

## Coronavirus Pandemic

# Correlation of BIPQ score with socioeconomic characteristics of patients with COVID-19 pneumonia and CT severity score

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### Abstract

**Introduction:** Coronavirus disease 2019 (COVID-19) rapidly became a global pandemic with clinical manifestations ranging from asymptomatic infection to life-threatening illness. While physician assessment of disease severity is largely objective, patient perception of illness is often influenced by psychosocial and demographic factors. This study aimed to explore determinants of illness perception among patients hospitalized with COVID-19.

**Methodology:** A cohort of 262 patients with confirmed SARS-CoV-2 infection was evaluated. Baseline characteristics included age, gender, smoking history, body mass index, and sociodemographic information (relationship status, education, employment, and physical activity). Disease severity was assessed using chest computed tomography (CT) scans. Illness perception was measured with the Brief Illness Perception Questionnaire (BIPQ).

**Results:** The median patient age was 56.3 years, and 65.6% were male. More than half (56.5%) had completed higher education, 90% were married or in a relationship, 57.6% were unemployed, and 85.9% reported no regular physical activity. Male patients demonstrated higher absolute CT scores ( $p = 0.018$ ) but lower BIPQ scores. Severe pneumonia, as defined by CT findings, correlated with longer hospitalization, although no significant differences in total BIPQ scores were observed across CT severity groups. Illness perception was not influenced by education ( $p = 0.43$ ), employment ( $p = 0.096$ ), or physical activity ( $p = 0.94$ ). However, relationship status significantly affected total BIPQ scores ( $p = 0.034$ ).

**Conclusions:** The study found BIPQ useful for rapid illness perception assessment, recommended for routine practice. Socio-economic factors influenced responses, while CT severity did not. Linking CT scores with BIPQ may identify patients at risk of psychological distress.

**Key words:** COVID-19; CT score; BIPQ; education; relationship.

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### Introduction

The coronavirus disease 2019 (COVID-19) initially began in Wuhan 2019, and became a global pandemic at the start of 2020 [1]. From that time onwards, it was a global emergency health concern, and many hospitals were repurposed to treat critically ill patients. Based on the 5 years' experience, it is evident that COVID-19 can cause a wide spectrum of disease presentation, from asymptomatic, mild with fever and cough, to life-threatening disorders with acute respiratory distress syndrome (ARDS) and multi-organ failure [2,3]. COVID-19 causes injuries in multiple organs and tissues, and also has psychological consequences. Due to the large number of in-hospital patients, the challenge was to recognize those at higher risk of

complications and lethal outcomes [2,4]. Previous studies showed that patients with chronic diseases (cardiovascular, cancer, respiratory, obesity) develop more severe forms of disease and poor outcomes [3,5].

COVID 19 was initially a highly contagious disease that quickly spread across all continents, with unusual clinical presentation, a high mortality rate, and initially without adequate therapy or vaccine [3]. A combined effort from healthcare professionals and patients was needed in the fight with the unknown. In previous studies, it was shown that healthcare workers were under huge stress because of heavy workload and spread the disease to their families. The patients were also under stress due to changes in all aspects of their lives due to a new and life-threatening disease [6,7].

Consequently, there were negative impacts on mental health with a higher rate of fear, anxiety, and depression [8]. The perception of the doctor and the patient about the health status is not always the same; therefore, the question that arises is how the patients perceive the disease. Patients often minimize their symptoms for various reasons, and may justify symptoms such as cough in chronic obstructive pulmonary disease (COPD) patients by attributing it to smoking, or fatigue in cardiovascular diseases by attributing it to age, or shoulder pain by attributing it to the workplace conditions; instead of seeking examination for lung cancer [9]. Delayed diagnostics can result in irreversible pathological changes, and result in fewer options for treatment. Therefore, it is necessary to raise awareness about preventive examinations, disease symptoms, and the need to start therapy as soon as possible.

Only a few studies have focused on illness perception of COVID-19 from the perspective of patients. The patients' perspective can be different, and it is important to understand the reason for this difference. Lack of information and inherent characteristics of patients could be reasons for this difference in perception.

Illness perception can be of two types: cognitive and emotional [10]. Cognitive perception includes self-perception and understanding of the disease and its consequences, symptoms, expected duration, and the effect of treatment. This perception depends on the available health information, and the patients' education and awareness [10,11]. Emotional perception includes patients' concerns, fear, anger, or anxiety; their usual reactions; suffering associated with an illness or because of certain situations; and the pandemic [11,12]. One of the most widely used scales for measuring illness perception is the brief illness perception questionnaire (BIPQ). BIPQ has a 9-item scale; but the ninth item illustrates the causes of illness as described by the patient [10]. It is used for various illnesses such as tuberculosis (TB), diabetes mellitus, COPD, and cancers. In these studies, the researchers were able to analyze the patients' responses and conclude that they can identify TB patients with poor treatment outcomes or a positive role in post-operative body image cognition [13,14]. During the interview, a real patient's knowledge about his disorder helps him understand the illness better. The interview responses can be used to refer him for further psychological counseling or change the routine clinical practice. However, many other factors can influence the overall BIPQ score, including the different phenotypes of patients, their

habits, education, financial stability, everyday activities, workplace, and lifestyle. Previous studies have examined the relationship between patients' level of education and understanding of the severity of their disease, such as myasthenia gravis and stroke [15]. Patients with lower educational and socioeconomic levels have a poorer understanding of their disease, have restricted resources for obtaining information, limited financial opportunities for diagnosis and treatment, and limited acceptance and understanding of information [15,16]. In a study by Tiemensm *et al.*, a stronger emotional response was associated with lower socioeconomic status [17]. Gender differences can take different courses of disease., possibly because of the different hormonal status and immune system responses [18], and differences in the reaction to disease. For example, women react more emotionally, have different lifestyles, and have better acceptance of illness than men. This could be a reason why women visit doctors more often than men [19].

The aim of this study was to explore factors influencing patients' perceptions of their disease during COVID-19 treatment. The socioeconomic status, education, sports activity, gender, and relationship status were analyzed to determine if any of the characteristics correlate with the severity of disease according to the BIPQ score and the chest-computed tomography (CT) score.

## Methodology

A cross-sectional study was carried out from January to October 2021 at the Clinic for Pulmonology, University Clinical Center of Serbia, and University Hospital Dr. Dragiša Mišović-Dedinje; in Belgrade, which were, in that period, part of the system of hospitals dedicated to the treatment of patients with COVID-19 infection. The cohort included patients who were  $\geq 18$  years, with confirmed COVID-19 infection through positive real-time reverse-transcription polymerase chain reaction (RT-PCR) assay or antigen testing, and who presented with COVID-19 pneumonia which required hospital treatment. The criteria for intensive care unit (ICU) treatment were radiographic or clinical worsening, need for high-flow oxygen therapy, or mechanical ventilation.

The study was conducted in line with the principles of the Declaration of Helsinki and approved by the local Ethics Committee (approval no. 01-1519/2, 2021). The patients signed the consent for hospital treatment upon hospital admission, and informed consent was also obtained from all subjects involved in the study.

*Data collection*

Data of all patients were collected from the hospital’s electronic health information system records and medical documentation. Sociodemographic information was obtained from the questionnaire. Sociodemographic information included relationship status (in a relationship\marriage or not), education level (higher level or not), sports activity (active sports training, gym, or recreational sports such as bicycling), and whether they were employed or not (students, unemployed, or retired). Data collected from the medical history included age, gender, clinical characteristics of COVID-19 pneumonia with CT score severity, length of stay, need for ICU treatment, smoking status, past medical history and comorbidity, laboratory parameters, and outcome (discharged or dead).

*Radiological assessment*

Chest CT scan was the main radiological imaging method, and it was more sensitive than chest X-ray radiography. Therefore, chest CT scan was used to determine the severity of COVID-19 pneumonia on admission. The severity score was calculated based on the degree of involvement of each of the 5 lobes of the lungs scored from 0 to 5 (0: no involvement; 1: < 5% involvement; 2: 5–25% involvement; 3: 26–49% involvement; 4: 50–75% involvement; 5: > 75% involvement) [20]. The total chest CT score was calculated based on the sum of each lobe’s scores, with a total range from 0 (indicating no lung involvement) to 25 (suggesting maximum lung involvement). A score in the range from 0 to 8 was considered mild, from 9 to 15 was moderate, and more than 15 was a severe CT score [20].

*Questionnaire assessment*

The BIPQ was used to evaluate the degree of illness perception. The BIPQ included 8 items and an additional 9<sup>th</sup> item that was an open-ended question where the responders wrote their opinion regarding the causal factors for the disease. Eight questions had scoring between 0 and 10 points. The first 5 items were cognitive illness representations: consequences (item 1), timeline (item 2), personal control (item 3), treatment control (item 4), and identity (item 5). The next two items were for emotional illness perceptions: concern (item 6) and emotions (item 8). One item assessed illness coherence (item 7). In summary, the scores of items 3, 4, and 7 were reversed and added to that of items 1, 2, 5, 6, and 8 [15]. BIPQ versions in the patients’ native Serbian language, which were

equivalent to the original, were offered to all patients after linguistic validation. The anonymous survey took 10–15minutes, and patients filled out the questionnaire during the first 7 days of hospitalization. The interview was performed by a doctor with more than 7 years of experience in that field working in a hospital.

*Statistical analysis*

SPSS Statistics 25.0 software (Chicago, IL, USA) was used for statistical analyses. Data were presented as a percentage or as a median. Statistical tests were performed using a significance level of  $p < 0.05$ . 95% confidence intervals (CI) were calculated for the questionnaire. The Kolmogorov–Smirnov test of normality was performed to test for normal distribution of data. The Mann–Whitney U test was performed for samples that did not have normal distribution to estimate the statistical significance between two groups with different diagnoses. A t-test was used when comparing normally distributed variables. The results are presented in tables and graphically.

**Results**

In this study, 262 patients with COVID-19 infection were included. The median age of the patients was 56.3 ± 11.4 years, and the analyzed participants were predominantly male (65.6%). Most of the participants suffered from comorbidities (71%), with cardiovascular disease, pulmonary disorders, and diabetes mellitus as leading conditions. Most patients received adequate education (56.5%), a significant number of patients

**Table 1.** Characteristics of the study population (n = 262).

<b>Study population</b>	<b>n</b>	<b>%</b>
<b>Gender</b>		
Males	172	65.6
Females	90	34.4
<b>Age (years)</b>	56.3 ± 11.4	
<b>Smoking (yes/no)</b>	118/144	45/55
<b>CT score</b>	11.3 ± 4.1	
Mild	59	22.5
Moderate	159	60.7
Severe	44	16.8
<b>Hospitalization duration (days)</b>	13.6 ± 4.9	
<b>ICU duration (n = 34) (days)</b>	7.7 ± 2.3	
<b>BIPQ score</b>	47.6 ± 5.1	
<b>Outcome (death/lived)</b>	9/253	3.4/96.6
<b>Education</b>		
No higher	114	43.5
Higher	148	56.5
<b>Work</b>		
No (students, unemployed, retired)	151	57.6
Yes	111	42.4
<b>Physical activity</b>		
No	225	85.9
Yes	37	14.1
<b>Relationship</b>		
No (or divorced)	26	10
Yes (or marriage)	236	90

**Table 2.** Median score by question and CT severity score.

Question	BIPQ score			p
	Mild CT score	Moderate CT score	Severe CT score	
1	8	7.2	8	0.74
2	4.1	3.7	4	0.28
3	5.6	4.6	4	0.02
4	9	8.8	8.7	0.88
5	5.6	5	5	0.93
6	6.8	7	7.2	0.31
7	5.8	6.9	7.2	0.008
8	6	6.8	4.7	0.013
Total	<b>50.9</b>	<b>50</b>	<b>48.8</b>	<b>0.54</b>

BIPQ: The Brief Illness Perception Questionnaire; CT: computed tomography.

were married or in relationship (90%), the majority of the study group had no job (57.6%), and did not have any kind of physical activity (85.9%). Their demographic and clinical characteristics are presented in Table 1.

The CT imaging findings were analyzed for all patients. Comparison of the CT severity scores indicated that most of them had moderate scores (60.7%), and less than a third of them had the other two scores (22.5% and 16.8%). Thirty two patients had involvement of only one lobe of the lungs, and the rest had pneumonia of two or more lobes with a higher severity score.

Men generally had a higher absolute CT score (Mann-Whitney-U test; median 13 in men vs 10 in women; MWU = 5835.5;  $p = 0.018$ ). In addition, more severe pneumonia according to the CT score (from mild to severe) was associated with a longer stay in the ICU (Kruskal-Wallis test;  $X^2 = 29.58$ ;  $p < 0.001$ ) and longer hospitalization (Kruskal-Wallis test;  $X^2 = 23.43$ ;  $p < 0.001$ ).

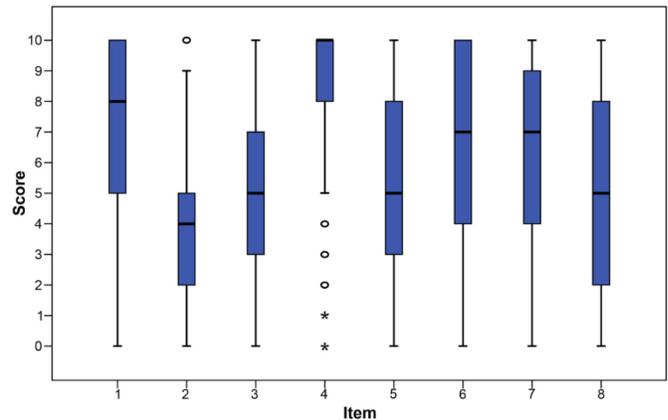
The mean clinical BIPQ score was  $49.9 \pm 1.02$ . The highest single item score, nearly 10, was found for treatment control, while the lowest score 4 was found for illness duration perception. The mean scores and SD of each BIPQ item were  $8.2 \pm 2.15$  (consequences),  $4.1 \pm 2.24$  (timeline),  $5.1 \pm 2.2$  (personal control),  $9.25 \pm 0.75$  (treatment control),  $5.17 \pm 2.49$  (identity),  $6.86 \pm 2.36$  (concern),  $6.79 \pm 1.93$  (understanding), and  $5.23 \pm 2.12$  (emotions), respectively. Score distributions by questions are presented on Figure 1. No statistically significant differences in total BIPQ score between severity groups by CT score were noted, but there are differences in a few items (item 3, 7 and 8; Table 2).

Females generally had a higher absolute BIPQ score (median scores of 49 vs 46, respectively,  $p = 0.028$ ).

Several differences in length of hospital treatment, treatment in ICU, age, values of inflammation parameters, IL6, body mass index (BMI) depending on CT severity score were noted and are summarized in the Table 3.

We found no difference in the total score or each item individually between people with different levels of education ( $p = 0.43$ ) and sports activity ( $p = 0.94$ ), except in sports activity in Item 7 ( $p = 0.004$ ). Results are presented in Table 4.

**Figure 1.** Score distributions by question.



**Table 3.** Differences in characteristics according to CT severity score.

CT score severity	Mild	Moderate	Severe	p
Age (years)	55.8	57.4	54.3	0.761
Length of hospital treatment (days)	9.6	11.9	17.9	0.013
Treatment in ICU (days)	6.3	9.7	9.9	0.445
CRP (mg/L)	38.7	71.2	99.9	0.009
IL6 (mg/L)	32.4	64.9	77.1	0.004
BMI kg/m <sup>2</sup>	27.2	27.7	30.1	0.812

CT: computed tomography; ICU: intensive care unit; CRP: C-reactive protein; BMI: body mass index.

**Table 4.** Median score by question and level of education or sports activity.

Question	Education		p	Sports		p
	No higher education	Higher education		No activities	yes	
1	8 (0–10)	8 (0–10)	0.93	8 (0–10)	6 (0–10)	0.6
2	4 (2–10)	4 (0–10)	0.88	4 (0–10)	3 (0–10)	0.15
3	5 (0–10)	5 (0–10)	0.78	5 (0–10)	5 (0–10)	0.11
4	9 (2–10)	10 (0–10)	0.78	10 (0–10)	10 (5–10)	0.25
5	5 (0–10)	5 (0–9)	0.74	5 (0–10)	5 (0–10)	0.85
6	7 (0–10)	6 (0–9)	0.21	7 (0–10)	5 (0–10)	0.12
7	7 (1–10)	6 (0–10)	0.52	7 (0–10)	10 (2–10)	0.004
8	5 (0–10)	5 (0–10)	0.13	5 (0–10)	4 (0–10)	0.62
<b>Total</b>	<b>49 (10–80)</b>	<b>46 (8–75)</b>	<b>0.43</b>	<b>47 (8–80)</b>	<b>46 (26–75)</b>	<b>0.94</b>

**Table 5.** Median score by question and relationship status or work status.

Question	Relationship		p	Work		p
	Not in a relationship	In a relationship		Employed	Unemployed	
1	8.5 (0–10)	8 (0–9)	0.36	8 (0–10)	10 (0–10)	0.009
2	5 (0–10)	4 (0–10)	0.19	4 (0–10)	5 (0–10)	0.07
3	5 (0–10)	5 (0–10)	0.35	5 (0–10)	5 (0–10)	0.98
4	10 (0–10)	10 (0–10)	0.87	10 (0–10)	9 (0–10)	0.77
5	5.5 (0–10)	5 (0–9)	0.27	5 (0–10)	5 (0–10)	0.95
6	7 (0–10)	6 (0–9)	0.08	6.5 (0–10)	7 (0–10)	0.07
7	7 (0–10)	7 (3–10)	0.97	7 (1–10)	6 (0–10)	0.054
8	5 (0–10)	5 (0–10)	0.6	5 (0–10)	6 (0–10)	0.019
<b>Total</b>	<b>51.5 (26–80)</b>	<b>46 (8–76)</b>	<b>0.034</b>	<b>46 (10–80)</b>	<b>49 (8–75)</b>	<b>0.096</b>

We have proven that there is a difference in the total score between people in relationships or not ( $p = 0.034$ ) but no difference between employed or not ( $p = 0.096$ ). Also, we found a statistically significant difference in the median scores for questions 1 and 8 when patient work subpopulations were analyzed. The median score by question and relationship status or work status is presented in Table 5.

The main cause of COVID-19 infection for both genders, according to answers in open question- Item 9 of this BIPQ questionnaire, was risky contact at work and outdoor particles in more than half of respondents. Other causes with less than 10% were irresponsible behaviour by others, perceived “bad immunity” and stress.

**Discussion**

This study was conducted to examine the adequacy of responses to the BIPQ questionnaire on COVID-19 and to get more information about the reliability of using the test for this disease in relation to the clinically validated severity, which may depend on some characteristics of the patients themselves. In order to do this, the study focused on illness perceptions and investigated whether these had an impact on outcomes and severity of clinical disease presentation. The research found significant differences in many questions between CT severity groups, and relationship status and gender. Significant predictors of health outcomes were CT score, longer stay in the ICU, and longer hospitalization. To our knowledge, this is the

first study in our country and the Balkan region dealing with the role of BIPQ in patients with COVID-19.

The BIPQ has been used in 36 countries and in 26 languages for different diseases and patients’ perceptions, such as tuberculosis, COPD and malignancy [21,22]. It is easy to use, and it is convenient for everyday clinical practice. Previous studies have reported that patients who have a negative perception of their illness have a slower recovery process or cause of medication discontinuation [23]. Therefore, it is very important to consider patient’s perception. The illness perception varies from patient to patient, even with the same disease. The perception of illness has a direct impact on the patient’s emotional response and functional state. Perhaps the emotional response of women is the reason for the difference in the total BIPQ score in this study group. Meta-analyses on emotion regulation in chronic disease showed that women’s emotion regulation capacities were lower than men’s. A greater understanding of the vulnerability in women is needed [19,24]. Women are more emotional, and experience more symptoms; this leads to greater worry and sensitivity. Since the impact of the disease on women is higher, they have more understanding of the situation and accept the disease more easily. Men are more inclined to deny illness and symptoms, and in addition to the problems they have, they are less absent from work. According to data from the Institute of Public Health of Serbia in 2019, 71.3% of men rated their general health condition as good, while among women that percentage was 62.1% [25]. Therefore, it is

in accordance with the results of this study which concluded that a higher percentage of women perceived themselves as ill, while fewer men considered themselves to be ill. Thus, with a higher total score, the female patients perceived COVID-19 as a more threatening disease.

Perception of a person's illness depends not only on the medical profile, but also on the patient's characteristics and understanding of the disease. The dilemma was whether education or sports activity have an effect on the answers about the perception of COVID-19 pneumonia. We found no difference in the score between the two patient groups. Numerous studies examined the connection between the level of education of the patients and the understanding of the severity and outcome of their disease, such as myasthenia gravis, prostatitis and stroke [26,27]. The conclusion was practically the same. Patients with lower educational levels have poorer understanding of their disease, have fewer means of obtaining disease-related information, as well as limited acceptance and understanding of such information. All of these result in poorer awareness of disease [26,27]. We found no difference in the total scores of people with different levels of education or sports activity. This could be because COVID-19 was new a disease and there was limited data available regarding the disease. Fear of the unknown may lead to severe negative health outcomes.

Among patients with other chronic pre-existing health conditions, the score was lower for personal control, and higher for consequences and treatment control. An unknown disease seriously affected their lives, but they had faith in the doctors and the treatment they received. Based on this experience for patients and doctors, it was clear that there was a need to improve disease-related knowledge among the patients and their families, and develop different types of health education materials such as fliers and media program. In addition, it was important to develop trust between patients and health workers.

There was no difference in the scores between patients who are well-trained in sports and those who were not involved in any kind of sport activity. It was assumed that people who train professionally or recreationally had less fear or greater control regarding the disease and greater trust in treatment; however, no statistically significant difference was observed except in one question about the understanding of the disease.

Use of physical activity to improve the physical and mental health of the general population have long been well acknowledged. According to data in the literature,

players showed better outcome in their perception of health, injuries and activity-rehabilitation [28]. This is a possible explanation for the higher score associated with the understanding of the disease between groups with and without sports activity.

Unemployment or poverty are recognized as factors that have negative effects on health. The unemployed do not have the opportunity for treatment, purchase of prescribed therapy, health insurance, regular controls, and examinations, which results in poor health status. Kawohl and colleges showed that suicide risk was elevated by 20–30% when associated with unemployment [29]. Hence there was the difference in questions 1 and 8 regarding the consequences of the disease and emotional impact (anger, fear). Patients that were unemployed had higher score and more concern because of pneumonia and its outcome. There was increased fear due to the unknown status of the disease. COVID-19 had impact on the entire social economy and the individual's life. The lockdown resulted in risks of job loss, and mental and physical stress due to lack of financial support for treatment [30]. This uncertainty increased psychological distress, and impaired quality of life.

Many previous studies showed that chest CT severity score was one of the most powerful and useful parameters for predicting the outcome of disease. Chest CT scores have been reported to be associated with ICU admission, need for mechanical support, and mortality during acute COVID-19 [31,32]. It has been reported that patients with higher values of leucocytes and C-reactive protein (CRP) had higher possibility of ICU treatment and extended hospitalization, or a history of at least one underlying disease. The CT severity scores in all lobes were significantly higher in critical patients [33,34]. Higher values of inflammation parameters and longer hospitalization were associated with higher total CT scores in chest CT of these patients. Age and body mass index (BMI) were similar in all groups. There were no statistically significant differences in total BIPQ scores between severity groups by CT score, but there were differences in a few items (items 3, 7 and 8). The responses from the group with severe disease indicated that they felt that they had no control over their disease. The score for understanding of the disease was higher in the mentioned group. This could be explained by the fact that their illness was more serious, they had more symptoms, and the hospitalization lasted longer; therefore they took the illness more seriously. It is possible that they asked more questions about the course of the disease and the treatment plan.

The main causes of COVID-19 infection, according

to the answers to the open question, were risky contact at work and outdoor particles in more than half of respondents. Other causes reported by less than 10% respondents were irresponsible behaviour by others, perceived “bad immunity”, and stress. Media and healthcare workers contributed towards raising awareness on reducing contact and socializing to reduce virus transmission. The patients concluded from some prior knowledge that poorer immunity may lead to more severe forms of the disease.

This study had some limitations. This was only a two-center experience and needed a bigger sample of participants. The gender distribution in the sample was a limitation because both the genders did not have equal representation; this could have been a result of the sampling process. Longitudinal follow-up studies would help to validate the effect of illness representation in medical care and compare differences in answers after a few years of experience and knowledge about this disease. The findings in our country may not apply to the situations in other countries or regions. Although self-report scales are commonly used in research, there may have been some associated social desirability biases during data acquisition. At that time, there were no data available that could influence the participant's response, such as access to the media, past experience with the pandemic, or available social support. To our knowledge, this is the first study in our country and the Balkan region dealing with BIPQ and COVID-19.

## Conclusions

The study concluded that BIPQ is a convenient tool for fast assessment of illness perception and its use in routine clinical practice is recommended. Identifying differences among patients' perceptions of COVID-19 consequences, concerns and emotional responses, might provide solutions for better outcome and treatment. There were differences in some aspects of socio-economic influence on the responses in this questionnaire, but there was no difference in the total score between different severity groups that are a consequence of fear of new disease. Understanding the correlation between the chest CT score and BIPQ can help clinicians identify patients who may be at higher risk of psychological distress and worst outcome.

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## Conflict of interests

No conflict of interests is declared.

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