The Impact of the COVID-19 Pandemic Outbreak on Eating and Lifestyle Habits of Adolescents in Bosnia and Herzegovina: a Cross-sectional Study

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Abstract

Background: Pandemic caused by the COVID-19 virus brought tremendous changes in the lifestyle of adolescents, about which numerous studies have been published. Due to extended restrictions, long term impact should be investigated.

Methods: This cross-sectional study enrolled 953 voluntary participants aged 14 to 21, from different regions of B&H. Participants were asked to complete an online 37-item survey, regarding socio-demographics, geographic, social characteristics, dietary and lifestyle habits, physical activity, including their consumption of dietary, vitamin and mineral supplements. They also needed to provide information about their weight, height and weight change during the entire period of the COVID-19 pandemic from March 2020 until the end of November when the study was completed. For data entry and analysis, SPSS (version 25) and Microsoft Excel were used.

Results: At the time of completing the survey, a slightly lower BMI of participants was noticed compared to the time before the pandemic. A statistically significant difference was determined between males and females BMI, boys BMI was slightly higher. Females gained and men lost BW. Increased intake of unhealthy types of food was associated with weight change. Increased mental stress during the pandemic was associated with dietary changes, respectively with decreased as also increased food amount. High percent of participants (40.4%) who increased their physical activity did not alter their eating in the form of the food amount. This study reported use of some dietary supplements which have not been used before the pandemic by 63.5% participants.

Conclusions: This paper presents a unique insight into the changing lifestyle and eating habits of adolescents in B&H during lockdown and post-lockdown period of research. Considering that pandemic is still ongoing, data from study like this may be useful to create further steps in battling the pandemic.

Background

The World Health Organization [1], on the 11th of March 2020, declared globally a pandemic caused by the COVID-19 virus. First case of the COVID-19 was found in Wuhan, China in December 2019, and from there it spread around the World. Many governments adopted emergency measures to prevent further transmission of the infection. All countries, especially the most affected, took wide range measures and restrictions that changed everything i.e. travel was stopped, schools, churches, pubs, restaurants were closed, and even free access to parks and streets has become a luxury. When observing parameters regarding a large lifestyle change, children and adolescents were one of the most affected groups of people because of closing the schools, playgrounds, and other activities that they were accustomed to. These changes didn’t mean only adaptation to the new way of life, but the new measures have brought a daily routine which may compromise maintaining a healthy lifestyle. That includes physical activity, interaction with others and a balanced diet which could prevent chronic diseases, depression, anxiety, respiratory infections and brings a better immune system [2, 3, 4]. In 194 countries over 1598 billion of students stayed home for education [5]. Unfortunately, measures during COVID − 19 pandemic influenced

the most socially vulnerable children living in small houses, without possibility of going out, or Internet access and equipment that would give them the opportunity for education [6].

In B&H (Bosnia and Herzegovina) the lockdown was decreed on 16th March 2020, which took children and adolescents out of schools and playgrounds for almost 12 weeks. Closing the schools was a good idea in the sense of stopping the spread of the virus, but it brought a lot of challenges, not only for students and teachers [7]. The interruption of work and school routine caused by the government's measures resulted in boredom, which in turn is associated with a greater energy intake [8], sedentary behavior, modification in smoking and alcohol drinking. Sedentary behavior and high mental demands have been associated with increased food intake, suggesting that this may lead to a positive energy balance and weight gain [9, 10].

This survey was carried out to explore and analyze lifestyle, eating habits and physical activity of B&H adolescents at the time of lockdown and after getting back to the school, related to mental and emotional mood caused by measures during the COVID-19. The measures have had a huge impact on eating habits, mental and emotional mood and physical activity, not only during these weeks, but also after the abolition of certain measures and return to school. There are already numerous studies on the impact of lockdown on eating habits and behavior, but in the period from March to May 2020.

Methods

The aim of the study

As the COVID-19 is a burning topic, the aim of this work is to find out how it influences the eating habits and physical activity among adolescents, and compare them to their usual diet. In addition, the use of dietary supplements was investigated. The question about mental and emotional health burden arising from the COVID-19 and related measures, was also investigated. Measures affected the adolescents in their previous habits in diet and physical activity. Although the negative effects of school closures on the lives of children and young people are daily, globally documented, a thorough assessment of the long-term consequences of the pandemic is yet to come.

Participants

The target population for this research was students of different high schools (grammar school, and different vocational high schools) and regions of B&H, which contributed to the representativeness of the sample. A total of 953 students between 14–21 years old (from 1st to 4th grade of high school) were evaluated through an online survey. Respondents with missing or implausible data were excluded from analyses, which led to a study sample of $n = 945$.

Survey development and content

The data were obtained through an online survey composed of 37 questions, covering socio-demographic, geographic, and social characteristics as well as eating and lifestyle habits. The survey is

divided into five sections that are presented in Table 1 (Appendix).

Table 1
Translated online survey

1.	**Gender**	• **Male** • **Female**
2.	Location of school	• Region, city
3.	Type of school	• Insert type of school: Example: Gymnasium, High Medical School Civil engineering, electrical-technical, etc.
4.	Class you attend	• Multiple choice: • 1st grade • 2nd grade • 3rd grade • 4th grade
5.	Year of birth	• Number
6.	Area of living	• Rural • Urban
7.	Number of family members at home	• ≤ 3 • 4 • ≥ 5
8.	Maternal employment	• Unemployed • Employed
9.	Father employment	• Unemployed • Employed
10.	Height	• Number in cm
11.	Weight	• Number in kg
12.	Has your weight changed since the Covid-19 outbreak?	• Decreased • Unchanged • Increased
13.	If it did change, since Covid-19 outbreak, please indicate how much!	• Number in kg

1.	**Gender**	• **Male** • **Female**
14.	How has this affected your food consumption?	• Marks for 1 to 5 • Mark "1" indicates a decrease in food intake • Mark "3" indicates that food intake does not change • Mark "5" indicates that food intake increases
15.	How has your overall food amount changed since the COVID-19 outbreak compared to the year before?	• Decreased • Unchanged • Increased • Can't define
16.	Eating breakfast (two hours of waking up)	• Every day • 2–4 times a week • Never
17.	Most common breakfast choice	Multiple choice • I don't have breakfast • Whole grains (oatmeal, millet, quinoa, granola, etc.) • Cereals with additives (CornFlakes, Vitalis, Nestle, i.e., cereals containing pieces of chocolate, dried fruit, etc.) • Pastry (muffin, roll, donut, Croissant) • Eggs • Salami, bacon, ham, and other processed meat products • Dairy products (cheese, cheese spread, milk, yogurt)

1.	**Gender**	• **Male** • **Female**
18.	Frequency of consumption of the following food groups • Vegetable • Fruit • Legumes • Dairy products • Red meat • Poultry • Fish (does not include fish sticks, but includes freshwater and saltwater fish; fresh or frozen; and canned fish)	Single choice • ≥ 2/day • 1/day • 3–4/week • 1–2/week • 1–2/month • Never
19.	Changes in intake of the following food groups changed due to the Covid-19 epidemic. • Vegetable • Fruit • Legumes • Dairy products • Red meat • nuts (walnuts, hazelnuts, peanuts, almonds) • Confections • Soft and soda drinks • Snack food (chips, crackers, flips) • Fast food • pizza, hotdog, burgers, traditional pie	Single choice • Decreased • Unchanged • Increased • Not consumed
20.	Have You been prescribed deficiencies in vitamins or minerals?	Multiple choice • No • Iron deficiency anemia • Vitamin B deficiency • Vitamin D deficiency • Other

1.	**Gender**	• **Male** • **Female**
21.	Are you currently taking any vitamin and mineral or vitamin-mineral complex supplements? (e. g. iron, vitamin C, vitamin D, B, Mg, Zn)	• Yes, recommended by health professional • Yes, at the sole discretion, the discretion of the parents and/ or someone from the immediate environment • No
22.	Which dietary supplements do you take now?	Multiple choice • None • Vitamin C • Vitamin D • Vitamin B • Magnesium • Calcium • Iron • Omega-3 supplements • Probiotics • Beta-glucans supplement • Other
23.	Did you use dietary supplements from above before the Covid-19 pandemic?	• Yes • No
24.	Are you using any herbal supplement (tea, tinctures, oil)?	• Yes • No
25.	If you are using, please write which one.	

1.	**Gender**	• **Male** • **Female**
26.	Purpose of use of herbal medicines	Multiple choice • Do not use • For weight loss • Laxatives, to stimulate the movement of the digestive system to induce a bowel movement • Boost immune system • To urinate • Other
27.	Changes in following habits due to the Covid-19 epidemic? Alcohol Cigarettes	Single choice • I use and have used before the pandemic • I started using it during the epidemic • I stopped using it during the epidemic • I have never used
28.	Do you feel mentally more stressed since the Covid-19 outbreak, compared to the year before (feeling of tension, fear, anxiety)?	• Yes • No • Can’t define
29.	Physical activity outside of school	• Yes • No
30.	How much sports do you do, compared to before lockdown?	• Decreased • Unchanged • Increased
31.	Frequency of physical activity outside of school	• Once a week • 1–3 times a week • > 3 times a week

1.	**Gender**	• **Male** • **Female**
32.	Forms of physical activity outside of school	Multiple choice • Walk from home to school and back • Cycling • Running and / or hiking • Training in a sports club (football, basketball, volleyball, handball, etc.) • Other • None of the above
33.	Average minutes/day of physical activity outside of school	Single choice • Do not have physical activity outside • < 30 min • > 30 min
34.	Changes in frequency of physical activity outside of school due to epidemic Covid-19	• Decreased • Unchanged • Increased
35.	Do you watch TV or use your smartphone during mealtimes?	• Always • Sometimes • Never
36.	Influence of time spent watching TV or using smartphones affects the amount of food you eat?	Single choice • No influence • Increased intake • Decreased intake • Not sure
37.	Does anyone in your immediate family (mom, dad) suffer from high blood pressure or diabetes?	• Yes • No

The first section comprised nine questions on demographic, geographic and social characteristics of the students. The second section consisted of 4 questions focused on weight change during COVID-19. BMI (body mass index) was calculated as the body mass divided by the square of the body height and

categorized based on the distribution of the data (< 18 kg/m2; 18–25 kg/m2; >25 kg/m2; >30kg/m2). The third section included 6 questions related to eating habits before and in the time of the pandemic while the fourth section was focused on dietary and herbal supplements. The end of the survey comprised questions about increased mental stress, physical activity, tobacco and alcohol use before and in the time of COVID-19.

The survey was prepared using Google Forms survey administration software, and distributed via accessible mailing list through school administration and staff. Teachers and parents were informed of the procedures and objectives of the study. The research was anonymous and was done exclusively according to the wishes and consent of the students themselves. The study was active for 4 weeks in November 2020. Due to physical restrictions, the online survey was one of very few possibilities to reach as many respondents as possible.

Statistical analysis

Statistical analysis and graphic design were done by SPSS version 25 for Windows (SPSS inc., Chicago, USA) and Microsoft Excel (Microsoft Corporation). Absolute and relative frequencies were calculated for data description. Normality of distribution was tested using Shapiro-Wilk tests. According to these tests, distribution of BMI before and during the COVID-19 pandemic variables as well as BW change variable (in kg) did not show a normal distribution ($p < 0.05$). But after assessment of the magnitude of skewness and kurtosis of data distribution with graphical methods it is observed that any kurtosis coefficient is greater than 10, and any skewness coefficient is greater than 3 [11]. According to this and due to the fact that the sample size is large and all extreme values as incorrect were excluded, parametric tests were used. Categorical variables (gender, age, BMI) were compared using Chi-squared test. Non categorical variables were compared using *t* Test and ANOVA. To compare the means of two independent groups (BMI, gender, employment of mother or father, place of residence, physical activity), in order to determine whether there is statistical evidence that the associated sample means are significantly different, independent samples *t* Test was used. ANOVA was performed to compare continuous variables (BMI, weight change) among groups. One-way ANOVA was performed to compare the difference between groups (“decreased”, “unchanged”, “increased”, “never consumed”) on weight change (in kg). Since the homogeneity of variances was violated, assessed by Levene's Test of the homogeneity of variance ($p < 0.05$), Welch ANOVA was used and Games-Howell post hoc test. Data are mean ± standard deviation, unless otherwise stated. Statistical significance was determined at $p < 0.05$. Since multiple response questions were present in the survey, frequencies and percentages for these questions were taken directly from Google Forms survey.

Results

Participants’ demographics

A total of 945 participants were from 21 different cities in B&H. From the Herzegovina region were 58.5% participants and from Bosnia 41.5% of them. Out of all participants, 26.9% were male ($n = 254$), 73.1% (n

= 691) females, and a mean age of 16.5 ± 1.1 years. In this sample, 59.8% participants live in the city and 40.2% in the village. Regarding economic status, 57.2% students have both employed parents, 36.5% one employed parent and 6.2% live in a family where neither one of the parents is employed. Followed, 14.6% students live in the household with 3 and less members, 29.9% with 4 and 55.4% with 5 and more. 47.4% of the students were from grammar school, while others were from different vocational high schools.

Participants' health characteristics and anthropometrics

Most of the participants, at the time of completing the survey, had a normal BMI 21.3 ± 2.8 kg/m2. According to the WHO classification of BMI [12], most participants, 82,6% of them, had a normal BMI, 8.5% were underweight and 7.6% were in the pre-obesity category, of which 1.2% were in obesity class I. BMI before the COVID-19 lockdown and restrictions was 21.3 ± 3.0 kg/m2. Distribution between males and females BMI (Fig. 1.) shows more female participants in the underweight category as well as in pre-obese. Using *t* Test for independent samples, a statistically significant difference ($p = 0.033$, $df = 392.4$, $t = 2.142$) was determined between males and females BMI, where boys have slightly higher BMI (21.7 ± 3.1 *vs* 21.2 ± 2.6). Statistically significant difference was not obtained between BMI and physical activity ($p = 0.663$), nor between BMI category and stress ($p = 0.381$). But a statistically significant difference was found ($p = 0.000$) between BMI before the COVID-19 and in the time of completing the study (survey), where BMI before the COVID-19 was slightly higher. Almost one third (28.4%, $n = 268$) of our participants reported a weight gain and 20.6% (n = 195) weight loss. Statistically significant difference was determined between males and females in BW (body weight) change ($p = 0.000$, $df = 943$, $t = 3.883$). Females gained BW (kg) (0.77 ± 3.86) compared to men who lost BW (-0.30 ± 3.71). Using ANOVA, no statistically significant difference in BW change (kg) between BMI groups was found nor between perceived stress.

Lifestyle habits

Lifestyle habit questions focused on participants' physical activity outside of school, type and duration of exercise, as well as changes in alcohol consumption and smoking during the COVID-19 pandemic lockdown and 8 months after. There were 74.1% ($n = 700$) participants who are physically active during the pandemic, while 25.9% of them are not. Most of them (34.6%) are physically active 1 to 3 times per week and usually more than 30 minutes. Outside of school, 84.7% ($n = 260$) of participants exercise more than 3 times per week and more than 30 minutes per activity. This means for most of the participants walk house - school - house, cycling, hiking, running and training in a sport club (soccer, basketball, handball) or some other activities or their combinations. It is interesting that larger percent of participants 33.0% ($n = 312$) had increased their physical activity during the pandemic in comparison with 27.5% ($n = 260$) who decreased. There was no statistical significance between physical activity modification and BMI category, nor between weight change (in kg) and physical activity modification or its duration.

Most of the participants (46.3% $n = 438$) felt more stressed than before the pandemic. Statistically significant difference ($p = 0.000$) was obtained between genders, where 53.0% ($n = 366$) girls felt more stressed than before pandemic in comparison to 28.3% ($n = 72$) of males, as well as adolescents from

urban areas (49.7%, *n* = 281) compared to adolescents from rural (41.3%, *n* = 157) (*p* = 0.039). 4.6% of students (*n* = 43) started to drink alcohol during the pandemic and those who started smoking during this time was 3.8% (n = 36). But, almost a similar number of students changed their lifestyle habits for the better in the form of quitting smoking and alcohol consumption (3.1%, *n* = 29; 3.9%, *n* = 37 respectively). Regarding the use of their phone or watch TV while eating, 86.4% of participants do it regularly or occasionally, and 15% of all participants stated that this increased the amount of consumed food.

The presence of one of the chronic non-communicable diseases (NCD) in the immediate family of 24.1% (n = 228) participants was established in this study. This was important since proper lifestyle and dietary habits can prevent many NCD [13].

Eating habits

Most of the participants (41.8%, *n* = 395) stated they did not alter their food consumption during the COVID-19 pandemic, while 25.9% (*n* = 245) of the participants increased their food intake, and 14.2% (*n* = 134) decreased, compared to the time before. Other participants were not able to conclude if their food intake had changed during specified time. Statistical analyses showed significant correlation between gender, increased mental stress, physical activity and change in food amount (Table 2). We found that male participants did not alter their food amount as much as girls (decreased: 16.5%, *n* = 114; increased: 20.4%, *n* = 141). Increased mental stress during the pandemic was associated with decreased (18.9%, *n* = 83) as well as increased (31.3%, *n* = 137) food amount. Significantly high percent of participants (40.4% *n* = 126) who increased their physical activity did not alter their eating in the form of the food amount. While 22.2% (*n* = 210) of all participants never eat breakfast, 48.4% of male participants (*n* = 123) and 41.1% (*n* = 284) of females consume breakfast daily. Statistically significant difference (p = 0.006) was found between participants from rural (39.2%, *n* = 149) and urban areas where more students from the city consume breakfast daily (45.7%, *n* = 258). Participants were asked multiple-choice questions to choose the type of food they most often consume for breakfast. Dairy products (milk, yogurt, cream cheese, etc.) are the most frequent food group consumed for breakfast by 39.1% (*n* = 373), bakery products (breads, bagels, pies, croissants) are on the second place (35.4% (*n* = 338). Meat products and eggs are consumed by 29.9% (*n* = 285) and 33.1% (*n* = 316) participants respectively. Whole cereals like oatmeal, granola, millet or buckwheat porridge are consumed by a smaller number of participants (13.2%, *n* = 126) as well as processed cereals like corn flakes or cereals with other ingredients and additives (22%, *n* = 210).

Table 2
Chi-squared test of changes in food consumption during epidemy COVID-19 and potential predictor variables.

Changes in food amount					
	Decreased % (n)	**Unchanged**	**Increased**	**Can't define**	p **value**
Gender					
Male	7.9 (20)	55.1 (140)	25.2 (64)	11.8 (30)	**0,000**
Female	16.5 (114)	36.9 (255)	26.2 (181)	20.4 (141)	
Place of residence					
City	15.9 (90)	39.6 (224)	26.5 (150)	17.9 (101)	0.184
Village	11.6 (44)	45.0 (171)	25.0 (95)	18.4 (70)	
Number of households					
< 3	18.1 (25)	42.0 (58)	27.5 (38)	12.3 (17)	0.387
4	13.1 (37)	41.3 (117)	27.9 (79)	17.7 (50)	
> 5	13.7 (72)	42.0 (220)	24.4 (128)	19.8 (104)	
Parents employment					
Both unemployed	11.9 (7)	54.2 (32)	20.3 (12)	13.6 (8)	0.380
One unemployed	14.5 (50)	38.0 (131)	28.4 (98)	19.1 (66)	
Both employed	14.2 (77)	42.9 (232)	25.0 (135)	17.9 (97)	
Mental stress increased					
Yes	18.9 (83)	29.9 (131)	31.3 (137)	19.9 (87)	**0.000**
No	8.1 (27)	59.2 (197)	20.1 (42)	12.6 (42)	
Can't define	13.8 (24)	38.5 (67)	23.6 (41)	24.1 (42)	
Change in physical activity					
Decreased	17.3 (45)	50.1 (187)	30.8(80)	31.5 (82)	**0.000**
Unchanged	10.2 (38)	31.5 (82)	22.3 (83)	17.4 (65)	
Increased	16.3 (51)	40.4 (126)	26.3 (82)	17.0 (53)	

Data are given as percentages (absolute numbers)

Bold values indicate statistically significant p values < 0.05

BMI - body mass index

Changes in food amount					
BMI category					
< 18.5	15.7 (19)	43.8 (53)	22.3 (27)	18.2 (22)	0.400
18.5–24.9	14.6 (108)	42.0 (311)	25.7 (190)	17.7 (131)	
> 25	8.4 (7)	36.1 (394)	33.7 (28)	21.7 (18)	

Data are given as percentages (absolute numbers)

Bold values indicate statistically significant p values < 0.05

BMI - body mass index

The present study also examined the frequency at which particular food groups were consumed at the time of completing the survey (Table 3). Interesting results were obtained in change of food categories. The vegetable and fruit consumption increased by 15.9% (n = 150) and 27.9% (n = 264) respectively, which showed increased fruit and vegetable intake of adolescents in a significant way during confinement. Respectively, our results also showed an increase in consumption of nuts (walnuts, hazelnuts, peanuts, almonds) by 16.2% (n = 153). In fact more than half of the participants reported an unchanged amount in these categories (Table 3). Soft and soda drinks consumption as also confections (chocolates, biscuits, waffles, ice creams, candies, etc.) were decreased by 26.9% (n = 254) and 19% (n = 180) participants, respectively. Snack food consumption (chips, crackers, flips) was also decreased by 24.1% (n = 228), and fast food like pizza, hotdog, burgers, traditional pie i.e. “pita” by 25.3% (n = 239) participants. BMI groups had no relevant effect on decrease or increase in food categories.

Table 3
Consumption of specific food groups according to gender

Frequency (%)												
	≥ 2/day		1/day		3–4/week		1–2/week		1–2/month		Never	
	M	F	M	F	M	F	M	F	M	F	M	F
Vegetable	15	11,1	33,9	34,9	32,7	30,2	15	17,9	2,8	5,1	0,8	0,7
Fruit	28	32,3	32,7	31	26,4	23,7	10,6	10,9	1,6	2	0,8	0,1
Legumes	0,8	1,2	4,7	2,3	10,6	13,5	48,8	45	22,4	25,6	12,6	12,4
Dairy products	42,5	34,6	31,9	38,8	18,9	17,9	6,3	6,4	0,4	1,3	0	1
Red meat	11	4,8	20,1	17,4	42,1	41,1	21,7	27,4	4,3	5,8	0,8	3,6
Poultry	10,2	5,6	15	15,8	41,3	43,1	28,3	29,4	4,7	5,4	0,4	0,7
Fish	1,2	0,7	2,8	2,9	7,9	7,7	46,1	39,4	32,7	36,8	9,4	12,6

Using ANOVA, a statistically significant effect in the change of BW with regard to the change to the consumption of confections, soft and soda drinks, snack food and fast food was determined (Table 4).

Table 4
Weight change (kg) with regard to the change of specific food groups.

Weight change (kg)							
Group of food	**Comparative groups**	**MD**	**Lower 95% CI**	**Upper 95% CI**	p **value**	Welch's F(df1,df2)	p ANOVA
Confections	Decreased	**2.762**	1.59	3.94	**0.000**	F(3, 94.705) = 13.589	**0.000**
Increased	Unchanged	**1.624**	0.76	2.49	**0.000**		
Consumption	Not consumed	**2.916**	0.34	5.49	**0.000**		
Soft and soda drinks	Decreased	1.235	-0.21	2.68	0.123	F(3, 260.347) = 3.424	**0.018**
Increased Consumption	Unchanged	0.594	-0.75	1.93	0.655		
	Not consumed	1.385	-0.15	2.92	0.093		
Snack food	Decreased	**2.518**	1.36	3.67	**0.000**	F(3,164.492) = 11.091	**0.000**
Increased Consumption	Unchanged	**1.521**	0.55	2.49	**0.000**		
	Not consumed	**2.419**	0.49	4.35	**0.008**		
Fast food	Decreased	**2.025**	0.68	3.36	**0.001**	F(3, 111.254) = 7.000	**0.000**
Increased Consumption	Unchanged	0.884	-0.34	2.11	0.240		
	Not consumed	1.432	-0.50	3.36	0.214		

A one-way Welch ANOVA was conducted to determine if the weight change (kg) was different for groups with modified consumption of specific food categories. In the table, multiple comparisons are presented, done by Games-Howell post hoc test. MD - Mean difference between group; CI – Confidence interval Bold values indicate statistically significant *p* values < 0.05.

Use of dietary supplements

It is an interesting fact that 63.5% (n = 600) of respondents did not use supplements before the COVID-19 pandemic. Although most of the participants 88.5% (n = 836) did not have any deficit diagnosed by specialists, 29.4% (n = 278) they used supplements based on their own or their parents' initiative. According to specialists recommendation, 10.5 %, n = 99 of participants used some supplement (Fig. 3). 7.1% (n = 67) of them have been diagnosed with iron deficiency anemia and 3.1% (n = 29) deficit of vitamin D. Other deficiencies include vitamin B deficiency and some other conditions that require vitamin and mineral supplementation. The most common nutrients supplemented during the period of pandemic were vitamin C (36.6%), magnesium (28.9%), vitamin D (22.9%), calcium (10.8%), iron supplements (11.6%), omega-3 fatty acids (5.9%). These nutrients were followed by probiotics, vitamin B supplements,

zinc and selenium. Additionally, adolescents (30.3%, n = 286) are also prone to use different natural bioactive compounds from herbs, tinctures, and oils, and as the main reason they state improving immunity (17.1%). Other reasons they state are weight loss, increasing stool motility and other - non specified. Herbal products generally included herbal teas (*Matricaria chamomilla*, *Thymus serpyllum*, *Mentha piperita*, cranberry and ginger tea and tea of *Artemisia annua*), black seed oil (*Nigella sativa*) and bee products (propolis, royal jelly, pollen).

Discussion

This cross-sectional study investigated the impact of changes caused by the COVID-19 pandemic on lifestyle and eating habits from the beginning of government measures in March 2020 to the end of the research in November 2020. We hypothesized that measures taken by the government to slow the transmission of COVID-19, affected the change in food consumption, food groups, changes in BW, physical activity and stress. As some researchers confirmed that different natural disasters can affect, not only lifestyle, but physical and mental health in the children and adolescents [14] it was assumed that measures caused by the pandemic COVID-19 may have similar effects. Research made by Medrano et al. [15] show that measures that were taken in Spain, negatively affected physical activity and sedentary behaviors among children.

Government measures in B&H included changes in the education system, the closure of sport clubs, fitness centers, caffes, bars, restaurants. All primary and secondary schools have switched to online teaching from March to June 2020, and for the current school year, from September 2020 to the combined type of teaching (online and contact). All of this affected the student's previous habits in diet and physical activity. They spent more time at home and after they enrolled back in the education process in September, classes lasted about three hours, a half time than usual classes. They did not have physical activity at school due to avoiding physical contact. Also it is important to mention that from September 2020, B&H had less restrictive measures in comparison to Western European countries (for example Italy, Germany, France), which means open bars, restaurants, fast foods, cafes as also sports facilities.

Similar to the research of Huber et al. [16] and Di Renzo et al. [17], in this study the female respondents represent 73.1% of the population. Almost one third (28.4%) of our study participants reported a weight gain, and females gained statistically significantly more on BW compared to males. Research by Di Renzo et al [17] has also detected positive association between perception of weight gain to the female gender. But ultimately, in the present study, BMI before the COVID-19 was slightly higher than BMI of participants at the time of completing. The reason for this could be found in the large number (40.4%) of participants who increased their physical activity but unchanged intake of food. Most of participants (41.8%) stated they did not alter their food consumption during the COVID-19 pandemic and that correlates with the current literature [16, 17]. Also, percent of participants who increased their food consumption is similar to these studies. The vegetable and fruit consumption increased in accordance with results of Ruiz-Roso et al. [18], as well with the results of Di Renzo et al [17]. Results from our study also showed increased consumption of nuts, which is a positive effect as their consumption is associated with less long-term

weight gain and a lower risk of obesity in adults [19]. A review by Jayawardena et al. [20] underlines that a balanced nutrition, which can help in maintaining immunity, is essential for prevention and management of viral infections. Overall, increased consumption of vegetables and fruits and decreased consumption of sweets, unhealthy snacks, fast food, sugary and soda drinks was an unexpected positive outcome. Survey by Di Renzo et al. [17] also showed decreased consumption of packaging sweets and baked products as well as delivery food, during confinement. A decrease in snack food consumption (chips, crackers, flips) and fast food like pizza, hot-dog, burgers, pies is in accordance with results of Ruiz-Roso et al. [18] where adolescents from 5 countries decreased their weekly consumption of fast food. In the present study a statistically significant effect in the change of BW with regard to the change to the consumption of confections, soft and soda drinks, snack food and fast food was determined (Table 4). Study of Pišot et al. [21] also reported healthier meals and less unhealthy food. The reason for these changes can be justified by the obstacles that prevent students from choosing a healthy meal at school. That includes time management for eating quickly, unhealthy food environment around the school and unpleasant food service at school [22] like absence of canteen in Bosnia and Herzegovinian schools. In absence of school canteen, young people are forced to take breakfast or lunch in fast food objects and bakeries around the school, which are usually nutrient-poor, energy-dense food. Moreover, it should be stressed that the nutritional quality of the eaten breakfast is likely to be of higher importance than only eating breakfast on a daily basis [23] and in the present study the first three places are engaged by dairy products, bakery products, meat products and eggs, respectively. In comparison to research by Sidor et al. [24], in our study it was not reported that specific BMI groups statistically decrease or increase food amounts which correlate with Italian study [17]. It seems that in B&H, restrictions in schools led to increased physical activity outdoors which may be due to additional free time. That is different from work of Moore et al. [25] who found that children and youth were less active, played outside less, were more sedentary, and engaged in recreational screen-based activities during the initial COVID-19 virus outbreak compared with before the restrictions.

The lack of treatment options for the COVID-19 has led to many attempts to find alternative options to decrease the probability of getting infected, prevent the transmission of the disease or to alleviate the progression of the infection by the use of herbal products or nutritional supplements [26]. It is an interesting fact that 63.5% (n = 600) of respondents did not use supplements before COVID-19 pandemic, even it was known that use of dietary supplements is often justified by the desire to improve immunity, overall health, to prevent illness, or to treat viral infections [20, 27]. Only 10.5% of participants used some supplement according to specialist's recommendations which is quite worrying. The most popular and commonly used supplements during the March-November period were vitamin C, magnesium, vitamin D, calcium, iron supplements and omega-3 fatty acids, followed by probiotics, zinc, selenium and vitamin B supplements, which is in accordance with results of PLifeCOVID-19 Online Studies [28]. Other supplements that overlap with the above study include herbal products like ginger tea, black seed oil (*Nigella sativa*) and bee products. Effective education of consumers in its rational use and health-protecting behaviors against COVID-19 should be developed and introduced at local and/or national levels.

Situation during 2020 has created a sense of uncertainty, stress and anxiety that might lead to unfavorable outcomes regarding the psychological health of students and indeed, they have been identified as a vulnerable group [29, 30]. This is confirmed by numerous studies [30, 31, 32]. Although study by Cao et al. [31] reported living in urban areas as a protective factor against anxiety, our study has shown that more adolescents from the city area felt more stressed compared to the period before the Covid-19, as well as female gender. It has been indicated that compared to adults, this pandemic may have long-term adverse consequences on children and adolescents [29].

Strengths, limitations, and future directions

To our knowledge, this is the first study conducted in B&H on eating habits, physical activity and the use of supplements in adolescents, in the entire period from the outbreak of the pandemic to the conclusion of the study in November. Most of the studies do not take into account BMI and weight change in currently published research, and this is one of the strengths of this research. The limitation of the study was that respondents were mostly females. Also, the presence of the COVID-19 infection in students was not reported. More clear and convincing studies need to clarify the role of dietary supplementation in the COVID-19 prevention and the existing risk of elevated intake of some nutrients due to increased use of dietary supplements. As the measures taken by the government affected physical and eating habits in adolescents, in the future more attention should be paid to measures in the same or similar situations. Also as the COVID-19 pandemic is ongoing, our data need to be more investigated in future with extensive population studies. These findings should be taken into consideration for future regulations incense disease is now again spreading in B&H with possible subsequent lockdowns and social distancing measures being enforced by the government.

Conclusion

Quarantine is an essential measure to protect public health and control the transmission of the virus, but this study shows the other side of the lockdown. The results of the study indicate that increased consumption of unhealthy types of food (sweets, sugary and soda drinks, snacks and fast food) affected weight gain in adolescents. Although BMI before the COVID-19 pandemic was slightly higher, this indicates that more attention should be paid to promote healthy eating practices, as this may prevent further weight gain. Positive outcome was recorded in consumption of vegetables, fruits, and nuts (by 15.9%, 27.9% and 16.2% respectively) and among 33.0% of participants who increased their physical activity. Since most participants feel more stressed than before the pandemic, governments should focus more on the psychological health of young adults during the lockdown and whole period of pandemic.

Abbreviations

COVID - 19: Coronavirus disease-2019

B&H: Bosnia and Herzegovina

BMI: body mass index

BW: body weight

WHO: World Health Organization

Declarations

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Authors' contributions

All authors conceptualized the study design and drafted the survey, oversaw the acquisition, analysis, and interpretation of data. At the end all authors read, reviewed, and approved the final version of the manuscript. AK drafted the initial draft of the manuscript. NĆ conducted the data analysis, populated data tables and created figures. AJ summarized qualitative responses using content analysis and drafted related results.

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Availability of data and materials

For all additional data and materials, the corresponding author needs to be contacted. .

Ethics approval and consent to participate

Participants passively consented to participate when they agreed to complete the survey.

Consent for publication

Not applicable.

Competing interests

Any of the authors have no conflicts of interest to declare.

References

1. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. 2021. Available online at: https://covid19.who.int/. Accessed 15 Mar, 2021.

2. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. Br J Sports Med. 2011; 8(1), 1-9. http://dx.doi.org/10.1136/bjsports-2011-090185.
3. Nieman DC, Wentz LM. The compelling link between physical activity and the body's defense system.J Sport Health Sci. 2019; 8(3), 201-217. https://doi.org/10.1016/j.jshs.2018.09.009.
4. Jordan RE, Adab P, Cheng KK. Covid-19: risk factors for severe disease and death. BMJ. 2020. https://doi.org/10.1136/bmj.m1198.
5. UNESCO. Covid-19 Impact on Education. 2020. Available online at: https://en.unesco.org/covid19/educationresponse. Accessed 17 Dec, 2020.
6. Guan H, Okely AD, Aguilar-Farias N,et al. Promoting healthy movement behaviours among children during the COVID-19 pandemic.Lancet Child Adolesc Health.2020; A, 416-418. https://doi.org/10.1016/S2352-4642(20)30131-0.
7. Honorato E, das Neves ALM, de Morais Pontes MTC et al. Waves of Mental Health Demands During the COVID-19 Pandemic.Res Soc Dev. 2020; 9(8), e767986204-e767986204. doi: 10.20944/preprints202005.0255.v1.
8. Moynihan AB, Van Tilburg WA, Igou ER et al. Eaten up by boredom: Consuming food to escape awareness of the bored self. Front Psychol. 2015; 27(2), 275-292. https://doi.org/10.3389/fpsyg.2015.00369.
9. Panahi S, Tremblay A. Sedentariness and health: is sedentary behavior more than just physical inactivity? Front Public Health. 2018; 6, 258. https://doi.org/10.3389/fpubh.2018.00258.
10. Mason TB, Barrington-Trimis J, Leventhal AM. Eating to Cope With the COVID-19 Pandemic and Body Weight Change in Young Adults. J Adolesc Health. 2021; 68(2), 277-283. https://doi.org/10.1016/j.jadohealth.2020.11.011.
11. Field A. Discovering statistics using SPSS: (and sex and drugs and rock n roll) (ed.). London, Royaume-Uni: Sage. 2009.
12. World Health Organization. Body mass index - BMI. 2020. Available online at: https://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi. Accessed 11 Dec, 2020.
13. World Health Organization. Guideline: implementing effective actions for improving adolescent nutrition. Geneva: World Health Organization. 2018. Available online at: https://apps.who.int/iris/bitstream/handle/10665/260297/9789241513708-eng.pdf;jsessionid=4D5C684A466B656. Accessed 16 Dec, 2020.
14. Sprang G, Silman M. Posttraumatic stress disorder in parents and youth after health-related disasters.Disaster Med Public Health Prep.2013; 7(1), 105-110.
15. Medrano M, Cadenas-Sanchez C, Oses M et al. Changes in lifestyle behaviours during the COVID-19 confinement in Spanish children: A longitudinal analysis from the MUGI project. Pediatr Obes. 2020; 16(4), e12731. https://doi.org/10.1111/ijpo.12731.
16. Huber BC, Steffen J, Schlichtiger J, Brunner, S. Altered nutrition behavior during COVID-19 pandemic lockdown in young adults. Eur J Nutr. 2020; 1-10.

17. Di Renzo L, Gualtieri P, Pivari F et al. (2020). Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. J Trans Med. 2020; 18, 1-15.
18. Ruiz-Roso MB, de Carvalho Padilha P, Mantilla-Escalante DC, et al. Covid-19 Confinement and Changes of Adolescent's Dietary Trends in Italy, Spain, Chile, Colombia and Brazil. Nutrients. 2020; 12(6), 1807. doi:10.3390/nu12061807.
19. Liu X, Li Y, Guasch-Ferré M et al. Changes in nut consumption influence long-term weight change in US men and women. BMJ NPH. 2019; 2(2), 90. doi: 10.1136/bmjnph-2019-000034.
20. Jayawardena R, Sooriyaarachchi P, Chourdakis M et al. Enhancing immunity in viral infections, with special emphasis on COVID-19: A review. Diabetes Metab Syndr. 2020; 14, 367-382. https://doi.org/10.1016/j.dsx.2020.04.015.
21. Pišot S, Milovanović I, Šimunič B et al. Maintaining everyday life praxis in the time of COVID-19 pandemic measures (ELP-COVID-19 survey). Eur J Public Health. 2020; 30(6), 1181-1186. https://doi.org/10.1093/eurpub/ckaa157.
22. Kim HS, Jiyoung PA, Yumi MA et al. What are the barriers at home and school to healthy eating?: Overweight/obese child and parent perspectives. J Nurs Res. 2019; 27(5), e48. doi: 10.1097/jnr.0000000000000321.
23. Rubin R. Does Skipping Breakfast Lead to Weight Loss or Weight Gain? JAMA. 2019; *321*(19), 1857-1858. doi:10.1001/jama.2019.2927.
24. Sidor A, Rzymski P. Dietary choices and habits during COVID-19 lockdown: experience from Poland. Nutrients. 2020; 12(6), 1657. https://doi.org/10.3390/nu12061657.
25. Moore SA, Faulkner G, Rhodes RE et al. Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey. Int J Behav Nutr Phys Act. 2020; 17(1), 1-11. https://doi.org/10.1186/s12966-020-00987-8.
26. Alyami HS, Orabi MAA, Aldhabbah FM et al. Knowledge about COVID-19 and beliefs about and use of herbal products during the COVID-19 pandemic: A cross-sectional study in Saudi Arabia. Saudi Pharm. J. 2020; 28(11), 1326-1332. doi: 10.1016/j.jsps.2020.08.023.
27. Sekhri K, Kaur K. Public knowledge, use and attitude toward multivitamin supplementation: A cross-sectional study among general public. Int J Appl Basic Med Res. 2014; 4(2), 77. doi: 10.4103/2229-516X.136780.
28. Hamulka J, Jeruszka-Bielak M, Górnicka M et al. Dietary Supplements during COVID-19 Outbreak. Results of Google Trends Analysis Supported by PLifeCOVID-19 Online Studies. Nutrients. 2021; 13, 54. https://doi.org/10.3390/nu13010054.
29. Singh S, Roy MD, Sinha CPTMK et al. Impact of COVID-19 and lockdown on mental health of children and adolescents: A narrative review with recommendations. Psychiatry Res. 2020; 293, 113429. https://doi.org/10.1016/j.psychres.2020.113429.
30. Bourion-Bédès S, Tarquinio C, Batt M, Tarquinio P, Lebreuilly R, Sorsana C, Legrand K, Rousseau H, Baumann C. Psychological impact of the COVID-19 outbreak on students in a French region severely affected by the disease: results of the PIMS-CoV 19 study. Psychiatry Res. 2021;

https://doi.org/10.1016/j.psychres.2020.113559Kaparounaki CK, Patsali ME, Mousa DP, Papadopoulou EV, Papadopoulou KK, Fountoulakis KN. University students' mental health amidst the COVID-19 quarantine in Greece. Psychiatry Res. 2020; *295*, 113559. https://doi.org/10.1016/j.psychres.2020.11311.

31. Cao W, Fang Z, Hou G, Han M, Xu X, Dong J, Zheng J. The psychological impact of the COVID-19 epidemic on college students in China. Psychiatry Res. 2020; 287, 112934. https://doi.org/10.1016/j.psychres.2020.112934
32. Kaparounaki CK, Patsali ME, Mousa DP et al. University students' mental health amidst the COVID-19 quarantine in Greece. Psychiatry Res. 2020; 290, 13111. https://doi.org/10.1016/j.psychres.2020.113111.

Figures

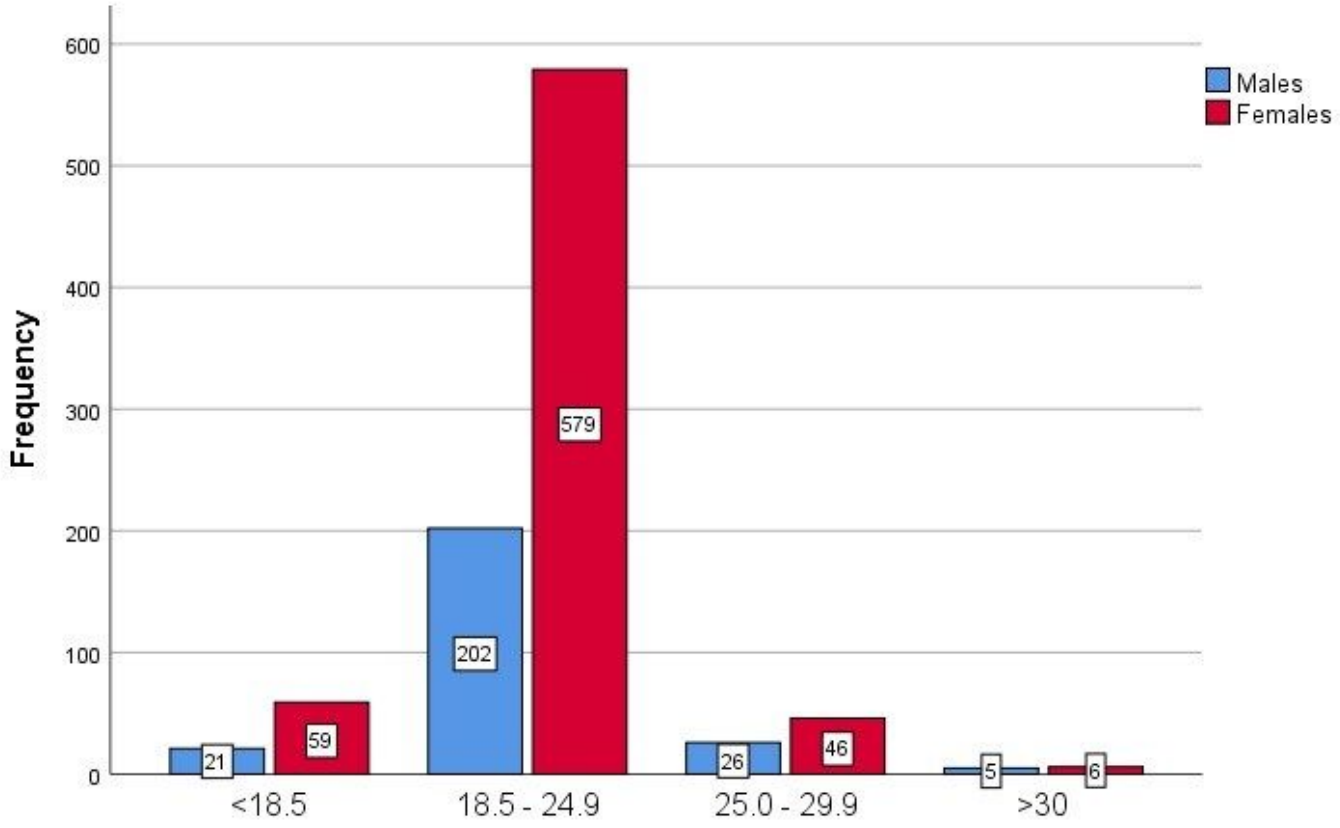
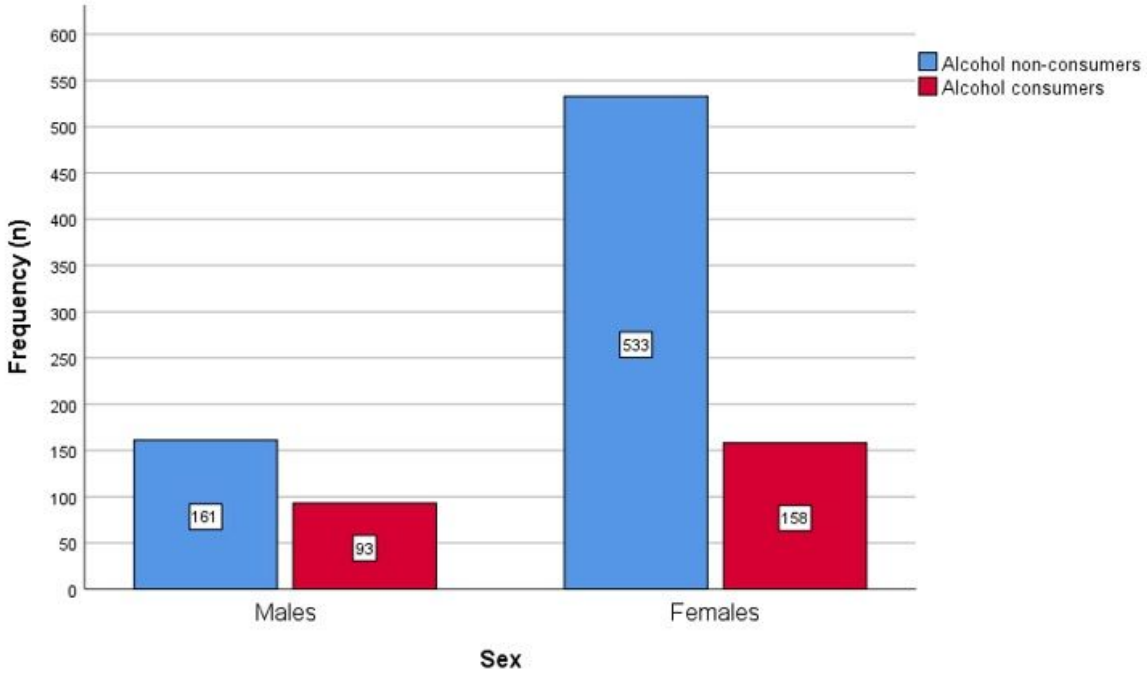


Figure 1

Males and females BMI classification at the time of completing the survey.



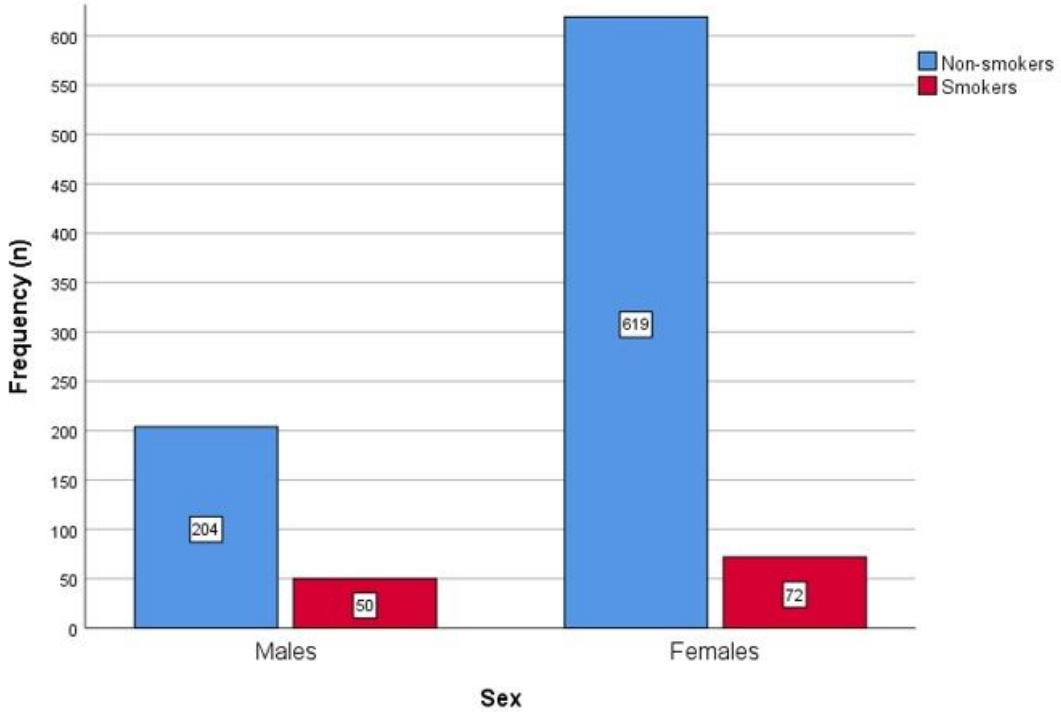


Figure 2

Alcohol and cigarette consumption between males and females

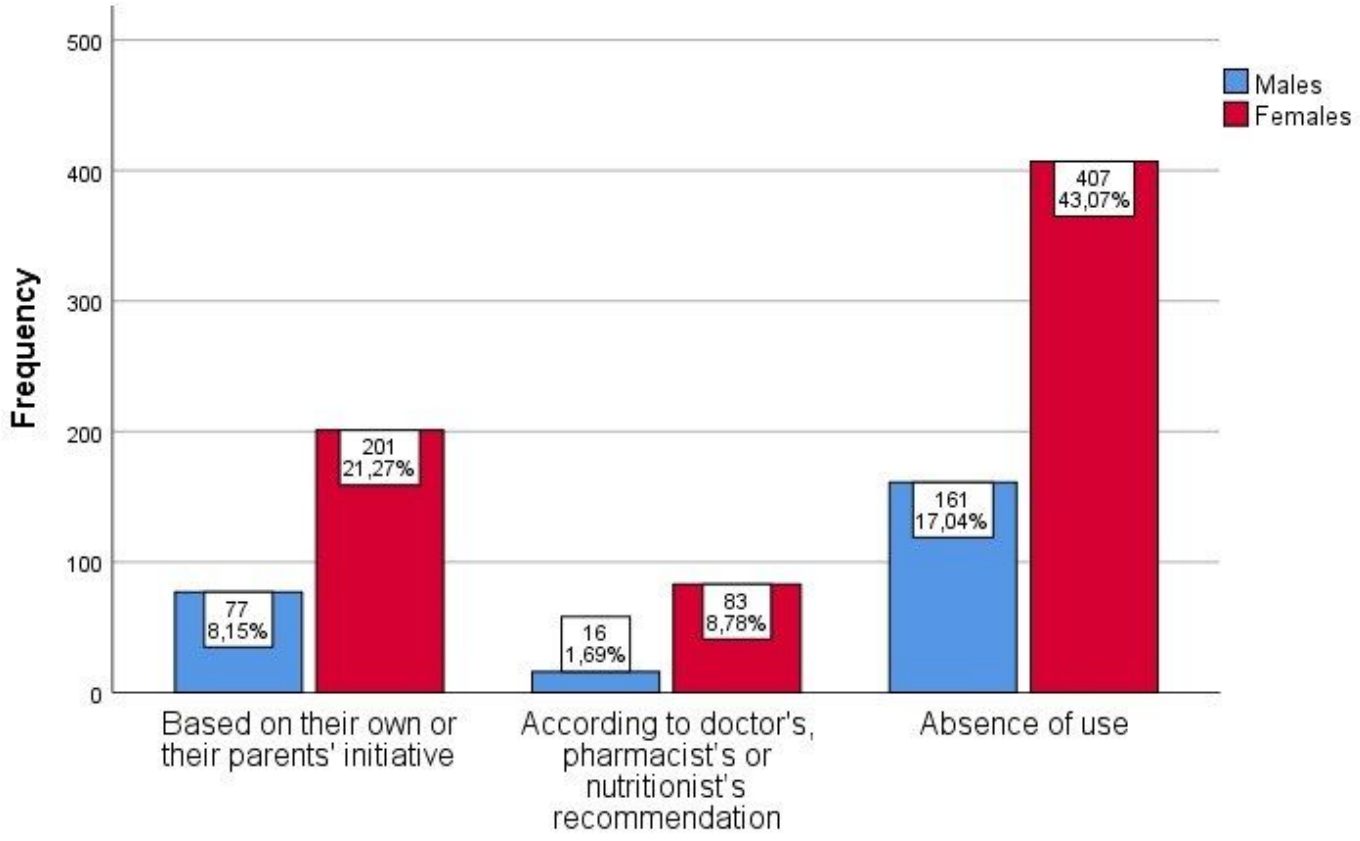


Figure 3

Supplement use between males and females