15	32	38	60	67	15	13
Southern Transdanubia	92	**94**	51	**64**	17	16	39	**45**	80	**99**	14	16
Northern Hungary	91	87	53	56	19	18	34	36	81	78	15	15
Northern Great Plain	86	90	54	60	19	**19**	35	39	72	82	16	**17**
Southern Great Plain	99	84	67	61	18	16	42	41	95	83	14	14
Budapest	60	60	41	44	13	12	42	**42**	69	64	8	8
Cities with county rights, larger rural towns	78	73	53	51	16	15	40	41	74	72	11	12
Other towns	88	78	55	52	18	15	40	37	82	71	15	15
Villages	99	**92**	58	**62**	19	**18**	33	38	79	**88**	17	**17**

The consumption: decreased, increased, stagnated

Source: The authors' own editing based on data from the KSH

Table 3 The tendencies of the health status in Hungary

Territorial Unit	Average life expectancy at birth					
	men			women		
	2001	2012	2014	2001	2012	2014
EU-28	n.d.	77.4	78.1	n.d.	83.1	83.6
Hungary	68.2	71.4	72.1	76.5	78.4	78.2
Central Hungary	69.1	72.9	73.5	76.5	78.8	79.7
Central Transdanubia	68.5	71.2	72.1	76.2	78.4	78.8
Western Transdanubia	68.9	71.6	72.6	77.4	78.7	79.0
Southern Transdanubia	67.8	71.0	71.8	75.8	78.3	78.6
Northern Hungary	66.7	69.7	70.5	76.3	77.2	78.0
Northern Great Plain	67.0	70.8	71.2	76.2	78.4	78.5
Southern Great Plain	68.2	71.1	71.7	76.6	78.2	78.7

Source: The authors' own editing based on data from the KSH

Table 4 The main figures of population number changes (per 1000 inhabitants)

Territorial Unit	Live birth		
	2001	2012	2014
EU-28	10.4	10.4	10.1
Hungary	9.5	9.1	9.3
Central Hungary	9.1	9.6	9.3
Central Transdanubia	9.1	8.9	8.9
Western Transdanubia	8.7	8.2	8.3
Southern Transdanubia	9.1	8.3	8.6
Northern Hungary	10.1	9.2	9.9
Northern Great Plain	10.8	9.3	10.1
Southern Great Plain	9.0	8.2	8.4
Territorial Unit	**Mortality**		
EU-28	9.9	9.9	9.7
Hungary	13.0	13.0	12.8
Central Hungary	13.1	12.2	11.5
Central Transdanubia	11.8	12.7	12.6
Western Transdanubia	12.4	13.2	12.8
Southern Transdanubia	13.2	13.8	13.6
Northern Hungary	13.6	14.2	14.3
Northern Great Plain	12.5	12.3	12.4
Southern Great Plain	13.5	14.1	14.0

Source: The authors' own editing based on data from the KSH

the Southern Great Plain, while the lowest one was found in the Southern Transdanubia. In 2012, there was no significant change among the regions in this sense. The highest life expectancy for women was measured in the Central Hungary, and this result was repeated in 2014 as well. The results point out that women have a much higher average life expectancy than men in all the regions. Life expectancy at birth is affected by food consumption habits, inherited diseases, and also by our efforts to remain or become healthier. It was also found on regional level that the more developed regions, with inhabitants presumably having better life quality, have better chances to live long, than the underdeveloped, lagging-behind areas.

When investigating the proportions of live births and deaths, it was found that the proportion of live births in Hungary is lower than the average of the EU-28 in all three investigated years; however, in the case of the Northern Great Plain region this value (10.8) was higher than the EU-28 average in 2001. The regional numbers remained below the EU average in both 2012 and 2014. On the other hand, the proportion of deaths shows a more negative tendency than the EU average. However, the results vary hectically on the regional level. The highest death per 1,000 inhabitants ratio was measured in the Northern Hungary region in 2001, 2012 and 2014, while the lowest ones were found in the Central Transdanubia in 2001, and in the Central Hungary in both 2012 and 2014 (Table 4).

The regional correlation between food consumption and health indicators

Based on Pearson's correlation analysis, we can observe significant and strong correlation between the female and male life expectancy and cereal consumption (women: r = -0.833; men: r = -0.816), fat consumption (women: r = -0.884; men: r = -0.920) and sugar (women: r = -0.838; men: r = -0.844), on the regional level. It means that if the consumption levels of such food stuffs decrease, we can statistically prove that it has a positive effect on indicators of life expectancy. Also, there is a medium-strong correlation between consuming these products and birth- and death related indicators (Table 5).

The partial correlation further increased the existence and strength of the correlation. The two-variable linear regression analysis brought the expected results. There is a model-valued cause-effect relation between life expectancy at birth and cereal, fat and sugar consumption. Based on the regression models, consuming cereals played an important role in the case of women (70%, $r^2 = 0.694$) and men (67%, $r^2 = 0.665$) as well in how their life expectancy changed. Consuming sugar has a significant effect on life expectancy (women: 70%, $r^2 = 0.703$; men: 71%, $r^2 = 0.713$). The consumption of fat has even greater impact on this indicator, especially in the case of men (women: 78%, r^2 = 0.782; men: 85%, r^2 = 0.846). Consuming fruits and vegetables does not affect life expectancy significantly, according to our investigation. The reason behind this is possibly the fact that consuming these products in adequate quantities is important for the optimal maintenance of

Table 5 The strength of the linear correlations and the explanatory power of the regression model

Basic food category	*r* (correlation strength)	*r* square (explanatory power of the model)
	Y = average life expectancy for women	
X = cereals	-0.833	70%
X = sugar	-0.838	70%
X = fat	-0.884	78%
	Y = average life expectancy for men	
X = cereals	-0.816	67%
X = sugar	-0.844	71%
X = fat	-0.920	85%
Basic food category	***r* (correlation strength)**	***r* square (explanatory power of the model)**
	Y = number of live births	
X = cereals	0.593	35%
X = sugar	0.643	42%
X = fat	0.451	20%
	Y = number of deaths	
X = cereals	0.602	36%
X = sugar	0.692	48%
X = fat	0.509	26%

Source: The authors' own calculation based on data from the KSH

Table 6 The estimation of regression coefficients between cereals, sugar, fat consumption and average life expectancy

Coefficients

Women	Unstandardized coefficients		Standardized coefficients	*t*	Sig.
	B	Std. Error	Beta		
Cereals, total (kg capita^{-1})	-0.042	0.013	-0.833	-3.365	0.020
(Constant)	82.178	1.022		80.433	0.000
Men	**Unstandardized coefficients**		**Standardized coefficients**	***t***	**Sig.**
	B	Std. Error	Beta		
Cereals, total (kg capita^{-1})	-0.073	0.023	-0.816	-3.153	0.025
(Constant)	77.828	1.887		41.241	0.000
Women	**Unstandardized coefficients**		**Standardized coefficients t**	***t***	**Sig.**
	B	Std. Error	Beta		
Fat, total (kg capita^{-1})	-0.260	0.061	-0.884	-4.232	0.008
(Constant)	82.937	0.991		83.663	0.000
Men	**Unstandardized coefficients**		**Standardized coefficients**	***t***	**Sig.**
	B	Std. Error	Beta		
Fat, total (kg capita^{-1})	-0.478	0.091	-0.920	-5.245	0.003
(Constant)	79.593	1.471		54.121	0.000
Women	**Unstandardized coefficients**		**Standardized coefficients**	***t***	**Sig.**
	B	Std. Error	Beta		
Sugar, total (kg capita^{-1})	-0.211	0.061	-0.838	-3.436	0.019
(Constant)	81.760	0.880		92.907	0.000
Men	**Unstandardized coefficients**		**Standardized coefficients**	***t***	**Sig.**
	B	Std. Error	Beta		
Sugar, total (kg capita^{-1})	-0.375	0.107	-0.844	-3.521	0.017
(Constant)	77.252	1.529		50.538	0.000

Source: The authors' own calculation based on data from the KSH

our body, and consuming too much of them does not pose as much threat for our health as food products containing high amounts of carbo-hydrate and fat. The regression lines can be seen in Table 6, which shows that they are suitable for projecting accurate predictions and are valuable for drawing up models, thanks to the low SEE (Std. Error of the Estimate) values of the ANOVA tables. The results of the One-Sample Kolmogorov-Smirnov Test also prove the viability of the model at significance level.

The regression lines give an overall picture about how the life expectancy at birth in the cases of both men and women would change by the changing levels of consumption of cereals, fats and sugar. This prediction must be taken into account with careful judgment, because there are other factors influencing health as well, beside the ones describing food consumption in a quantitative way. Such indicators are the healthy lifestyle (doing sports, cycling to work, etc.), other nutrition-related factors and biological properties. However, we believe that the results of the investigation are very indicative.

Conclusions

The regional inequalities of food consumption can be observed in the tendencies of the volume of food consumed per capita. This also reflects the continuing existence of traditional ways in certain regions and health-aware food consumption in others. The results of the empirical analyses show that it can be statistically proven on the regional level that consuming food containing high amounts of carbo-hydrate and fat affects the life expectancy negatively. Therefore, it is important to create and implement a national food industry and health strategy, which could indirectly contribute to the preservation and improvement of the population's health levels, and which could directly increase regional productivity and competitiveness to create jobs in rural areas and to decrease health-related costs (which is an important element, seeing how it is a major cost element in Hungarian households). Therefore, there is a great responsibility on food industry and the strategic decision makers.

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