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Sleep quality and patterns of young West Balkan adults during the third wave of COVID-19 pandemic: a cross-sectional study

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ABSTRACT

Objectives To evaluate the sleep patterns among young West Balkan adults during the third wave of the COVID-19 pandemic.

Design and setting Cross-sectional study conducted using an anonymous online questionnaire based on established sleep questionnaires Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI) (February–August 2021).

Participants Young adults of Bosnia and Herzegovina, Croatia and Serbia.

Results Of 1058 subjects, mean age was 28.19±9.29 years; majority were women (81.4%) and students (61.9%). Compared with before the pandemic, 528 subjects (49.9%) reported a change in sleeping patterns during the pandemic, with 47.3% subjects reporting sleeping less. Mean sleeping duration during the COVID-19 pandemic was 7.71±2.14 hours with median sleep latency of 20 (10.0–30.0) min. Only 91 (8.6%) subjects reported consuming sleeping medications. Of all, 574 (54.2%) subjects had ISI score >7, with majority (71.2%) having subthreshold insomnia, and 618 (58.4%) PSQI score ≥5, thus indicating poor sleep quality. Of 656 (62.0%) tested subjects, 464 (43.9%) were COVID-19 positive (both symptomatic and asymptomatic) who were 48.8%, next to women (70%), more likely to have insomnia symptoms; and 66.9% were more likely to have poor sleep quality. Subjects using sleep medication were 44 times, and subjects being positive to ISI 15.36 times more likely to have poor sleep quality. In contrast, being a student was a negative independent predictor for both insomnia symptoms and poor sleep quality, and mental labour and not working were negative independent predictors for insomnia symptoms.

Conclusions During the third wave of the pandemic, sleep patterns were impaired in about half of young West Balkan adults, with COVID-19-positive subjects and being women as positive independent predictors and being a student as negative independent predictor of impaired sleep pattern. Due to its importance in long-term health outcomes, sleep quality in young adults, especially COVID-19-positive ones, should be thoroughly assessed.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ International multicentric study with data on sleep quality and insomnia during the COVID-19 pandemic.
⇒ Use of a standardised questionnaire with high internal reliability.
⇒ Limited possibility to infer causality due to the cross-sectional study design.
⇒ Small sample size with a small sample of men and limited age groups.
⇒ A thorough psychiatric assessment is required to detect any pre-existing mental health problem, risk factors, social or economic difficulties that may be contributing to the development of sleep disturbances.

INTRODUCTION

Sleep health impacts both physical and mental health.[1] Chronic poor sleep quality is linked to an increased risk of diabetes, hypertension, stroke, obesity, dementia and other health complications which significantly reduce an individual's quality of life.[2] COVID-19, an infectious disease caused by the novel coronavirus (SARS-CoV-2) and labelled a worldwide pandemic as of March 2020,[3 4] has impacted sleep health on a global level.[5] It has been shown to impair sleep quality itself by causing breathing disorders or by altering structures in the central nervous system that control sleep–wake cycles, resulting in an abnormal sleep rhythm.[6] Besides the direct effect of the SARS-CoV-2 infection-related symptoms and complications,[7 8] various epidemiological measures implemented by countries all over the world in order to suppress virus transmission, to a considerable extent, have unintended consequences on individuals' well-being, especially in terms of mental health and sleep quality.[9 10] Those epidemiological measures include the closing

of public spaces, limiting movement of the population, curfews, suspension of public transportation, closing borders, mandatory quarantine for people returning to their home country, as well as temporary closures of non-essential services while limiting working hours of essential services such as grocery stores, restaurants and others.[11]

Epidemiological measures have been linked to sleep disturbances[12] and also to an increase in substance abuse as a form of coping mechanism which further affects sleep architecture, potentially exacerbating sleep pathologies and worsening daytime sleepiness.[13] Furthermore, individuals with pre-existing mental health conditions, such as depression and anxiety, may be at higher risk of worsened mental health which may lead to difficulty going to and maintaining sleep, daytime drowsiness and nightmares.[14]

It is therefore assumed that the COVID-19 pandemic-related disruption of routine daily life, as well as feelings of anxiety, fear, worry, depression and isolation, all pose a significant challenge to sleep[15 16] among healthcare professionals and the general population[17] regardless of gender.[18] As healthy sleep helps people cope with the side effects of the pandemic and save their physical and mental health, it plays an important role in the prevention of pandemic-related mental distress. So, the importance of healthy sleep in general, and especially in public health, during the pandemic cannot be overstated.[19]

Because of these facts and due to lack of data from the Western Balkan, we aimed to evaluate sleep patterns among the young West Balkan adults during the third wave of the COVID-19 pandemic.

METHODS
This observational cross-sectional study was conducted between 2 February and 11 August 2021, that is, during the third wave of the COVID-19 pandemic among young adults of Bosnia and Herzegovina, Republic of Croatia and Republic of Serbia using an anonymous online questionnaire. All respondents were informed about the study objectives, anonymity of the data given in the study, instructions on how to fill out the questionnaire and the online informed consent. Exclusion criteria were as follows: (1) those younger than 18 and older than 40 years, (2) not a resident of the three countries mentioned and (3) not able to complete the questionnaire.

Study instrument and data collection
An anonymous online questionnaire created using Google Forms was based on established sleep questionnaires—Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI)—and translated into Bosnian/Croatian/Serbian languages for residents of respective countries. It was distributed via various social media platforms, respecting the socio-epidemiological measures of each country during the COVID-19 pandemic.

The study questionnaire was divided into three sections, as follows: (1) demographic information which included gender, age, education, marital status, occupation, living environment, country of current residence and general SARS-CoV-2 profile (positivity and symptoms during the last 12 months); (2) ISI-based questions and COVID-19-related sleep disorders; and (3) PSQI-based questions and sleep-related questions regarding the period before the pandemic.

The ISI[20]-based questions included seven questions rated by a 5-point Likert scale (eg, 1=no problem; 5=very severe problem) which assessed sleep dissatisfaction, trouble with sleep onset, sleep maintenance, early morning waking, concern about sleeping problems, observation of sleep problems by others and potential usage of sleep medications. The total score ranging from 7 to 28 was interpreted as follows: no clinically significant insomnia (0–7); subthreshold insomnia (8–14); moderate clinical insomnia (15–21) and severe clinical insomnia (22–28). Cronbach's alpha coefficient of the ISI was 0.814 indicating a very good level of reliability.

The PSQI[21]-based questions consisted of 19-item standardised self-rated questions for evaluating subjective sleep quality over the previous month which are separated into seven component scores (each weighing equally from 0 to 3), each measuring several different aspects of sleep (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, usage of sleep medication and daytime dysfunction). The seven scores are added up to obtain an overall score ranging from 0 to 21, with lower scores indicating healthier sleep quality, and scores higher than 5 indicating poor sleep quality. Cronbach's alpha coefficient of the PSQI seven-component score was 0.714, indicating an acceptable level of reliability.

Statistical analysis
The collected data were analysed using the SPSS V.20.0. Data were summarised with categorical variables presented in frequencies and percentages and numerical variables by mean±SD if normally distributed or by median (25th, 75th percentile) if not normally distributed. The X^2 was used to investigate associations between different categorical variables, and the t-test or Mann-Whitney U test was used to evaluate differences in numerical variables across different groups. The Mann-Whitney U test also revealed age differences between different sleep quality patterns and insomnia. A binary logistic regression model was run in order to determine independent predictors associated with the development of insomnia and poor sleep quality associated with COVID-19.

RESULTS
In total, 1067 subjects completed the questionnaire and after excluding nine subjects who were not residents of the three countries that we focused on, the final sample consisted of 1058 subjects. Of all subjects, 405 (38.3%) were from Bosnia and Herzegovina, 372 (35.1%) subjects from Croatia and 281 (26.6%) subjects

Table 1 Demographic characteristics and COVID-19-related data of subjects based on Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI) score

	No clinically significant insomnia (ISI <7) N=484	Subthreshold and clinical insomnia (ISI >7) N=574	Good sleep quality (PSQI <5) N=440	Poor sleep quality (PSQI ≥5) N=618	Total
Gender					
Men	113 (23.3)	84 (14.6)	85 (19.3)	112 (18.1)	197 (100.0)
Women	371 (76.7)	490 (85.4)**	355 (80.7)	506 (81.9)	861 (100.0)
Education					
High school	96 (19.8)	134 (23.3)	88 (20.0)	142 (22.9)	230 (100.0)
Higher school	20 (4.1)	33 (5.8)	25 (5.6)	28 (4.5)	53 (100.0)
Faculty	368 (76.1)	407 (70.9)	327 (74.4)	448 (72.6)	775 (100.0)
Marital status					
Single	218 (45.0)	215 (37.4)	172 (39.0)	261 (42.2)	433 (100.0)
In a relationship	184 (38.0)	188 (32.7)	173 (39.3)	199 (32.2)	372 (100.0)
Married	76 (15.7)	163 (28.4)**	85 (19.3)	154 (24.9)*	239 (100.0)
Divorced	6 (1.3%)	8 (1.5%)	10 (2.4)	4 (0.7)	14 (100.0)
Occupation					
Not working	28 (5.7)	35 (6.1)	30 (6.8)	33 (5.3)	63 (100.0)
Student	322 (66.5)	333 (58.0)	283 (64.3)	372 (60.1)	655 (100.0)
Mental labourer	114 (23.5)	157 (27.3)	99 (22.5)	172 (27.8)	271 (100.0)
Manual labourer	20 (4.3)	49 (8.6)*	28 (6.4)	41 (6.8)	69 (100.0)
Living environment					
Urban	439 (90.7)	516 (89.9)	401 (91.1)	554 (89.6)	955 (100.0)
Rural	45 (9.3)	58 (10.1)	39 (8.9)	64 (10.4)	103 (100.0)
COVID-19-related info					
COVID-19 tested	288 (59.5)	368 (64.1)	165 (37.5)	491 (79.4)	656 (100.0)
COVID-19 positive	186 (38.4)	278 (48.4)*	102 (23.1)	362 (58.5)**	464 (100.0)
COVID-19 negative	298 (61.6)	296 (51.6)	338 (76.9)	256 (41.5)	594 (100.0)
COVID-19 symptoms	212 (43.8)	335 (58.4)	187 (42.5)	360 (58.2)	547 (100.0)

Data are presented as n (%) or mean±SD.
*P<0.05, **p<0.001.

from Serbia. Subjects were mostly women (861; 81.4%) and students (655; 61.9%). The mean age was 28.19±9.29 years (minimum–maximum range: 18–40 years). Of all subjects, 656 (62.0%) were tested for COVID-19 and out of them 464 (70.7%, that is, 43.9% from all subjects) were positive. Also, 547 (51.7%) of all subjects, and all subjects who tested positive (464, 100.0%) reported experiencing classic COVID-19 symptoms during the last 12 months. All demographic characteristics are presented in table 1.

Sleep patterns and perceptions

Of all subjects, 528 (49.9%), that is, almost 50% reported a change in their sleeping patterns during the COVID-19 pandemic compared with the period prior to the pandemic with 250 (47.3%) subjects reporting sleeping less, 219 (41.4%) sleeping more than before the pandemic and 59 (11.2%) sleeping the same quantity.

Only 91 (8.6%) subjects reported consuming some form of sleeping medication every day with 53 (58.2%) subjects using benzodiazepines, 17 (18.7%) subjects using natural remedies such as leaves of valerian, lavender, passionflower or glycine, 15 (16.6%) subjects using melatonin capsules and 6 (6.5%) subjects using sedative hypnotics such as zolpidem.

Demographic characteristics of subjects based on ISI and PSQI score are presented in table 1, and between COVID-19-positive and COVID-19-negative subjects are presented in table 2.

Insomnia severity

Of all subjects, 574 (54.2%) had a score of more than 7 on ISI questionnaire with 409 (38.6.%) subjects having subthreshold insomnia and 165 (15.6%) subjects having moderately severe insomnia (table 1). There were no

Table 2 Demographic characteristics of COVID-19-positive and COVID-19-negative subjects

	COVID-19 positive N=464	COVID-19 negative N=594
Gender		
Men	84 (18.1)	113 (19.0)
Women	380 (81.9)	481 (81.0)
ISI score	9.0±5.8	7.4±5.1
PSQI score	7.0±3.9	5.4±3.0
Education		
High school	114 (24.6)	116 (19.5)
Higher school	29 (6.3)	24 (4.0)
Faculty	321 (69.2)	454 (76.5)
Marital status		
Single	147 (31.7)	286 (48.1)
In a relationship	153 (33.0)	219 (36.9)
Married	159 (34.3)	80 (13.5)
Divorced	5 (1.0)	9 (1.0)
Occupation		
Not working	39 (8.4)	24 (4.0)
Student	226 (48.7)	429 (72.3)
Mental labourer	161 (34.7)	110 (18.5)
Manual labourer	38 (8.2)	31 (5.2)
Living environment		
Urban	422 (90.9)	533 (89.7)
Rural	42 (9.1)	61 (10.3)

Data are presented as n (%) or mean±SD.
ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index.

severe insomnia cases. The median duration of insomnia was 4 (2.0, 10.5) months. Married couples and those in a relationship were statistically (X^2=7.410, p=0.007) more likely to have subthreshold and clinical insomnia than those who were single and divorced.

Sleep problems reported by subjects with poor sleep quality in the past month and sleep patterns reported by a partner/roommate in the past month among subjects with poor sleep quality are presented in table 3. Of all subjects, 545 (51.5%) reported that their sleep problem is interfering with their daily functioning and 457 (43.2%) reported having moderate to severe problems maintaining sleep. Subjects with insomnia were significantly younger (24 (22–27) vs 25 (22–35) years, U=124 716.5, p=0.003) compared with those without insomnia. This however was not confirmed by binary logistic regression analysis.

When assessing COVID-19 positivity and insomnia, individuals who tested positive (ISI 9.07±5.8) had significantly higher mean ISI score (t(1058)=4.682, p<0.001) compared with COVID-19-negative subjects (ISI 7.47±5.16). Those who tested positive were significantly

(X^2=11.923, p=0.001) and almost 50% more likely to have problems with insomnia (OR=1.488, 95% CI 1.153 to 1.920, p=0.002) compared with subjects who tested negative. All independent predictors of ISI positive cases, that is, development of insomnia, identified by binary logistic regression, are presented in table 4. Other independent predictors of ISI positive cases including being women and occupation (being a student, mental labourer and not working) were identified by binary logistic regression (table 4).

Sleep quality

Of all subjects, 618 (58.4%) had a score of ≥5 in the PSQI, thus indicating poor sleep quality. The mean sleep duration during the COVID-19 pandemic was 7.71±2.14 (minimum–maximum range: 1–13) hours with a median sleep latency of 20 min (10.0, 30.0). Subjects with poor sleep quality were significantly older (25 (23–36) vs 24 (22–26) years; U=63 409.0; p<0.001) compared with those with good sleep quality. This however was not confirmed by binary logistic regression analysis.

When assessing COVID-19 positivity and sleep quality, individuals who tested positive (PSQI 7.03±3.9) had significantly higher mean PSQI score (t(1058)=6.492, p<0.001) compared with COVID-19-negative subjects (PSQI 5.41±3.08). Those who tested positive were significantly (X^2=24.197, p<0.001) and 67% more likely to have poor sleep quality (OR=1.669, 95% CI 1.143 to 2.437, p=0.008). Other independent predictors of PSQI positive cases including occupation (being a student), being positive on ISI and using sleep medication were identified by binary logistic regression (table 4).

DISCUSSION

To our knowledge, this is the first study investigating sleep patterns among young adults during the COVID-19 pandemic in West Balkan. Our findings indicate that more than half of subjects noticed a change in their sleep pattern during the COVID-19 pandemic compared with prior the pandemic, with sleeping less than before. Individuals who tested positive for COVID-19 were 48.8% more likely to have insomnia symptoms, and 66.9% more likely to have poor sleep quality, while being a student was a protective factor regarding both insomnia symptoms and poor sleep quality. Women were more likely to have insomnia symptoms, while individuals using sleep medication were 44 times and having insomnia were 15.36 times more likely to have poor sleep quality. Next to being a student, mental labour and not working were also protective factors regarding insomnia symptoms.

The effect of COVID-19 pandemic on sleep patterns has been confirmed by many studies.[5 6 14 22–24] Although studies were conducted among different geographical and ethnic societies, with people of different ages and occupations, the common conclusion was that the SARS-CoV-2 pandemic affects sleep quality by changing subjective sleep quality, sleep latency, sleep duration, habitual

Table 3 Sleep problems reported by subjects with poor sleep quality in the past month and sleep patterns reported by a partner/roommate in the past month among subjects with poor sleep quality

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
Sleep problems reported by subjects with poor sleep quality in the past month				
Cannot fall asleep within 30 min	119 (19.2%)	132 (21.3%)	172 (27.8%)	195 (31.7%)
Waking up in the middle of the night or early in the morning	125 (20.2%)	144 (23.3%)	165 (26.7%)	184 (29.8%)
Need to get up to use the bathroom	217 (35.1%)	131 (21.2%)	128 (20.7%)	142 (23.0%)
Cannot breathe comfortably	368 (59.5%)	123 (19.9%)	70 (11.3%)	57 (9.3%)
Cough or snore loudly	403 (65.2%)	98 (15.8%)	68 (11.0%)	49 (8.0%)
Feeling too cold	265 (42.9%)	157 (25.4%)	124 (20.0%)	72 (11.78%)
Feeling too hot	247 (39.9%)	155 (25.1%)	143 (23.1%)	73 (11.9%)
Nightmares	157 (25.4%)	201 (32.5%)	153 (24.7%)	107 (17.4%)
Experiencing pain	362 (58.6%)	122 (19.7%)	76 (12.3%)	58 (9.4%)
Sleep patterns reported by a partner/roommate in the past month among subjects with poor sleep quality				
Loud snoring	222 (57.4%)	57 (14.7%)	58 (14.9%)	50 (13.0%)
Long pauses between breaths while asleep	259 (66.9%)	46 (11.9%)	44 (11.4%)	38 (9.8%)
Leg twitches during sleep	172 (44.4%)	89 (22.9%)	67 (17.3%)	59 (15.4%)
Episodes of disorientation or confusion during sleep	249 (64.3%)	62 (16.0%)	36 (9.3%)	40 (10.4%)

Data are presented as n (%).

sleep efficiency, daytime dysfunction and by causing sleep disturbances and usage of sleeping medication.[6 13 22–24] Our study results were in line with the results of the study by Yuksel *et al* that was conducted across 59 countries and confirmed increased sleep disturbances during the COVID-19 pandemic, with their different distributions among different gender groups, age groups and marital status.[5]

Some studies also proposed an impact of SARS-CoV-2 on the central nervous system on wake–sleep cycle

Table 4 Independent predictors determined by binary logistic regression models in association with Insomnia Severity Index (ISI) positive cases and Pittsburgh Sleep Quality Index (PSQI) positive cases

Independent predictors	OR	95% CI	P value
Independent predictors for testing positive on ISI*			
COVID-19 positive	1.488	1.153 to 1.920	0.002
Gender (women vs men)	1.700	1.237 to 2.337	0.001
Occupation (student vs other)	0.421	0.243 to 0.731	0.002
Occupation (mental labour vs other)	0.552	0.309 to 0.985	0.044
Occupation (not working vs other)	0.480	0.232 to 0.995	0.048
The model was not statistically significant (X^2=8.175, p=0.147); it explained 4.6% (Nagelkerke R^2) and correctly classified 56.0% of cases.			
Independent predictors for testing positive on PSQI (poor sleep quality)†			
COVID-19 positive	1.669	1.143 to 2.437	0.008
Occupation (student vs other)	0.669	0.451 to 0.992	0.046
Being positive on ISI	15.359	10.587 to 22.281	<0.001
Using sleep medications	44.067	5.753 to 337.512	<0.001
The model was not statistically significant (X^2=4.700, p=0.696); it explained 50.6% (Nagelkerke R^2) and correctly classified 81.4% of cases.			

*ISI score being >7 points.
†PSQI score being ≥5.

leading to sleep disorders.[6] According to Perez-Carbonell *et al*, 70% of respondents had a change in their sleep pattern with difficulty falling or staying asleep, later bedtimes, the appearance of nightmares and getting sleepier than before the pandemic.[24] This could be associated with higher alcohol consumption during the COVID-19 pandemic as a coping mechanism for anxiety, depression and other mental health issues, which further worsens them and puts them in a certain vicious cycle.[13] Also, pandemic-related change in sleep pattern with sleeping less and falling asleep taking longer than before, as also shown in our study, can be attributed to fatigue and exhaustion caused by SARS-CoV-2 virus infection.[25] Furthermore, a Chinese study on sleep duration and sleep efficiency, which used the same sleep quality questionnaire, showed SARS-CoV-2 infection to be related to reduced sleep duration and sleep efficiency, as well as prevalent nightmares among medical workers who were on the first line in the fight against the coronavirus disease.[22] This phenomenon could be explained by several factors including an increase in anxiety and fear of bad outcome and death among the infected,[11] by confrontation with critically ill patients inside a healthcare institution where they seek treatment, as well as by constant media pressure with COVID-19-related news (death toll, severe cases and overcrowded health systems).[23]

According to our results, students, mental labourers and the unemployed had around 50% less chance to develop insomnia, while students, in addition, had 33% less chance of having poor sleep quality. This is likely due to the fact that students are, compared with mental labourers and the unemployed, younger individuals who typically develop mild forms of the disease, are more social and have fewer responsibilities in their lives.

In contrast, married couples and those in a relationship had more frequent insomnia and nightmares than singles and divorced people, which can be explained by poor relationship statuses caused by prolonged time spent together, social disintegration and closed space,[26] but also by the fact that nightmares and insomnia may have occurred to singles and divorced people but no one was there to record it and disclose it.

Although more than half of our subjects had a problem with subthreshold and clinical insomnia that interfered with their everyday functioning, only a small percentage of them indicated that they were taking sleeping medications as a result of it.

Although this is an international multicentric study that used a standardised questionnaire with high internal reliability, our study had numerous limitations. First, the cross-sectional research design restricted our ability to infer causality. Second, our study included limited number of participants and limited age groups. Also, only a small sample of men was included and this may have conditioned the results obtained in terms of gender. Third, the online sampling method confined the study to participants with internet access and particular social media accounts. Finally, a thorough psychiatric assessment is required to detect any pre-existing mental health problems, risk factors, social or economic difficulties that may be contributing to the development of sleep disturbances.

In perspective, as the effect of different strategies of combating the COVID-19 pandemic on population's well-being, including effects on mental health and thus on sleep, may likely differ, it would be important to understand which approach may be the best in terms of balancing the pandemic effects and effects of implemented epidemiological measures. For that, further prospective studies with a psychiatric interview to investigate timeline effect of COVID-19 and related epidemiological measures on an individual's well-being and sleep quality should be conducted.

CONCLUSION

Our data suggest that the COVID-19 pandemic generally negatively affects sleep patterns of the young West Balkan adults with individuals who tested positive for COVID-19 being significantly more likely to experience both insomnia symptoms and poor sleep quality, and women being significantly more likely to experience insomnia symptoms. Thus, more attention needs to be brought to sleep quality in young adults during the pandemic, especially those who are COVID-19 positive. More studies are needed to assess all factors that contribute to the development of sleep disorders during the COVID-19 pandemic and to identify preventive and protective measures.

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