

## Vaccination Attitudes and Impact of the Second COVID-19 Lockdown on Mood, Mental State, and Exercise Habits in Germany: A Cross-Sectional Study

Göbel H<sup>1\*#</sup>,  
Mayer D<sup>2#</sup>,  
Adamovic I<sup>3</sup>,  
Bloß H-B<sup>4</sup>,  
Demirović S<sup>6</sup>,  
Kühnlein P<sup>7</sup>,  
Mäffert R<sup>8</sup>,  
Raabe A<sup>5</sup>,  
Sterner M-G<sup>9</sup>,  
Zintl K<sup>10</sup>,  
Zühlke C<sup>11</sup> and  
Đogaš Z<sup>12</sup>

<sup>1</sup>Department of Gastroenterology, REGIOMED Klinikum, Prof.-Arneth-Str. 2b, D-96215 Lichtenfels, Germany

<sup>2</sup>Department of Gastroenterology, REGIOMED Klinikum, Ketschendorfer Strasse 33, D-96450 Coburg, Germany

<sup>3</sup>Department of Surgery, Klinikum am Bruderwald Bamberg, Buger Str. 80, D-96049 Bamberg, Germany

<sup>4</sup>Department of Neurosurgery, REGIOMED Klinikum, Prof.-Arneth-Str. 2b, D-96215 Lichtenfels, Germany

<sup>5</sup>Department of Nephrology, REGIOMED Klinikum, Ketschendorfer Strasse 33, D-96450 Coburg, Germany

<sup>6</sup>Department of Neuroscience, Sleep Medicine Center, University of Split School of Medicine, Soltanska 2, HR-21000 Split, Croatia

<sup>7</sup>Department of Neurology, REGIOMED Klinikum, Ketschendorfer Strasse 33, D-96450 Coburg, Germany

<sup>8</sup>Department of Internal Medicine, REGIOMED Klinikum, Seilersgründchen 8, D-96450 Neustadt, Germany

<sup>9</sup>Ärztegemeinschaft TauPunkt, Fregestraße 74, D-12159 Berlin, Germany

<sup>10</sup>Kardiologische Praxis, Lossaustraße 5, D-96450 Coburg, Germany

<sup>11</sup>Department of Neuroradiology, REGIOMED Klinikum, Prof.-Arneth-Str. 2b, D-96215 Lichtenfels, Germany

<sup>12</sup>Department of Neuroscience, Sleep Medicine Center, University of Split School of Medicine, Soltanska 2, HR-21000 Split, Croatia

<sup>1-5,7-11</sup>Postgraduate study program Evidence-based medicine, University of Split School of Medicine, Soltanska 2, HR-21000 Split, Croatia

### Article Information

**Article Type:** Research Article

**Journal Type:** Open Access

**Volume:** 1 Issue: 4

**Manuscript ID:** JCV-v1-1128

**Publisher:** Science World Publishing

**Received Date:** 24 Aug 2021

**Accepted Date:** 02 Sep 2021

**Published Date:** 07 Sep 2021

#### \*Corresponding Author:

**Holger Göbel,**

Department of Gastroenterology,  
REGIOMED Klinikum, Prof.-Arneth-Straße  
2b, D-96215 Lichtenfels, Germany,

Tel: +49 9571 12-2309;

E-mail: holger.goebel@regiomed-kliniken.de

#### Citation:

Göbel H, Mayer D (2021). Vaccination Attitudes and Impact of the Second COVID-19 Lockdown on Mood, Mental State, and Exercise Habits in Germany: A Cross-Sectional Study.

J Corona Virus. 1(4); 1-12

#### #Author Contributions:

Göbel H, and Mayer D these authors are equally contributed to these article..

**Copyright:** © 2021, Goebel H, *et al.*, This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 international License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

### ABSTRACT

**Background:** A recurring increase in incidence of COVID-19 infection in winter 2020 led to a reinforcement of restrictions with relevant psycho-social consequences.

**Objective:** The aim of the study was to investigate effects of the second lockdown on parameters of mood, mental state, exercise habits, and vaccine acceptance.

**Methods:** Between December 2020 and January 2021, a questionnaire was spread via e-mail/social media, containing questions in four categories: demographic data, health-related behavior, mental status, and attitudes towards vaccination. We included 719 participants

living in Germany, 445 (61.9%) females, median age 36 years (95% confidence interval [CI] 23–52).

**Results:** The mental state and mood worsened significantly during lockdown ( $p \leq 0.014$ ). Exercise workload per week decreased from 143 minutes (95% CI 130–155) before to 105 minutes (95% CI 90–120) during lockdown ( $p < 0.001$ ). Acceptance of vaccination (49.6%) was significantly higher in those often following restrictions, often feeling content, having pleasant mood, and rarely feeling angry or discouraged about the future or sad ( $p \leq 0.004$ ).

**Conclusions:** Parameters of mood, mental status and health-related activities were significantly impaired during the second lockdown. Willingness to be vaccinated was reported by around one half of respondents, positively associated with acceptance of restriction measures and pleasant moods.

**KEYWORDS:** COVID-19, exercise, lockdown, mental state, mood, vaccine hesitancy

### Highlights

1. The second COVID 19-lockdown in Germany was associated with an impairment of parameters of mood and mental status.
2. During the lockdown physical activity decreased significantly.
3. Out of the total sample, only around one half were willing to be vaccinated.
4. Those who accept restrictions and maintain a positive basic attitude show a greater willingness to be vaccinated.
5. A test period assumed being too short was most often reported as a reason for vaccine hesitancy.

Since its start in December 2019, the COVID-19 pandemic became a worldwide problem harming personal living conditions of large proportion of population to an unprecedented extent [14]. In many countries restrictive measures from closure of public institutions, cancellation of public events, wearing masks and social distancing, to quarantine or lockdown, were established to reduce infection rates. The first lockdown, which started in Germany in March 2020, was already associated with a large impact on everyday life including symptoms of psychological distress, changes of lifestyle, sleep habits and physical activities [1,4-6]. Anxiety and depression increased in the general population [31]. In May 2020, the World Health Organization warned of a negative influence on psychological health on a solid database [23]. Additionally, physical repercussions became obvious. Obese individuals significantly gained weight already in the first month after beginning of the lockdown, which was correlated with lower exercise, self-reported boredom, solitude, anxiety, depression, and enhanced consumption of unhealthy food [21].

After a relaxation of the measures during summer of 2020, a retightening was necessary throughout Europe in November 2020, due to a rapidly increasing COVID-19 incidence. It had to be assumed that the recurring lockdown was probably associated with an even higher psychological burden than the first lockdown, and its acceptance among the population seemed to decrease continuously the longer the restrictions lasted [10]. Furthermore, confusion and uncertainty have increased due to the occurrence of virus mutations in December 2020 [17]. On the other hand, the implementation of vaccination programmes in 2021 provided a chance for a return to normality. As vaccines are needed to reduce COVID-19-related morbidity and mortality, several research groups developed vaccine candidates as rapidly as possible [30,32]. Data about safety and efficacy of vaccines against COVID-19 is promising [22], but vaccine hesitancy still remains a relevant problem. A study from June 2020 showed differences in acceptance rates ranging from 89% in China to less than 55% in Russia [13]. In the majority of survey studies, the level of acceptance of COVID-19 vaccination was  $\geq 70\%$  with lower rates in several European countries (Italy 53.7%, Poland 56.3%, France 58.9%, Germany 68.4%) [25].

Therefore, we aimed to investigate factors influencing the willingness to get a COVID-19 vaccine in this population. Furthermore, we examined the impact of the second lockdown on mental state, mood, and exercise habits in a general German population during the second lockdown at the turn of the year 2020/2021.

### METHODS

#### Study design and data collection

The protocol of the study was approved by the Biomedical Research Ethics Committee at the University of Split School of Medicine (2181-198-03-04-20-0056). An online, self-reported questionnaire addressing demographic data, lifestyle, mood, and vaccination attitude, was distributed using the authors' contact lists via e-mail messages or social media platforms between 17<sup>th</sup> December 2020 and 18<sup>th</sup> January 2021. The questionnaire was based on a recently published, cross-sectional study evaluating the influence of lockdown on psychosocial aspects in a Croatian general population during the current COVID-19 pandemic [12]. Items concerning mental state and attitude towards vaccination were added to the questionnaire for these study purposes. A total of 719 respondents living in Germany during the second lockdown were included.

The questionnaire contained 48 questions divided into four categories: demographic data, health-related behavior (smoking, exercise, alcohol, media use), mood and mental status, and vaccination acceptance. Mood before and during lockdown was self-assessed on a Likert scale from 1 to 4 (1 - Not at all, 2 - Somewhat, 3 - Moderately, 4 - Very much so), and changes in mental state during compared to before lockdown were categorized as "Less", "Constant"

or “More”. “Pleasant moods” were composed of feeling calm, rested and content, whereas feeling angry, anxious, discouraged about the future and sad, were considered “Unpleasant moods.”

**Statistical analysis**

Data analysis was performed with MedCalc Statistical Software version 19.7.2 (MedCalc Software by Ostend, Belgium; 2021). Normality of distribution was tested with the Shapiro-Wilk test. Data are presented as median and interquartile range (IQR) or as mean and 95% confidence interval (CI). Wilcoxon test was used to evaluate differences between characteristics before and during lockdown. Differences between subgroups were evaluated using the chi-squared test, additionally, OR (odds ratio) with 95% CI

were calculated. Statistical significance was set at p-value less than 0.05.

**RESULTS AND DISCUSSION**

**Results**

Of 719 respondents, 61.9% were female, and 42.0% were academics. The median age was 36 years (IQR 23–52 years). Details of demographic data are listed in Table 1.

In the total cohort, all tested characteristics of mental state (memory, concentration, judgement) and of mood (pleasant mood, feeling calm, rested, content, anxious, angry, discouraged, sad) worsened significantly during lockdown ( $p \leq 0.014$ , Table 2).

**Table 1.** Demographic data of study respondents

	Total	Men	Women	p <sup>a</sup>
	N=719 (100%)	N=274 (38.1%)	N=445 (61.9%)	
<b>Age (median, IQR), years</b>	36 (23-52)	41 (24-57)	33 (22-47.75)	<b>p&lt;0.001</b>
Range (years)	18-81	18-75	18-81	
<b>Education (no, %)</b>	N=715 (100%)	N=272 (38.0%)	N=443 (62.0%)	
Elementary school	26 (3.6)	7 (2.6)	19 (4.3)	
Middle school	91 (12.7)	24 (8.8)	67 (15.1)	
High school	56 (7.8)	17 (6.3)	39 (8.8)	
College	241 (33.7)	86 (31.6)	155 (35.0)	
Bachelor degree	80 (11.2)	29 (10.7)	51 (11.5)	
Master degree	142 (19.9)	67 (24.6)	75 (16.9)	
PhD	79 (11.0)	42 (15.4)	37 (8.4)	
<i>Higher education<sup>b</sup></i>	301 (42.1)	138 (50.7)	163 (36.8)	<b>p&lt;0.001</b>

IQR - interquartile range <sup>a</sup>chi-square test <sup>b</sup>Higher education: academic degree

**Table 2.** Comparisons of the mental state, mood and exercise workload of respondents during vs. before the lockdown (less, constant or more).

		Total	p <sup>b</sup>	Gender			p <sup>c</sup>	Age (years) <sup>a</sup>			p <sup>c</sup>
				Men	Women	OR (95% CI)		<36	≥36	OR (95% CI)	
		N=719		N=274	N=445		N=345	N=370			
		-100%		-38.10%	-61.90%		-48.30%	-51.70%			
<b>Mental state</b>											
Memory			<b>p&lt;0.001</b>				n.s.			<b>p=0.035</b>	
	less	26.00%		22.30%	28.20%		29.90%	22.20%	0.67 (0.48-0.94)	<b>p=0.021</b>	
	constant	69.80%		72.10%	68.50%		65.20%	74.20%	1.53 (1.11-2.12)	<b>p=0.010</b>	
	more	4.20%		5.70%	3.40%		4.90%	3.60%		p=0.387	
Concentration			<b>p&lt;0.001</b>				<b>p=0.003</b>			<b>p&lt;0.001</b>	
	less	40.90%		32.80%	45.70%	1.72 (1.26-2.37)	<b>p&lt;0.001</b>	53.00%	29.20%	0.36 (0.27-0.50)	<b>p&lt;0.001</b>
	constant	53.50%		60.80%	49.10%	0.62 (0.46-0.85)	<b>p=0.003</b>	40.60%	66.10%	2.86 (2.10-3.88)	<b>p&lt;0.001</b>
	more	5.60%		6.40%	5.20%		p=0.491	6.40%	4.70%		p=0.337
Judgement			<b>p&lt;0.001</b>				n.s.				p=0.058
	less	21.60%		18.90%	23.20%		24.90%	18.10%			
	constant	67.40%		69.80%	66.00%		63.50%	71.40%			
	more	11.00%		11.30%	10.80%		11.60%	10.60%			
<b>Positive moods</b>											
Pleasant mood <sup>d</sup>			<b>p&lt;0.001</b>				p=0.081				n.s.
	less	67.50%		66.40%	68.10%		67.20%	67.80%			
	constant	11.40%		14.60%	9.40%		13.00%	10.00%			
	more	21.10%		19.00%	22.50%		19.70%	22.20%			
Calm			<b>p&lt;0.001</b>				p=0.073				<b>p=0.026</b>
	less	40.80%		40.50%	40.90%		36.20%	45.10%	1.45 (1.07-1.95)	<b>p=0.016</b>	
	constant	40.50%		44.50%	38.00%		45.50%	36.20%	0.68 (0.50-0.92)	<b>p=0.012</b>	
	more	18.80%		15.00%	21.10%		18.30%	18.60%			p=0.894
Rested			<b>p=0.014</b>				<b>p=0.007</b>				n.s.
	less	33.90%		31.40%	35.50%		p=0.257	32.20%	35.90%		
	constant	40.30%		47.40%	36.00%	0.62 (0.46-0.84)	<b>p=0.002</b>	40.60%	40.50%		

	more	25.70%		21.20%	28.50%	1.49 (1.04-2.12)	<b>p=0.028</b>	27.20%	23.50%		
Content			<b>p&lt;0.001</b>				<b>p=0.007</b>				n.s.
	less	52.30%		45.30%	56.60%	1.58 (1.17-2.14)	<b>p=0.003</b>	51.00%	53.80%		
	constant	34.60%		41.20%	30.60%	0.63 (0.46-0.86)	<b>p=0.003</b>	37.40%	32.20%		
	more	13.10%		13.50%	12.80%		p=0.788	11.60%	14.10%		
<b>Negative moods</b>											
Anxious			<b>p&lt;0.001</b>				<b>p=0.007</b>				n.s.
	less	16.00%		12.80%	18.00%		p=0.064	15.40%	16.50%		
	constant	41.70%		48.90%	37.30%	0.62 (0.46-0.84)	<b>p=0.002</b>	44.90%	38.90%		
	more	42.30%		38.30%	44.70%		p=0.092	39.70%	44.60%		
Angry			<b>p&lt;0.001</b>				<b>p=0.001</b>				<b>p=0.006</b>
	less	16.60%		13.10%	18.70%		p=0.053	14.20%	18.40%		p=0.131
	constant	37.80%		46.00%	32.80%	0.57 (0.42-0.78)	<b>p&lt;0.001</b>	44.10%	32.40%	0.61 (0.45-0.83)	<b>p=0.001</b>
	more	45.60%		40.90%	48.50%	1.36 (1.01-1.85)	<b>p=0.045</b>	41.70%	49.20%	1.35 (1.01-1.82)	<b>p=0.046</b>
Discouraged about future			<b>p&lt;0.001</b>				<b>p=0.022</b>				<b>p=0.017</b>
	less	12.50%		10.90%	13.50%		p=0.319	9.90%	14.60%		p=0.054
	constant	39.20%		45.60%	35.30%	0.65 (0.48-0.88)	<b>p=0.006</b>	44.30%	34.90%	0.67 (0.50-0.91)	<b>p=0.010</b>
	more	48.30%		43.40%	51.20%	1.37 (1.01-1.85)	<b>p=0.042</b>	45.80%	50.50%		p=0.205
Sad			<b>p&lt;0.001</b>				n.s.				<b>p=0.024</b>
	less	13.90%		11.70%	15.30%			10.40%	17.00%	1.76 (1.14-2.73)	<b>p=0.011</b>
	constant	39.20%		43.40%	36.60%			42.60%	36.20%		p=0.080
	more	46.90%		44.90%	48.10%			47.00%	46.80%		p=0.957
<b>Exercise workload</b>											
			<b>p&lt;0.001</b>				<b>p=0.004</b>				<b>p=0.001</b>
	less	40.00%		39.20%	40.40%		p=0.757	44.70%	36.10%	0.70 (0.51-0.95)	<b>p=0.023</b>
	constant	39.70%		46.20%	35.70%	0.65 (0.47-0.89)	<b>p=0.007</b>	32.00%	45.90%	1.81 (1.32-2.47)	<b>p&lt;0.001</b>
	more	20.40%		14.60%	23.90%	1.83 (1.22-2.76)	<b>p=0.004</b>	23.30%	17.90%		p=0.084

<sup>a</sup>Median Age = 36 years, <sup>b</sup>Wilcoxon test, <sup>c</sup>chi-square test, <sup>d</sup>Mood variables were defined on a 4-point Likert scale. "Pleasant mood" is composed of feeling calm, rested and content and inversed evaluation of feeling angry, anxious, discouraged about the future and sad, respectively. p<0.05 in bold, n.s. - non significant, OR - Odds ratio, CI - Confidence interval

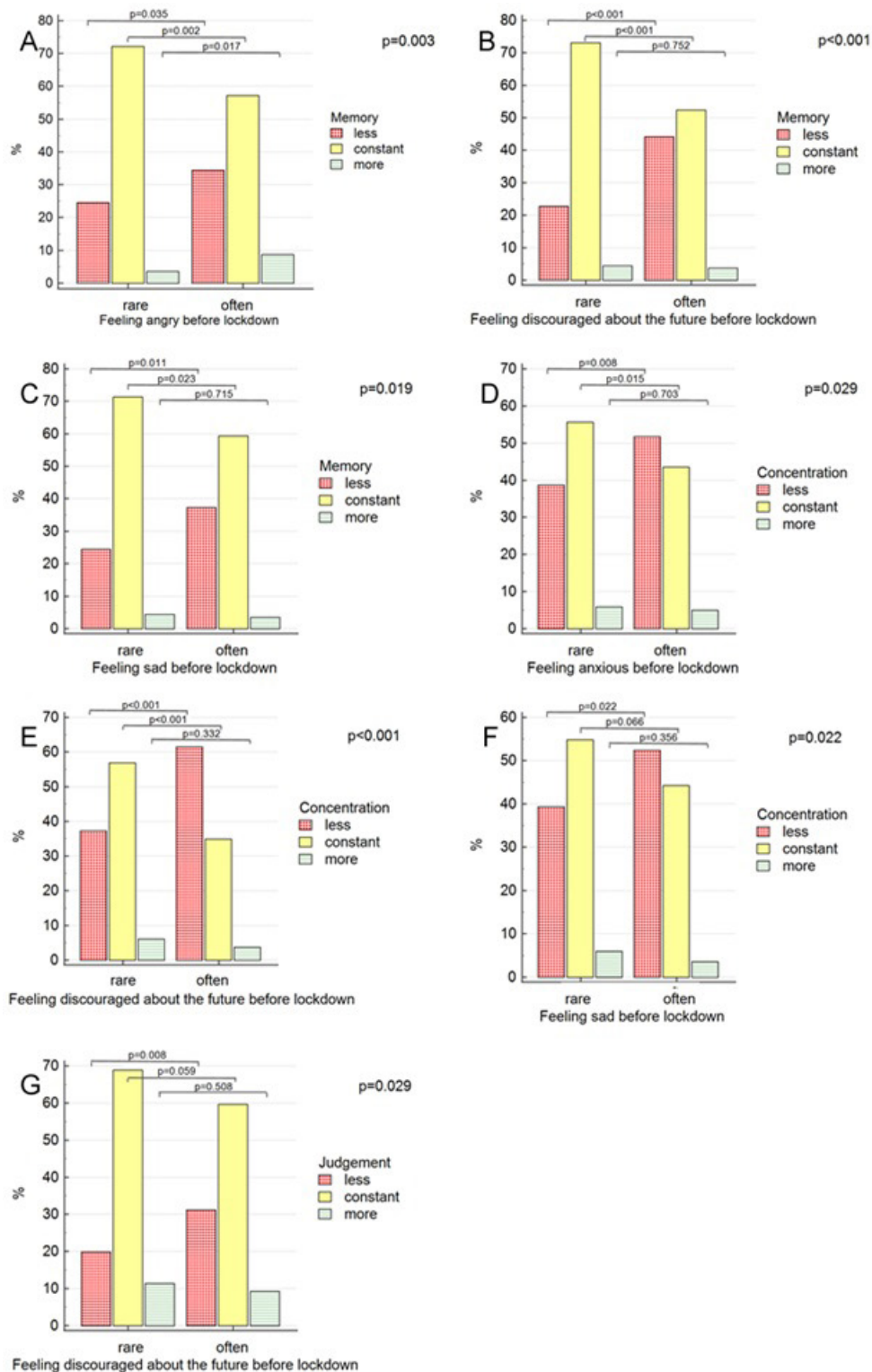
Mental state and moods were significantly more stable in men when compared to women during the second lockdown, such as being concentrated (OR 0.62 (95% CI 0.46–0.85), p=0.003), rested (OR 0.62 (95% CI 0.46–0.84), p=0.002), content (OR 0.63 (95% CI 0.46–0.86), p=0.003), anxious (OR 0.62 (95% CI 0.46–0.84), p=0.002), angry (OR 0.57 (95% CI 0.42–0.78), p<0.001), and discouraged about the future (OR 0.65 (95% CI 0.48–0.88), p=0.006), whereas women were less concentrated (OR 1.72 (95% CI 1.26–2.37), p<0.001), more rested (OR 1.49 (95% CI 1.04–2.12), p=0.028), less content (OR 1.58 (95% CI 1.17–2.14), p=0.003), more angry (OR 1.36 (95% CI 1.01–1.85), p=0.045), and more discouraged about the future (OR 1.37 (95% CI 1.01–1.85), p=0.042).

Respondents were divided into younger and older group, using the median age (36 years) as a cut-off value. Younger respondents reported memory and concentration impairment significantly more during the second lockdown in comparison to older respondents (OR 0.67 (95% CI 0.48–0.94), p=0.021, and OR 0.36 (95% CI 0.27–0.50), p<0.001, respectively). On the other hand, older respondents lost their calmness (OR 1.45 (95% CI 1.07–1.95), p=0.016), were angrier (OR 1.35 (95% CI 1.01–1.82), p=0.046) and changed their attitude towards the future (OR 0.67 (95% CI 0.50–0.91), p=0.010) during the second lockdown. A higher proportion of older respondents reported that they were less sad (OR 1.76 (95% CI 1.14–2.73), p=0.024) during the lockdown.

Respondents with a higher educational level lost concentration less frequently (OR 0.50 (95% CI 0.36–0.68), p<0.001).

As presented in Figure 1, mental state during lockdown has been constant and less impaired (significantly or at least as a trend) if mood was pleasant before lockdown. This was shown for feeling less discouraged about the future before lockdown related to memory (constant: OR 2.47 (95% CI 1.63–3.74), p<0.001; less: OR 0.37 (95% CI 0.34–0.57), p<0.001), concentration (constant: OR 2.46 (95% CI 1.61–3.77), p<0.001; less: OR 0.37 (95% CI 0.24–0.56), p<0.001), and judgement (constant: OR 1.50 (95% CI 0.98–2.28), p=0.059; less: OR 0.55 (95% CI 0.35–0.86), p=0.008) during lockdown, as well as feeling less sad before lockdown related to memory (constant: OR 1.70 (95% CI 1.07–2.70, p=0.023; less: OR 0.54 (95% CI 0.34–0.87), p=0.011), and concentration (constant: OR 1.52 (95% CI 0.97–2.40), p=0.066; less: OR 0.59 (95% CI 0.38–0.93), p=0.022). Similarly, memory has been kept more stable and less impaired during lockdown if people felt less angry before lockdown (constant: OR 1.93 (95% CI 1.26–2.95), p=0.002; less: OR 0.62 (95% CI 0.40–0.97), p=0.035), as well as concentration if people felt less anxious (constant: OR 1.63 (95% CI 1.10–2.41), p=0.015; less: OR 0.59 (95% CI 0.40–0.87), p=0.008). However, memory improved during lockdown in case of being angrier before lockdown (OR 0.38 (95% CI 0.17–0.86), p=0.017), but the number of respondents reporting an improvement of memory was small (30 out of 709).





**Figure 1.** Association of changes in the mental state during COVID-19 lockdown with mood before lockdown.

Mental state variables changes “During lockdown” – “Before lockdown” are presented in three categories (less, constant, more). Mood variables were defined on a 4-point Likert scale. Respondents' answers “not at all” and “somewhat” were grouped as “rare”, and respondents' answers “moderately” and “very much so” were grouped as “often”.

**A, B, C** Changes in memory during lockdown depending on feeling angry, discouraged about the future, and sad before lockdown.

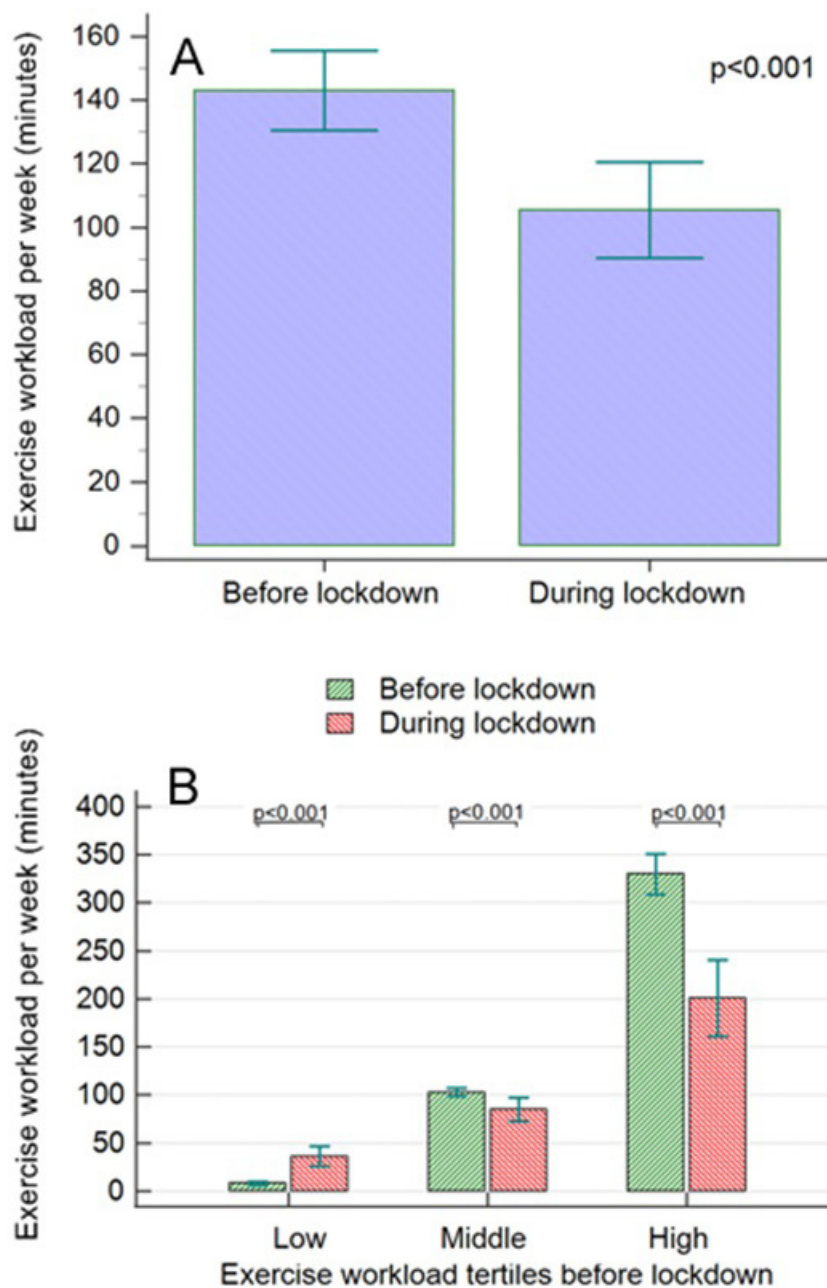
**D, E, F** Changes in concentration during lockdown depending on feeling anxious, discouraged about the future, and sad before lockdown.

**G** Changes in judgement during lockdown depending on feeling discouraged about the future before lockdown.

p-values were obtained using the chi-square test.

Exercise workload per week decreased significantly from mean 143 minutes (95% CI 130–155) before lockdown to 105 (95% CI 90–120) minutes during lockdown, ( $p < 0.001$ , Figure 2A). Workload was constant in a greater extent in men and older respondents compared to women and younger people ( $p = 0.007$ , and  $p < 0.001$ , respectively), whereas more women increased, and younger people decreased their workload per week ( $p = 0.004$ , and  $p = 0.023$ , respectively, Table 2). Considering weekly exercise workload before lockdown, the cut-off value between low and middle exercisers was 45 minutes/week, with 158 minutes/week as a cut-off value

for distinguishing middle and high exercisers. Low exercisers increased their weekly exercise workload during lockdown from mean 8 minutes (95% CI 6–10) to 36 minutes (95% CI 26–47). Weekly exercise workload of middle exercisers decreased by a significant amount during lockdown from 103 minutes (95% CI 99–107) to 85 minutes (95% CI 73–98), whereas high exercisers decreased their activity from 330 minutes (95% CI 309–351) to 201 minutes (95% CI 161–240) ( $p < 0.001$ ,  $p < 0.001$ , and  $p < 0.001$ , respectively, Figure 2B).



**Figure 2.** Exercise workload per week (minutes) before and during the COVID-19 lockdown.

**A** Entire cohort (mean and 95% CI)

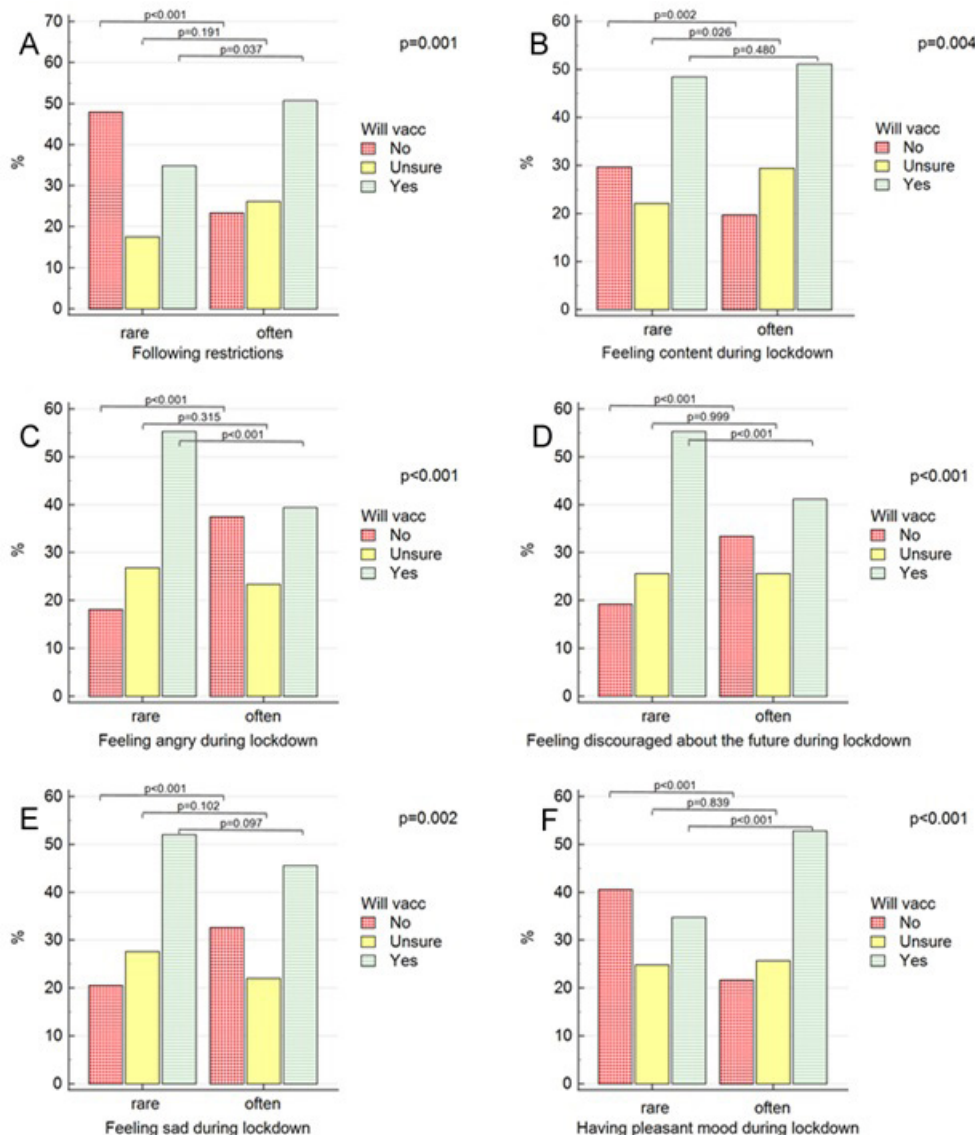
**B** Tertiles (mean and 95% CI) depending on the extent of exercise before lockdown:

Low - workload before lockdown  $\leq 45$  minutes per week, Middle - workload before lockdown  $> 45$  and  $\leq 158$  minutes per week,

High - workload before lockdown  $> 158$  minutes per week. p-values were obtained using the Wilcoxon test.

Regarding the total cohort, 24.8% would refuse vaccination, 25.5% were unsure about it and 49.6% were willing to be vaccinated. Gender, age, suffering from chronic disease, smoking status, and living in community had no influence on acceptance of vaccination. Respondents with lower educational level were significantly more unsure about vaccination than those with an academic degree (OR 0.65 (95% CI 0.46–0.93),  $p=0.017$ ). Acceptance of vaccination was greater among respondents who widely agreed with restrictions ( $p=0.001$ ) and were feeling more content ( $p=0.004$ ), less angry ( $p<0.001$ ), less discouraged about the future ( $p<0.001$ ), less sad ( $p=0.002$ ), and had pleasant mood ( $p<0.001$ ) during lockdown (Table 3 and Figure 3).

Respondents who would refuse vaccination or those being unsure about it, most often selected “Vaccines should be tested more intensively” (73% and 72%, respectively) as a reason for their decision. Thirty-six percent of people who would refuse vaccination did not trust in public health recommendations regarding vaccination and 34% refused vaccinations in general. Thirty-five percent of respondents being unsure were confused about the situation and, consequently, unable to decide. People who were willing to get a vaccine mentioned individual protection (64%) and building up a herd immunity (71%) as reasons for their decisions. Forty-eight percent of them trusted public recommendations (Figure 4). There was no significant association with gender, age, education, and living with children.

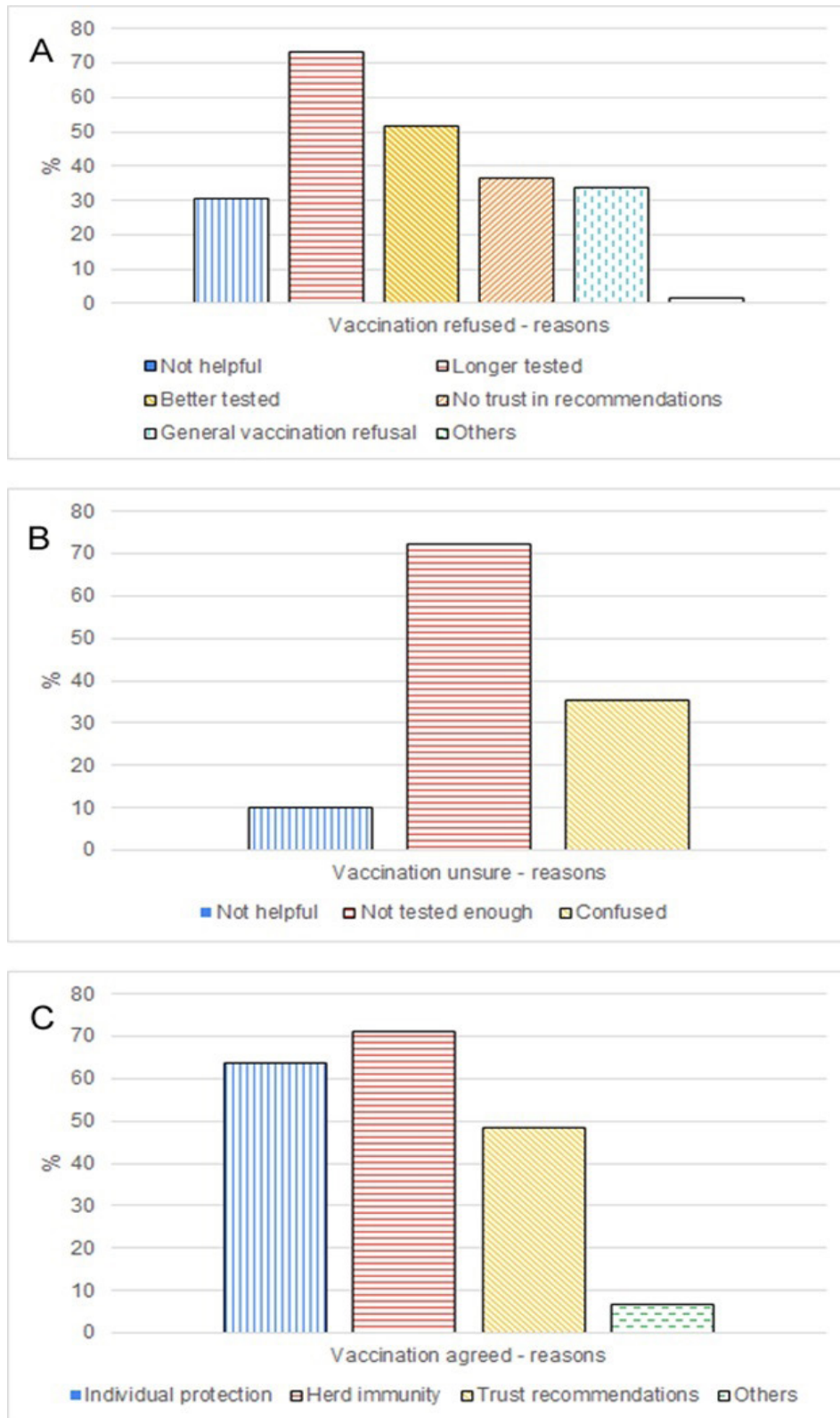


**Figure 3.** The association of the willingness for vaccination with lifestyle and mood during the COVID-19 lockdown.

Mood variables were defined on a 4-point Likert scale. Respondents' answers “not at all” and “somewhat” were grouped as “rare”, and respondents' answers “moderately” and “very much so” were grouped as “often”.

**A** Willingness for vaccination depending “Following restrictions”.

**B, C, D, E, F** Willingness for vaccination depending on mood during lockdown: “Feeling content”, “Feeling angry”, “Feeling discouraged about the future”, “Feeling sad”, and “Having pleasant mood”. “Having pleasant mood” is composed of feeling calm, rested and content and inversed evaluation of feeling angry, anxious, discouraged about the future and sad, respectively. Will vacc - Willingness for vaccination p-values were obtained using the chi-square test.



**Figure 4.** Willingness for vaccination reasons (multiple answers possible).

**A** Reasons for refusing vaccination (N=150). **B** Reasons for being unsure (N=140). **C** Reasons for agreeing to get vaccination (N=254).

*Not helpful* “I doubt that vaccination will be helpful in this case.” *Longer tested* “I think the vaccines should be tested for a longer period of time.”

*Better tested* “The vaccines have to be tested more precisely.” *No trust in recommendations* “I don’t trust the public recommendations.”

*General vaccination refusal* “I don’t like to be vaccinated in general.” *Not tested enough* “I am not sure if the vaccines are tested thoroughly enough.”

*Confused* “I am confused by all the different opinions.” *Individual protection* “I don’t want to get ill with COVID-19.”

*Herd immunity* “I would like to contribute in developing herd immunity.” *Trust recommendations* “I trust the recommendations.”



**Table 3.** Willingness for being vaccinated according to respondents' answers (Yes, No, Unsure) with regard to gender, age, education, chronic diseases, smoking status and living conditions.

	N (%)	"No"	"Unsure"	"Yes"	p <sup>c</sup>
<b>Total</b>	709 (100)	176 (24.8)	181 (25.5)	352 (49.6)	
<b>Gender</b>					
Male	265 (100)	59 (22.3)	60 (22.6)	146 (55.1)	p=0.081
Female	444 (100)	117 (26.4)	121 (27.3)	206 (46.4)	
<b>Age<sup>a</sup></b>					
<36	345 (100)	74 (21.4)	100 (29.0)	171 (49.6)	p=0.05
≥36	360 (100)	101 (28.1)	81 (22.5)	178 (49.4)	
<b>Education<sup>b</sup></b>					
Lower	414 (100)	94 (22.7)	119 (28.7)	201 (48.6)	<b>p=0.044</b>
Higher	293 (100)	81 (27.6)	61 (20.8)	151 (51.5)	<b>p<sub>unsure</sub>=0.017<sup>d</sup></b>
<b>Chronic disease</b>					
No	560 (100)	145 (25.9)	144 (25.7)	271 (48.4)	n.s.
Yes	149 (100)	31 (20.8)	37 (24.8)	81 (54.4)	
<b>Smoking status</b>					
Non-Smoker	636 (100)	155 (24.4)	163 (25.6)	318 (50.0)	n.s.
Smoker	73 (100)	21 (28.8)	18 (24.7)	34 (46.6)	
<b>Living conditions</b>					
Not living alone	626 (100)	156 (24.9)	153 (24.4)	317 (50.6)	n.s.
Living alone	83 (100)	20 (24.1)	28 (33.7)	35 (42.2)	

<sup>a</sup>Median Age = 36 years, <sup>b</sup>Higher Education - Academic degree, <sup>c</sup>chi-square test, <sup>d</sup>chi-square test unsure compared to not unsure, p<0.05 in bold, n.s. - non significant, Will vacc - Willingness for vaccination, p-values were obtained using the chi-square test.

## DISCUSSION

The results of our study showed a deterioration of all tested characteristics of mood such as being calm, rested, content (pleasant moods), being anxious, angry, sad, and discouraged about the future (unpleasant moods), and of mental status parameters such as memory, concentration, and judgement, during the second COVID-19 lockdown. Women were affected in a greater extent than men and were less able to keep their mood and mental state stable during the second lockdown. Furthermore, younger respondents exhibited mental state worsening during the second lockdown, whereas mood deteriorations were observed in older respondents in a greater extent. Overall physical activity decreased significantly during lockdown, especially in extensive exercisers who reduced their weekly workload substantially. Despite all that, only about one half of the respondents were willing to be vaccinated, and the most reported reason was to help build up herd immunity.

Our findings concerning people living in Germany are consistent with the results of studies from different countries indicating the potential negative impacts of restrictive measures on psychosocial stability [8,9,3]. It may be assumed that the increase of unpleasant moods cannot be balanced by pleasant moods as they are affected, too. Moreover, an instable mental state in critical circumstances may promote irrational decisions and in this way initiate vicious circles [19].

The COVID-19 effects on mental state were more pronounced among women in this study, similarly to reports in another German cross-sectional study [13]. During the COVID-19 pandemic women and younger people reported more anxiety, depression symptoms and mental problems. It is well known that women have significantly higher anxiety scores compared with men [16,11]. This

observation could be explained by a generally higher incidence of anxiety-depressive disorders in women [28], and a traditionally stronger involvement of females in the management of problems of everyday life. Additionally, our results confirm a possibly higher mental burden of young people as memory and concentration of younger respondents in our study were significantly more impaired compared to those of older ones, and the ability of judgement appeared to be more diminished.

When compared to the younger subgroup, older participants reported an increase of anger, loss of calmness and a change of their attitude towards the future in a greater extent. On the other hand, older people even reported a decrease in sadness. It is known that older people suffer more from psychological distress while younger ones tend to develop mental disorder or major depression [3]. Youth may be more affected by social isolation than elderly people who are more concerned about the life-threatening character of the pandemic and therefore react more worried and excited.

In our study, the reported impairment of mental abilities (concentration, memory, judgement) during the lockdown was more distinctive in those respondents having unpleasant moods before the lockdown. Thus, a lower level of mood stability at the starting point seems to be associated with a higher mental vulnerability possibly caused by the lack of compensation abilities. Based on a higher initial level, increasing anxiety and depression during the lockdown may explain problems concerning concentration, memory, and judgement. Accordingly, an Italian study reported that during the pandemic 38% of the population were affected by significant psychological distress, resulting in a deterioration of mental health [18].

Our results show a significant reduction of weekly mean exercise workload (27%) during the second lockdown. This is in accordance with Ammar et al. 2020 [1], who described a 35% reduction in number of days per week walking. During home confinement, 29% of the individuals reported sitting for 6 to 8 h a day (vs. 24% before) and the proportion of those sitting for more than 8 h a day increased from 16% to 40%. Excessive physical inactivity and a more sedentary lifestyle during prolonged stay at home is described in different countries and cultures [5,15,26]. This change in physical activity increases the risk for cardiovascular and all-cause mortality [20]. We found a highly significant (39%) reduction of the weekly workload especially in the group of extensive exercisers (workload before lockdown >158 minutes per week). These highly active people may be more affected by the restraining effects of the lockdown on possibilities for training, as facilities for sporting areas are often closed and team sports are not allowed. On the other hand, low exercisers (workload before lockdown ≤45 minutes per week) and especially women, even increased their physical activity. Possibly, for these groups the change of living and working conditions opens the opportunity to start with a training program previously not realizable.

In the present study only 49.6% of all participants were willing to get vaccinated, which is below data reported in recent studies. A worldwide comparison study concerning the acceptance of COVID-19 vaccine which surveyed more than 13.000 respondents in 19 countries was performed by Lazarus et al. 2020 [13]. Although vaccine acceptance rates differed from 55% to 88.6% locally, overall 71.5% would take a vaccine if it were proved to be safe and effective. Comparable to a recent study, a relatively high rate of uncertainty (25.5%) about whether to get a COVID-19 vaccine or not was found in our study [2].

The relatively low acceptance rate of our respondents living in Germany is not much far away from given rates in European countries like Italy 53.7%, Greece 57.7% and Poland 56.3% [2,12]. Furthermore, studies from Australia showed dropping willingness for vaccination from 86% in April 2020 [7] to 75% in June 2020 [24]. In USA the intent to get vaccinated fell from 72% in May 2020 to 51% in September 2020 [29]. Our present low rate might be an alarming expression of a declining vaccine acceptance in the course of the pandemic and a sign of exhaustion during the second wave. In accordance with Attwell et al. [2], we found a significantly higher acceptance rate in those respondents often following restrictions. It can be assumed that this group may trust government or science advice in a greater extent and consequently accept official recommendations of vaccination.

The acceptance of vaccination in our study was significantly reduced by parameters of unpleasant mood like feeling angry, sad, or discouraged about the future. It has to be considered that rational decisions – seemingly paradoxically – are strongly influenced by

moods. An inclining anxiety and depression level during a long lasting or a repeated lockdown might be the reason for an increasing vaccine fatigue. A lower education level is associated with a reluctance to be vaccinated against COVID-19 [7]. In our study respondents with a lower level of qualifications were significantly more unsure about vaccination.

The reason most frequently reported for refusing vaccination or uncertainty on this point was a too short test period of the newly developed vaccines. This is in accordance with the results that 77% of Americans believe that a COVID-19 vaccine will be approved before it is fully known whether it is safe and effective [29].

More than 50% of participants with a negative or uncertain attitude towards vaccination were not trusting official recommendations. Lazarus et al. also found a strong association between trust in government and vaccine acceptance [13]. Belief of appropriate and correct government measures seems to be an important prerequisite for the success of a vaccination campaign. Also, it has been pointed out that further studies are needed to understand the attitudes, beliefs, and influencing factors concerning the indecisive part of the population [2]. It is undoubtedly important to learn as much as possible about the motives of people opposing or being sceptical of vaccination.

Our study has some limitations. Firstly, respondents with academic degrees are in a vast majority. This may be of minor importance as in our study education had only small influence on the interesting variables. Secondly, in our study we used a subjective estimation of the variables before lockdown. This retrospective assessment from a point during lockdown implies the risk of possible misjudgement. Nevertheless, self-report questionnaires spread by Internet networks are an appropriate method to collect current data which then have to be confirmed by using prospective study designs.

## CONCLUSIONS

Characteristics of mental state and mood were significantly impaired, and the physical activity was decreased during the ongoing second lockdown due to COVID-19 pandemic in the studied population, all with possibly negative consequences for the public health. Therefore, a harm-benefit assessment should be seriously taken into account during decisions of recurring restrictive measures. Despite worldwide agreements in the scientific communities, international health organizations and national health authorities, that the only efficient solution of this pandemic is vaccination of the large proportion of population, the results of this study, similar to numerous other reports, showed rather modest percentage of respondents in general population that clearly exhibited their willingness to be vaccinated. Obviously, there is still a great effort ahead of health authorities supported by the scientific community to reduce scepticism and improve positive attitude toward vacci-

nation in order to reach a satisfactory proportion of people to get vaccine, which may finally end the COVID-19 pandemic.

## ACKNOWLEDGEMENTS

The authors wish to thank the participants of the EBM course “Introduction to research in medicine” (University of Split, School of Medicine, held by Prof. Zoran Dogas) for their assistance in data collection. The present work was performed in fulfilment of the requirements for obtaining the PhD degree within the Clinical Evidence-Based Medicine postgraduate program at USSM.

## REFERENCES

1. Ammar A, Brach M, Trabelsi K, Chtourou H, Boukhris O, Mas-moudi L, et al. Effects of COVID-19 Home Confinement on Eating Behaviour and Physical Activity: Results of the ECLB-COVID19 International Online Survey. *Nutrients*. 2020; 12: 1583.
2. Attwell K, Lake J, Sneddon J, Gerrans P, Blyth C, Lee J. Converting the maybes: Crucial for a successful COVID-19 vaccination strategy. *PLoS one*. 2021; 16: e0245907.
3. Bäuerle A, Teufel M, Musche V, Weismüller B, Kohler H, Hetkamp M, et al. Increased generalized anxiety, depression and distress during the COVID-19 pandemic: a cross-sectional study in Germany. *Journal of Public Health*. 2020; 42: 672-8.
4. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet*. 2020; 395: 912-20.
5. Chen P, Mao L, Nassif GP, Harmer P, Ainsworth BE, Li F. Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. *J Sport Health Sci*. 2020; 9: 103-04.
6. De Mello MT, Silva A, de Carvalho Guerreiro R, da-Silva FR, Esteves AM, Poyares D, et al. Sleep and COVID-19: considerations about immunity, pathophysiology, and treatment. *Sleep Science*. 2020; 13: 199-209.
7. Dodd RH, Cvejic E, Bonner C, Pickles K, McCaffery KJ, Ayre J, et al. Willingness to vaccinate against COVID-19 in Australia. *The Lancet Infectious Diseases*. 2021; 21: 318-19.
8. Đogaš Z, Kalcina LL, Dodig IP, Demirović S, Madirazza K, Valić M, et al. The effect of COVID-19 lockdown on lifestyle and mood in Croatian general population: a cross-sectional study. *Croatian medical journal*. 2020; 61: 309.
9. Fiorillo A, Sampogna G, Giallonardo V, Del Vecchio V, Luciano M, Albert U, et al. Effects of the lockdown on the mental health of the general population during the COVID-19 pandemic in Italy: Results from the COMET collaborative network. *Eur Psychiatry*. 2020; 63: e87.
10. Gollwitzer M, Platzer C, Zwarg C, Göritz AS. Public acceptance of potential Covid-19 lockdown scenarios. *PsyArXiv*. 2021; 56: 551-65.
11. Hinz A, Mitchell AJ, Dégi CL, Mehnert-Theuerkauf A. Normative values for the distress thermometer (DT) and the emotion thermometers (ET), derived from a German general population sample. *Quality of Life Research*. 2019; 28: 277-82.
12. Kourlaba G, Kourkouni E, Maistrelli S, Tsopela C-G, Molocha N-M, Triantafyllou C. Willingness of Greek general population to get a COVID-19 vaccine. *Global health research and policy*. 2021; 6: 1.
13. Lazarus JV, Ratzan SC, Palayew A, Gostin LO, Larson HJ, Rabin K. A global survey of potential acceptance of a COVID-19 vaccine. *Nature Medicine*. 2021; 27: 225-28.
14. Lima CKT, de Medeiros Carvalho PM, Lima IdAS, de Oliveira Nunes JVA, Saraiva JS, de Souza RI, et al. The emotional impact of Coronavirus 2019-nCoV (new Coronavirus disease). *Psychiatry research*. 2020; 287: 112915.
15. Lippi G, Henry BM, Sanchis-Gomar F. Physical inactivity and cardiovascular disease at the time of coronavirus disease 2019 (COVID-19). *Eur J Prev Cardiol*. 2020; 27: 906-08.
16. Löwe B, Decker O, Müller S, Brähler E, Schellberg D, Herzog W, et al. Validation and Standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the General Population. *Medical Care*. 2008; 46: 266-74.
17. Mahase E. Covid-19: What new variants are emerging and how are they being investigated? : British Medical Journal Publishing Group. 2021; 18: 372.
18. Moccia L, Janiri D, Pepe M, Dattoli L, Molinaro M, De Martin V, et al. Affective temperament, attachment style, and the psychological impact of the COVID-19 outbreak: an early report on the Italian general population. *Brain Behav Immun*. 2020; 87: 75-9.
19. Nicomedes CJC, Avila RMA. An analysis on the panic during COVID-19 pandemic through an online form. *Journal of affective disorders*. 2020; 276: 14-22.
20. Owen N, Sparling PB, Healy GN, Dunstan DW, Matthews CE. Sedentary behavior: emerging evidence for a new health risk. *Mayo Clin Proc*. 2010; 85: 1138-41.
21. Pellegrini M, Ponzio V, Rosato R, Scumaci E, Goitre I, Benso A, et al. Changes in weight and nutritional habits in adults with obesity during the “lockdown” period caused by the COVID-19 virus emergency. *Nutrients*. 2020; 12: 2016.
22. Polack FP, Thomas SJ, Kitchin N, Absalon J, Gurtman A, Lockhart S, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *New England Journal of Medicine*, 2020; 383: 2603-15.
23. Rajkumar RP. COVID-19 and mental health: A review of the existing literature. *Asian journal of psychiatry*, 2020; 52: 102066.
24. Rhodes A, Hoq M, Measey M-A, Danchin M. Intention to vaccinate against COVID-19 in Australia. *The Lancet Infect Dis*. 2021; 21: e110.
25. Sallam M. COVID-19 vaccine hesitancy worldwide: a systematic review of vaccine acceptance rates. *medRxiv*. 2021; 9: 160.
26. Savage MJ, James R, Magistro D, Donaldson J, Healy LC, Nevill M, et al. Mental health and movement behaviour during the COVID-19 pandemic in UK university students: Prospective cohort study. *Mental Health and Physical Activity*. 2020; 19: 100357.

27. Skoda E-M, Spura A, De Bock F, Schweda A, Dörrie N, Fink M, et al. Veränderung der psychischen Belastung in der COVID-19-Pandemie in Deutschland: Ängste, individuelles Verhalten und die Relevanz von Information sowie Vertrauen in Behörden. *Bundesgesundheitsblatt - Gesundheitsforschung – Gesundheitsschutz*. 2021; 64: 322-33.
28. Steel Z, Marnane C, Iranpour C, Chey T, Jackson JW, Patel V, et al. The global prevalence of common mental disorders: a systematic review and meta-analysis 1980–2013. *International Journal of Epidemiology*. 2014; 43: 476-93.
29. Tyson A, Johnson C, Funk C. U.S. Public Now Divided Over Whether To Get COVID-19 Vaccine. Pew Research Center. 2020.
30. Walsh EE, Frenck RW, Falsey AR, Kitchin N, Absalon J, Gurtman A, et al. Safety and Immunogenicity of Two RNA-Based Covid-19 Vaccine Candidates. *New England Journal of Medicine*. 2020; 383: 2439-50.
31. Wang C, Pan R, Wan X, Tan Y, Xu L, McIntyre RS, et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, behavior, and immunity*. 2020; 87: 40-8.
32. Zhu F-C, Guan X-H, Li Y-H, Huang J-Y, Jiang T, Hou L-H, et al. Immunogenicity and safety of a recombinant adenovirus type-5-vectored COVID-19 vaccine in healthy adults aged 18 years or older: a randomised, double-blind, placebo-controlled, phase 2 trial. *The Lancet*. 2020; 396: 479-88.