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Nutritional behavior of students during COVID-19 quarantine

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Abstract

COVID-19 has now been declared a pandemic by the World Health Organization (WHO), and people are under quarantine. During quarantine, continuously hearing or reading about the pandemic can have effects on different aspects of people's lives. One of these very significant effects is on human nutrition. This study aimed to summarize the experiences of the student population in behavior and the quality of nutrition during COVID-19 quarantine with special reference to certain microelements that are necessary for immune responses. Students were invited to do an online survey during May 2020. None of the participants were infected with COVID-19. 34.2% of respondents were under stress due to constant information about the pandemic. A significant number of students had good nutritional habits. Most students did not feel a constant need for food (63.2%), nor did they consume larger amounts of food than usual (67.5%). Students (36.0%) were careful about the nutritional and energy value of food. Most of the students (86.8%) ingested micronutrients mostly through meals. The students had well-balanced meals that had a beneficial effect on their immune responses. Few students (13.2%) have used dietary supplements. Generally, this research may help for a better understanding of the importance of a proper and balanced diet and the use of dietary supplements for maintaining good health.

Key words: *Coronavirus; College students; Nutrition; Micronutrients; Daily activities; Online survey; Questionnaire.*

INTRODUCTION

The world is facing the COVID-19 pandemic caused by the SARS-CoV-2 virus (referred to as the COVID-19 virus). Many countries are following the advice given by the WHO [1] regarding the introduction of physical distancing measures. People in many countries are under quarantine, in order to reduce the spread of the virus.

COVID-19 is a respiratory illness and the primary transmission route is through contact between people and through direct contact with respiratory droplets generated when an infected person coughs or sneezes. Unlike foodborne gastrointestinal viruses, such as norovirus and hepatitis A, there is currently no evidence that food or food packaging is a likely source or route of transmission of the COVID-19 virus [1-4]. Besides that, scientists and authorities across the world are monitoring the spread of the virus and there have not been any reports of transmission through food.

Currently, there is no registered treatment or vaccine for the disease. In the absence of a specific treatment for this novel virus, there is an urgent need to find an alternative solution to prevent and control the replication and spread of the virus. Studies have been published proposing a specific diet as therapeutic options available for the treatment of this novel coronavirus [5]. WHO/Europe [6] has published a new guide on how to eat healthily during the COVID-19 self-quarantine. It contains valuable information about nutrition to help keep the immune system strong.

Good nutrition and physical activity are major determinants of health and disease [7]. Nevertheless, a longer stay in isolation and quarantine can prevent a good and healthy diet and physical activity. The student population is usually very socially active. Students usually spend a large part of the day outside the home. Therefore, isolation and quarantine can have a significant effect on changing the daily activity of this population as well as their diet.

From March 16th to May 6th 2020, a state of emergency was in force in Serbia due to the coronavirus pandemic and all residents were obliged to be in quarantine. During that period, among other things, the faculties and dormitories were closed and students were at their homes. Given the importance of nutrition and great changes in daily activities, the aim of this study was to examine nutrition and behavior of students during COVID-19 quarantine, with special reference to certain microelements that are necessary for body's defense against the new coronavirus.

PARTICIPANTS AND METHODS

This research was conducted using a questionnaire. Participants answered an online survey questionnaire. Data collection was completed during the May 2020. Students gave written consent to participate in the survey and data processing. This questionnaire is in line with the General Regulation on Data Protection of the European Union. The collected data were used exclusively for scientific purposes. This research is a part of a broader study titled "Attitudes and behavior of students in relation to food and nutrition" conducted among students of the Faculty of Agriculture, University of Belgrade, on the subject of "Food Biochemistry".

The study sample included 114 students of the second year of bachelor studies at the Institute of Food Technology and Biochemistry, Faculty of Agriculture, University of Belgrade, between the ages of 20 and 23 (the average age was 21.78±1.3) and all were of Serbian nationality. The sample was composed of 90 females (78.0%) and 24 males (21.0%), **Table 1**. The surveyed students were selected randomly; all students had an equal chance of being selected for the sample.

Descriptive statistics methods were used to process and analyze the data. Version 8.0 software (StatSoft Co., Tulsa, Oklahoma, USA) was used for statistical processing of the results.

RESULTS AND DISCUSSION

Nutritional habits and behavior in quarantine

Current reports in the world about patients with COVID-19 show that this virus "attacks" all population. However, the latest clinical research suggests that COVID-19 is associated with negative outcomes in older and comorbid patients [8]. These characteristics are not specific to the student population. None of the participants were infected with COVID-19, even if seven students reported their chronic non-communicable disease. Such a good result can be a consequence of the correct behavior in quarantine and proper diet. The emerging studies on patients with COVID-19 indirectly highlight the relevance of nutrition. Namely, these new

Table 1. Participants' socio-demographic characteristics, individual habits and health status (N=114).

Characteristics	**n**	**%**
Gender		
male	24	21.0
female	90	78.0
Age groups (average age – 21.78±1.3)		
21–23	114	100.0
Class status		
2nd year	114	100.0
Nationality		
Serbian	114	100.0
Physical activity		
yes, every day	17	14.9
yes, 1–2 per week	30	26.3
yes 3–4 per week	32	28.1
no	35	30.7
Activities in quarantine conditions		
studying	84	73.7
hobby	23	20.2
I'm bored	7	6.1
Have you been sick of COVID-19?		
yes	–	–
no	114	100.0
Have someone from your family been sick of COVID-19?		
yes	3	2.6
no	111	97.4
Are you under stress due to constant information about the pandemic?		
yes	39	34.2
no	75	65.8
Are you under stress for fear of illness?		
yes	26	22.8
no	88	77.2
Do you think quarantine has a negative impact on your mental health?		
yes	35	30.7
no	79	69.3
Do you suffer from a chronic non-communicable disease?		
yes	7	6.1
no	107	93.9
Do you sleep well at night?		
yes	88	77.2
no	26	22.8
Have you spent any time in the Sun?		
yes	100	87.7
no	14	12.3

studies indicate that the presence of comorbid conditions with impaired nutritional status, a high body mass index score and sarcopenic obesity may have an impact on the occurrence and outcome of this disease [9,10] Peng et al. [10] pointed out that higher BMI is more common in critical patients and non-survivors, so that as many as 88.24% of non-survivors had a BMI>25 kg/m^2. According to the WHO [11] we can classify the weight of adults according to BMI: underweight (BMI <18.5 kg/m^2), normal weight (BMI=18.5-24.9 kg/m^2), overweight (BMI=25-29.9 kg/m^2), and obese (BMI>30 kg/m^2). Most of the surveyed students were not at this risk, although 23% of students reported a BMI>25 kg/m^2 and 58.8% of the students had a BMI that fits in "normal weight" (**Table 2**). However, even over 80% (**Table 2)** of the respondents think that they are not obese, which is contrary to the reported BMI. This indicates that the surveyed students need education in this regard.

New guidelines for preventive defense against this virus prescribe the intake of a sufficient amount of energy [12]. Larger proportion of surveyed students (64.0%) stated that they did take higher amount of energy than needed daily (**Table 3**). Need for higher energy intake is in line with a significant number of students who were physically active (69.3%; **Table 1**) at the time of quarantine. Many studies promote physical activity as a significant potential for reducing the severity of some diseases and improving the quality of life in adults [13].

Of the surveyed students 73.7% spent most of their time completing college assignments and studied, while 20.2% of the surveyed students spent a large part of their time in activities related to their hobbies, and 6.1% of the surveyed students were bored (**Table 1**). The appearance of boredom was expected, since quarantine is associated with the interruption of work routine. But, boredom has been associated with a greater energy intake, as well as the consumption of higher quantities of proteins, fats and carbohydrates, as well as with increased desire to snack and consume less healthy foods [14]. Although most students (61.5%) had regular three meals a day (breakfast (81.6%), lunch (90.4%), and dinner (72.8%), there were respondents who also had a snack (more than three meals a day; 19.3%), **Table 2**. However, since most students (70.2%) did not gain weight during quarantine (**Table 2**), we can assume that their snacks mostly were not high calorie.

Muscogiuri and associates [15] stated that during quarantine continuously hearing or reading about the pandemic without a break can be stressful. In this regard Yilmaz et al. [16] concluded that the stress pushes people toward overeating, mostly looking for sugary "comfort foods". Although most of the surveyed students (65.8%) did not feel stress due to the pandemic,

Table 2. Characteristics of nutritional behavior in quarantine (N=14).

Questions	Answers	
	n	%
Do you have a constant need for food?		
yes	42	36.8
no	72	63.2
Do you eat a much larger amount of food than usual?		
yes	37	32.5
no	77	67.5
Have you gained weight?		
yes	34	29.8
no	80	70.2
Do you think you are obese?		
yes	20	17.5
no	94	82.5
What is your body mass index?		
<18.5	20	17.6
18.5–24.9	67	58.8
25–29.9	17	14.9
30–34.9	7	6.1
35–39.9	3	2.6
≥40	–	–
How many meals do you have per day?		
1	1	0.9
2	22	19.3
3	69	60.5
more than 3	22	19.3
Do you have a regular breakfast?		
yes	93	81.6
no	21	18.4
Do you have a regular lunch?		
yes	103	90.4
no	11	9.6
Do you have a regular dinner?		
yes	83	72.8
no	31	27.2
Are you ordering food to be delivered to your home?		
yes	11	9.6
no	103	90.4
Do you miss eating in restaurants?		
yes	27	23.7
no	87	76.3
Have you succumbed to excessive buying food?		
yes	9	7.9
no	105	92.1

Table 3. Energy and nutritional value of food.

Questions	Answers	
	n	%
N=114		
Are you careful about the nutritional and energy value of food?		
yes	41	36.0
no, I eat what I like	51	44.7
no, I eat according to my capabilities	22	19.3
Do you take more energy per day than you need?		
yes	73	64.0
no	41	36.0
Do the foods you consume contain carbohydrates?		
yes	99	86.8
no	15	13.2
Do the foods you consume contain fat?		
yes	83	72.8
no	31	27.2
Do the foods you eat contain protein?		
yes	114	100.0
no	–	–
Do the foods you consume contain antioxidants?		
yes	93	81.6
no	21	18.4
Do the foods you consume contain vitamins?		
yes	112	98.2
no	2	1.8
Do the foods you consume contain minerals?		
yes	109	95.6
no	5	4.4
N=83		
***Do you have dinner late in the evening?**		
yes	31	37.4
no	52	62.6
***Is your dinner rich in carbohydrates?**		
yes	42	50.6
no	41	49.4

a significant number of respondents were stressed (34.2%), and even believe that quarantine had a negative effect on their mental health (30.7%; **Table 1**). Besides that, Rodríguez-Martín and Meule [17] defined this desire to consume a certain type of food as "food craving" and these foods usually have high palatability and are energy dense and have high fat and/or sugar content. "Food craving" is a multidimensional phenomenon including behavioral (e.g., seeking and consuming food), cognitive (e.g., thinking about food), emotional (e.g., desire to eat), and physiological (e.g., salivation) processes [18,19]. Although most of the surveyed students (63.2%) did not feel constant need for food, a significant number of respondents (36.8%) felt constant need for food and in addition, a significant number of respondents (32.5%) ate much larger amounts of food than usual (**Table 2**).

Quarantine-related stress has also resulted in sleep disorders in a significant number of students (22.8%; **Table 1**). This in turn can further exacerbate stress and increase food intake perpetuating a "vicious circle" that can endanger health. That is why it is important to consume food that stimulates the secretion of serotonin and melatonin. However, there is also a trap here that can lead to a "vicious circle". Namely, foods rich in carbohydrates stimulate the production of serotonin, which in turn has a positive effect on mood. Almost all of the students surveyed (86.8%) consumed foods rich in carbohydrates. In addition, of those students who answered that they had a regular dinner (83 students) 50.6% of students ate carbohydrates and 37.4% of them had dinner in the late evening (after 10 pm; **Table 3**). This unhealthy nutritional habit could increase the risk of developing obesity, hypertension, diabetes, and lung disease that have been demonstrated to increase the risk for more serious complications of COVID-19 [20]. It is much better to consume other foods that contain melatonin and/or serotonin such as: root and green-leafy vegetables, fruits such as bananas and cherries and nuts (walnuts, hazelnuts, cashew, and almonds). These foods also contain tryptophan, which is a precursor of serotonin and melatonin [21]. In addition to these foods, protein foods such as milk and milk products, eggs (white), meat, fish are the main sources of tryptophan [21]. Tryptophan is involved in the regulation of satiety and caloric intake via serotonin that mainly lowers carbohydrate and fat intake. Moreover, tryptophan is a sleep-inducing amino acid [22]. A review of individual groups of foods consumed by students indicated a presence in the diet of foods that can be sources of tryptophan (**Table 4**).

Macronutrients and micronutrients

Usually during quarantine, the intake of macronutrients is increased and the intake of micronutrients is reduced which can lead to obesity [15,23]. All macronutrients (fats, proteins, carbohydrates) were present in the daily diet of the students. To questions related to the composition of foods consumed during quarantine, students answered that the foods contained:

Table 4. Foods consumed by the surveyed students (N=114).

Foods*	yes		no	
	n	%	n	%
spinach, chard, greens, lettuce ...	108	94.7	6	5.3
potatoes	109	95.6	5	4.4
beets, celery, parsley …	76	66.7	38	33.3
carrots	101	88.6	13	11.4
peas, green beans, beans …	109	95.6	5	4.4
soybeans products	22	19.3	92	80.7
onion, garlic, leek…	101	88.6	13	11.4
cauliflower, broccoli, artichoke…	50	43.9	64	56.1
asparagus, kohlrabi…	15	13.2	99	86.8
mushrooms	85	74.6	29	25.4
wheat germ	51	44.7	63	55.3
sunflower seeds	67	58.8	47	41.2
pumpkin seeds	46	40.4	68	59.6
sesame seeds	79	69.3	35	30.7
maize	77	67.5	37	32.5
whole-flour	22	19.3	92	80.7
walnuts, almonds, hazelnuts ...	71	62.3	43	37.7
bananas, pineapples, dates ...	92	80.7	22	19.3
citrus fruits (lemon, oranges ...)	101	88.6	13	11.4
raspberries, blackberries, strawberries, blueberries ...	97	85.1	17	14.9
apples, pears ...	101	88.6	13	11.4
plum, peach ...	67	58.8	47	41.2
milk and cheese	110	96.5	4	3.5
milk yoghurt (from milk of animal origin)	104	91.2	10	8.8
fish	101	88.6	13	11.4
liver	23	20.2	91	79.8
eggs	114	100.0	–	–
poultry meat	112	98.2	2	1.8
„red meat"	93	81.6	21	18.4

* Foods can be fresh, dried or frozen.

carbohydrates (86.8%), fats (72.8%), and proteins (100.0%). Although 64.0% of respondents did not care about the energy and nutritional values of food (44.7% ate the food they liked, while 19.3% of respondents ate according to their abilities, regardless of nutritional and energy value of foods; **Table 3**), the diet of the examined students was obviously well balanced, considering that no student suffered from COVID-19. Students had well-balanced meals that had a beneficial effect on their immune responses.

Most of the students ingested minerals (95.6%), antioxidants (81.6%) and vitamins (98.2%, **Table 3**) mostly through meals, not through dietary supplements. Several studies reported that fruits and vegetables supplying micronutrients can boost immune function [24,25]. Micronutrients important for a good immune response are antioxidants, vitamin A and β-carotene, vitamin C and vitamin D, as well as zinc and selenium. Anti-oxidants (such as: vitamin E, selenium, zinc) increase the number of T-cell subsets, enhance lymphocyte response [26]. Deficiency in selenium induces not only impairment of host immune system, but also rapid mutation of benign variants of RNA viruses to virulence [27]. Zhang and Liu [5] pointed out that selenium supplementation could be an effective choice for the treatment of this novel virus, COVID-19. A relatively small number of students (15 students, 13.2% of respondents) used dietary supplements as addition to their diet. But a large number of students consumed foods that could be a source of selenium (**Table 4**),

such as: red meat, fish, milk, eggs, whole grains, onions, tomatoes, nuts and different seeds [27]. Selenium often exhibits antioxidant activity (prevents the formation of free radicals and prevents oxidative damage to cells and tissues) in synergy with vitamin E [5]. Vitamin E is found primarily in plant products, the richest sources being plant oils (soybean, sunflower, corn, wheat germ, and walnut), also green plants tend to contain vitamin E (spinach and broccoli) as well as, nuts and seeds [5,28]. Except soy-food, students mostly consumed foods that could be a source of vitamin E (**Table 4**).

Vitamin C also supports immune functions and protects against infection caused by the SARS coronavirus [29]. Further, vitamin C may function as a weak antihistamine agent to provide relief from flu-like symptoms such as sneezing, a runny or blocked-up nose, and swollen sinuses [30]. Sources of vitamins C include: peppers, broccoli, cabbage, oranges, strawberries, mangoes, lemons, and other fruits and vegetables, and organ meats (e.g., liver and kidney) [5,28]. Apart from mango, which is not a traditional fruit in the Balkans, and liver, which was consumed by a relatively small number of students, other foods that can be sources of vitamin C were consumed by a large number of students (**Table 4**). In addition, all students who used dietary supplements used vitamin C as well as zinc (**Table 5**).

Zinc is another essential trace element that is crucial for the maintenance of immune function [31], in addition, it has been reported that zinc at low concentrations inhibits the replication of SARS coronavirus [32]. Zhang and Liu [5] pointed out that zinc supplement may have effect not only on COVID-19-related symptom like diarrhea and lower respiratory tract infection, but also on COVID-19 itself. The most common food to get zinc is represented from: nuts, pumpkin seeds, sesame seeds, beans, red meat and poultry [5]. The results of this study showed that a significant number of students consumed foods that could be a source of zinc (**Table 4**).

Ebadi and Montano-Loza [33] pointed out that potential immunomodulators may help alleviate severity and improve the outcomes of these diseases. Vitamin D has a wide spectrum of anti-inflammatory, antifibrotic, immunomodulatory, and antioxidant actions. The same authors have found that severe vitamin D deficiency is associated with disease progression and increased mortality in patients [33]. Epidemiological studies have reported that vitamin D deficiency is associated with viral respiratory tract infections and acute pneumonia [34]. Zhang and Liu [5] pointed out that vitamin D could work as another therapeutic option for the treatment of this novel virus. Namely, vitamin D reduces the risk of developing several chronic diseases such as: cardiovascular disease and hypertension, diabetes mellitus, metabolic bone diseases, and cancers. Adequate vitamin D status protects respiratory tract, therefore reducing the risk of pneumonia [15, 28,35,]. Vitamin D, the "sunshine vitamin," is actually a hormone produced from sterols in the body by the photolytic action of ultraviolet light on the skin [28]. However, quarantine could be associated to less sun-exposure, and reduced production of vitamin D. Nonetheless, most of the surveyed students spent time in the sun (87.7%; **Table 1**). Still, as the appearance of COVID-19 and quarantine covered mostly the winter months, and consequently the sun exposure was limited, it was encouraged to get more vitamin D from diet. Vitamin D, as either ergocalciferol (vitamin D2) or cholecalciferol (vitamin D3), is rather sparsely represented in nature and few foods are rich in vitamin D. The richest natural sources are fish liver, and oils (cod, tuna and mackerel oils are particularly rich sources of vitamin D3). However, these foods are not usually used every day in Serbia, and in addition, their price is very high. Therefore, the population uses fish, liver, egg yolk and foods with added vitamin D (e.g., milk, yogurt) as sources of vitamin D [28]. A relatively small number of students consumed liver, but a large number of students used fish, eggs, milk and dairy products (**Table 4**). Vitamin D can also be obtained from nutritional supplements, but few students have used vitamin D in the form of capsules and tablets (**Table 5**). Perhaps students should be encouraged (especially in the winter months) to use vitamin D in the form of dietary supplements.

The B vitamin group is very important in viral infections for the host immune response. Zhang and Liu [5] pointed out those B vitamins could be chosen as a basic option for the treatment of COVID-19. Given that these vitamins are found in a large number of foods of plant and animal origin, it is considered that

Table 5. Use of dietary supplements.

Questions	Answers	
	n	%
Do you use dietary supplements? (N=114)		
yes	15	13.2
no	99	86.8
*I take from supplements: (N=15)		
vit D	8	55.3
vit C	12	100.0
vit E	2	13.3
vit A (or β–carotene)	6	40.0
essential fatty acids	1	6.7
zinc	12	100.0
selenium	5	33.3

* This question was only applied to students who answered that they take supplements (most of them take several different supplements, not just one) (N=15).

proper nutrition can be ingested in sufficient quantities. Foods containing B vitamins include: red meat, liver (beef), fish, eggs, milk and dairy products, rice, whole-flour, celery, cabbage, beans, asparagus, broccoli, spinach, carrots, cauliflower, potatoes, tomatoes, cucumber, corn, soy, oranges, apples, grapefruit, pineapple, peaches, strawberries, plums, and nuts. The exception is vitamin B12, whose source is only in foods of animal origin that were previously listed [28]. Students consumed most of these foods (**Table 4**), so it can be assumed that they ingested a sufficient amount of B vitamins.

CONCLUSIONS

A large number of students did not belong to the risk group for COVID-19. Only a few students suffer from chronic diseases and a small number of students are obese. A significant number of surveyed students were careful about the nutritional and energy value of food. The diet of the examined students was well balanced, considering that no student suffered from COVID-19. The students had well-balanced meals that had a beneficial effect on their immune response. The students had all the macronutrients in their diet during COVID-19 quarantine. Most of the students ingested micronutrients mostly through meals. A relatively small number of students ingested minerals, antioxidants, and vitamins through dietary supplements. Students should be encouraged to use vitamin D in the form of dietary supplements, especially in the winter months. Generally, this research may help for a better understanding of the importance of a proper and balanced diet for maintaining good health. In addition, it can have an educational significance on the student population about proper nutrition as well as about the need to use dietary supplements during pandemics.

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Ishrana studenata tokom karantina zbog COVID-19

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Kratak sadržaj

Svetska zdravstvena organizacija je COVID-19 proglasila pandemijom i veliki broj ljudi je bio ili je u karantinu. Tokom karantina, kontinuirano slušanje ili čitanje o pandemiji može imati efekte na različite aspekte života ljudi. Jedan od ovih vrlo značajnih efekata je na ishranu ljudi. Cilj ove studije bio je da sumira iskustva studentske populacije o ponašanju i kvalitetu ishrane tokom karantina COVID-19, sa posebnim osvrtom na određene mikroelemente koji su neophodni za imunološki odgovor. Studenti su pozvani da urade online anketu tokom maja 2020. Nijedan od učesnika nije bio zaražen sa COVID-19. Od ispitanih studenata 34.2% je bilo pod stresom zbog stalnih informacija o pandemiji. Značajan broj studenazta je imao dobre prehrambene navike. Većina ispitanika nije osećala stalnu potrebu za hranom (63.2%), niti su konzumirali veće količine hrane nego obično (67.5%). Studenti (36.0%) su bili pažljivi u pogledu nutritivne i energetske vrednosti hrane. Većina ispitivanih studenata (86.8%) je unosila mikroelemente uglavnom hranom. Studenti su imali dobro uravnotežen obrok koji je blagotvorno uticao na njihov imunološki odgovor. Veoma mali broj studenata (13.2%) je koristio dijetetske suplemente. Generalno, ovo istraživanje može pomoći boljem razumevanju važnosti pravilne i uravnotežene ishrane i upotrebe dijetetskih suplemenata radi održavanja dobrog zdravlja.

Ključne reči: *Koronavirus; Studenti; Ishrana; Mikroelementi; Dnevne aktivnosti; Online anketni upitnik.*