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Original Paper

Statistical indicators of milk consumption in Slovakia

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ABSTRACT

The aim of the paper is to analyse the total milk consumption, consumption of selected types of milk in Slovakia. The consumption of fresh cheese and cottage cheese is also presented in comparison with selected types of milk in Slovakia. The paper presents data from the Statistical Office of the Slovak Republic. The data consist of milk and dairy products, cow's milk and dairy products, goat's milk, sheep's milk, drinking milk, drinking cow's milk, drinking goat's milk, fresh cheese, and cottage cheese. The analysis was carried out using basic mathematical statistics; other values of mathematical statistics were examined: skewness expression, sample variance, z - test etc. The results of the research indicated a behaviour change in consumption (an increase in the consumption of the last dairy product).

KEYWORDS: milk consumption, milk products, mathematical statistics, consumer behaviour

JEL CLASSIFICATION: Q13, L11, L66

INTRODUCTION

Dairy products represent nutritionally rich foods in the diet and contain essential building nutrients necessary for life such as calcium, potassium, protein, fat, and vitamin D. They are very important in a balanced diet. Dairy products reduce the risk of osteoporosis and cardiovascular disease and are an addition to a healthy diet. Dairy products are characterised by their limited storage capacity, instability, and difficulty in storage and transport. Milk is a perishable product that requires rapid handling at a set low temperature (up to 4 °C), transport to its destination as quickly as possible and processing within 24 hours. Over time, the bacterial count increases and the metabolism of the milk intensifies. Tukker et al. (2006) pointed out that dairy products are the second most consumed food and beverages in the

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world. Dairy processing is also very important for the EU economy. The EU exports milk and dairy products all over the world and is the largest milk producer in the world.

Based on the results obtained, Kubicová et al. (2021) found that milk consumption in Slovakia and Hungary is very low, while in the Czech Republic and Poland, milk consumption is recorded within the range of recommended rations, i.e. it is sufficient. Looking to the future, the consumption trend described above suggests that the situation in the Slovak Republic will follow an unfavourable trend. Research has shown that Slovakia consumes the least milk and dairy products per capita compared to neighbouring V4 countries. Over the last 10 years, increased attention has been paid to the impact of dairy consumption on health.

Healthy nutrition and eating habits are the main pillars of a healthy lifestyle. The well-known Hippocratic dictum: 'let your food be your medicine' is still relevant at the beginning of the third millennium. Diet has been shown to have a significant impact on health. The European Union's fundamental objective is to achieve the highest possible level of consumer health protection and to improve the availability of healthy food. Statistics from the World Health Organisation (WHO) testify to the deteriorating health status of the Slovak population. According to them, the most common cause of mortality is incorrect eating habits (Krivánek, 2004).

Alfred Adler, an Austrian psychologist, originally addressed the idea of lifestyle around the beginning of the 20th century. From his point of view, a lifestyle was a kind of defence mechanism, a pattern of behaviour that an individual adopted at a young age. He considered it as one of the dynamic components of personality (Hayward, 2004). According to Kulčáková and Richterová (2010), lifestyle represents the way a person lives. In terms of consumer behaviour, it examines what products the consumer is interested in, the way they are used, and what the consumer thinks about them. A healthy lifestyle is primarily a set of behavioural patterns of an individual whose role is to maintain and improve their own health. When examining it, it is possible to come across the basic categories of these behaviours, which include: a regular regime, nutrition, drinking, physical activity, protective elements - obtained through the intake of a varied and balanced diet; sometimes it is necessary to supply it to the body, for example in the form of food supplements.

Bakke et al. (2016) others report that consumer consumption behaviour of conventional milk in relation to skimmed milk, low-fat milk and whole milk has received attention at the beginning of the third millennium; relatively few studies have examined the consumption of unprocessed and processed liquid milk. This study aimed to analyse the consumption and preferences of fluid milk consumers in Turkey using data from a cross-sectional national survey. The results indicate that consumption of unprocessed liquid milk is positively related to household size, number of children in the family, household income and age of the female householder, and negatively related to education level.

The authors also discussed goat's milk. Zine-Eddine et al. (2018) considers goat farming in Morocco as a strategic manufacturing sector. This activity is of particular importance. Goat rearing plays an important socio-economic role for farmers and women in rural areas; for example, in 2018, the number of goats reached 5,731,000 head and 44,618 tons of goat milk was produced in the same year. However, a small amount of this milk is practically consumed in conventional form. However, a small amount of this milk is practically consumed in liquid form, after which most of the product is processed into cheese.

Redondo et al. (2019) investigated the impact of dairy products on health and examined the association between dairy consumption and the risk of mortality from multiple causes. The findings show that dairy consumption is not associated with an increased risk of mortality. This study has been registered in PROSPERO as CRD42018091856. Wang et al. (2020) have also investigated the associations of milk consumption with mortality risk in a population with low milk consumption. They enrolled 18,214 participants from China over the age of 50 years. The results showed that nearly 70% of the respondents did not consume milk, 15% consumed milk no more than 3 times per week, and 15% had high milk consumption. There were 2697 deaths over 12 years, high consumption was associated with a higher risk of overall cancer mortality. In a sample of Chinese individuals with significantly lower milk consumption compared to the Western population, it was observed that moderate milk consumption is associated with a lower risk of mortality. However, high milk consumption was found to be associated with an increased risk of overall cancer mortality.

Neves et al. (2021) and Baker et al. (2021) have considered time trends in the consumption of different types of milk (breast milk, formula milk and animal milk) among children under 2 years of age from 2000 to 2019 at the global level. The consumption of formula milk in the first 6 months of life increased in higher-middle-income countries and in East Asia and the Pacific, while it remained below 8% in Central Africa and South Asia. The consumption of animal milk among children under 6 months of age has decreased significantly in less developed African and Asian countries.

MATERIAL AND METHODS

In the research we used data obtained from the website of the Statistical Office of the Slovak Republic. Basic descriptive mathematical statistics were used to evaluate the data. The name of the Z-test is derived from the Z-score of the normal distribution. Z-tests are the most commonly used statistical tests in various scientific fields such as economics, medicine and others. Tables 1 and 2 present statistical data on the consumption of milk and selected dairy products between 2001 and 2021.

Table 1 Statistical data on the consumption of milk and selected dairy products between 2002 and 2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
milk and dairy products (volume)	161.4	158.7	148.9	150.2	148	148	148.6	149.4	158.1	152.4
cow milk and dairy products	159.2	151.4	146.8	147.9	145.8	145.8	146.6	147.2	155.9	150.2
goat milk	0.6	0.6	0.6	0.6	0.6	0.6	0,6	0.6	0.6	0.6
sheep milk	1.6	1.7	1.5	1.7	1.6	1.6	1,4	1.6	1.6	1.6
milk for drinking	65.1	62.1	57.4	54.1	54.2	54.2	46.9	48.1	52.9	51.6
cow milk for drinking	64.5	61.5	56.8	53.5	53.6	53.6	46.3	47.5	52.3	51
goat milk for drinking	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
fresh cheese	2.6	2.5	2.3	2.9	2.7	2.7	2.8	2.6	2.8	2.9
curd	2.1	2.1	1.9	2.2	2	2	1.9	2	2.1	2

Source: http://datacube.statistics.sk/

We analyse milk consumption in the third millennium and compare the consumption of cow's, goat's and sheep's milk, as well as the consumption of fresh cheese and cottage cheese.

Table 2 Statistical data on the consumption of milk and selected dairy products between 2012 and 2021.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
milk and dairy products (volume)	154	153.9	162	164.3	171.1	169.5	166.2	168.7	174.8	183.5
cow milk and dairy products	151.7	151.5	159.4	161.8	168.5	167	163.3	165.8	171.8	180.5
goat milk	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
sheep milk	1.7	1.8	1.9	1.8	1.9	1.8	2.2	2.2	2.3	2.3
milk for drinking	52.8	47.9	46.9	46.7	45.1	45	44.7	44.1	48.6	45.6
cow milk for drinking	52.2	47.3	46.2	46	44.4	44.3	44	43.4	47.9	44.9
goat milk for drinking	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.,7
fresh cheese	3.2	4	4.4	4.9	5.2	5.3	5.2	5.3	5.8	6.3
curd	2.1	2.2	2,4	2.6	2.6	2.8	2.8	2.8	2.9	3.1

Source: http://datacube.statistics.sk/

RESULTS AND DISCUSSION

Based on Tables 1 and 2, it can be observed that in recent years, Slovaks have developed a greater preference for curds and cheeses. According to the recommendations of the World Health Organisation, each of us should consume 220 kg of milk and milk products per year. In Slovakia, the average annual consumption is only 173.6 kg per person per year. It is a lower number; however, it is positive that it has been increasing over the years. Ten years ago, the consumption of milk and milk products was 20 kg lower per person per year. Consumption of cheese and cottage cheese, for example, has risen significantly by four kilograms per person per year since 2009. The support for increasing interest in Slovak milk and dairy products has been a long-standing effort of the Dairy Fund, to which Slovak primary milk producers and processors have been contributing since its establishment in 2008.

While the interest in the consumption of milk and dairy products in Slovakia is slowly growing, the self-sufficiency of Slovakia in production, especially of raw cow's milk, is decreasing, according to dairy farmers. According to them, the reason for this is the decline of both dairy cows and entire farms, which have been unable to continue to function in the rather difficult competition with foreign producers. The latter are often at an advantage due to higher national subsidies. This is why dairy farmers and dairy processors are calling on the state, when preparing the next common agricultural policy, to also focus on support for livestock production, dairy farms and investment in processing plants. In the table 3 is statistical analyse milk consumption between 2001 and 2021.

Table 3 Development of milk consumption - mathematical statistic

	milk and dairy products (volume)	cow milk and dairy products	goat milk	sheep milk	milk for drinking	cow milk for drinking	goat milk for drinking	fresh cheese	curd
Mean	159.585	156.905	0.640	1.790	50.700	50.060	0.640	3.820	2.330
Standard Error	2.297	2.256	0.011	0.060	1.320	1.327	0.011	0.297	0.086
Median	158.400	153.800	0.600	1.700	48.350	47.700	0.600	3.050	2.150
Mode	148.000	145.800	0.600	1.600	54.200	53.600	0.600	2.600	2.100
Standard Deviation	10.274	10.087	0.050	0.267	5.901	5.36	0.050	1.328	0.383
Sample Variance	105.565	101.748	0.003	0.071	34.823	35.235	0.003	1.763	0.146
Kurtosis	-0.271	-0.272	-2.018	-0.282	0.577	0.542	-2.018	-1.419	-1.040
Skewness	0.679	0.733	0.442	0.853	1.051	1.038	0.442	0.501	0.665
Range	35.500	34.700	0.100	0.900	21.000	21.100	0.100	4.000	1.200
Minimum	148.000	145.800	0.600	1.400	44.100	43.400	0.600	2.300	1.900
Maximum	183.500	180.500	0.700	2.300	65.100	64.500	0.700	6.300	3.100
Sum	3191.700	3138.100	12.800	35.800	1014.000	1001.200	12.800	76.400	46.600
Count	20.000	20.000	20.000	20.000	20.000	20.00	20.000	20.000	20.000

Source: author's calculations

Kurtosis expresses the distribution of data in a file. In Table 3, only two values of kurtosis are positive, that is, only milk for drinking and cow milk for drinking had values close to the mean. Skewness expresses the skewness of the file, that is, simply whether high values or low values prevail in the file. In Table 3, all skewness values are positive, that is, it is a left-skewed distribution (more smaller values and few larger ones). Sample Variance was lowest for goat and sheep milk.

We will use the z - test to see if there is a significant difference in dairy consumption. The z-test is used to see if the difference between the sample means is statistically important. The name of the Z-test is derived from the Z-score of the normal distribution. According to Chen (2011), Eden and Yates (2009) z-tests are the most commonly used statistical tests in various scientific fields such as economics, medicine and others. Using the F test, we found that the research samples have a normal distribution. The variance and the mean of the population are known. We will divide the research samples into two groups: Sample A - from 2002 to 2010, and Sample B - from 2011 to 2021.

The values presented in Table 1 and Table 2 were used as baselines to compare dairy consumption in each year. Based on this, the research objective was to determine whether dairy consumption differs significantly when comparing the periods 2002-2010 and 2011-2021.

The research hypotheses were proposed based on theoretical knowledge and economic practice. In the research, we test the hypothesis:

H0: The difference in dairy consumption is not statistically significant when comparing the periods 2002 - 2010 and 2011 - 2021.

H1: There is a statistically significant difference in dairy consumption is not statistically significant when comparing the periods 2002 - 2010 and 2011 - 2021.

In Table 4 is results of F-test.

Table 4 Results of F-test

	milk and dairy products (volume)	
	2002 - 2011	2012 - 2022
Mean	151.2375	166.8
Known Variance	25.82	83.69
F Stat	0.039	
F Critical one-tail	0.272	

Source: author's calculations

In Table 4 we see that the z-test value is 0.039 for 2012 – 2022 and 2002 - 2011 and the critical value is 0.272 at the significance level. We found that the value of the F-test is greater than the critical value, equality of variances is not rejected.

In Table 5 is results of z-test.

Table 5 Results of z-test

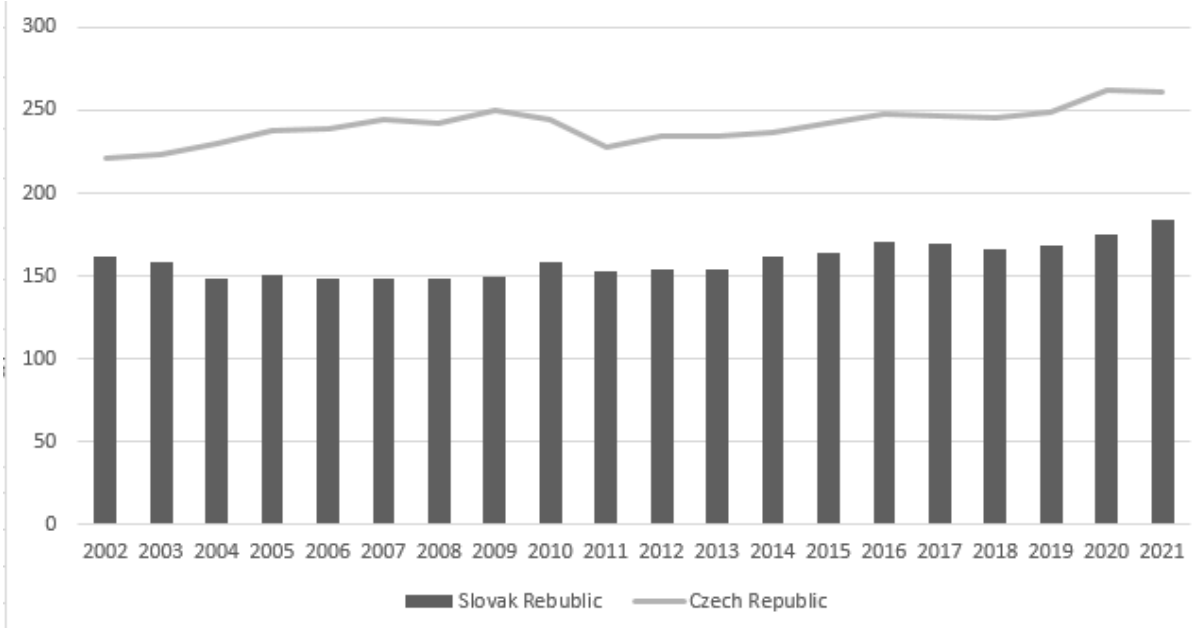
	milk and dairy products (volume)	
	2002 - 2011	2012 - 2022
Mean	151.2375	166.8
Known Variance	25.82	83.69
Z Stat	-4.57	
z Critical one-tail	1.644854	

Source: author's calculations

In Table 5 we see that the z-test value is – 4.57 for 2012 – 2022 and 2002 - 2011 and the critical value is 1.64 at the significance level. We found that the value of the z-test is greater than the critical value, so we reject the null hypothesis. That is, we accept the alternative hypothesis that there is a significant difference in the milk consumption.

Figure 1 compares the consumption of milk and milk products in Slovakia and the Czech Republic.

Figure 1 Consumption of milk and milk products (kg annual per capita averages)



Source: author's calculations

The consumption of milk, milk products and butter in the Czech Republic is relatively high compared to other European countries. The average person in the Czech Republic drinks 56,6 litres of cow's milk per year and consumes 14,4 kg of cheese. In 2020, this was already 262.5 kg, an increase of 5.4 %, which brings them significantly closer to the EU average of 265 kg. Compared to the Slovak Republic, dairy consumption is 60 per cent higher. In Slovakia, the average consumption of cow's milk is 50 litres per year, which is 11 percent less than in the Czech Republic. The consumption of milk and dairy products is incomparably lower in comparison with the Czech Republic.

CONCLUSIONS

The paper presented the consumption of milk and dairy products in the Slovak Republic over the last 20 years. Current milk consumption is 160 kg per capita per year, which is below the recommended consumption allowance of 220 kg per capita. For comparison with the Czech Republic, research has confirmed that Czech consumers consume on average up to 250 kg of milk and milk products per year, which exceeds the recommended consumption level by 30 kg. Dairy producers are adapting their production to demand, but it is important to point out the problems associated in particular with the introduction of new technologies in production, the rising cost of input investments and the growing disinterest of consumers in consuming milk and milk products.

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