

Co-occurrence of psychopathological symptom severity and personality predisposition in post-traumatic stress disorder in patients several months after hospitalisation due to COVID-19

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Summary

Aim. The study's aim was to determine co-occurrence of psychopathological symptoms and personality predispositions in post-traumatic stress disorder (PTSD) and its dimensions several months after hospitalisation of patients with severe COVID-19 during the 2nd and 3rd waves of the epidemic.

Methods. At 7–8 months after admission, 138 patients completed the PCL-5 and TIPI questionnaires, as well as the HADS and AIS scales. Correlation analysis and stepwise multiple regression analysis were used in the models.

Results. 22.5% of patients met the PTSD criteria. There were no significant differences between women and men in terms of severity of anxiety, depression, sleep disorders, distress and PTSD. Anxiety, sleep disorders and depression co-occurred with PTSD severity. All dimensions of PTSD were associated with anxiety. Intrusion, changes in arousal and reactivity correlated with sleep disorders. Changes in arousal and reactivity were explained by subjective assessment of distress. Negative changes in cognition and mood were related to depression and low levels of extraversion.

Conclusions. There is a co-occurrence of the severity of psychopathological symptoms: anxiety, depression, distress and sleep disorders with the severity of PTSD and its dimensions among patients who have undergone severe COVID-19 in the recent past. A protective factor against post-hospitalisation PTSD is higher level of extraversion.

Key words: psychopathological symptoms, post-traumatic stress disorder (PTSD), long COVID

Introduction

The COVID-19 pandemic has had a remarkable influence on the health of people around the world, particularly on those who were infected with the virus and required hospitalisation. Not only their somatic health was endangered, but also the mental state was put at risk. The exposure to a dangerous virus, such as SARS-CoV-2, and the changes of a lifestyle and habits caused by the pandemic could be categorised as a traumatic event and therefore have psychological repercussions for those affected [1, 2].

Among the psychological difficulties during hospitalisation in patients the predominant ones were fear for one's own health and life, restriction of direct contact with people, feelings of loneliness and isolation (especially among the elderly, cognitively impaired or those with previously diagnosed mental disorders) [3–7].

Having contracted COVID-19 has become a risk factor for developing psychological problems, including PTSD. Conducted analysis of studies from different countries showed that other common mental health problems were: generalised anxiety disorder, obsessive-compulsive disorder, depression, cognitive impairment, insomnia, chronic fatigue syndrome [4, 8–15]. A meta-analysis of anxiety and depression among COVID-19 survivors showed that the pooled prevalence of anxiety was 47% while 45% of patients suffered from depression [12]. The prevalence of anxiety in COVID-19 patients ranged approximately from 29% to 60%, whereas for depression from 23% to 81% [4, 5, 7] as measured with the HADS scale. Considering gender differences, hospitalised women obtained higher results in HADS-A and HADS-D subscales in comparison to male patients [1, 6, 16]. PTSD diagnosis was received by approximately 10%–28% of COVID-19 patients [11, 15, 17] while in the post-illness stage the point prevalence of PTSD was 32%, in this group of study patients [14].

The COVID-19 pandemic has affected the quality of sleep in a number of people, both patients infected with the virus, medical staff and general population. The prevalence rate of sleeping disorders symptoms during pandemic are approximately 20–45% worldwide [18]. While anxiety and depression are major concerns for patients during the course of their illness, which often take on a milder form as a result of the passage of time and ongoing treatment, symptoms of insomnia and fatigue persist even as mood improves in people who are in the process of recovering from COVID-19 infection [18].

Analysis of the psychological factors that may influence the onset of PTSD in the course of COVID-19 indicated the significance of personality predisposition as a protective and risk factor in the development of post-traumatic stress disorder. With regard to the Big Five Model aspect, past research clearly indicated that high negative emotionality is significant for the occurrence of PTSD [19–21] or mood and anxiety disorders [9, 22]. Meta-analysis conducted by Ikizer et al. [23] revealed that neuroticism in particular was a factor in vulnerability to stress and isolation during the pandemic and may be a useful indicator in detecting people at risk of mental health problems in relation to the COVID-19 infection. Studies have revealed that extraversion had

a positive association with adherence to means related to constructive coping with the pandemic [24], and negative association with anxiety and depression in patients with post-COVID syndrome [9]. It was found that higher levels of conscientiousness and extraversion were protective factors against psychological distress [25], and higher levels of conscientiousness and agreeableness were the ones that protected against distress in the course of COVID-19 [26, 27]. In contrast, another study found that levels of extraversion and openness to experience did not significantly influence the development of disorders in relation to COVID-19 infection [2]. Taking into account all five personality traits, two personality profiles of relevance in coping with the pandemic were identified. The first is a non-adaptive personality profile characterised by high neuroticism, low levels of extraversion, openness to experience, agreeableness and conscientiousness. The second profile, adaptive, involved people with low levels of neuroticism with high levels in the other personality factors [28].

The above review indicates that there is a lack of research on the importance of personality in the development of long-term post-COVID implications in the form of post-traumatic stress disorder within a group of hospitalised patients.

Given the health problems described, research was conducted in order to analyse the co-occurrence of single psychopathological symptoms and personality factors in the development of post-traumatic stress disorder in patients several months after hospitalisation due to COVID-19 throughout the 2nd and 3rd waves of pandemic.

Due to the exploratory nature of the study, the following research questions were formulated:

1. What is the diagnosis frequency of PTSD in the group of patients who were hospitalised due to COVID-19 and are there any gender differences?
2. Are there any differences between patients who were hospitalised due to COVID-19 with and without a diagnosis of PTSD in terms of severity of anxiety, depression, sleep disorders, level of distress, and personality factors?
3. Do anxiety, depression, sleep disorders, distress and personality predispositions co-occur with the severity of post-traumatic stress disorder and its individual dimensions in a group of patients who were hospitalised due to COVID-19?

The research model adopted anxiety symptoms, depression, sleep disorder index, perceived distress, and personality factors as independent variables. Whereas are the presence and the severity of another category of disorder in the form of PTSD measured 7–8 months after COVID-19 diagnosis and hospitalisation are dependent variables. The selection of variables is a result of the clinical characteristics of those experiencing a life and health emergency, and such was the incidence of COVID-19 and its moderate to severe form that required hospitalisation. The obtained results are an attempt to provide answers to the raised questions. Simultaneously, we predict that the obtained results would have practical implications related to in-depth diagnosis of mental status and planning the psychological intervention in this group of patients, with consideration of their personality traits.

Materials and methods

Participants

The research was conducted in the group of 138 patients (mean age 50–52; $SD = 12,82$), including 78 men and 60 women. The criteria for inclusion into the study group were: consent to participate, hospitalisation due to COVID-19 during the 2nd and 3rd waves of the pandemic. These were patients with a severe clinical course of COVID-19, requiring medical supplies and hospital observation. 85% of subjects required transient oxygen therapy. Treatment according to currently accepted guidelines was applied.

Method

1. PTSD scale Checklist-5 for DSM-5 (PCL-5 [29]) in a Polish adaptation by Ogińska-Bulik et al. [30] is used for screening for the presence of post-traumatic stress disorder (PTSD) in the context of its overall intensity and the severity of its dimensions as a consequence of a traumatic event. The scale consists of 20 statements describing the symptoms of PTSD according to the criteria of the DSM-5 classification, representing four dimensions: (1) intrusion, (2) avoidance, (3) negative changes in cognitive functioning and mood, (4) changes in arousal and reactivity. The scale features strong reliability (Cronbach's alpha coefficient 0.96).
2. The *Hospital Anxiety and Depression Scale* (HADS) – originally developed in order to evaluate emotional state level in patients of non-psychiatric hospital clinics [31]. HADS consists of two subscales: HADS-A for anxiety symptoms and HADS-D for depressive symptoms both with seven items [32, 33]. It should be considered as a screening method [34, 35]. In terms of research on the psychological health of patients in the COVID-19 pandemic, the scale showed high reliability and validity, with a Cronbach's alpha coefficient of 0.890 for the HADS-A subscale and 0.856 for the HADS-D subscale [33, 36].
3. *Ten-Item Personality Inventory* (TIPI [37]) in the Polish version TIPI – PL [38] – a short method for screening five personality factors (neuroticism, extraversion, conscientiousness, openness to experience and agreeableness) in accordance with the “Big Five” model. The reliability and validity of this scale is satisfactory. The Cronbach's Alpha coefficient ranges between 0.45 for “Openness to Experience” and 0.83 for “Neuroticism” [38]. The TIPI-PL is recognised as a useful screening tool for the rapid assessment of personality variables in research but should not be employed for detailed, clinical personality assessment.
4. The *Athens Insomnia Scale* (AIS) – a brief 8-items instrument designed for measurement of the severity of insomnia [39]. The scale is based on the ICD-10 criteria. The internal consistency (Cronbach's alpha coefficient 0.90) and reliability (0.92) were found very satisfactory [40].

5. *Distress Thermometer* (DT; The National Comprehensive Cancer Network, 1997) in the Polish adaptation with the permission of the American Cancer Society [41]. The subject marks on an analogue scale (0–10, where 0 is no stress and 10 is the maximum level of stress) the subjective level of stress perceived in the context of the experienced life situation. The higher the score, the greater the severity of the experienced stress.
6. Interview data including information such as gender, age, co-existing mental disorders.

Statistical methods

The analyses of the results were performed using the SPSS 27 package (2020). Firstly, the mean values of the variables in the research model were presented. Further, the differences between the mean intensity of the variables in the male and female groups were measured. At this stage the Mann-Whitney U test and χ^2 test were applied. The strength of the relation between the psychological explanatory and explanatory variables was further measured using correlation analysis. Stepwise multiple regression analysis was used to estimate the strength and direction of the association of psychopathological indicators and personality predispositions with the severity of PTSD and its dimensions.

Results

Table 1 presents the descriptive characteristics of the variables for PTSD symptoms, anxiety, depression, sleep and distress disorders, as well as personality predisposition.

Table 1. Characteristics of PTSD symptom variables: anxiety, depression, sleep and distress disorders and personality predisposition in the study group (for continuous variables)

Psychopathological and personality variables	M	SD	min–max
PCL-5			
Overall result	20.13	15.75	0–68
Intrusion	5.38	4.96	0–20
Avoidance	2.24	2.16	0–8
Negative changes in cognitive functioning and mood	5.72	5.41	0–26
Changes in arousal and reactivity	6.79	5.03	0–22
HADS, AIS and DISTRESS THERMOMETER			
Anxiety	5.63	4.13	0–17
Depression	3.83	3.89	0–16

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Sleep disorders	7.48	4.91	0–19
Distress	4.19	2.26	1–10
TIPI			
Neuroticism	4.76	1.32	1–7
Extraversion	5.39	1.32	1–7
Openness	4.50	1.13	2–7
Agreeableness	5.60	0.96	3.5–7
Conscientiousness	5.69	1.09	1–7

In an attempt to answer the question about the differences between men and women in terms of the analysed variables, higher values were only observed in the personality factor “Conscientiousness” in women compared to men. There were no statistically significant differences between men and women with regard to the other studied variables. Detailed results are presented in Table 2.

Table 2. Differences between men (n = 78) and women (n = 60) in the severity of psychopathological and personality variables

Psychopathological and personality variables	Mean		Standard deviation		t(98)	p
	M	F	M	F		
PCL-5						
Overall result	19.33	21.18	16.36	14.96	-0.69	0.494
Intrusion	4.76	6.20	4.91	4.95	-1.71	0.090
Avoidance	2.18	2.32	2.20	2.13	-0.38	0.708
Negative changes in cognitive functioning and mood	5.76	5.67	5.75	4.97	0.10	0.921
Changes in arousal and reactivity	6.63	7.00	5.23	4.78	-0.43	0.671
HADS, AIS and DISTRESS THERMOMETER						
Anxiety	5.42	5.90	4.10	4.18	-0.67	0.503
Depression	3.55	4.18	3.73	4.09	-0.95	0.346
Sleep disorders	7.38	7.60	4.88	4.99	-0.25	0.799
Distress	4.10	4.30	2.34	2.17	-0.51	0.611
TIPI						
Neuroticism	4.88	4.60	1.39	1.21	1.24	0.217
Extraversion	5.32	5.48	1.39	1.22	-0.71	0.479

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Openness	4.49	4.52	1.04	1.26	-0.012	0.906
Agreeableness	5.56	5.65	1.03	0.88	-0.056	0.575
Conscientiousness	5.51	5.93	1.26	0.76	-2.24	0.027

Among the respondents, 31 people (i.e. 22.5 %) met a score of 33 or more on the PCL-5 test, indicating that they were experiencing post-traumatic stress disorder. A comparison was carried out in terms of psychopathological and personality variables in relation to the presence of PTSD – detailed results are presented in Table 3.

Table 3. Differences in the severity of psychopathological and personality variables between the group with PTSD (n = 31) and the group without PTSD (n = 107)

Psychopathological and personality variables	Mean		Standard deviation		t(98)	p
	PTSD	no PTSD	PTSD	no PTSD		
PCL-5						
Overall result	43.65	13.40	9.70	9.38	15.69	<0.001
Intrusion	12.13	3.45	3.93	3.24	12.49	<0.001
Avoidance	4.61	1.57	1.91	1.71	8.51	<0.001
Negative changes in cognitive functioning and mood	12.94	3.66	4.93	3.40	11.99	<0.001
Changes in arousal and reactivity	13.97	4.72	3.40	3.19	13.99	<0.001
HADS, AIS and DISTRESS THERMOMETER						
Anxiety	9.80	4.32	3.77	3.26	7.83	<0.001
Depression	7.40	2.75	3.77	3.21	6.72	<0.001
Sleep disorders	10.50	6.45	5.10	4.35	4.33	<0.001
Distress	5.66	3.69	2.19	2.09	4.39	<0.001
TIPI						
Neuroticism	4.10	4.93	1.46	1.23	13.12	0.002
Extraversion	4.60	5.62	1.54	1.17	13.94	<0.001
Openness	4.23	4.58	1.37	1.06	11.50	0.137
Agreeableness	5.45	5.63	0.97	0.97	10.90	0.368
Conscientiousness	5.63	5.71	0.90	1.14	10.36	0.718

Respondents who obtained a score indicating the presence of PTSD had higher values in all psychopathological parameters ($p < 0.001$) compared to those without PTSD. Regarding the area of personality predispositions, differences emerged in neuroticism and extraversion, indicating higher values in neuroticism ($p = 0.002$) and extraversion ($p < 0.001$) in patients without PTSD.

In the following step, a correlation analysis was conducted between PTSD symptom severity and measures of anxiety, depression, sleep disorder, subjective distress, and personality predispositions. Detailed results are shown in Table 4.

Table 4. Correlation analysis of psychopathological and personality variables with PTSD symptoms

Variables	Presence of PTSD	Overall result	Intrusion	Avoidance	Negative changes in cognitive functioning and mood	Changes in arousal and reactivity
Anxiety	0.56**	0.72**	0.70**	0.45**	0.65**	0.65**
Depression	0.50**	0.61**	0.53**	0.29**	0.64**	0.56**
Sleep disorders	0.35**	0.46**	0.45**	0.26**	0.34**	0.51**
Distress	0.37**	0.49**	0.44**	0.26**	0.47**	0.49**
Neuroticism	-0.26**	-0.35**	-0.30**	-0.24**	-0.36**	-0.32**
Extraversion	-0.32**	-0.33**	-0.23**	-0.12	-0.42**	-0.29**
Openness	-0.13	-0.12	-0.16	-0.04	-0.13	-0.04
Agreeableness	-0.08	-0.16	-0.11	-0.13	-0.16	-0.16
Conscientiousness	-0.03	-0.17	-0.13	-0.17*	-0.19*	-0.12

* $p < 0.05$; ** $p < 0.01$

Statistically significant correlations were found between PTSD severity, anxiety, depression, sleep disorders, stress levels, and individual personality dimensions.

The overall PTSD symptom severity score correlated strongly positively with anxiety ($r = 0.72$) and depression ($r = 0.61$), and was moderately associated with sleep disorders ($r = 0.46$) and distress ($r = 0.48$). PTSD symptom severity correlated negatively with personality predispositions: neuroticism ($r = -0.35$) and extraversion ($r = -0.33$). PTSD dimension in the form of intrusion symptoms was strongly positively associated with anxiety ($r = 0.70$) and a medium positive correlation was observed with depression ($r = 0.53$), sleep disturbance ($r = 0.45$) and distress ($r = 0.45$). Avoidance was moderately correlated with anxiety ($r = 0.45$). Severity of negative changes in cognitive functioning and mood was strongly associated with anxiety ($r = 0.65$) and depression ($r = 0.64$), moderately associated with distress ($r = 0.47$), sleep disorders ($r = 0.34$) and with personality predispositions: neuroticism ($r = -0.36$) and extraversion ($r = -0.42$). Changes in arousal and reactivity correlated strongly positively with

anxiety, moderately with depression ($r = 0.56$), sleep disorders ($r = 0.51$) and distress ($r = 0.49$), and negatively with neuroticism ($r = 0.32$). Weak correlations have not been described and may be found in Table 4.

In determining the role of psychopathological symptoms in predicting the severity of post-traumatic stress disorder symptoms, a stepwise multiple regression analysis was conducted in which all psychopathological and personality variables included in the model of this study were included. The obtained results are presented in Table 5.

Table 5. Predictors of PTSD severity and its dimensions in COVID-19 patients

Dependent variables from the PCL-5 test	Predictors	B	Beta	r_{semi}	% of variance	t	p
OVERALL RESULT $R = 0.74$; $R^2 = 0.54$ $F = 47.49$; $p < 0.001$	(Constant)	2.72				1.40	0.163
	Anxiety	1.85	0.48	0.31	9.39	4.97	<0.001
	Sleep disorders	0.60	0.19	0.17	2.80	2.71	0.008
	Depression	0.77	0.19	0.13	1.64	2.08	0.040
INTRUSION $R = 0.72$; $R^2 = 0.52$ $F = 67.31$; $p < 0.001$	(Constant)	-0.27			0.00	-0.43	0.667
	Anxiety	0.77	0.63	0.56	31.62	9.01	<0.001
	Sleep disorders	0.18	0.18	0.16	2.52	2.54	0.012
AVOIDANCE $R = 0.43$; $R^2 = 0.19$ $F = 28.42$; $p < 0.001$	(Constant)	0.96				3.21	0.002
	Anxiety	0.23	0.43	0.43	18.77	5.33	<0.001
NEGATIVE CHANGES IN COGNITIVE FUNCTIONING AND MOOD $R = 0.70$; $R^2 = 0.49$ $F = 38.40$; $p < 0.001$	(Constant)	5.06			0.00	2.64	0.009
	Depression	0.44	0.31	0.20	3.84	3.01	0.003
	Anxiety	0.47	0.34	0.23	5.31	3.54	0.001
	Extraversion	-0.65	-0.16	-0.14	1.93	-2.14	0.035
CHANGES IN AROUSAL AND REACTIVITY $R = 0.71$; $R^2 = 0.50$ $F = 39.97$; $p < 0.001$	(Constant)	0.24			0.00	0.32	0.749
	Anxiety	0.45	0.36	0.27	7.23	4.17	<0.001
	Sleep disorders	0.33	0.33	0.29	8.48	4.52	<0.001
	Stress assessment	0.43	0.20	0.16	2.54	2.47	0.015

R – coefficient of multiple correlation; R^2 – coefficient of multiple determination; F – F statistic of the analysis of variance for the entire model; p (next to F) – probability p for the entire model; B – partial coefficient of regression; Beta – partial standardised coefficient of regression; r_{semi} – semi-partial correlation coefficient; % of variance – the percentage of the variance of the dependent variable explained by a given predictor (calculated as the square of the semi-partial correlation multiplied by 100%); t – value of Student's t-statistic for the given predictor; p – probability p for a given predictor

For the PTSD “Overall score” variable, the model indicated a positive effect of three predictors: anxiety, sleep disorders and depression ($R = 0.74$; $p < 0.001$) explaining respectively 9.39%, 2.80% and 1.64% of the percentage of variance in this variable. For the “Intrusion” variable, anxiety and sleep disturbance proved to be significant variables ($R = 0.72$; $p < 0.001$), explaining successively: 31.62% and 2.52% of the variance for this variable. The “Avoidance” variable was explained by anxiety ($R = 0.43$; $p \leq 0.001$) providing 18.77% of the variance for the dependent variable. For the variable “Negative changes in cognitive functioning and mood”, matching the model ($R = 0.70$; $p \leq 0.001$) indicated that this variable could be explained by depression, anxiety and low levels of extraversion explaining respectively 3.84%, 5.31% and 1.93% of the variance in the dependent variable. The variable “Changes in arousal and reactivity” with a highly fitted model ($R = 0.70$; $p \leq 0.001$) was explained by variables: anxiety, sleep disturbance and distress, explaining successively: 7.23%, 8.48% and 2.54% of the variance in the dependant variable.

Discussion

With regard to COVID-19 pandemic crisis situation in the 2nd and 3rd waves and the necessity for hospitalisation of individuals with a COVID-19 diagnosis due to symptom severity, the aim of our study was to determine the role of the diagnosis of core psychopathological symptoms and personality predispositions in the assessment of post-traumatic stress disorder PTSD several months after hospitalisation for COVID-19. In the research model it was adopted that the dependent variables are the presence of PTSD measured 7–8 months after COVID-19 diagnosis and the intensity of PTSD symptoms, while the independent variables are symptoms of anxiety, depression, sleep disorder index, personality predisposition, and subjectively perceived distress.

The results of the study indicate that 22.5% of patients had symptoms that met the criteria for post-traumatic stress disorder. The prevalence of PTSD in the study appeared to be comparable to that in other groups of patients hospitalised due to COVID-19 [11, 15, 17]. Simultaneously, by comparing this result with the prevalence of post-traumatic stress disorder at the post-hospital stage, it did not reach the higher value (one third of the patients) reported in the study by Rogers et al. [14]. Possibly, adopting the guidelines of the DSM-V classification and extending the time of our follow-up by additional months, a diagnosis of PTSD with delayed onset could be made in even more recovering patients.

In an attempt to answer the question about the differences between men and women in terms of the degree of severity of psychopathological and personality variables, only higher values were observed in the “Conscientiousness” dimension in women compared to men, indicating a high homogeneity of the study group in terms of the analysed variables. Deng et al. [12] also noted an analogous lack of correlation between the gender of patients and vulnerability to anxiety and/or depressive disorders. In other reports [1, 3, 6, 15] female gender was a risk factor for anxiety, depressive symptoms

or PTSD following COVID-19. In the study by Tristani et al. [42] male gender was a protective factor against PTSD symptoms in terms of COVID-19 illness.

Another aim of our study was to determine differences in psychopathological symptoms and personality variables between the group of patients hospitalised due to COVID-19 who were diagnosed with PTSD and the group of hospitalised patients without PTSD. Higher values were found in all psychopathological parameters among the respondents who obtained a score indicating the presence of PTSD in comparison to those who did not meet the criteria for a diagnosis of PTSD that were measured 7–8 months after contracting COVID-19 and being hospitalised.

In the analysis of the associations of PTSD and its dimensions with psychopathological symptoms and personality factors, a number of results were obtained. Anxiety proved to be the variable most frequently and strongly associated with the presence of post-traumatic stress disorder and all four of its examined dimensions. Depressive symptoms also correlated with the presence of PTSD in the overall score and with all its dimensions with a strength of association varying from low to moderate. Furthermore, anxiety level played a predictive role in the overall PTSD score and its dimension “Negative changes in cognitive functioning and mood”. Previous world reports have already noted that infections of various nature may be a trigger for, for instance, psychopathological symptoms, especially in individuals prone to psychological difficulties or with a history of psychological disorders [43]. Even minor environmental exposures that activate the immune system may contribute to symptoms of anxiety, depression or distress. Thus, experiencing symptoms of moderate to severe SARS-CoV-2 infection and hospitalisation associated with it, may have been a source of trauma and psychological difficulties manifested in the form of anxiety and depressive symptoms or, as a further consequence, PTSD. The results of recent studies on the association between COVID-19 morbidity and immune and endocrine system responses in patients hospitalised during the pandemic are consistent with the above data. Investigating the effect of cortisol on anxiety and depressive symptoms, and survival in patients hospitalised for SARS-CoV-2 infection, Ramezani et al. [44] showed a positive relation between serum cortisol levels and the intensity of anxiety and depression in patients. Those with high anxiety, depression and distress results were also more likely to die from COVID-19. Whereas Mazza et al. [15] pointed out the positive association of depression and anxiety with the initial systemic inflammatory index, which reflects the systemic and immune inflammatory response of the body, as a reaction to SARS-CoV-2 infection one month after the illness.

In our study, anxiety and depression explained more than 10% of the variation in PTSD symptoms in general and more than 9% of the symptom in the form of negative changes in cognitive functioning and mood of the subjects. Respondents reported difficulties with concentration and memory – especially recalling details of events related to the illness, which may be understood as symptoms of PTSD or post-infection cognitive impairment, as reported by a number of researchers [14, 43]. In parallel, anxiety alone explained almost 32% of the symptom “Intrusion” and nearly 19% of “Avoidance”,

meaning that the subjects felt strongly nervous in situations that reminded them of the trauma of the illness. They were also experiencing flashbacks, i.e. a sensation as if a stressful event from the past had happened again. And all of this with conceivable accompanying physical symptoms, such as an accelerated heartbeat, heavy sweating or breathing difficulties.

The consequences of COVID-19 infection and hospitalisation in the 2nd and 3rd waves of the pandemic were also reactive symptoms such as avoidance of memories, thoughts and feelings (e.g. people, places, situations, conversations) associated with the traumatic event. In terms of activity and mood, difficulties in experiencing and showing positive feelings, social distancing or frequent outbursts of anger or showing irritability, anhedonia and guilt, among others, became visible. Anxiety symptoms (more than 7%) were significant in estimating the severity of changes in arousal and reactivity, in the form of increased fear response, general neuroticism, increased vigilance, or engaging in risky behaviour.

The above symptoms indicate that anxiety and depressive symptoms have a significant impact on the quality of life of people who have been hospitalised for SARS-CoV-2 infection. Similarly, in another Polish study [35] concerning an adaptation of the HADS, both anxiety and depression were associated with higher levels of stress, lower quality of life and quality of sleep among the subjects. Our study also reported a higher intensity of sleep disturbance in patients with PTSD symptoms, compared to patients without PTSD, and a moderately strong association of insomnia with the overall score, on the intrusiveness dimension and the changes in arousal and reactivity dimension of the PCL-5 scale. The greater the intensity of insomnia, the more severe were the above symptoms of post-traumatic stress disorder. The sleep disorders present in COVID-19 are most probably multifactorial [45], therefore it is difficult to prove the direction of causality between sleep disorders or insomnia and PTSD. However, the strength of the study, which confirms the presented direction of the relation, are the results of the stepwise multiple regression analysis. The analysis revealed that, among the psychopathological symptoms and personality predispositions we examined in estimating PTSD severity, it was sleep disturbance, along with anxiety and depression, that was significantly important for overall PTSD levels. They exacerbated intrusions, i.e. repeated, unpleasant and unwanted memories of the stressful event or dreams related to it, and increased vigilance, impatience and difficulty in concentrating, as a consequence of the traumatic event in COVID-19 patients. The results indicating an association and a predictive role for sleep disorders in the psychopathophysiology of PTSD are consistent with previous findings [46, 47, 48].

In the evaluation of psychological condition, an approach that takes into account the subjective assessment of the stress experienced by the subject is extremely relevant, as emphasised in one of the most prominent models for understanding the stress relation – the transactional stress model of Lazarus and Folkman [49]. In our study, patients with COVID-19 and a PTSD diagnosis evaluated the experienced stress of the illness significantly higher than those without PTSD, which is in line with an earlier study

conducted by Liu et al. [50], in which low levels of distress tolerance in COVID-19 patients were associated with PTSD, anxiety and depression. The distress experienced by our study participants correlated most strongly with PTSD dimensions such as “Negative changes in cognitive functioning and mood”, and “Changes in arousal and reactivity”. In other words, when experiencing the intense stress of a life-threatening illness, patients’ mood and responsiveness to stimuli may be the areas of functioning subjectively most strongly affected by negative consequences. Moreover, the distress experienced by the patients was a predictor of one of the dimensions of PTSD – changes in arousal and reactivity – demonstrating the significance of considering the individual experience of the trauma situation related to the infection and hospitalisation of people with COVID-19. Also Hoşgören et al. [8] noted that a factor significantly influencing the reduction of anxiety and depression in patients was hospital discharge after treatment of SARS-CoV-2 infection, which was most likely related to the elimination of stress associated with the hospitalisation itself.

Regarding the area of personality predispositions, differences emerged in neuroticism and extraversion, indicating higher values in these factors in patients with no diagnosis of PTSD. Notable is the fact that in both groups, sten values were obtained within the population norm.

The clinical picture of psychological functioning subsequent to a traumatic experience may differ between individuals depending, for example, on their style of managing stress, which in turn is determined by personality traits. Individuals with higher neuroticism are characterised by vulnerability to experiencing negative emotions and increased sensitivity to stress. Nevertheless, people with higher neuroticism, using an avoidance-focused style, may limit unpleasant experiences by engaging defence mechanisms of the repression or suppression type, which we adopt as an explanation for the higher values of the neuroticism factor in people without a diagnosis of PTSD. The mediating role of immature defence mechanisms in COVID-19 patients with higher scores in neuroticism was also stressed by Gori et al. [2].

Within the personality variables explaining post-traumatic stress disorder severity, only extraversion level was significant for the PTSD dimension “Negative changes in cognitive functioning and mood”. The higher the level of extraversion, the lower the changes in this dimension of PTSD. Individuals with higher levels of extraversion are characterised by greater emotion expression, stimulus-seeking tendencies and optimism, and are more likely to have an avoidance-focused stress management style [51], which may be adaptive in the early stages of recovery to maintain relative mental balance in the face of destabilising memories associated with trauma [52]. Extraversion has also been shown to be correlated with a task-oriented and social-seeking style of managing stress [53], which could potentially result, in a hospital setting, in patients being more likely to seek informational and emotional support from medical staff, and thus be associated with less negative changes in cognitive functioning, mood, arousal, and reactivity.

The results of our study, as well as that of Kim et al. [10], Tarsitani et al. [11] and Forte et al. [54], suggest that in addition to providing mental status monitor-

ing during hospitalisation due to COVID-19 symptoms, clinicians should consider an assessment for possible psychopathological symptoms during follow-up visits after hospital discharge. Analyses that describe the impact of surviving SARS-CoV-2 infection on daily functioning and return to work indicate that approximately 3 years after the illness, nearly 77% of individuals return to work and the psychopathological symptoms associated with COVID-19 disappear [14]. Despite this high percentage, clinicians should be aware of a possible psychiatric disorder in the form of depression, anxiety disorders or PTSD, also in recovering patients [14]. Screening for personality traits may also contribute towards effective detection of individuals at risk of experiencing more severe psychopathological symptoms during the course of their illness. This approach may be conducive not solely to improved outcomes in the treatment of PTSD, but also in the broader treatment of disorders following COVID, as well as improving the overall quality of life of people following a COVID-19 hospitalisation with severe symptoms. Particularly, in a group of patients with psychological disorders present even before contracting COVID-19, early crisis intervention seems to be essential to improve their further prognosis in both psychological and somatic health condition.

Conclusions

The results of the study indicate that the presence of post-traumatic stress disorder and its dimensions in individuals who were hospitalised for COVID-19 may be estimated by the severity of individual psychopathological symptoms such as: anxiety, sleep disorders, depression, and subjectively perceived distress. Within personality factors, extraversion appeared to have a protective effect against PTSD. The obtained data imply the importance of clinical assessment of psychopathological symptoms in the context of COVID-19 incidence.

The identification of a group of patients with higher levels of anxiety, depression, distress and experiencing sleep disturbances suggests the need for a more profound assessment of psychological condition for PTSD. Knowledge of the described correlations may be helpful to clinicians diagnosing these patients, sensitising them to the risk of these patients developing a serious psychopathological disorder requiring therapy and support.

Prompt and precise identification of those at risk of developing post-traumatic stress disorder allows pharmacological and psychological therapeutic procedures to be applied in the treatment process in order to prevent or reduce the severity of psychopathological symptoms as long-term after-effects of COVID-19.

Limitations of the study and prospects

In the study, self-reporting methods were used, a limitation of which is the risk of biased responses by the subjects. In an attempt to predict the occurrence of PTSD,

apart from individual or demographic group variables, one should also take into consideration the characteristics of the traumatic event, in this case related to the severity of the course of the potentially life-threatening illness, the applied medical procedures, the hospitalisation in strict isolation and subjective assessment of these by the patient.

Author contributions:

BBK and DD designed the study; BBK drafted application to the Bioethical Committee of the Jagiellonian University Medical College; ALW, JW qualified patients for the group and conducted psychological tests; BBK, KOT, APD, ALW conducted literature searches and provided summaries of previous research studies and wrote the first draft of the sections Introduction and Discussion; BBK conducted the analysis and interpretation of the data; BKB, KOT, DD revised the manuscript; APD – final editing of the text; ASF prepared the text to be placed in the system

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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