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THE ROLE OF HEALTHY EATING AND FUNCTIONAL FOODS IN THE PROTECTION OF THE IMMUNE SYSTEM, ESPECIALLY THE CONSUMPTION OF VEGETABLES AND FRUITS: LIFESTYLE SURVEY AMONG ADULT POPULATION

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SUMMARY

Our manuscript focuses on vegetables and fruits as functional foods. Our questionnaire survey was conducted at the end of the third wave of the pandemic, however, we also paid increased attention to lifestyle, mostly dietary, changes in the active stages of the coronavirus pandemic, especially vegetable and fruit consumption patterns. Our quantitative analysis was carried out with the help of 9 questionnaires, including 4 cumulative closed-ended questionnaires, which were divided into four main groups of statistical activities. We first analysed demographic data and then focused on health status, knowledge of concepts, and assessment of consumer needs. For the statistical evaluation of our survey, we performed a descriptive statistical analysis, including a distribution analysis of demography and related issues. Next, we calculated the appropriate type of correlation between the questions, which was evaluated in Microsoft Excel and IBM SPSS Statistics 26. The number of respondents was n = 109, of which 37% were male and 63% female. Before evaluating our results, we also asked a research question: To what extent did the attitudes related to regular exercise, healthy eating and the importance of health change during the active stages of the pandemic? Based on our empirical analyses, an increase in extremes can be observed with regular exercise. In terms of general health, there was an increase in the "extremely important" category. In

the active phase of the pandemic, the number of vegetable consumers was lower, and among the proponents of a healthy diet, the consumption of fruit foods was not significantly higher. Based on our conclusions, this is due on the one hand to the restrictions during the pandemic and on the other hand to the endowment of fruit-containing foods with negative properties (e.g. made with the addition of sugar).

Keywords: coronavirus, vegetables, fruits, functional food, healthy eating, disease prevention

INTRODUCTION

Nowadays, we pay more and more attention to health and healthy lifestyle. In order to increase vitality, the acquisition of appropriate nutritional habits also plays a key role (*Bencsik & Labáth*, 2000; *Rodler*, 2005; *Naicker et al*., 2021). Among the main elements of the practice of good nutrition is the knowledge of functional foods (*Csapó & Albert*, 2018; *Nagy et al.*, 2008; *Choudhary & Tandon*, 2009), the beneficial effects and useful content values of which are addressed in many countries. That is why several wordings have come to light in connection with these foods. Their positives include a beneficial physiological effect on the body, an improvement in physical and mental performance, and evidence of research and development results. Nutritionists recommend SMART PLATE (*URL$_1$*: http://www.okostanyer.hu/) for the practical application of the quantitative and qualitative requirements of functional foods in a healthy diet. The divided plate also helps everyone to consume cereals, meats and meat products, fish, milk and dairy products, vegetables and fruits. At the same time, it contributes to better energy levels and health. Supporting our immune system with the emergence of a coronavirus also requires increased attention (*Dey et al*., 2020*; Alsenani,* 2021). Among foods that support the functioning of the immune system, vegetables and fruits play a prominent role (*Sutton et al*., 2019; *Cömert et al*., 2020), mainly due to their fibre, vitamin, mineral and fluid content. That is why, in our manuscript, we aimed primarily to evaluate the fruit and vegetable consumption patterns during the active phase of the pandemic and during the lifting of restrictions. Doing this, we also performed a detailed analysis of the demographics, health status and conceptual knowledge related to healthy eating of the respondents. We hope that with our manuscript we can contribute to the work of food, marketing and nutrition scientists alike.

MATERIALS AND METHODS

In our survey, we conducted quantitative research on a sample taken from a multi-element population. Our 9 online questionnaires, including 4 cumulative closed-ended questions, were filled in by people living in the towns and villages of Győr-Moson-Sopron County, during the lifting of the restrictions implemented because of the coronavirus. We considered it an important aspect that all of the respondents should be regular consumers of vegetables and fruits. No other conditions were set for completing the questionnaire. In the quantitative study, we focused on 4 groups of statistical activities, which were demographic data, health status, knowledge of concepts, and consumer demand survey. Before evaluating our results, we also formulated a research question, to which we sought the answer with the help of our empirical analyses. The obtained data were evaluated in Microsoft Excel and IBM SPSS Statistics 26, during which descriptive statistical analysis, demographic distribution and correlation analysis were performed.

Our sample cannot be considered representative, but it examines the correlations between vegetable and fruit consumption under hitherto uncharacteristic conditions, so it can be a starting point for exploratory and further studies.

RESULTS AND EVALUATION

Findings for the whole sample

In evaluating our results, we first performed demographic analyses, where we sought answers to the gender distribution, place of residence, marital status, income, and age of the respondents. 63% of the respondents are women, while 37% are men, most of whom (58%) live in big cities. Furthermore, the majority of respondents to the questionnaire (36%) are married. The exact distribution of residence and marital status data is shown in *Figures 1* and *2*.

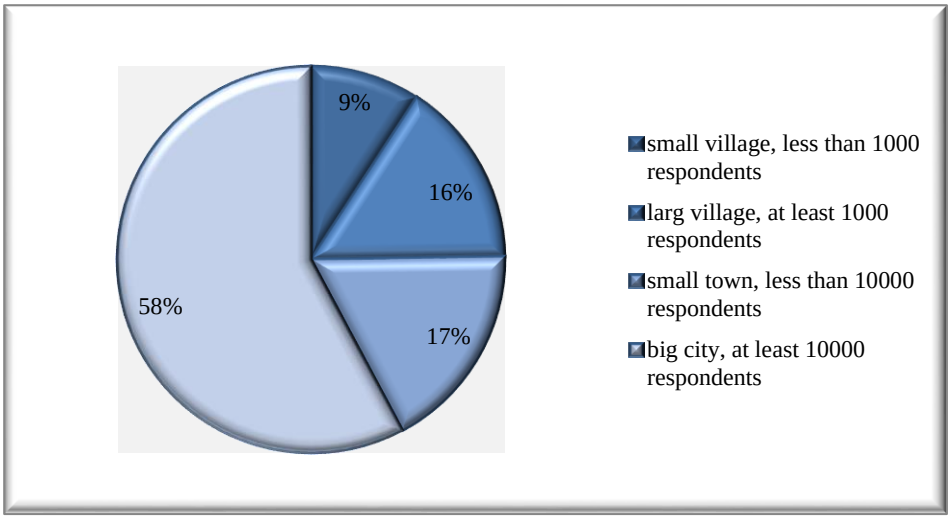

Figure 1: Residents' place of residence in % distribution

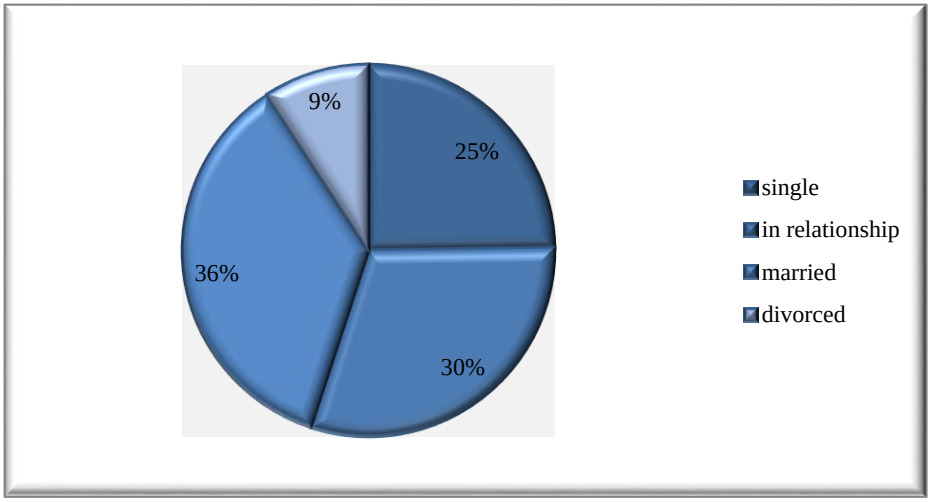

Figure 2: Family status of respondents in % distribution

Based on the % distribution of net family income per capita, most (26%) indicated the income category below HUF 150,000. The exact evaluation of these data is summarized in *Figure 3*.

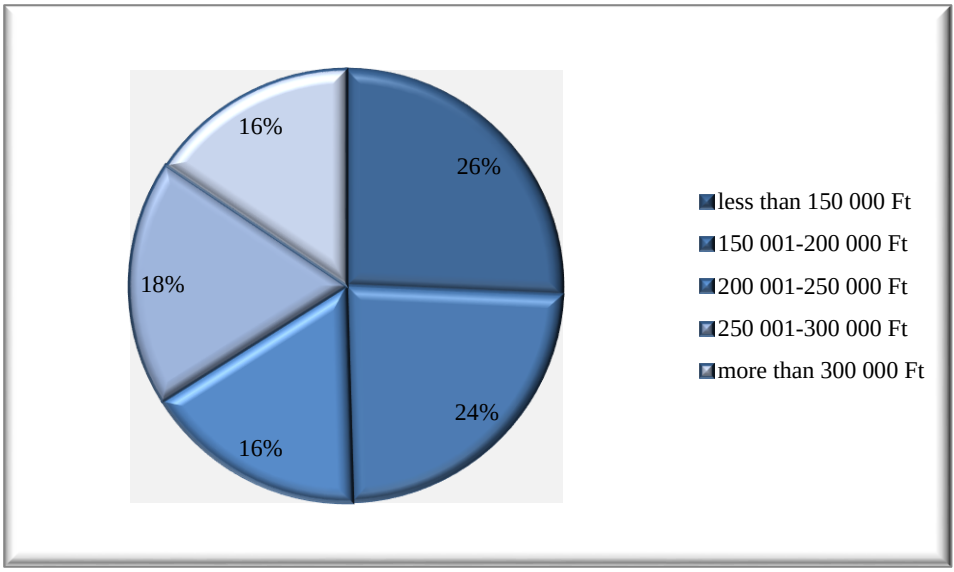

Figure 3: Percentage distribution of respondents by income

Finally, we also examined the age distribution among the adult population, according to which those aged 30-39 were the most active participants in the survey (n = 29 people). The inter-class distribution of age is shown in *Figure 4*. Our oldest respondent was 93 years old, which proves that the topic of vegetable and fruit consumption can be an interesting factor determining the quality of life even for the eldest ones.

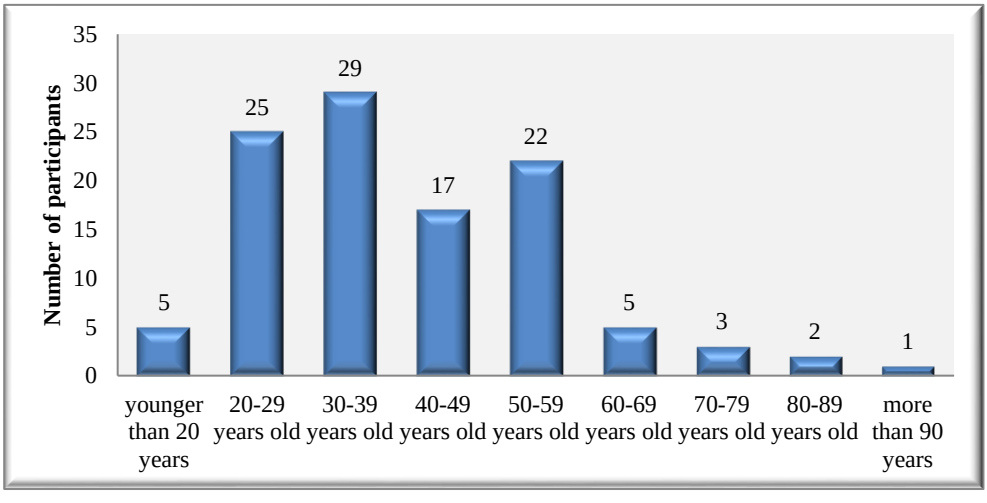

Figure 4: Age categories of respondents

An important part of our manuscript is to assess the health status of the respondents and their relationship to a healthy lifestyle during the active waves of the pandemic and during the lifting of restrictions. In addition, averages were calculated from the scores assigned to the responses (1; 2; 3; 4; 5). Our results are shown in *Figure 5.-7. illustrated by figures*.

Figure 5 shows a trend that, although the mean score did not change significantly, the variance increased and the number of those for whom exercise was not important or extremely important increased. This time, due to the low number of groups, we did not conduct a significance study, but it would be worthwhile to examine the increase in extremes and their causes. When the restrictions were lifted, many people might have mistakenly thought that going to work already means enough movement, and the supporters of the other side became more active when the sports opportunity was available again. No change can be detected in the assessment of healthy eating. There is no average change in the importance of good health, but there are several respondents for whom this factor has become extremely important. The reasons are researchable, one of which may be the response to perceived negative changes, lower performance.

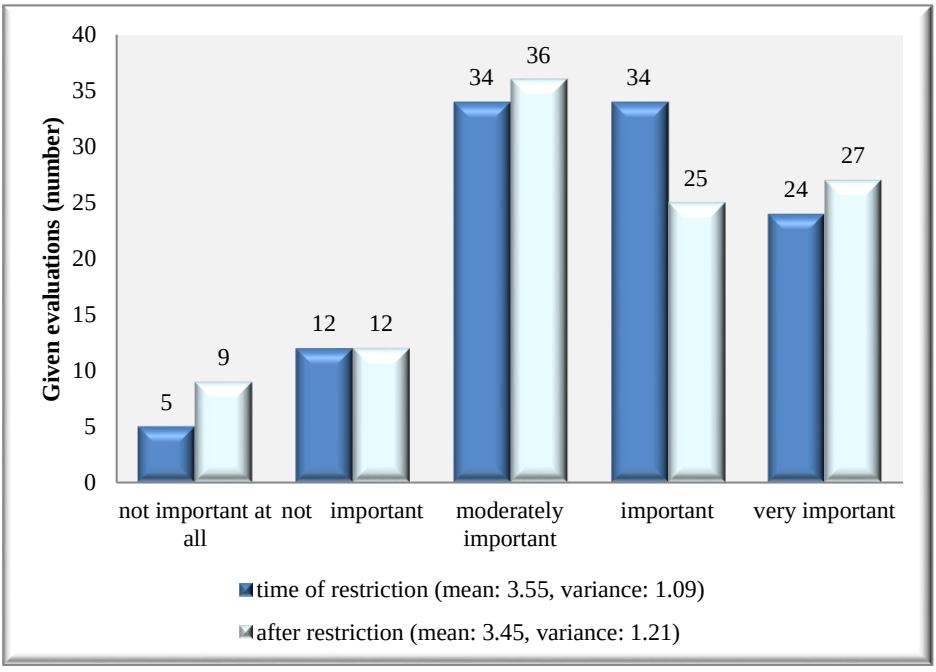

Figure 5: The importance of regular exercise in the active phase of the coronavirus and the lifting of restrictions

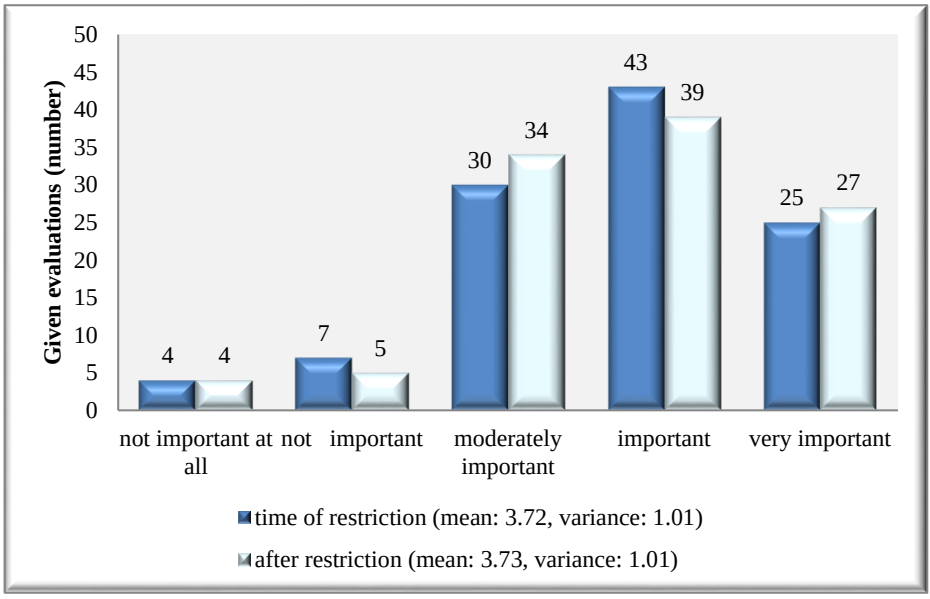

Figure 6: The significance of a healthy diet in the active phase of the coronavirus and the lifting of restrictions

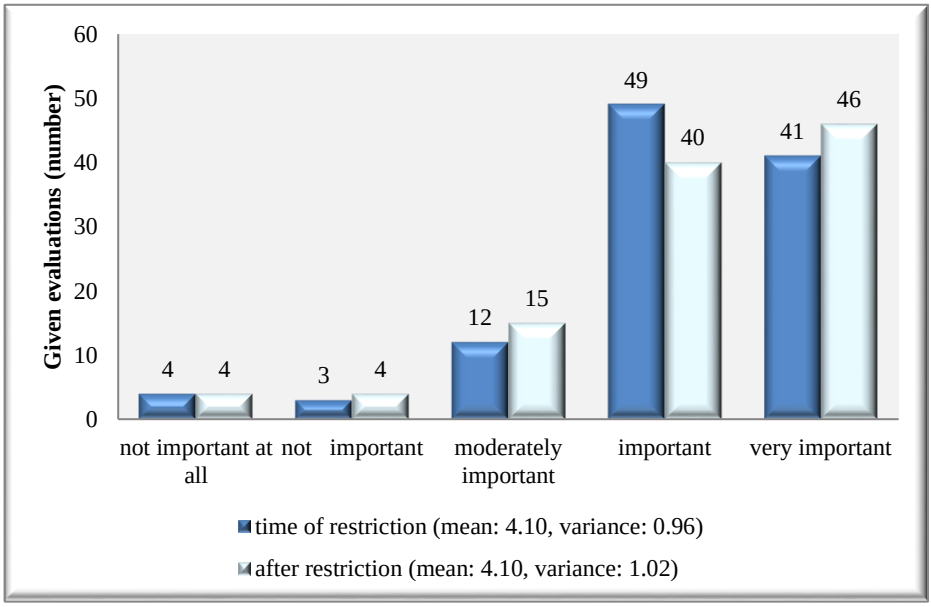

Figure 7: The significance of favourable health status in the active phase of the coronavirus and the lifting of restrictions

In further evaluating our data, we were also interested in understanding the concepts related to functional foods and healthy eating (*Table 1*), and then we also surveyed the frequency of consumption of vegetables and fruits (*Table 2*).

Our respondents are confident in their ability to recognize foods that belong to a healthy diet (average: 3.77, standard deviation: 0.87), so for this question, the majority marked the "reached" category. For the other questions, the level of self-declaration knowledge in most cases is incomplete. Mineral content is less known than vitamin content, and the most uncertain were the respondents on what constitutes a functional food.

Comparing the data in the table analysing the frequency of consumption of vegetables and fruits, we see that at the time of the restrictions, the subjects consumed less raw vegetables, raw fruits, and vegetable foods. We did not perform a significance test now, we only present the presumed trends. Consumption of less raw vegetables and fruits may be due to the fact that staying at home is more conducive to consuming more calorie-rich foods, or because there are fewer vegetables and fruits available in the spring, or more difficult to procure due to store closures and other restrictions.

Table 1: Self-reported knowledge of the concepts of healthy eating and functional foods

Question Categories	not at all (%)	not reached (%)	incomplete knowledge (%)	expert in this (%)	perfectly reached (%)	average level of perceived knowledge	dispersion of perceived level of knowledge
Self-reported knowledge of the vitamin content of foods	5.5%	10.1%	40.4%	33.9%	10.1%	3.33	0.98
Self-reported knowledge of the mineral content of foods	5.5%	11.0%	49.5%	23.9%	10.1%	3.22	0.97
Self-declaration of belonging to functional foods	9.2%	20.2%	37.6%	22.9%	10.1%	3.05	1.10
Self-declaration of belonging to a healthy diet	1.8%	5.5%	23.9%	51.4%	17.4%	3.77	0.87

Table 2: Survey of fruit and vegetable consumption based on self-declaration

Question Categories	less than weekly (%)	weekly (%)	Several times a week (%)	daily (%)	several times a day (%)	Trained average of the frequency	trained standard deviation of frequency
Raw vegetables, by lifting frequency restrictions	13.8%	15.6%	36.7%	22.0%	11.9%	3.03	1.19
Raw vegetables, frequency of consumption during restrictions	18.3%	13.8%	37.6%	17.4%	12.8%	2.93	1.25
Raw fruit, by lifting frequency restrictions	5.5%	12.8%	30.3%	37.6%	13.8%	3.41	1.06
Raw fruit, frequency of consumption during restrictions	9.2%	12.8%	32.1%	31.2%	14.7%	3.29	1.15
Vegetable food, by lifting frequency restrictions	5.5%	19.3%	42.2%	23.9%	9.2%	3.12	1.01
Raw vegetables, frequency of consumption during restrictions	18.3%	13.8%	37.6%	17.4%	12.8%	2.93	1.25
Fruity food, by lifting frequency restrictions	17.4%	25.7%	34.9%	13.8%	7.3%	2,68	1.14
Fruity food, frequency of consumption during restrictions	**19.3%**	**20.2%**	**32.1%**	**20.2%**	**8.3 %**	2.78	**1.21**

The characteristic presented with the following distributions is why the surveyed consumers value vegetables and fruits. Based on the data presented, the mineral content was rated higher than the vitamin content. This was followed by fibre content and water content, while low calorie content was pushed to the last place (*Table 3*). Members of the study sample seem to recognize the needs of the organization and consider them more important than appearance.

Table 3: Correlations between fruit and vegetable consumption in the active stages of the coronavirus and the lifting of restrictions

Question Categories	extremely important (%)	important (%)	moderately important (%)	unimportant (%)	not important at all (%)	The average of the judgment	Dispersed judgment
the role of high fibre content in the healthy category	3.7%	5.5%	19.3%	44.0%	27.5%	3.86	1.00
the role of high water content in the healthy category	4.6 %	11.0%	31.2%	33.9%	19.3%	3.52	1.07
the role of high mineral content in the healthy category	2.8%	0.0%	11.0%	34.9%	51.4%	4.32	0.88
the role of high vitamin content in the healthy category	2.8%	4.6 %	9.2%	39.4%	44.0%	4.17	0.97
the role of low calorie content in the healthy category	8.3 %	17.4%	27.5%	27.5%	19.3%	3.32	1.21

THE RESULT OF THE CORRELATION TEST

Following our empirical study, we performed a correlation analysis, in which we mainly examined the correlations between vegetable and fruit consumption. First, we present age-related relationships. We outline possible causes, but their precise examination deserves separate analysis. In the case of the responses, income has a significant impact, as expected. Therefore, the significant correlations are as follows:

- There is a negative correlation between age and the perceived importance of a healthy diet ($r = -0.265$, $p < 0.01$), which can be attributed partly to the adherence to traditional foods and partly to the financial status.
- There is another negative correlation with age ($r = -0.274$, $p < 0.01$). The older the person, the more they think they do not know what belongs to healthy eating, presumably because of the tradition mentioned earlier, the nutrition theories of the past, and the information coming from the media. Furthermore, even with

our overburdened health care system, more attention should be given to nutrition advice for the elderly, including diseases.

- The higher the income per capita, the more important regular exercise ($r = 0.302$, $p < 0.01$).
- The higher the income per capita, the more confident the respondent is able to recognize what belongs to a healthy diet ($r = 0.250$, $p < 0.01$). People with higher income can afford to consult a nutritionist or buy scientific works.
- The higher the income per capita of the respondents, the more important the vitamin and mineral content they consider for vegetables and fruits ($r = 0.209$, $p < 0.05$ and $r = 0.226$, $p < 0.05$).

Issues related to exercise, healthy eating, and general health are, of course, associated with higher fruit and vegetable consumption. Here, rather, we need to draw attention to the lack of significant correlations. Our respondents who value sports, healthy eating and general health do not consume significantly more fruit foods. Based on this, more people think of high-sugar cakes, creams, sauces as healthy salads or smoothies as fruit-containing ready meals. Promoting these would be important in the form of publications with appropriate recipes.

CONCLUSION

Our research was conducted during the period free of pandemic restrictions, however, we also paid close attention to the changes in lifestyle and eating habits during the active phase of the coronavirus, especially with regard to vegetable and fruit consumption. Therefore, during the evaluation of our results, we obtained an overview (involving $n = 109$ people) of the distribution of the demographic sample of the participants, their health status, their knowledge of concepts and the distribution of the demand for fruit and vegetables. Furthermore, the empirical answers to our previously researched question (To what extent did attitudes related to regular exercise, healthy eating, the importance of health?) during the pandemic confirm the importance of a healthy lifestyle and favorable general health. In addition to these results, we considered correlation studies for deeper evaluation important. While the consumption of raw vegetables and fruits and vegetable foods was significantly higher in the case of people living a healthy lifestyle, we did not find a similar correlation in the case of fruit foods. That is why we recommend

highlighting the beneficial properties of vegetables and fruits and mastering the right cooking procedures.

AZ EGÉSZSÉGES TÁPLÁLKOZÁS ÉS FUNKCIONÁLIS ÉLELMISZEREK SZEREPE AZ IMMUNRENDSZER VÉDELMÉBEN, KÜLÖNÖS TEKINTETTEL A ZÖLDSÉGEK ÉS GYÜMÖLCSÖK FOGYASZTÁSÁRA: ÉLETMÓD-FELMÉRÉS FELNŐTT LAKOSSÁG KÖRÉBEN

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ÖSSZEFOGLALÁS

Kéziratunk középpontjában a zöldségek és gyümölcsök, mint funkcionális élelmiszerek állnak. Kérdőíves felmérésünket a pandémia harmadik hullámának megszűnésével készítettük el, azonban fokozott figyelemmel kísértük a koronavírus-járvány aktív szakaszaiban bekövetkező megváltozott élethelyzet okozta életmódbeli, leginkább táplálkozási változásokat is, különös tekintettel a zöldség és gyümölcsfogyasztási szokásokra. Kvantitatív vizsgálatunkat 9 db, ebből 4 db halmozott zárt kérdésből álló kérdőív segítségével végeztük el, amit négy fő statisztikai tevékenységcsoportra bontottunk. Elsőként a demográfiai adatokat elemeztük, ezt követően pedig az egészségi állapotra, fogalmak ismeretére és fogyasztói igények felmérésére fókuszáltunk. Felmérésünk statisztikai értékeléséhez leíró statisztikai elemzést, ezen belül pedig a demográfia és egyes témához kapcsolódó kérdések megoszlás-vizsgálatát végeztük el. Ezt követően, kiszámoltuk a kérdések közötti megfelelő típusú korrelációt, amit Microsoft Excel és IBM SPSS Statistics 26 programban értékeltünk ki. A kérdőívet kitöltők száma n=109 fő, amelyből 37 % férfi és 63 % nő. Eredményeink értékelése előtt, egy kutatási kérdés is megfogalmazódott bennünk: A pandémia aktív szakaszaiban milyen mértékben változtak meg a rendszeres testmozgással, egészséges táplálkozással, egészségi állapot fontosságával kapcsolatos attitűdök? Empirikus elemzéseink alapján a

rendszeres testmozgásnál a szélsőségek növekedése figyelhető meg. Az általános egészségi állapottal kapcsolatosan pedig a "rendkívül fontos" kategória növekedése volt jellemző. A pandémia aktív szakaszában alacsonyabb volt a zöldségfogyasztók száma, az egészséges táplálkozás hívei között pedig nem nagyobb szignifikánsan a gyümölcsös ételek fogyasztása. Következtetéseink alapján, ennek oka egyrészt a pandémia alatti korlátozások, másrészt pedig a gyümölcs-tartalmú ételek negatív tulajdonságokkal (pl.: cukor hozzáadásával készült) történő felruházása.

Kulcsszavak: koronavírus-járvány, zöldségek, gyümölcsök, funkcionális élelmiszer, egészséges táplálkozás, betegség-prevenció

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ONLINE RECOMMENDATION

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