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The influence of face masks use, immunity boosters and visiting risky places on mental health during the COVID-19 pandemic in Serbia and Republic of Srpska (Bosnia and Herzegovina)

Bojan Joksimovic[1], Jelena Dotlic[2,3], Marija Milic[4,5], Milan Kulic[1], Dejan Bokonjic[1], Sinisa Ristic[1], Jasmina Stevanovic[4], Zorica Stanojevic Ristic[6], Dragoslav Lazic[7], Jelena Filimonovic[4], Vojkan Nestorovic[8], Milan Dimitrijevic[9], Milica Cakic[2], Dajana Nogo-Zivanovic[1] and Tatjana Gazibara[10*]

Abstract

Background Because of the COVID-19 pandemic, people were recommended to implement new health behaviors into their daily routines to prevent the viral spread. The aim of this study was to investigate whether specific health behaviors, such as wearing face masks, taking immunity boosters and visiting risky places were associated with a higher level of stress due to COVID-19 in the general adult population.

Method This cross-sectional study was conducted from September 1, 2020 to October 1, 2021 in eight randomly chosen cities of two Serbian speaking countries (Republic of Serbia and Republic of Srpska - Bosnia and Herzegovina). Participants filled a socio-epidemiologic questionnaire, COVID Stress Scales (CSS) and the Perceived Stress Scale (PSS).

Results The study included 2,301 participants with an average age of 36.72 ± 13.82 years of whom 54.9% were female ($p = 0.001$). Most participants were healthy, highly educated, employed, married, non-smokers and consumed alcohol. The mean total CSS score was 32.7 ± 23.8 out of 144, suggesting a relatively low stress due to COVID-19. The mean PSS was 19.43 ± 5.05 out of 40 indicating slightly increased level of general stress. Participants who reported higher CSS scores were more likely to wear face masks, use immunity boosters, go to cafes and clubs, have chronic illnesses, have suspicious, but not proven contact with COVID-19 positive people, and use multiple sources of information about COVID-19.

Conclusion Few participants experienced high levels of stress due to COVID-19. People who used face masks, immunity boosters and visited risky places reported a higher level of stress during the pandemic.

Keywords COVID-19, Stress response, Health behaviors, Face masks, Immunity boosters, Social distancing

*Correspondence:
Tatjana Gazibara
tatjana.gazibara@med.bg.ac.rs; tatjanagazibara@yahoo.com

Full list of author information is available at the end of the article

Background

Since the beginning of the COVID-19 pandemic, people were asked to adopt specific preventive measures, such as limiting social contact and keeping physical distance at all times, avoiding visits to risky places i.e. places where there is a high level of social contact (cafes, restaurants, clubs, concerts, etc.), wearing protective face masks and maintaining hygiene (regular hand washing and disinfection) to lessen the risk of COVID-19 exposure. However, because of these recommendations and rules, many people were compelled to spend a lot of time on their own. This global social isolation has had a negative impact on people's mental health [1].

Psychological distress was grounded in the fear of caching the virus, not being able to receive treatment due to overcrowding in hospitals, high mortality, and uncertainty about the effectiveness of the vaccines. Additional stressors included financial losses, disruptions of daily routine, inability to participate in social activities and infodemic [2, 3]. This rise in stress levels during the COVID-19 pandemic has led to a global increase in depressive and anxiety disorders (27.6% and 25.6%, respectively) compared to the pre-pandemic period [4]. Empirical evidence suggests that in the first year of the COVID-19 pandemic 29.6–57% adults experienced symptoms of mental distress. Moreover, the prevalence of depression in the general population was estimated at 20–58% and that of anxiety at 32–51% [5, 6].

Before the COVID-19 pandemic, the term "health behavior" comprised healthy eating, physical exercise, regular sleep or avoidance of addictive substances. However, after the onset of the COVID-19, a new set of health behaviors was introduced [7], as they had a major role in prevention and propagation of the viral spread. These new behaviors included wearing facemasks, avoiding attendance of risky places and intake of immunity boosters.

Use of facemasks was essential as it represented a mechanical barrier to the portal of viral entry. But, social contact, especially in indoor spaces with a high density of people, favored viral transmission via droplet spread, so protection of nasal mucosa and avoiding close communication with others was critical in efforts to prevent the exposure [8]. Wearing masks has been associated with more perceived health benefits [9]. Still, they may have hindered comprehension of verbal and facial expressions or caused breathing difficulties and excessive sweating around the lips [10, 11].

Further, use of face masks was observed among adults who had higher levels of anxiety about COVID-19 because of fear of catching the infection [12]. Yet, use of face masks among adolescents was observed to lower the symptoms of anxiety due to COVID-19 [13]. Those who wore masks consistently were also more likely to practice social distancing [14]. However, people who worked in restaurant business and hospitality industry were burdened by, among other issues, stress of catching COVID-19 as those were the places with high level of viral transmission [15, 16]. Thus, expectedly, frequenting bars and restaurants could have caused visitors to worry about potential exposure to the virus.

Dietary supplements have been discussed in literature to be beneficial in prevention and treatment of COVID-19 [17, 18] because they show immunity boosting properties. Intake of dietary supplements, such as herbal extracts, vitamins and minerals, was observed in different populations as a means to decrease the risk of contracting COVID-19 [19]. Still, association between dietary supplements as immunity boosters and stress due to COVID-19 remains inconsistent. For example, in Brazil, people aged 18 to 60 years who used dietary supplements reported lower levels of fear from COVID-19 [20]. However, in Greece, both among young adults [21] and older people [22] those who had higher levels of COVID-19-associated anxiety were more likely to take dietary supplements.

Bearing in mind inconsistent data in the available body of literature about major health behaviors related to prevention of COVID-19 in the population, further exploration of face masks use, visiting risky places of intense social contact and intake of immunity boosters is in place because they can help health care workers, policy makers and researchers define specific recommendations in future health crises. The purpose of this study was to investigate whether wearing face masks, taking immunity boosters and visiting risky places were associated with a higher COVID-19-related stress in the general adult population.

Materials and methods

Study settings

The cross-sectional study was conducted over a one-year period (September 2020 to October 2021) in eight randomly selected cities of the Republic of Serbia and Republic of Srpska (Bosnia and Herzegovina), two regions/countries where Serbian language is spoken.

On separate sheets of paper, we printed the names of all the official administrative cities in both regions/countries (29 in Serbia and 6 in Republic of Srpska, Bosnia and Herzegovina), and we placed them in a non-transparent container. After selecting the number 4 from a table of random numbers, one person from the research team read the name of the city written on every fourth piece of paper that was drawn from the container. The chosen city was included in the study. To remedy the disparity in city sizes, we opted to distribute the questionnaires only in one randomly chosen municipality per selected city, because smaller towns had just one, while larger cities

had many municipalities. We printed the names of every municipality on different pieces of paper and made random selection of paper with municipality names in the same way the names of the cities were drawn.

Selection of study participants

People who came to the chosen municipality office headquarters for civil administration affairs (taxation, legal counseling, and certificate issuance) were invited to participate in the study. In Serbia and Republic of Srpska–Bosnia and Herzegovina, are still mostly done in person, while on-line administration has been developing as of recently. Therefore, almost all citizens have had to visit their municipality office at least once in their life. This approach enabled us to select random participants with diverse socio-demographic features.

The inclusion criteria were: being ≥ 18 years and speaking Serbian language fluently. The exclusion criteria were: reporting psychiatric disorders previously diagnosed by a physician (F-coded diagnoses of the International Classification of Diseases 10th revision) and providing less than 90% of answers.

We approached 2,907 people out of which we had to exclude 38 individuals due to confirmed psychiatric disorders, 154 due to not fulfilling 90% of the questionnaire, while 414 refused participation. The response rate was 85.7%.

Data collection

Socio-demographic data, lifestyle and health behaviors, information on knowing or interacting with COVID-19 positive people, obtaining COVID-19 information, and brief medical history information were collected using a paper-and-pen questionnaire Participants were asked whether they used protective gear (face masks) and when (all the time outside, only indoors, only in crowded spaces, never), whether they used immunity boosters (defined as natural/herbal remedies or medical supplements– pharmaceutically prepared vitamins and/or minerals) and whether they visited places that are known for an increased risk of COVID-19 transmission i.e. the following risky places: cafes, restaurants, night clubs, gyms, pools and beauty salons.

The lockdown in Serbia and Republic of Srpska was instituted only once, from March to May 2020, after which less strict control measures were in place. For this reason, places where people get together were open to public, albeit from November 2020 to March 2021 the opening hours were reduced and public spaces had to close down at 5 pm. Wearing face masks was recommended at all times, but was never enforced. As a result, citizens of Serbia and Republic of Srpska were free to visit various public places during the study period and wear face masks based on their own judgment and perception of risk to catch COVID-19.

Additionally, this general questionnaire contained 15 items regarding the attitudes (AT) toward COVID-19. Responses to each item were graded on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The sum of the item grades, which ranged from 15 to 75, represented the total score. A lower AT score suggested more intense worry about COVID-19.

The COVID Stress Scales (CSS) survey was developed to evaluate stress due to COVID-19 [23]. The 36 items are classified into six clusters: danger (DAN), socio-economic consequences (SEC), xenophobia (XEN), contamination (CON), traumatic stress symptoms (TSS) and compulsive checking and reassurance seeking (CHE). The responses are graded ranges from 0 (never / not at all) to 4 (nearly always / extremely) and represent either frequency or intensity. The sum of the grades for each item in each of the six domains is used to calculate the domain scores. Finally, the domain scores are summed into one total CSS score. Higher scores on CSS suggest indicate greater levels of stress. The total CSS score ranges from 0 (low COVID-19-related distress) to 144 (severe COVID-19-related distress). This scale been translated to Serbian language and its psychometric properties showed good validity [24].

The Perceived Stress Scale (PSS) was used to evaluate general stress levels [25]. Through questions about psychological distress symptoms, as well as the perception of unpredictability, uncontrollability, and a sensation of overload, it provides information about the extent to which people see their life circumstances and situations as stressful. The PSS is made up of 10 items, with ratings ranging from 0 (never) to 4 (very often). To calculate the PSS scores, responses to the affirmative items (items 4, 5, 7, and 8) are reversed, and all item-level scores are subsequently added to one another. Greater levels of stress are identified through a higher PSS score. The PSS has been translated and psychometrically tested in the Serbian speaking population [26].

Statistical analyses

Distribution of the obtained data was assessed using the Kolmogorov-Smirnov test. Differences in observed characteristics were tested by Kruskal-Wallis χ^2 test. We used the Spearman's correlation to investigate relationships of the observed parameters. The multiple linear regression modeling was applied to assess factors associated with a higher total CSS score. First, the unadjusted model was tested where the total CSS score (continuous variable) was the dependent variable, and use of face masks, immunity boosters and visiting risky places were the independent variables. Next, the second model was adjusted for general stress (as measured by the PSS) and worry about

COVID-19 (as measured by the AT score). The third model was additionally adjusted for socio-demographics and COVID-19-related data. The full fourth model tested each risky place separately in addition to independent variables in the previous three models. The values of $p < 0.05$ were accepted as statistically significant. Analyses were performed using the SPSS statistical software for Windows version 22.0 (SPSS, Inc, Chicago, IL).

Results

This study analyzed data from 2,301 participants of whom 45.1% males and 54.9% females ($p = 0.001$). Study participants were overall healthy i.e. most of them had no chronic illnesses (63.9%). The average age of the participants was 36.7 years (age range 18 to 90 years, standard deviation 13.8). In the whole sample there were no significant differences in terms of relationship status categories (partnered, single, etc.) ($p = 0.091$). The average age of the participants was 36.7 ± 13.8 years (age range 18 to 90 years). There were no differences in terms of relationship status (partnered, single, etc.). Few study participants had primary education (5.2%), while a similar proportion of participants had secondary and university level of education. Most participants (66%) were employed throughout the COVID-19 pandemic. Study participants generally did not report having contact with COVID-19 positive people. Moreover, only 10.2% of participants have had COVID-19. Study participants received information about COVID-19 typically from non-medical sources (58.2% got information from media, internet, friends and family, etc.). Data describing study participants are presented in Tables 1 and 2.

Use of face masks and immunity boosters, visiting risky places and COVID stress

The study participants generally used face masks for protection against COVID-19 (92.7%), but mostly wore them indoors only (38.3%). Significantly more people used immunity boosters during the COVID-19 pandemic (57.8%) compared to those who did not. They mostly used dietary supplements (vitamins and minerals, 41%), while natural/herbal remedies were less frequently used (16.8%).

There were no significant differences in the proportions of people who visited (51.4%) and did not visit places where risk of COVID-19 spread was high ($\chi 2 = 1.836$; $p = 0.175$). Of all the places, study participants mostly visited cafes (50.1%) during the pandemic.

The average CSS total score was 32.7 ± 23.8 indicating a rather low level of stress due to COVID-19 among our study participants. Contrary, the mean perceived stress as measured by the PSS score was slightly above the average value (19.4 ± 5.0). Moreover, the mean AT score was somewhat above average (43.9 ± 10.8) suggesting a somewhat increased level of worry about COVID-19 (Table 2).

Correlations

Wearing face masks in general, correlated with being older and female, being in a relationship, being employed, having a higher level of education, having chronic illnesses, not having COVID-19 symptoms, COVID-19 personally nor in family, getting informed about COVID-19 from numerous sources, having lower AT and higher PSS and CSS scores. Wearing face masks at all times also correlated with being older, in relationship, employed, having chronic illnesses, not having confirmed or suspicious COVID-19 contact, having had COVID-19 and being informed about COVID-19 using multiple sources (Additional file 1).

Using immunity boosters during the COVID-19 pandemic correlated with being older and female, being in a relationship, having a higher level of education, having chronic illnesses, having confirmed or suspicious COVID-19 contact, having had COVID-19, being informed about COVID-19 from multiple sources, having lower AT and higher PSS and CSS scores (Supplementary Table S1).

Visiting places of high risk for COVID-19 spread was associated with being younger and male, not being in a relationship, not being employed, not having COVID-19 symptoms, COVID-19 personally nor in family and not having confirmed COVID-19 contact. Visiting different risky places was associated with a higher AT score and a lower CSS score (Supplementary Table S1).

Regression models

Significant models for the total CSS score based on health behaviors during the COVID-19 pandemic were obtained. When only health behaviors were examined in the unadjusted model, use of immunity boosters and wearing face masks were associated with a higher total CSS score ($r = 0.280$; adjusted r square = 0.377; $p = 0.001$).

When model was adjusted for AT and PSS scores, it can be seen that all the examined wearing face masks, use of immunity boosters and visiting risky places were associated with higher stress due to COVID-19. Also, having lower AT score, suggesting increased worry about COVID-19, and higher PSS scores, suggesting increased general stress, were associated with a higher level of stress due to COVID-19 ($r = 0.613$; adjusted r square = 0.573; $p = 0.001$).

After adjustment for sociodemographic characteristics, using immunity boosters, wearing face masks, and visiting risky places remained associated with higher levels of stress due to COVID-19. Additionally, having chronic illnesses, having had a suspicious, but not a confirmed contact with a COVID-19 positive person, being informed

Table 1 Characteristics of the sample according to the face masks use and visiting risky places

Parameters		Wearing masks n (%)		p	Visiting risky places n (%)		p	Total sample n (%)
		No (169, 7.3%)	Yes (2132, 92.7%)		No (1183, 51.4%)	Yes (1118, 48.6%)		
Sex	male	115 (68.0)	922 (43.2)	0.001	485 (41.0)	552 (49.4)	0.001	1037 (45.1)
	female	54 (32.0)	1210 (56.8)		698 (59.0)	566 (50.6)		1264 (54.9)
Age group	< 25	57 (33.7)	494 (23.2)	0.001	244 (20.6)	307 (27.5)	0.001	551 (23.9)
	25 to 50	89 (52.7)	1193 (56.0)		668 (56.5)	614 (55.0)		1282 (55.7)
	≥ 50	23 (13.6)	445 (20.8)		271 (22.9)	197 (17.5)		468 (20.3)
Being in a relationship	yes	114 (67.5)	1077 (50.5)	0.001	569 (48.0)	622 (55.6)	0.001	1191 (51.8)
	no	55 (32.5)	1055 (49.5)		614 (52.0)	496 (44.4)		1110 (48.2)
Education level	8 years	15 (8.9)	105 (5.0)	0.001	53 (4.5)	67 (6.0)	0.548	120 (5.2)
	12 years	103 (60.9)	1035(48.5)		591 (50.0)	547 (49.0)		1138 (49.5)
	more	51 (30.2)	992 (46.5)		539 (45.5)	504 (45.0)		1043 (45.3)
Currently employed	no	78 (46.1)	704 (33.0)	0.001	356 (30.1)	426 (38.1)	0.001	782 (34.0)
	yes	91 (53.9)	1428 (77.0)		827 (69.9)	692 (61.9)		1519 (66.0)
Money loss in pandemic	no	115 (68.0)	1630 (76.5)	0.014	928 (78.5)	817 (73.0)	0.003	1745 (75.8)
	yes	54 32.0)	502 (23.5)		255 (21.5)	301 (26.9)		556 (24.2)
Having chronic illnesses	no	125 (74.0)	1346 (63.1)	0.015	746 (63.0)	725 (64.8)	0.599	1471 (63.9)
	yes one	22 (13.0)	494 (23.3)		283 (24.0)	233 (20.8)		516 (22.4)
	yes > 1	22 (13.0)	292 (13.6)		154 (13.0)	160 (14.4)		314 (13.6)
Weight change in pandemic	loss	23 (13.6)	377 (17.7)	0.028	219 (18.5)	181 (16.2)	0.904	400 (17.4)
	same	86 (50.9)	1159 (54.4)		617 (52.1)	628 (56.2)		1245 (54.1)
	gain	60 (35.5)	596 (27.9)		347 (29.4)	309 (27.6)		656 (28.5)
Smoking cigarettes	no	80 (47.3)	1311 (61.5)	0.001	697 (58.9)	694 (62.0)	0.122	1391 (60.5)
	yes	89 (52.7)	821 (38.5)		486 (41.1)	424 (38.0)		910 (39.5)
Smoking in pandemic	less	9 (5.3)	148 (18.0)	0.113	87 (18.1)	70 (16.8)	0.736	157 (17.5)
	same	59 (34.9)	520 (63.3)		296 (61.5)	273 (65.5)		569 (63.4)
	more	19 (11.2)	153 (18.7)		98 (20.4)	74 (17.7)		172 (19.2)
Alcohol drinking	no	42 (24.8)	652 (30.6)	0.118	331 (28.0)	363 (32.5)	0.019	694 (30.2)
	yes	127 (75.2)	1480 (69.4)		852 (72.0)	755 (67.5)		1607 (69.8)
Alcohol in pandemic	less	41 (24.5)	624 (31.5)	0.028	302 (27.2)	363 (31.3)	0.001	665 (31.1)
	same	104 (62.5)	1163 (59.0)		668 (60.2)	599 (52.4)		1267 (59.2)
	more	22 (13.0)	187 (9.5)		139 (12.6)	70 (16.3)		209 (9.8)
Sleeping quality in pandemic	very bad	5 (2.9)	37 (1.7)	0.909	24 (2.0)	18 (1.6)	0.596	42 (1.8)
	bad	20 (11.8)	156 (7.3)		83 (7.0)	93 (8.3)		176 (7.6)
	average	49 (29.0)	800 (37.5)		450 (38.0)	399 (35.7)		849 (36.9)
	good	70 (41.4)	826 (38.7)		457 (38.6)	439 (39.3)		896 (38.9)
	very good	25 (14.8)	313 (14.8)		169 (14.4)	169 (15.1)		338 (14.7)
COVD-19 contact	no	65 (38.5)	786 (38.9)	0.475	415 (35.0)	436 (39.0)	0.001	851 (37.0)
	do not know	49 (29.0)	582 (27.3)		274 (23.2)	357 (31.9)		631 (27.4)
	yes	55 (32.5)	764 (35.8)		494 (41.8)	325 (29.1)		819 (35.6)
Suspicious COVID-19 contact	no	61 (36.0)	737 (34.6)	0.839	405 (34.2)	393 (35.2)	0.728	798 (34.7)
	do not know	53 (31.4)	706 (33.1)		394 (33.3)	365 (32.6)		759 (33.0)
	yes	55 (32.6)	689 (32.3)		384 (32.5)	360 (32.2)		744 (32.3)
COVID-19 in family	no	130 (77.0)	1401 (65.7)	0.003	745 (63.0)	786 (70.3)	0.001	1531 (66.5)
	yes	39 (23.0)	731 (34.3)		438 (37.0)	332 (29.7)		770 (33.5)
Having COVID-19	no	162 (95.5)	1905 (89.3)	0.007	1046 (88.4)	1021 (91.3)	0.021	2067 (89.8)
	yes	7 (4.5)	227 (10.7)		137 (11.6)	97 (8.7)		234 (10.2)
COVID-19 symptoms	no	121 (71.6)	1273 (59.7)	0.002	678 (57.3)	716 (64.0)	0.001	1394 (60.6)
	yes	48 (28.4)	859 (40.3)		505 (42.7)	402 (36.0)		907 (39.4)
Protective gear wearing	no	169 (100.0)	0 (0.0)	0.001	76 (6.4)	93 (8.3)	0.082	169 (7.3)
	yes	0 (0.0)	2132 (100.0)		1107 (936)	1025 (91.7)		2132 (92.7)

Table 1 (continued)

Parameters		Wearing masks n (%)		p	Visiting risky places n (%)		p	Total sample n (%)
		No (169, 7.3%)	Yes (2132, 92.7%)		No (1183, 51.4%)	Yes (1118, 48.6%)		
Visiting risky places	no	76 (45.0)	1107 (51.9)	0.082	1183 (100.0)	0 (0.0)	0.175	1183 (51.4)
	yes	93 (55.0)	1025 (48.1)		0 (0.0)	1118 (100.0)		1118 (48.6)
Taking immunity boosters use	no	117(69.2)	855 (40.1)	0.001	467 (39.5)	505 (45.2)	0.001	972 (42.2)
	natural	21 (12.4)	365 (17.1)		177 (15.0)	209 (18.7)		386 (16.8)
	pills	31 (18.4)	912 (42.8)		539 (45.5)	404 (36.1)		943 (41.0)
Information	no info at all	21 (12.4)	81 (3.8)	0.001	51 (4.3)	51 (4.6)	0.528	102 (4.4)
	other sources	102 (60.4)	1237 (58.0)		680 (57.5)	659 (58.9)		1339 (58.2)
	medical sources	6 (3.6)	64 (3.0)		44 (3.7)	26 (2.3)		70 (3.0)
	all sources	40 (23.6)	750 (35.2)		408 (34.5)	382 (34.2)		790 (34.3)
CSS category	< 100	165 (97.6)	2094 (98.2)	0.585	1164 (98.4)	1095 (97.9)	0.419	2259 (98.2)
	≥ 100	4 (2.4)	38 (1.8)		19 (1.6)	23 (2.1)		42 (1.8)

Legend: CSS - COVID Stress Scales

Table 2 The stress response of study participants according to the facemasks use and visiting risky places

Parameters	Wearing masks				Visiting risky places				Total sample	
	No		Yes		No		Yes			
	Med	IR	Med	IR	Med	IR	Med	IR	Med	IR
AT score	54.0	20.5	43.0	13.0	43.0	13.0	44.0	15.0	44.0	14.0
PSS score	19.0	5.0	19.0	6.0	19.0	6.0	19.0	6.0	19.0	6.0
Total CSS	18.0	28.5	28.0	29.0	27.0	27.0	28.0	31.0	28.0	28.0
DAN	6.0	9.0	10.0	7.8	10.0	7.0	10.0	7.0	10.0	7.0
SEC	1.0	6.0	2.0	6.0	2.0	6.0	2.0	6.0	2.0	6.0
XEN	2.0	6.5	5.0	10.0	5.0	10.0	5.0	10.0	5.0	10.0
CON	1.0	5.0	4.0	7.0	3.0	6.0	3.5	7.0	3.0	7.0
TSS	1.0	5.0	1.0	4.0	1.0	4.0	1.0	4.0	1.0	4.0
CHE	2.0	6.0	3.0	7.0	3.0	7.0	3.0	6.0	3.0	7.0
Age	30.0	20.0	35.0	22.0	27.0	22.0	33.0	20.3	35.0	21.5

Legend: AT-attitude, PSS-perceived stress scale, CSS-COVID Stress Scales, DAN-CSS domain of danger, SEC-CSS domain of socio-economic consequences, XEN-CSS domain of xenophobia, CON- CSS domain of contamination, TSS-CSS domain of traumatic stress symptoms, CHE-CSS domain of compulsive checking and reassurance seeking, Med-median and IR-interquartile range

about COVID-19 from multiple sources as well as a lower AT and a higher PSS score were associated with higher levels of stress due to COVID-19 ($r = 0.624$; adjusted r square = 0.583; $p = 0.001$).

The final model showed that out of all risky places for COVID-19 transmission, going to cafes and clubs was associated with higher levels of stress due to COVID-19 (Table 3).

Discussion

It has been well documented that levels of general stress, depression and anxiety have increased substantially during the COVID-19 pandemic compared to the pre-pandemic period. In fact, some authors suggest that the level of stress due to COVID-19 in the general population was close to that in the clinical samples [27]. This study reports that from late 2020 until late 2021 stress due to COVID-19 assessed by the CSS in Serbia and Republic of Srpska (Bosnia and Herzegovina) was low. However, general stress assessed by the PSS was slightly above average. The present study provides evidence that, in the general population, health behaviors such as wearing masks, visiting specific risky places (such as cafes and clubs) and intake of immunity boosters were independently associated with a higher stress level due to COVID-19.

Over the first epidemic wave in spring and summer 2020, there was a shortage of face masks for public use, because all face masks supplies were redirected towards the hospitals that were repurposed to accommodate people with severe COVID-19, while people who were tested positive, but had mild symptoms of COVID-19 were placed in halls for collective accommodation so as to not spread the virus in the population. The second pandemic wave hit in mid-autumn of 2020 and it was the period where most people died from COVID-19 in Serbia and Republic of Srpska (Bosnia and Herzegovina). At this time, face masks were available and recommended to be worn in all indoor spaces. Many shops, public

Table 3 A series of multiple linear regression models based on the: association of wearing masks and visiting risky places with a higher stress score using the COVID stress scales

Parameters	B	95% Confidence interval		*p*
		Lower limit	Upper limit	
Basic model				
Taking immunity boosters	4.28	3.24	5.31	0.001
Wearing masks	8.22	4.49	11.95	0.001
Visiting risky places	1.40	-0.54	3.35	0.158
Stress model				
AT score	-1.07	-1.14	-0.99	0.001
PSS score	1.05	0.89	1.21	0.001
Taking immunity boosters	1.25	0.38	2.13	0.005
Wearing masks	1.40	0.54	2.26	0.001
Visiting risky places	1.96	0.41	3.51	0.013
Social interactions model				
AT score	-1.02	-1.11	-0.94	0.001
PSS score	0.98	0.81	1.14	0.001
Taking immunity boosters	1.26	0.32	2.19	0.008
Wearing masks	1.34	0.47	2.20	0.002
Visiting risky places	1.58	0.02	3.14	0.047
Sex	-0.33	-1.94	1.27	0.680
Age	-0.03	-0.10	0.03	0.339
Being in a relationship	1.38	-0.42	3.18	0.133
Education level	-0.53	-1.93	0.87	0.458
Employment status	-1.37	-3.25	0.50	0.151
Having chronic illness	2.63	1.48	3.78	0.001
Having had COVID-19	-2.03	-4.75	0.68	0.142
Had verified COVID-19 contact	-1.53	-2.70	-0.35	0.011
Had suspicious COVID-19 contact	2.15	1.05	3.25	0.001
Family members had COVID-19	0.81	-1.00	2.63	0.381
No. of information sources	0.87	0.06	1.67	0.034
Full model				
AT score	-0.99	-1.08	-0.91	0.001
PSS score	0.99	0.82	1.15	0.001
Sex	-0.11	-1.75	1.53	0.893
Age	-0.07	-0.14	-0.01	0.036
Being in a relationship	0.50	-1.33	2.34	0.589
Education level	0.16	-1.25	1.57	0.824
Employment status	-1.49	-3.40	0.40	0.124
Having chronic illness	2.78	1.63	3.92	0.001
Having had COVID-19	-2.37	-5.07	0.33	0.086
Had verified COVID-19 contact	-1.09	-2.28	0.08	0.069
Had suspicious COVID-19 contact	2.71	1.60	3.82	0.001
Family members had COVID-19	1.08	-0.73	2.90	0.242
No. of information sources	1.01	0.20	1.81	0.014
Visiting cafes	-4.43	-6.41	-2.45	0.001
Visiting restaurants	-0.62	-2.52	1.26	0.517
Visiting clubs	3.02	0.12	5.92	0.041
Visiting gyms	-1.54	-3.91	0.83	0.203
Visiting pools	-0.46	-3.19	2.26	0.737
Visiting beauty salons	-1.60	-3.42	0.22	0.085
Taking immunity boosters	0.97	0.09	1.85	0.031
Wearing masks	1.40	0.47	2.34	0.003

Legend: AT - attitude, PSS-perceived stress scale, CI - confidence interval

institutions, and public transportation vehicles, were encouraging the use of face masks before entry, and many people indeed wore them, albeit not everyone.

It is likely that at this time the stress due to COVID-19 was at its highest, because many people were dying from COVID-19 from the end of 2020 until mid-2021, and there were intense daily media reports about the number of people who died. A qualitative study suggested that media reporting also contributed to mental health burden and increased stress among people in Serbia [28]. Overwhelmed by discouraging prospects of ending the pandemic, many wore face masks whenever they were in contact with other people and were afraid of social interactions, as use of face mask was found not to be the absolute protection against COVID-19 [29]. These circumstances may explain why people who wore masks in this study were more likely to report higher stress due to COVID-19, independently from general stress caused by other issues such as balance between work and taking care of family, potential financial losses, reduced social interaction with family and friends and overall uncertainty about the future.

At the end of 2020 when the second epidemic wave hit, there were recommendations to work online as much as it was possible in terms of logistics. At this time, the working hours of public spaces, such as cafes, restaurants and shops, were reduced to 5 pm to limit social contacts in effort to prevent the viral spread. This was mandated until the spring of 2021, after which the opening hours were extended to 8 pm. Following the introduction of COVID-19 vaccination certificates, only those people who had one were allowed to stay in bars and restaurants past 8 pm. It was well-known that the viral transmission most likely occurs in social settings, where many people stay close to each other indoors. For example, reopening of bars, clubs and restaurants in the Netherlands saw exponential increase in newly infected cases [30]. Because there was much emphasis on social contacts as a means to prevent and control COVID-19, people who were frequenting bars and clubs were aware that the likelihood of exposure to COVID-19 in these places was high.

Although bars and restaurants did reorganize to lower the risk of transmission by adding panels between tables, taking off face masks only when eating or drinking, having disinfectants readily available at every table, these practices varied from place to place [31]. Further, people were longing for social interactions after the restrictions on opening hours of bars were lifted, and were, perhaps, willing to take on this risk, because seeing friends, enjoying music, dance and food also boosted happiness. As viral spread was facilitated indoors where people meet and gather [30] and was being reported continuously in Serbian media, it was apparent that people who chose to

visit bars and clubs were at the same time aware of their conscious exposure to the virus, but decided to forgo the risk. Specifically, in bars and clubs, people talk to one another closely and are exposed to droplet spread which potentially contains the virus. Therefore, participants in this study were knowingly exposing themselves by visiting risky places, such as bars and clubs, and were possibly experiencing increased stress due to COVID-19.

Looking through the public health lens, there is a strong justification for interventions such as physical distancing of people, because it is an effective strategy for prevention of viral transmission by respiratory droplets [32]. Although stay-at-home orders are necessary to stop the viral spread, those measures can also contribute to the rise in poor psychological outcomes, such as symptoms of depression and anxiety, reduced social support and loneliness [33]. Despite behavioral changes introduced worldwide to lessen the risk for catching COVID-19, they were difficult to maintain long-term, especially after lockdowns [34]. As a result, the increase in COVID-19 attack rate after restrictions had been relaxed was expected. Still, consistent use of face masks could have mediated the exposures to virus.

Use of immunity boosters was associated with higher levels of stress due to COVID-19 in this study. Various dietary supplements have been shown to boost immunity and exhibit antiviral, antioxidant, and anti-inflammatory properties. This was discussed in Serbian popular media, so it is not surprising that evidence from Serbian pharmacies suggests an increase in consumption of vitamins C and D, but also magnesium, selenium, zinc and alpha lipoic acid [35]. A similar trend before and after pandemic was observed in other populations, where increase in the proportion of people who regularly used natural or herbal products rose from 7.3% before to the pandemic to close to 46% during the pandemic [36]. Use of immunity boosters throughout the COVID-19 pandemic suggested that the prevalence was as high as 83.1% in the general population [37]. Furthermore, beside vitamins and minerals, people in Serbia used medicinal plants as immunity boosters, such as garlic, ginger and chamomile during the COVID-19 pandemic [38]. This rise in dietary supplements consumption during the pandemic was grounded in the belief that these would help to boost immunity and build capacity to fight the virus. Bearing in mind that this survey was conducted over the period when the second and the third epidemic waves occurred in Serbia and Republic of Srpska (Bosnia and Herzegovina), many people were affected by COVID-19 and daily life was disrupted, people made effort to do their due diligence and influence as much as they possibly could to decrease the risk of developing the infection likely because they were afraid of having severe COVID-19.

There are some limitations that should be taken into account when analyzing our findings. Firstly, even though the linear regression models were adjusted for multiple covariates, we were unable to include all potential confounding factors, so residual confounding cannot be ruled out. Secondly, due to the cross-sectional design, it is impossible to tell whether the association is causal because we are unable to establish the temporal relationship between the examined variables. This means that reverse causality may be in place. Thirdly, since questionnaire data is inherently a subject to information bias, some pieces of information might not have been reported.

Practical recommendations

This research provides evidence that adults in the general population of Serbia and Republic of Srpska (Bosnia and Herzegovina) did not report high stress levels due to COVID-19 during the second and the third pandemic wave. However, use of face masks, immunity boosters and visiting bars and clubs were associated with a higher level of stress due to COVID-19. To help people better understand the widespread infection, it is necessary to clearly address modes of transmission and prevention. To effectively communicate essential information in health crises, it is important to use lay language in a calm manner, so that people can understand the risk associated with behaviors they choose to engage in. Structural efforts need to be made to mitigate panic, and promote conscious exercise of precaution.

In conclusion, few study participants experienced a high level of stress due to COVID-19. People in Serbia and Republic of Srpska (Bosnia and Herzegovina) who wore face masks, used immunity boosters, went to cafes and clubs which were known high risk places for COVID-19 transmission experienced higher levels of stress due to COVID-19. These findings can be used in future health crises involving respiratory infections to mitigate stress and foster positive approaches to prevention and control. Being knowledgeable on the matter could enhance resilience and mediate stress response. Psychological counseling for those in need should be organized to support public mental health.

Abbreviations

AT	Attitudes toward COVID-19 score
CHE	Compulsive checking and reassurance seeking subscale
CON	Contamination subscale
CSS	COVID Stress Scales
DAN	Danger subscale
PSS	Perceived Stress Scale
SEC	Socio-economic consequences subscale
TSS	Traumatic stress symptoms subscale and
XEN	Xenophobia subscale

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s41043-025-00833-2.

Supplementary Material 1

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Conceptualization: BJ, JD, MM, MK, DB, SR, JS, ZSR, DL, JSF, VN, MD, MC, DN-Z and TG; Methodology: BJ, JD, MM, MK, DB, SR, JS, ZSR, DL, JSF, VN, MD, MC, DN-Z and TG; Validation: BJ, JD, MM and TG. Formal Analysis: BJ, JD, MM, and TG; Investigation: BJ, JD, MM, MK, DB, SR, JS, ZSR, DL, JSF, VN, MD, MC, DN-Z and TG; Data Curation: BJ, JD, MM and TG; Writing– Original Draft preparation: BJ; Writing– Review & Editing: JD, MM, MK, DB, SR, JS, ZSR, DL, JSF, VN, MD, MC, DN-Z and TG; Visualization: BJ, JD, MM and TG; Supervision: JD, MM and TG; Project Administration MM.

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Data availability
The minimum dataset to replicate the study results is attached to this submission. The entire dataset underlying this study is available on a reasonable request to the corresponding author.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Ethics Committee of the University of Pristina temporarily settled in Kosovska Mitrovica (protocol code No. 2179). All participants signed informed consent before enrolment.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Faculty of Medicine Foča, Republic of Srpska, University of East Sarajevo, Istočno Sarajevo, Bosnia and Herzegovina
[2]Clinic for Obstetrics and Gynecology, University Clinical Center of Serbia, Beograd, Serbia
[3]Faculty of Medicine, University of Belgrade, Beograd, Serbia
[4]Department of Preventive Medicine, Faculty of Medicine, University of Pristina temporarily settled in Kosovska Mitrovica, Kosovska Mitrovica, Serbia
[5]Institute of Public Health of Serbia "Dr Milan Jovanovic Batut", Beograd, Serbia
[6]Department of Pharmacology, Faculty of Medicine, University of Pristina temporarily settled in Kosovska Mitrovica, Kosovska Mitrovica, Serbia
[7]Department of Dentistry, Faculty of Medicine, University of Pristina temporarily settled in Kosovska Mitrovica, Kosovska Mitrovica, Serbia
[8]Department of Physiology, Faculty of Medicine, University of Pristina temporarily settled in Kosovska Mitrovica, Kosovska Mitrovica, Serbia
[9]Clinic for Allergology and Immunology, University Clinical Center of Serbia, Beograd, Serbia
[10]Institute of Epidemiology, Faculty of Medicine, University of Belgrade, Visegradska 26A, Belgrade 11000, Serbia

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