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Original Article

Gender differences in consumption habits and spending behaviour regarding food groups in one of the most obese countries in Europe

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Abstract:
Background: Currently, healthy eating is receiving increased attention. Numerous studies have demonstrated the importance of consuming food groups that are recommended by United States Department of Agriculture (USDA) and World Health Organization (WHO) to maintain health. However, few studies have evaluated spending on these food groups. Aim: In this study, we examined nutrition in terms of consumption habits and spending behaviour. The aim of this study is to evaluate gender differences according to the two studied aspects (i.e., consumption and spending) in one of the most obese countries in Europe, in Hungary. Methods: Principal component analysis and two-block partial least-squares were chosen as research methods. The participants were university students (n = 701). Results: In this study, we observed significant gender differences in every consumption component and in several spending components. Among women, the consumption of coffee and dairy products is relatively more frequent compared to men; however, men consume more trendy and less healthy products. Conclusions: This study successfully showed gender difference in the spending behaviour and consumption habits. The consumption of less healthy food groups is most noticeable among young men, which greatly contributes to obesity.
Key Words: **nutrition, consumption habits, spending behaviour, university students, gender differences**

Introduction

Currently, increased attention is paid to health and healthy eating. However, this subject can be evaluated from many aspects, e.g., ecological (Tompa et al., 2020), physiological (Ganasegeran et al., 2012), economic (Vanheuvelen & Vanheuvelen, 2019), and social (Higgs & Thomas, 2016) points of view. We examined healthy nutrition from an economic perspective. Several studies (Senbanjo & Adejuyigbe, 2007; Rauber et al., 2018; Albataineh at al., 2019; World Health Organization, 2020a) have dealt with obesity and overweightness, which are exist worldwide and cause serious health problems. In addition, these problems increase the risk of many comorbidities. Malta (28.9%), the United Kingdom (27.8%), and Hungary (26.4%) are among the most obese countries in Europe (Armstrong, 2019). The abovementioned percentages show the proportion of obese population in those countries. Our research was conducted in one of the most obese countries, i.e., Hungary. We examined nutrition and related spending habits of postadolescents because, during this young adulthood, food choice patterns develop that are associated with the development of obesity. The sample of postadolescents was composed of students from one of the largest universities in Hungary.

International recommendations help choose a healthy food consumption pattern. In 2015, the U.S. Department of Agriculture and the U.S. Department of Health and Human Services issued a recommended food consumption pattern for the Americans (USDA, 2015). The recommendation includes patterns of dietary reference intakes, which are determined by daily amounts for gender, age, or even physical activity level. Healthy eating patterns include consumption of vegetables, fruits, cereals, dairy products, protein foods, and oils (USDA, 2015). In the American recommendation by gender and physical activity level, men need to consume more calories than women. From the age of 14–18, men need to consume more protein than women. Meat is the primary source of protein, and this is a key food group that contains several individual meat categories. Meat is frequently grouped into red, white, and processed meat categories (Cosgrove at el., 2005). Previous studies (Cosgrove at el., 2005) have shown that protein intake of men was significantly higher than that of women. Overall, meat consumption has shown an increasing trend between 1960s and 2010s (Godfray et al., 2018). This increase can be seen too in total meat consumption in the USA between 1909 and 2007 (Daniel et al., 2010). In the USA, poultry consumption has increased the most in recent years; however, red meat is still consumed in the largest proportion (58%) (Daniel et al., 2010).

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The World Health Organization (WHO) issued a recommendation, although it is less detailed. It draws attention to the importance of consuming vegetables and fruits, which should be 400 grams per day. While legumes, nuts, and whole grains are only listed item by item. WHO also made recommendations regarding the percentage of total energy intake made up by sugar and fats. This recommendation specifies the optimal consumption level of sugars, fats, and salt (World Health Organization, 2020b).

Previous studies have shown that if a less healthy food choice pattern develops in young adulthood, it is likely to persist for the rest of their lives (Sharma et al., 2010; Fitzgerald et al., 2013). The study by Salameh et al. (2014) has shown that women consume fewer "less healthy products" than men. Furthermore, based on their results, the consumption of fast food and sweets depends on socio-economic status (Salameh et al., 2014).

Numerous studies have shown that the adequate consumption of fruits and vegetables reduces the risk of cardiovascular disease and some types of cancer (Van't Veer et al., 2000; Allen & Baines, 2002; Slavin & Lloyd, 2012). In addition, inadequate consumption of vegetables and fruits led to the death of more than 3.9 million people worldwide in 2017 (OECD, 2019). Balogh et al. (2004) have examined the consumption of fruits and vegetables in South-East Hungary. Their results showed that daily consumption of fruits was higher among women and among people of better economic status. In the consumption of vegetables, there was no significant difference by gender (Balogh et al., 2004). Based on the results of other studies (Al ani et al., 2016), it is observed that consumption of fruits and vegetables did not meet adequate consumption levels (F&V $\geq$ 5 times/day) among most adolescents. Dairy products greatly contribute to children's nutrient intake (e.g., Ca, riboflavin, iodine, vitamin B12, K, and vitamin A), growth, and health (Dror & Allen, 2014; Dougkas at el., 2019); however, previous studies have indicated a secular decline in dairy products consumption and a tendency for decreasing intake with age (Dror & Allen, 2014). Furthermore, in recent years, a connection between dairy products consumption and obesity has been observed; however, this relation has not been confirmed yet (Dougkas at el., 2019).

Materials and methods

This study aims to show how much attention is paid by undergraduate students to healthy eating and how this manifests in their spending. We examined university students using a questionnaire survey that is based on surveys of El Ansari et al. (2015) and Balatoni (2011). The questionnaire survey was conducted in the fall of 2019. The questionnaire included questions on demographics, nutrition, and related spending. The size of data was 701; however, there was missing data for 9 questions (the ratio of missing cases was under 6%). Missing data was replaced by the series mean to properly perform PCA. Regarding the sample, gender distribution was as follows, i.e., 38.5% of the participants were males and 61.5% were females. The sample did now show normal distribution by age. More than 50% of respondents were 19–21 years old. Regarding the distribution by place of residence, 1.57% of the participants lived in the capital, 36.38% lived in a county town, 41.37% lived in a city, and 20.68% lived in a village or a farm. In terms of their income situation, the respondents thought that it was sufficient (74.5%).

We used the food group separation of El Ansari et al. (2015) to determine food consumption. The following food groups were defined as sweets, snacks, fast food, fruits, vegetables, meat, fish, dairy products, eggs, soft drinks, sugar-free drinks, energy drinks, and coffee. The vegetables category was not separated into potatoes and other vegetables. The meat food group included red, white, and processed meat. The dairy products food group included milk, yoghurt, cottage cheese, cheese, and dairy desserts. We did not differentiate between fermented and unfermented dairy products. The abovementioned food groups contain healthy and less-healthy groups. Less-healthy food groups were those that were not included in the healthy eating pattern by USDA (2015) or WHO (2018). Consumption of these food groups was examined according to 5 frequency factors: several times per day, daily, several times per week, 1–4 times per month, and never. In addition, 5 factors were identified for the food groups to determine spending behaviour, i.e., below HUF 500 per week, HUF 501–1000 per week, HUF 1001–2000 per week, above HUF 2001 per week, and no spending on this.

All calculations were performed using the R 3.4.4. statistical software (R core team, 2019). To handle missing values, the Multivariate Imputation by Chained Equations (MICE) package was used; to calculate Principal Components (PCs), psych package was applied. Because we used Likert-type scales, during the calculation of PCs we used Spearman's correlation matrix to determine PC scores. PC scores were formed for each respondent by applying weights according to values given by the respondent for the variables (Consumption and Spending) belonging to given PC. PCs are normally distributed latent variables with 0 expected value and 1 standard deviation. The 0 value indicates that the sample means were given for the variables that belonged to PC. PC scores can range between +1 and −1 depending on the assessment of variables on PCs. Variables that are positively correlated with PCs increase PC scores if they are considered to be relatively more important by the respondents then the sample mean. In contrast, variables can decrease PC scores if they were perceived to be relatively less important or received lower values compared to the sample mean. Individual differences in PC scores were analysed by Two-Way Analysis of Variance (ANOVA) based on gender and age as categorical factors. Age was categorised into six groups (i.e., 18, 19, 20, 21, 22–24, and 25<); thus, relative frequencies should be closer to a quasi-normal distribution. We also applied the two-block partial least-squares (PLS2B) method described by Rohlf and Corti (2000). The method is similar to PCA analysis but

with two sets of variables. The procedure identifies dimensions (axes) to maximize covariance between the two sets of variables and obtains the maximum correlations between corresponding factors from both sets (called blocks 1 and 2). The complete algorithm is implemented in R 3.4.4. by the Morpho package. The mathematical algorithm partitions the correlation matrix according to the two blocks and decomposes only the cross-correlation matrix of the two blocks by creating two axes (dimensions) for each block.

Results

Students from the University of Debrecen participated in the questionnaire survey (n = 701). The gender distribution of respondents is as follows, i.e., 38.5% of the participant are men and 61.5% are women. In this study, we examined nutrition from the consumption and spending perspective. The obtained results will be presented below. Five PCA components can be established for the consumption habits of the studied food groups (Table 1), which kept 63% of the information, and the Kaiser–Meyer–Olkin measure was also acceptable (0.66). The highest explained variances can be observed for vegetables, fruits, sweets and snacks, dairy products, coffee, and energy drinks. Table 1 shows 5 well-separated food groups: sweets, snacks, fast food (1), fruits and vegetables (2), eggs and meat (3), trendy products (4), and coffee and dairy products (5).

Next, we performed principal component analysis to determine the spending behaviour of respondents (Table 2).

Table 1. Consumption habits of the respondents by food groups determined using PCA

Source: Own edition, 2020

	Components					Explained variance (%)
Food groups	1: snack, sweets, fast food, soft drinks	2: vegetables, fruits	3: eggs, meat	4: trendy products	5: coffee, dairy products	
Sweets	**0.78**	0.10	−0.05	−0.15	0.16	67
Snacks	**0.84**	0.04	0.01	0.04	−0.01	70
Fast food	**0.64**	−0.13	0.07	0.28	−0.17	53
Fruits	0.05	**0.87**	0.11	−0.01	0.04	78
Vegetables	−0.07	**0.86**	0.16	−0.03	0.08	78
Meat	0.04	0.06	**0.73**	0.03	−0.04	55
Fish	−0.06	0.28	**0.48**	0.19	−0.24	50
Dairy products	0.12	−0.05	0.50	−0.02	**0.67**	72
Eggs	0.03	0.11	**0.74**	0.04	0.16	59
Soft drinks	**0.55**	−0.22	0.10	0.46	−0.03	56
Sugar-free drinks	−0.06	0.11	0.18	**0.71**	0.01	56
Energy drinks	0.21	−0.10	−0.06	**0.73**	0.19	62
Coffee	−0.09	0.14	−0.13	0.19	**0.79**	71
Explained variance (%)	16%	13%	13%	11%	10%	
Cumulative variance (%)	16%	29%	42%	53%	**63%**	

Kaiser–Meyer–Olkin measure = 0.65; Bartlett's test value = 760.85 ($p < 0.001$)

Table 2. Spending behaviour of the respondents by food groups determined using PCA

Source: Own edition, 2020

	Components					Explained variance (%)
Food groups	1: vegetables, fruits, meat	2: sweets, snacks	3: Fast food, soft drinks	4: fish, sugar-free drinks	5: coffee, energy drinks	
Sweets	0.11	**0.87**	0.10	0.03	0.07	78
Snacks	0.11	**0.84**	0.26	0.11	0.06	81
Fast food	0.05	0.36	**0.71**	0.01	−0.05	65
Fruits	**0.81**	0.19	−0.16	0.11	0.01	73
Vegetables	**0.83**	0.12	−0.20	0.14	0.02	76
Meat	**0.70**	−0.04	0.41	0.10	0.02	67
Fish	0.33	−0.01	−0.08	**0.76**	−0.12	70
Dairy products	**0.59**	0.00	0.43	0.15	0.23	61
Eggs	0.52	0.02	0.23	0.43	0.17	53
Soft drinks	−0.09	0.39	**0.55**	0.41	0.12	64
Sugar-free drinks	0.10	0.15	0.19	**0.69**	0.26	61
Energy drinks	−0.16	0.16	0.37	0.26	**0.60**	62
Coffee	0.24	0.03	−0.13	0.01	**0.86**	82
Explained variance (%)	21%	14%	12%	12%	10%	
Cumulative variance (%)	21%	35%	47%	59%	**69%**	

Kaiser–Meyer–Olkin measure = 0.80; Bartlett's test value = 217.01 ($p < 0.001$)

Table 2 shows that 5 PCA components were established based on the spending behaviour of the studied food groups, which kept 69% of the information, and the Kaiser–Meyer–Olkin measure was excellent (0.80). The highest explained variances can be observed for vegetables, fruits, sweets, snacks, and coffee. Table 2 shows 5

well-separated food groups: fruits, meat, and vegetables (1), sweets and snacks (2), fast food and soft drinks (3), fish and sugar-free drinks (4), and coffee and energy drinks (5).

After defining the components, we examined consumption habits and spending behaviour by gender and age (Table 3).

Table 3. Results of two-way ANOVA by gender and age* *Source: Own edition, 2020*

Component	**Gender**	**Age**	**Interaction (Gender × Age)**	**Male**	**Female**	
Consumption	**F-statistics (p-value)**			**Mean value**		**Age groups**
Component 1	**5.08 (0.025)**	**2.98 (0.011)**	0.269 (0.930)	**0.112**	−0.070	+:18,19,20
(snacks, sweets, fast food, soft drinks)						−: 20<
Component 2	**14.35 (<0.001)**	1.01 (0.411)	0.24	−0.185	**0.116**	+: 21<
(vegetables, fruits)			(0.946)			−: 18,19,20,21
Component 3	**32.13 (<0.001)**	0.82 (0.535)	0.695 (0.627)	**0.272**	−0.170	+:20
(eggs, meat) Component 4	**9.38 (0.002)**	1.35 (0.241)	1.86	**0.144**	−0.090	−: 22–24 +: 18,19,20
(trendy products)			(0.100)			−: 20<
Component 5	**41.66 (<0.001)**	**2.39 (0.037)**	**3.14**	−0.291	**0.182**	+: 21–24
(coffee, dairy products)			**(0.008)**			−: 25<
Spending	**F-statistics (p-value)**			**Mean value**		**Age groups**
Component 1	3.83 (0.051)	2.12 (0.061)	0.981 (0.427)	−0.097	0.060	+: 25<
(vegetables, fruits, meat, dairy products)						−: 18,19
Component 2	0.708 (0.400)	0.254 (0.938)	0.624 (0.682)	−0.040	0.025	+: 18
(snacks, sweets)						−: 25<
Component 3	**64.90 (<0.001)**	**4.10 (0.001)**	0.459 (0.807)	**0.367**	−0.230	+: 18,19,20
(fast food, soft drinks)						−: 21>
Component 4	**29.54 (<0.001)**	0.73 (0.601)	1.07	**0.253**	−0.158	+: 25<
(fish, sugar-free drinks)			(0.377)			−: 21–24
Component 5	2.98 (0.085)	0.97 (0.431)	1.16	−0.079	0.050	+: 18
(coffee, energy drinks)			(0.328)			−: 25<

*: Type III sum of squares was applied in the calculation

By assessing differences in consumption, it can be stated that gender greatly affects each aspect. For coffee and dairy products, both age and gender are influential. This means that among women, coffee and dairy products consumption is relatively more frequent compared to men especially among 21- and 24-year-old students. The consumption of "trendy products" (e.g., sugar-free drinks and energy drinks), snacks, and sweets is more frequent among men, especially among students under 20-years of age. Thus, women consume relatively more vegetables and fruits compared to men who eat relatively more eggs and meat. When studying spending behaviour, we identified fewer differences regarding gender and age. Men spend more on fast food, soft drinks, and fish products. Regarding differences concerning age, independently from gender, younger students (under 20 years old) spend more on fast food products and soft drinks. Regarding the other components, significant differences were not identified by gender and age. Data set consisted of two blocks (consumption habits and spending behaviour) that could be represented in a two-dimensional space, which depicted the correlation structure between them. Figure 1 shows the blocks ("cons" indicates consumption, and "spend" stands for spending). Dimensions are latent variables represented by two axes; if a variable is closer to one axis, this means that the variable belongs to that dimension. If the vector from the origin to the point representing the variable is short, then its correlation with the given axis is low. Therefore, variables are relatively less important if they are closer to the origin. In contrast, the opposite is also true. Distance from the origin indicates significance.

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Figure 1. Result of PLS2B by gender *Source: Own edition, 2020*

The first axis explains approximately 69% of the total variance. Regarding the first dimension, the level of correlation between the two blocks was 0.600. The first dimension separates fruits, vegetables, and coffee consumption (Block1) and spending (Block2) from mainly soft and energy drinks consumption (Block1) and spending (Block2). These results allow to identify the respondents who consume and spend more on vegetables and fruits, and who consume and spend less on energy and soft drinks. The second axis explains approximately 28% of the total variance and shows that both the consumption of and spending on "less healthy products" (e.g., soft drinks, fast food, snacks, and sweets) are well-separated from fish, fruits, vegetables, and sugar-free drinks. In the second dimension, the correlation between two consumption and spending blocks was 0.568. This also indicates that the respondents who consume more "less healthy products" would spend more on these food groups and consume less fish, fruits and vegetables, and spend less on these. In addition, we calculate the average values of the two dimensions per block by gender and show the results as a map. It is observed that females consume relatively more fruits and vegetables (and spend more on them), while males consume more "less healthy products" (e.g., energy drinks, fast food, sweets and snacks) and also spend more on these. The two block PLS methodology successfully showed different patterns in spending behaviour and consumption habits regarding gender and separated different food groups based on consumption and spending.

Conclusions

In this study, we examined nutrition along with consumption habits and spending behaviour. For both aspects, five factors were established by PCA. Consumption habits are clearly separated into healthy and less healthy food groups. A similar result is obtained for spending behaviour. Gender is essential for every component of consumption. Based on the obtained result, it can be said that consumption of less healthy foods is relatively more frequent among men under 20 years old. Women, who are 21–24 years old (there is a significant difference by gender and age), consume more coffee, dairy products, vegetables, and fruits than men. In addition to consumption, spending also shows that men spend relatively more on "less healthy products" (fast food and soft drinks), while there is no significant difference by gender in other components. The PLS2B analysis shows that people who consume and spend more on vegetables and fruits, spend and consume less on energy and soft drinks. The correlation of second dimension indicates that people who consume more on "less healthy products" spend more on these food groups and consume and spend less on fish, fruits, and vegetables. By performing the PLS2B analysis by gender, it is determined that females consume and spend relatively more on fruits and vegetables, while males consume and spend more on "less healthy products" such as energy drinks, fast food, sweets, and snacks. Consumption of the latter products greatly contributes to the development of obesity. Based on the obtained results, it is determined that nutrition habits of young people (specifically those of men, based on our results) and their spending behaviour contribute to obesity in Hungary. This occurs because a less healthy food choice pattern develops during young adulthood, which determines subsequent consumption patterns. Overall, this study demonstrated different patterns in spending behaviour and consumption habits by gender.

Conflicts of interest

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