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Article

Investigation of The Relationship Between the Changes in Consumption of Macronutrients and Raw Materials with Economic Growth Among the Visegrad Countries Between 1993 and 2018

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Abstract: The aim of the study was to investigate the relationship between economic growth and changes in consumption of macronutrients and raw materials in the Visegrad countries. Data on diet are from the World Health Organization's HFA online database, while GDP per capita data are from the Penn World Table database from 1993 to 2018. Spearman rank correlation with correlation coefficients was used to analyse the relationship between economic growth, average number of calories available per person per day (kcal), protein available per person per day (g), average amount of cereal available per person per year (kg), average amount of fruit and vegetables available per person per year (kg), and fat available per person per day (g). As economic activity increased in the Visegrad countries, the average number of calories available per person per day also increased. Also, there is a significant relationship between economic growth and the changes in consumption of macronutrients and raw materials in the Visegrad countries, although, some exceptions were identified. Based on our findings decision-makers within the Visegrad countries should strengthen policies promoting a healthier diet.

Keywords: Visegrad Countries, Economic Growth, Health Economics, Consumption, Macronutrients, Raw Materials,

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INTRODUCTION

Nutrition is a fundamental element of our sustenance. Balanced nutrition is based on the consumption of energy and nutrients in the appropriate quantity, quality and proportion, which can be influenced by several parameters such as basal metabolism, physical activity, age, sex, etc. In a healthy diet, energy intake and expenditure are in balance and the amount of energy taken in is not more than the amount of energy used (World Helath Organiztion, 2023).

Today's fast-paced world has a negative impact on our eating habits. Trends linked to our modern way of life has increased the proportion of processed foods in our diets (Povey et al., 1998; Singh & Singh, 2023). The high energy content of these foods could lead to an imbalance, that is where the energy intake exceeds the energy used by the human body, which clearly leads to an increase in the prevalence of obesity (EUPHA, 2023). Unhealthy diets could be accounted for more than 950,000 deaths and more than 16 million healthy years lost each year, which could have worse impact on the groups of lower socio-economic strata (EUPHA, 2023). This issue has grown to be a public health crisis, with over 4 million people dying each year as a result of being overweight or obese in 2017 according to the Global Burden of Disease (World Health Organization, 2023). Further aggravates the fact, that the rates of overweight and obesity continue to grow in adults and children. From 1975 to 2016, the prevalence of overweight or obese children and adolescents aged 5–19 years increased more than four-fold from 4% to 18% globally (World Health Organization, 2023). In 2016, the overall prevalence of obesity among children in the US was 18.5% (Hales et al., 2017). These data showed significant differences, highlighting increased prevalence among adolescents, certain ethnic groups, and those of lower socioeconomic status (Hales et al., 2017). More than half of adults in the EU are overweight or obese, leading to an increase in chronic diseases such as type 2 diabetes, (Bailey et al., 2023; DA GEUS, 1958) cardiovascular disease, (Lamina & Ward, 2022) certain types of cancer (Crosbie et al., 2022; Hillers-Ziemer et al., 2022; Kelsey et al., 2022) high blood pressure and coronary heart disease (EUPHA, 2023). Based on current trends, global obesity prevalence will expectedly continue to increase between 2019 and 2024, with the rate of increase being higher in low- and middle-income countries. Obesity also imposes considerable direct and indirect costs on health systems and other social system resources (EUPHA, 2023). Thus, a strong health policy initiative to prevent obesity is imperative. All countries, regardless of their income level, should focus on tackling obesity and preventing its onset in order to reduce the health and economic burden on families.

Alola and Bekun found that an increase in life expectancy reduces the prevalence of obesity in the United States (Bardou et al., 2022). In a study by Aydin the relationship between obesity and economic growth was examined within the framework of the Kuznets curve of obesity (OKC) for the 20 most obese countries between 1991 and 2016. The results showed cointegration between variables in all countries except the Bahamas, Fiji, Mexico, New Zealand, Tunisia and the United Kingdom. The long-run coefficients indicated that the hypothesis holds for Oman, Saudi Arabia, Turkey and the United Arab Emirates. The main finding of the study was that countries should improve the well-being of individuals to encourage healthy lifestyles and reduce the risk of obesity. The prevalence of obesity in the population is often associated with economic well-being, reflecting the potential adverse consequences associated with economic growth. The pattern and strength of the empirically observed relationship between national income and the prevalence of adult obesity, and the moderating role of the macro-environment of countries on this relationship. The prevalence of obesity in the population showed a positive relationship with national income and there was no evidence that this relationship, although weakening, becomes negative at higher income levels (”obesity Kuznets curve”) (Alola & Bekun, 2021).

Within the United Nations the Food and Agriculture Organization (FAO) has proposed a dual pyramid of healthy food for people and sustainable food for the planet in its document ”Sustainable diets and biodiversity“. (Food and Agriculture Organization of the United Nations, 2010). In 1992, the International Conference on Nutrition identified the need to develop food-based dietary guidelines as a new strategy for disseminating nutritional information to the public, which led many countries to develop their own dietary guidelines (Bechthold et al., 2018). In many countries, pictorial representations have been developed, mainly in the form of food pyramids. The European Food Information Council has reviewed the European food guidelines; most of these guidelines contain recommendations on food consumption using a triangle known as a ‘food pyramid’, although some countries have adopted other forms, such as circles imitating bowls or three-dimensional figures (Aydin, 2019).

The aim of this study was to investigate the relationship between changes in daily per capita

calorie supply, daily protein intake per capita, average amount of cereal available per person per year, average per capita consumption of fruit and vegetables per year, fat available per person per day, with a special focus on the economic development in the Czech Republic, Hungary, Poland and Slovakia. These countries are called the Visegrad countries or the Visegrad Four. Because of their close proximity and similar history, culture and economic performance several studies have compared these four countries to one another in a wide variety of research topics (Bányai et al., 2021; Bíró et al., 2020; Sagan et al., 2022).

METHODOLOGY

Using data from 1993 to 2018, a study on ecological correlations was executed for the Visegrad countries. For the analysis World Health Organization (WHO) "Health for All" (HFA) online database-derived indicators were used (European Health for All Database, 2023). This data can be used to assess the European Region's fundamental demographics, health status, health care resources. The Penn World Table database includes expenditure-side real Gross domestic product (GDP) at chained purchasing power parities (PPPs) (University of Groningen, 2023). In order to assess relative living standards between nations and across time, as well as the populations of countries (in millions), these two indicators were divided to get the GDP per capita.

To analyse the relationship between economic growth, average number of calories available per person per day (kcal), protein available per person per day (g), average amount of cereal available per person per year (kg), average per capita consumption of fruit and vegetables per year (kg), and fat available per person per day (g), spearman rank correlations were conducted. Correlation coefficients were also calculated. The results were considered significant if the p-values from the given statistical analysis were less than 0.05.

RESEARCH RESULTS

In all four countries the amount of cereal available per person per year (kg) stagnated over the 25 years period (Figure 1). Average amount of cereal available per person per year (kg) was lowest in Slovakia and highest in Poland. In Poland, the average amount of cereal available per person per year was 150.44 kg, a minimum of 141.03 kg in 2016 and a maximum of 158.24 kg in 1993. While in Slovakia, the average amount of cereal available per person per year in kg was 121.35 between 1993-2018. The lowest value was 86.79 kg in 2017 and the highest 144.87 kg in 1994. In the Czech Republic the correlation between GDP per capita and this indicator is significant ($p=0.043$) and shows a negative correlation (rho=-0.400) (Table 1). While in Hungary ($p<0.001$, rho=0.763) and Poland ($p=0.001$, rho=0.708) the correlation between GDP per capita and average amount of cereal available per person per year (kg) is significant and shows a positive correlation. And finally, in Slovakia the correlation between GDP per capita and this indicator is not significant ($p=0.132$), but shows a negative correlation (rho=-0.303).

The average amount of fruit and vegetables available per person per year (kg) in Poland and in the Czech Republic stagnated between 1993 and 2018 (Figure 2). In Poland the average per capita consumption of fruit and vegetables per year (kg) was 175.10 kg, and the lowest value measured was 158.21 kg in 2002 and the highest value was 190.26 kg in 2018. While in the Czech Republic, the average per capita consumption of fruit and vegetables per year (kg) was 142.62 kg, over the 25 years investigated and the lowest value was 124.04 kg in 2014 and the highest value was 161.67 kg in 1996. In the case of Hungary, the average amount of fruit and vegetables available per person per year (kg) rose between 1993 and 2006 and then fell sharply from 2007 to 2013. For Slovakia, two peaks in average amount of fruit and vegetables available per person per year were found on the curve, one in 1999 and the other in 2009. Since 2009 there has been a steady decline in consumption. When comparing the four countries, the Poles consumed the most and Slovaks the least average amount of fruit and vegetables available per person per year (kg) over the period in question. In the Czech Republic the correlation between GDP per capita and this indicator is significant ($p=0.013$) and shows a negative correlation (rho=-0.481). In Hungary ($p=0.110$, rho=-0.321) and Poland ($p=0.797$, rho=-0.053) the correlation was not significant, but showed a negative correlation. Finally, for Slovaks we found that the correlation between GDP per capita and this indicator was borderline significant ($p=0.078$) and negatively correlated (rho= 0.351) (Table 1).

GDP per capita increased over the period we studied, with calorie consumption being lowest for Slovaks and highest for Poles. In Slovakia, the daily per capita availability of calories increased from 2,718 (kcal) to 2,979 (kcal) while in Poland from 3,300 (kcal) to 3,537 (kcal) (Figure 3).

In summary, the daily per capita supply of calories has increased along with GDP growth in all four Visegrad countries over the 25 years period; however, the associations were not significant in all cases. The correlation between GDP per capita and the respective indicator was non-significant and showed a strong positive correlation for Czechs (p=0.128, rho=0.306,) and Slovaks (p=0.964, rho=0.009), while a significant positive correlation was found for Hungarians (p<0.001, rho=0.596) and Poles (p=0.002, rho=0.578) in the analysis (Table 1).
In Visegrad countries, an increasing trend was also observed between economic development, the passage of time and the amount of fat available per person per day (Figure 4). Comparing the four countries, Hungary had the highest fat available per person per day over the whole investigated period. In Hungary, the average available fat consumption was 135.49 g, the lowest value being 123.16 g in 1997, while the highest value was 152.82 g in 2018. Slovakia had the lowest fat consumption between 1993 and 2017. Poland took over this position between 2015 and 2017. For all four countries the correlation between GDP and the respective indicator was significant and positively correlated (Table 1).
Over the 25 years of steady GDP per capita growth, the lowest protein-consuming country was Slovakia, while the highest was Poland (Figure 5). Protein available per person per day (g) increased year on year for Poles and decreased for Slovaks. In Slovakia the average per capita protein intake was 73.48 g. The lowest per capita protein consumption was 67.95 g in 2015 and the highest was 82.70 g in 1994. In Poland, the average per capita protein consumption was 100.38 g. The lowest value measured was 97.17 g in 1994, while the maximum was 105.59 g in 2018.
For Hungary, there has been a noteworthy growth from 2013 to 2017. The correlation between GDP per capita and daily per capita supply of protein was significant and negative in the Czech Republic (p=0.008, rho=-0.508) and Slovakia (p<0.001, rho=-0.777) and positive in Poland (rho=0.710) (Table 1). However, in Hungary the correlation was not significant (p=0.972) and was only slightly positive (rho=0.001).

CONCLUSIONS

The current research examined the relationship between essential foods and macronutrients and economic well-being in the Visegrad countries over 25 years, from 1993 to 2018. The overall analysis clearly showed the relationship between food consumption trends and changes in economic development in each country. However, no significant relationship was found in all cases; thus, there are some exemptions.
In the case of the Visegrad countries, if we looked at per capita protein consumption (g) over the 25 years and we found that all four countries have improved regarding economic development using GDP per capita as an indicator, but there were differences in the level of protein intake. For the Czech Republic and Slovakia, we found that per capita protein intake per day had decreased significantly as economic prosperity increased, while in Hungary daily protein consumption stagnated and in Poland there was a clear significant increase in daily protein intake. As the acquisition of protein sources for food purposes has major financial consequences for the food market, it is not surprising that the global economic crisis of 2008/2009 showed a significant decrease in per capita protein consumption for all countries. Of these, the data regarding Hungary is most notable, where the decline in consumption is significant and almost on par with the Czech Republic.
Looking at the annual per capita cereal consumption, we found that the increase in economic activity had produced different results in terms of cereal consumption over the examined period. While in Hungary, the economic growth had led to an increase in annual per capita cereal consumption, a decrease in cereal consumption could be observed in Poland, Slovakia and the Czech Republic. Interestingly, the economic crisis had no effect on cereal consumption, although it should be noted that the availability of cereals in terms of prices on the staple food market is relatively low (Csiszárik, 2014; Organisation for Economic Co-Operation and Development *(OECD)* ILibrary, 2023; Sooriyaarachchi & Jayawardena, 2023).
In terms of annual per capita consumption of fruits and vegetables, the picture is rather flat for the 25 years studied. When analysing the trend for all four countries, we found that economic growth showed a decrease in fruit and vegetable consumption. The global economic crisis in 2008/2009 resulted in a larger decline in fruit and vegetable consumption in Hungary and Slovakia.
According to our results there was a clear and significant connection between the increase in the amount of fat consumed per person per day and the increase in economic activity. However, from the available data it is impossible to determine what types of fat and of which origin have increased in consumption over the 25 years.
Globally, given that most people currently live in low- and middle-income countries where incomes are rising, our findings strengthen the urgent need

for effective policy initiatives, particularly those that target the 'nutritional transition' that is taking place simultaneously with economic growth. The main aim of these policies should should be to break or at least further mitigate the positive relationship between the prevalence of chronic diseases due to unhealthy diets and economic growth (Talukdar et al., 2020).

For the Visegrad countries the patterns of food consumption were described in the Maciejewski article, which were contrasted with the WHO-recommended healthy diet model (Maciejewski, 2018). In this document the Visegrad countries' identified consumption patterns deviate from the advised model of a healthy diet. Therefore, policy-makers should first restrict the use of sugar, salt, animal fats, alcohol, and cigarettes if they want to reduce the occurance of chronic diseases among the population. In addition, they should encourage and incentivize the consumption of vegetables and fruits, dairy products, eggs as well as fish and fats of plant origin (Maciejewski, 2018). To achive these goals, several recommendations were introduced among the Visegrad countries.

The Czech Society for Nutrition had published the Czech Nutrition Recommendation document in 2012. The nutritional guideline was called the Nutritional recommendations for the population of the Czech Republic (Food and Agriculture Organization of the United Nations, 2023; The Czech Society for Nutrition, 2012). Changes had been made to the nutritional parameters in line with the European Nutrition Objectives of the WHO and the recommendations of European professional societies. The wording of the Nutritional Recommendations for the Population of the Czech Republic was discussed and approved by the Presidium and the Board of Directors of the Society for Nutrition (The Czech Society for Nutrition, 2012).

The National Association of Hungarian Dietitians has prepared the Hungarian Nutrition Recommendation, which had the support of the Scientific Committee for Food Science of the Hungarian Academy of Sciences. The recommendation was called Okostányér (Smart Plate) and contained guidance for both adults and children to follow a healthy diet (Eurepean Comission, 2023; Harvard Medical School, 2011).

Poland published the latest version of its dietary guidelines for the general population in 2020. In 2019, the healthy eating and lifestyle recommendations for children were updated, which are now in the form of a Healthy Lifestyle Pyramid. The guidelines (Food-based dietary guidelines – Poland) were developed and endorsed by the National Institute of Public Health – National Institute of Hygiene (NIZP-PZH), in collaboration with the Ministry of Health (Eurepean Comission, 2023; Food and Agriculture Organization of the United Nations, 2023).

Finally, the Public Health Authority of the Slovak Republic had prepared the Slovak Nutrition Recommendation in 2016. The recommendation was called the Ten rules of a healthy plate and contains guidance for a healthy population (Food and Agriculture Organization of the United Nations, 2023).

Beyond these recommendations, a Hungarian legislation introduced in 2011 is worth highlighting. In this year a special public health product tax – as known as "chips-tax" –was introduced on some products that were deemed unfavorable from the perspective of public health. These products are foods and soft drinks that contain a high amount of sugar, caffeine, or salt. The legislators made the claim that citizens should be urged to consume fewer of these products since they contribute to obesity, diabetes, and high blood pressure, rather than claiming that these products would be unhealthy. By increasing the cost of these goods with this specific tax the Hungarian consumer might think twice before purchasing such foods (Devenyi, 2011). As these measures were introduced in 2011, and no meaningful improvement was identified in our study period for Hungary, further action is recommended.

The data of four similar countries could be analyzed over a 25 year period. However, because of the study design, the observed correlations cannot be interpreted on an individual level due to the ecological fallacy. Also, in the absence of analyses corrected for multiple confounders, the correlations presented in this study could be considered as descriptive; therefore, no clear causal relationship can be established and interpreted between the variables based on our results.Decision-makers in each of the Visegrad countries should pay special attention in order to counteract the trends identified in this study by formulating and implementing proven economic and public health policies that can lead to an increase in fruit and vegetable consumption and a decrease in fat consumption. Such endeavor can pay off in the long run by reducing the overall health burden among the citizens within the Visegrad countries.

Availability of the data and materials

The data presented in this study are available to the public (World Health Organization, European Health Information Gateway: https://gateway.euro.who.int/en/hfa-explorer/ and Groningen Growth and Development Centre: https://www.rug.nl/ggdc/productivity/pwt/?lang=en).

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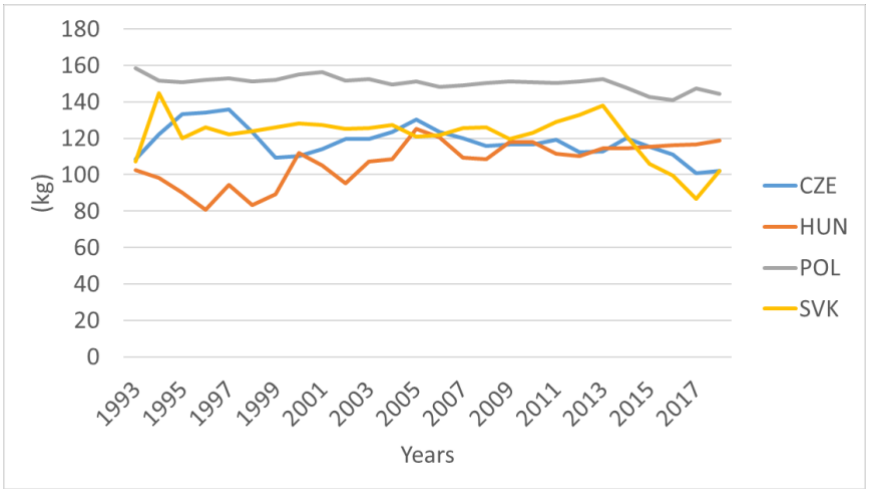

Figure 1.
Changes in the average amount of cereal available per person per year (kg) in the Visegradi countries (1993-2018)

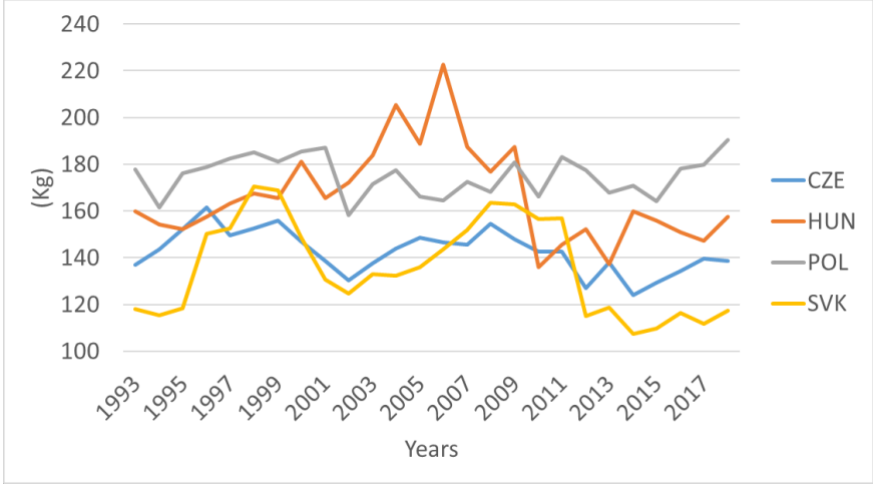

Figure 2.
Changes in the average amount of fruit and vegetables available per person per year (kg) in the Visegradi countries (1993-2018)

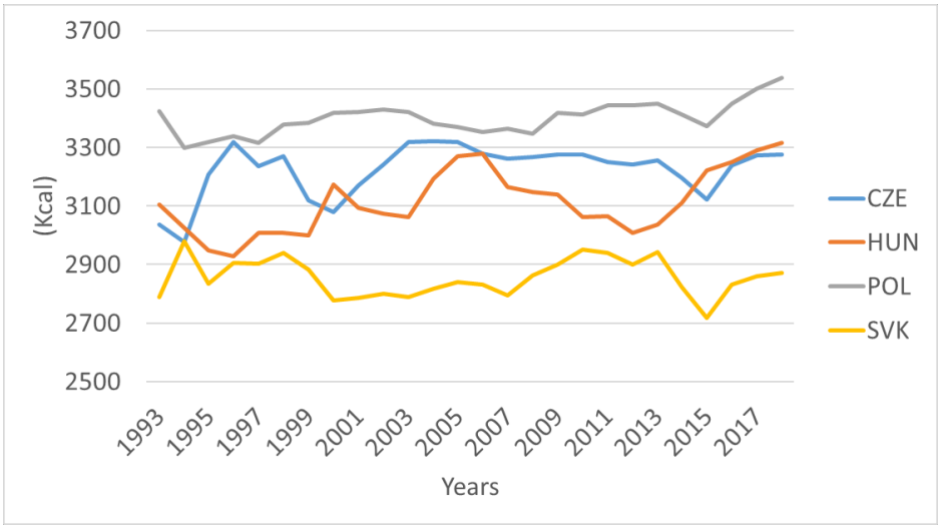

Figure 3.
Changes in the average number of calories available per person per day (kcal) in the Visegradi countries (1993-2018)

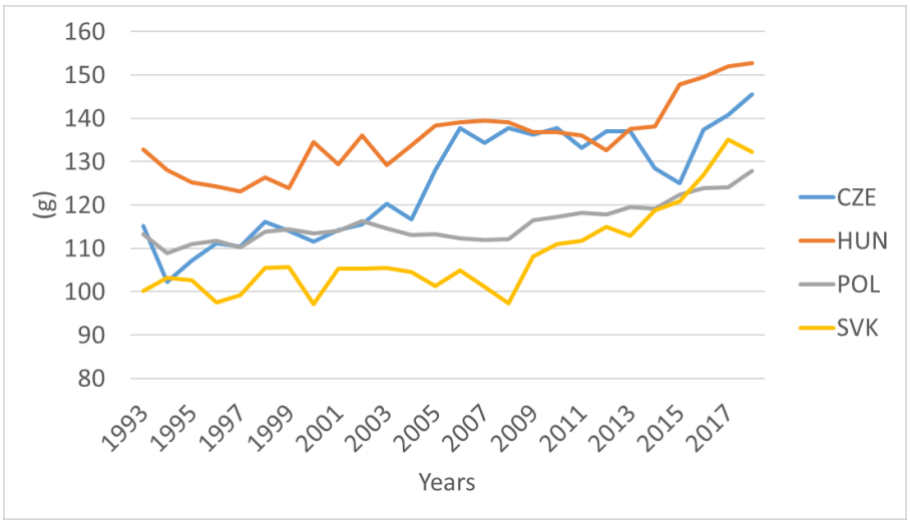

Figure 4.
Changes in the fat available per person per day (g) in the Visegradi countries (1993-2018)

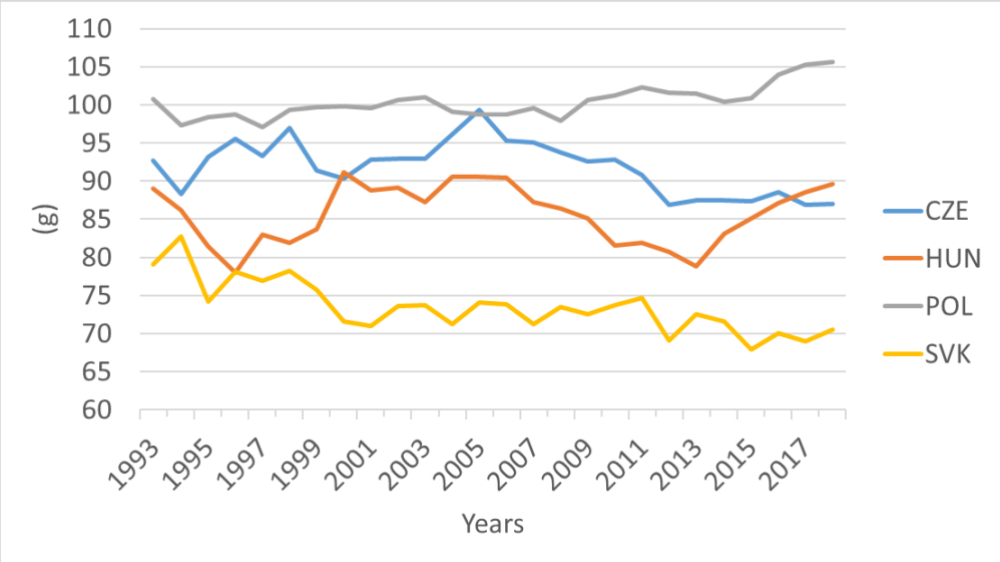

Figure 5.
Changes in the protein available per person per day (g) in the Visegradi countries (1993-2018)

LIST OF TABLES

Table 1
Correlation table of investigated indicators and economic growth expressed by GDP per capita for the Visegrad countries between 1993 and 2018

Indicator	Czech Republic		Hungary		Poland		Slovakia	
	Correlation coefficient	p-value	Correlation coefficient	p-value	Correlation coefficient	p-value	Correlation coefficient	p-value
Average amount of cereal available per person per year (kg)	-0.3997	0.043*	0.7627	<0.001*	-0.7080	<0.001*	-0.3032	0.132
Average amount of fruits and vegetables available per person per year (kg)	-0.4810	0.012*	-0.3211	0.109*	-0.0530	0.797	-0.3511	0.078
Average number of calories available per person per day (kcal)	0.3061	0.128	0.5957	0.001*	0.5784	0.002*	0.0092	0.964
Fat available per person per day (g)	0.8421	<0.001*	0.8263	<0.001*	0.8243	<0.001*	0.7468	<0.001*
Protein available per person per day (g)	-0.5077	0.008*	0.0072	0.972	0.7101	<0.001*	-0.7771	<0.001*

*Significant findings ($p<0.05$)