

Correlation Study of Short-Term Mental Health in Patients Discharged After Coronavirus Disease 2019 (COVID-19) Infection without Comorbidities: A Prospective Study

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Objective: The WHO has upgraded the status of coronavirus disease 2019 (COVID-19) from epidemic to global pandemic. The psychometric properties aspects of COVID-19 patients without comorbidities in the short term after discharge have not been reported. In this study, the Short Form 36 (SF-36) was used to evaluate the psychometric properties and to find relevant risk factors.

Methods: The study was conducted in seven hospitals from January 2020 to April 2020. The SF-36 questionnaire was administered one month after discharge. Univariate analysis and multivariate regression model were used to analyze the risk factors of psychometric properties impairment.

Results: In univariate analysis of independent risk factors, according to the comparison of whether the duration of positive nucleic acid was greater than 20 days, the positive nucleic acid duration was independently related to the decreased role-emotional value [100, IQR (66–100) vs 100, IQR (0, 100); $p = 0.0156$]. In addition, multivariable linear regression model showed that male sex and positive nucleic acid duration were related to decreased role-emotional value ($p = 0.03 < 0.05$; $p = 0.01 < 0.05$, respectively). Mental health was associated with age ($p = 0.0435$). Subsequently, we divided into three subgroups: less than seven days, 7 to 14 days and more than 14 days according to the positive nucleic acid duration. The results revealed that there were significant differences in the vitality value and mental health value of patients aged 46 to 69 in the subgroup where the positive nucleic acid duration longer than 14 days ($p = 0.0472$; $p = 0.0311 < 0.05$, respectively). Similarly, there are also significant differences in role-emotional value in different genders ($p = 0.0316$).

Conclusion: The study described the psychometric properties of COVID-19 patients without comorbidities shortly after discharge. Risk factors for psychometric properties damage included age, male sex, and nucleic acid duration.

Keywords: COVID-19, psychometric factor, SF-36

Introduction

The global epidemic of the coronavirus disease 2019 (COVID-19) was expanding rapidly, raising widespread concern in the international organization. The cases were initially reported in Wuhan, China, and quickly spread in other area of China, as well as other countries, such as Korea, Europe and so on. As of 25 August 2020, there have been 23,518,343 confirmed cases of COVID-19 globally, including 810,492 deaths, reported to WHO.¹ On the aspect of epidemiology, pathogenicity

and clinical features, COVID-19 is similar to severe acute respiratory syndrome coronavirus (SARS-CoV). Between November 2002 and June 2003, the severe acute respiratory syndrome (SARS) broke out in Guangdong, China.² There were 8422 cases worldwide, including 916 deaths (case fatality rate 11%).³ However, the lab polyprotein and surface glycoprotein or S protein of the amino acid sequence of COVID-19 is different from the other coronaviruses.⁴ COVID-19's clinical features include fever, radiology change or acute respiratory distress, decreased or normal leukocytes and lymphocytes, and not responding to 3 to 5 days of antibiotic treatment. Most cases are reported as a mild illness course.⁵ Most human coronaviruses are mainly transmitted through the respiratory tract or in contact with infected secretions. Viruses have also been detected in patient stool samples.⁶ The management of COVID-19 treatment in Zhejiang Province, China, is rigorous. Discharge requirements include: more than three days of normal body temperature, significant improvement of respiratory symptoms, and nucleic acid test results for respiratory pathogens are negative twice consecutively (sampling time at least one day apart). All patients need another 14-day isolation after discharge. Many patients presented abnormal mood and behavior while hospitalized. Therefore, we conducted a follow-up evaluation of patients with COVID-19 one month after discharge. Some studies have shown the clinical characteristics of the COVID-19, especially the impact of the patient's age on the prognosis.⁷ In addition, psychological disorders during the epidemic have also attracted the attention of many scholars,⁸ but no one has implemented the follow-up analysis of COVID-19 patients in the short term after they are discharged from the hospital.

The clinical outcome of a disease is not only described in terms of survival and mortality. However, it can also be measured by subjective results, such as health-related quality of life (HRQOL). It is reported that survivors of other epidemic diseases such as the Middle East respiratory syndrome (MERS) and H1N1 Influenza have a short-term or long-term quality of life problems.^{9–11} Short-Form General Health Survey 36 (SF-36) is the most widely used tool to evaluate HRQOL, and it is often used to evaluate the health status of the population, the effect of treatment and the disease burden.¹² SF-36 has been proven to have excellent psychometric characteristics, retested reliability values, and a high degree of internal consistency for people of different ages and health conditions from the United States and around the world.¹³ SF-36 measures the two main components of health,

including Likert-type and dichotomous items, each composing of four subforms. The physical component summary (PCS) contains role-physical (RP), physical functioning (PF), general health (GH), and bodily pain (BP). The mental component summary (MCS) contains social functioning (SF), vitality (VT), mental health (MH), and role-emotional (RE).¹⁴ Some researchers employed the SF-36 scale to evaluate the quality of life of survivors in intensive care units (ICU) one year after discharge. During the follow-up period, the overall SF-36 score of patients after discharge was lower than that of normal people, and up to 31.6% of survivors developed symptoms of post-traumatic stress disorder, and up to 31.5% of survivors were diagnosed with clinical significance anxiety or depression symptoms.⁷ Therefore, we used the SF-36 to evaluate the psychometric properties of COVID-19 patients in short-term after discharge.

Methods

Patients

The study was conducted in seven hospitals in southern Zhejiang, China, from January 2020 to April 2020. There were 504 patients receiving COVID-19 treatment in the hospital, 380 of them completed the questionnaire. These hospitals are tertiary hospitals designated to treat COVID-19 patients. We followed up in one month after hospital discharge.

Setting and Samples

Patients diagnosed as COVID-19 positive in the aforementioned hospitals were eligible to join in this study. If the patient had epidemiological risk, typical clinical manifestations, and met one of the following two criteria, they can be diagnosed as COVID-19: 1) blood or airway samples were tested to be SARS-CoV-2 positive by real-time polymerase chain reaction (PCR). 2) Viral gene sequencing shows that blood or respiratory samples are highly homologous to known SARS-CoV-2.¹⁵ The following patients will be excluded: 1) patients younger than 18; 2) patients who were pregnant at the time of diagnosis; 3) unable to participate; 4) lost to follow-up (SF-36 questionnaire is not available); 5) the main reason for admission is not COVID-19, and there were also serious diseases including metastatic malignant tumors, weakness, and serious injuries.

Ethical Considerations

The study conducted in accordance to the Helsinki Declaration, was permitted by the Ethics Committee of the Second Affiliated Hospital and Yuying Children's

Hospital of Wenzhou Medical University (2020–002), with informed consent of participants.

Measurements

Our research applied SF-36 form, which contains 8 scales, to assess physical and mental health. The mental health indicators were composed of social functioning (SF, 2 items), vitality (VT, 4 items), mental health (MH, 5 items), and role-emotional (RE, 3 items). The physical health indicators include four scales of role-physical (RP, 4 items), physical functioning (PF, 10 items), general health (GH, 5 items), and bodily pain (BP, 2 items). In our study, SF-36 was recalled at the standard time (4 weeks), and Likert scales or Yes/no options were used to evaluate well-being and function on this 36-item questionnaire. In order to make SF-36 scores comparable, the scale is standardized using a scoring algorithm to obtain a score. The score range is 0–100 points, the higher the score means the better your health. The Chinese version of SF-36 has been well verified among the Chinese population.^{16–18}

We recorded demographic data such as age and gender. Then comparisons of SF-36 value by the duration of positive nucleic acid for longer than 20 days, or whether the use of corticosteroids and compared whether the patients have a drinking or smoking history.

Statistical Analysis

Demographic and baseline characteristics were summarized using descriptive statistics. In univariate analysis, continuous variables were summarized as medians and interquartile ranges, while categorical variables were expressed as the counts and percentages of patients in each category. Kruskal–Wallis rank sum test was used for group comparison among the continuous variables, and Fisher's Exact test or the chi-squared test was used to determine the association among categorical data.¹⁹ The estimates of regression coefficients and their corresponding 95% confidence intervals were calculated by multi-variable linear regression model. All statistical tests were two-sided, and a p-value of less than 0.05 was considered statistically significant. We use SPSS software for statistical analysis (version 22.0; SPSS Inc., Chicago, IL).

Results

Patient Characteristics

A total of 504 patients from 7 hospitals were included in this study, and 380 patients completed follow-up one month after discharge. In order to eliminate the

psychological influence of chronic diseases, we excluded 121 patients with chronic diseases, and finally, 259 patients were included in the study. Among them, male and female patients accounted for 46.9% and 53.1%, respectively. The proportions of each age groups are 1.6% for younger than 18 years old, 53.1% for the group between 18–46 years old, and 43.3% for the group between 46 and 69 years old (Table 1).

Univariate Analysis of SF-36 Score Decline

We first investigated some univariate correlations with risk factors related to the SF-36 score one month after discharge. Gender and different ages had nothing to do with related psychometric factors (including SF, VT, MH and RE) in the SF-36 score. In patients with smoking or drinking, as well as whether the use of corticosteroids, there was no statistically significant variation in the influence of psychometric factors in univariate analysis. The extension of positive nucleic acid duration was related to the decreased RE scores [100, IQR (66–100) vs. 100, IQR (0, 100); $p = 0.0156$] (Table 2).

Table 1 Clinical Characteristics

	Overall (N=259)
Sex (%)	
Female	135 (53.1)
Male	119 (46.9)
Age (%)	
≤18	4 (1.6)
(18, 46]	130 (53.1)
(46, 69]	106 (43.3)
>69	5 (2.0)
Treated with corticosteroids (%)	
N	213 (86.9)
Y	32 (13.1)
Smoke history (%)	
N	236 (95.9)
Y	10 (4.1)
Drink history (%)	
N	238 (96.7)
Y	8 (3.3)
Duration of positive (%)	
≤20 days	146 (63.2)
>20 days	85 (36.8)

Note: The values in the table are the counts (percentages) of patients.

Table 2 Comparisons of SF-36 Scales by Univariate Analysis

	Vitality (Median [IQR])	p	Social Functioning (Median [IQR])	p	Role-Emotional (Median [IQR])	p	Mental Health (Median [IQR])	p
Sex		1.00		0.38		0.40		0.12
Female	85.00 [77.50, 92.50]		66.60 [44.44, 88.80]		100.00 [0.00, 100.00]		84.00 [74.00, 96.00]	
Male	90.00 [75.00, 92.50]		77.70 [44.44, 100.00]		100.00 [66.60, 100.00]		84.00 [74.00, 92.00]	
Age		0.07		0.38		0.50		0.07
≤18	90.00 [85.00, 92.50]		83.30 [63.82, 100.00]		100.00 [100.00, 100.00]		88.00 [83.00, 94.00]	
(18,46]	85.00 [70.00, 90.00]		66.60 [44.44, 88.80]		100.00 [66.00, 100.00]		82.00 [68.00, 92.00]	
(46,69]	90.00 [80.00, 95.00]		66.60 [44.44, 100.00]		100.00 [0.00, 100.00]		88.00 [80.00, 92.00]	
>69	90.00 [90.00, 90.00]		100.00 [77.70, 100.00]		100.00 [100.00, 100.00]		80.00 [76.00, 92.00]	
Treated with corticosteroids		0.26		0.10		0.65		1.00
N	85.00 [75.00, 95.00]		66.60 [44.44, 100.00]		100.00 [66.00, 100.00]		84.00 [76.00, 92.00]	
Y	85.00 [77.50, 90.00]		55.50 [44.40, 80.48]		100.00 [0.00, 100.00]		90.00 [67.00, 92.00]	
Duration of positive		0.50		0.33		0.02*		0.89
≤20 days	85.00 [75.00, 90.00]		72.15 [47.17, 100.00]		100.00 [66.60, 100.00]		84.00 [73.00, 92.00]	
>20 days	90.00 [80.00, 90.00]		55.50 [44.44, 100.00]		100.00 [0.00, 100.00]		84.00 [72.00, 92.00]	
Drink history		0.91		0.65		0.84		0.58
N	85.00 [75.00, 90.00]		66.60 [44.44, 100.00]		100.00 [41.47, 100.00]		84.00 [76.00, 92.00]	
Y	80.00 [68.75, 100.00]		61.05 [30.52, 100.00]		100.00 [49.50, 100.00]		92.00 [66.00, 97.00]	
Smoke history		0.50		0.85		0.94		0.75
N	85.00 [75.00, 90.00]		66.60 [44.44, 100.00]		100.00 [57.83, 100.00]		84.00 [75.00, 92.00]	
Y	92.50 [71.25, 98.75]		55.50 [55.50, 86.02]		100.00 [25.00, 100.00]		88.00 [72.00, 92.00]	

Note: *Statistically significant ($p < 0.05$).

Abbreviation: IQR, interquartile range.

Multivariable Linear Regression Model Analysis of Independent Risk Factors for Decreased SF-36 Scales

A multiple linear regression model was established to find the independent risk factors for the decline of the SF-36 scores. Male sex and positive nucleic acid duration were related to decreased RE scores ($p = 0.03$; $p = 0.01$, respectively) (Table 3). Subsequently, we divided into three subgroups: less than seven days, 7 to 14 days and more than 14 days according to the positive nucleic acid duration. Linear regression analysis was performed on these three subgroups. The results revealed that there were significant differences in the VT scores and MH scores of patients aged 46 to 69 in the subgroup of the positive nucleic acid duration longer than 14 days ($p = 0.0472$; $p = 0.0311$, respectively). Similarly, there are also significant differences in RE scores in different genders ($p = 0.0316$) (Table 4).

Discussion

Our study reported for the first time, the HRQL test results of COVID-19 patients one month after discharge. The results

showed that after the hospitalization of COVID-19 patients, the mental health was damaged. Based on the above results, we can find that the related factors that affect the patient's psychometric properties include gender, age and the positive nucleic acid duration. These data provide a more sensitive and meaningful experience in assessing the mental state of patients and can help improve the quality of care.

Interestingly, our data found that in univariate analysis, only the extension of positive nucleic acid duration was related to the decreased RE scores. Moreover, in the multivariable linear regression model of RE, it can be seen that the positive nucleic acid duration is negatively correlated with the declined of the values, and the age is positively correlated with the increased of the values. The extension of positive nucleic acid duration is related to the decreased RE value; it might be associated with anxiety and depression. Some studies have shown that the RE scale can be used for outpatient screening for depression and anxiety, and the sensitivity and specificity of the results are acceptable.^{20–22} Under strict regulation in Zhejiang Province, China, hospital discharge should meet the

Table 3 Investigation of Independent Risk Factors for SF-36 Value Reduction by Multivariable Linear Regression Model

Factors	Vitality		Social Functioning		Role-Emotional		Mental Health	
	Estimate [95% CI]	P	Estimate [95% CI]	P	Estimate [95% CI]	P	Estimate [95% CI]	P
Sex (female as reference)	-0.11 [-4.30, 4.09]	0.96	5.19 [-2.03, 12.40]	0.16	12.82 [1.47, 24.17]	0.03*	-2.31 [-6.60, 1.97]	0.29
Age (18,46] (≤18 as reference)	-6.75 [-24.94, 11.43]	0.47	-3.19 [-34.46, 28.08]	0.84	-23.97 [-73.18, 25.23]	0.34	-11.99 [-30.57, 6.58]	0.20
Age (46,69]	-0.42 [-18.72, 17.89]	0.96	-4.99 [-36.46, 26.49]	0.76	-23.74 [-73.27, 25.79]	0.35	-7.45 [-26.15, 11.24]	0.43
Age >69	5.83 [-17.36, 29.03]	0.62	17.41 [-22.47, 57.29]	0.39	-11.96 [-74.72, 50.80]	0.71	-5.68 [-29.37, 18.01]	0.64
Use of corticosteroids (no as reference)	-5.97 [-12.86, 0.92]	0.09	-10.83 [-22.68, 1.02]	0.07	-4.61 [-23.26, 14.04]	0.63	-1.24 [-8.28, 5.80]	0.73
Duration of positive (≤20 days as reference)	1.56 [-2.81, 5.93]	0.48	-4.43 [-11.94, 3.08]	0.25	-15.27 [-27.09, -3.45]	0.01	0.75 [-3.71, 5.21]	0.74
Smoke history (no as reference)	-2.64 [-15.63, 10.35]	0.69	-7.03 [-29.37, 15.31]	0.54	-3.61 [-38.76, 31.54]	0.84	1.02 [-12.25, 14.29]	0.88
Drink history (no as reference)	4.73 [-6.69, 16.15]	0.41	-2.71 [-22.35, 16.92]	0.79	-9.99 [-40.89, 20.91]	0.52	2.51 [-9.16, 14.17]	0.67

Note: *Statistically significant (p < 0.05).
Abbreviation: CI, confidence intervals.

Table 4 Investigation of Independent Risk Factors for SF-36 Value Reduction in the Positive Nucleic Acid Duration Longer Than 14 Days by Multivariable Linear Regression Model

Factors	Vitality		Social Functioning		Role-Emotional		Mental Health	
	Estimate [95% CI]	P	Estimate [95% CI]	P	Estimate [95% CI]	P	Estimate [95% CI]	P
Sex (female as reference)	2.3 [-3.04, 7.63]	0.40	5.41 [-3.64, 14.46]	0.24	16.34 [1.46, 31.23]	0.03*	-0.33 [-5.92, 5.26]	0.91
Age (46,69] (age 18 to 46] as reference)	5.68 [0.07, 11.29]	0.047*	-1.85 [-11.38, 7.68]	0.70	-2.77 [-18.43, 12.90]	0.73	6.48 [0.6, 12.36]	0.03*
Age >69	15.16 [-7.95, 38.26]	0.20	27.83 [-11.39, 67.06]	0.16	35.81 [-28.68, 100.29]	0.27	12.85 [-11.36, 37.07]	0.30
Use of corticosteroids (no as reference)	-4.73 [-13.36, 3.91]	0.28	-14.46 [-29.12, 0.20]	0.05	-4.61 [-23.26, 14.04]	0.63	-0.33 [-9.38, 8.72]	0.94
Smoke history (no as reference)	-5.74 [-16.92, 28.39]	0.62	2.59 [-35.88, 41.05]	0.89	-27.55 [-90.79, 35.68]	0.39	16.11 [-7.63, 39.85]	0.18
Drink history (no as reference)	-9.67 [-41.82, 22.47]	0.55	-4.81 [-59.39, 49.76]	0.86	12.92 [-76.80, 102.65]	0.78	-26.48 [-60.17, 7.21]	0.12

Note: *Statistically significant (p < 0.05).
Abbreviation: CI, confidence intervals.

following criteria: more than three days of normal body temperature; significant improvement of respiratory symptoms; the nucleic acid test results for respiratory pathogens should turn as negative twice consecutively (sampling time at least one day apart); and another 14 days of isolation after discharge. As a result, many recovered patients have to be isolated or long-term hospitalized, which may cause depression and anxiety. Studies have found that COVID-19 can cause a certain degree of anxiety symptoms in the community population,²³ so specific COVID-19 patients, such as patients with longer positive nucleic acid duration, should receive psychological intervention as much as possible. We also noticed that there were significant differences in the VT scores and MH scores of patients aged 46 to 69 in the subgroup of the positive nucleic acid duration were longer than 14 days. Compared with other age groups, the group which positive nucleic acid duration was longer than 14 days was more likely to have psychometric properties. This may be because people in this group assume more important responsibilities in the family or society. The pressure they bear is greater than that of other groups. Similarly, there are also significant differences in RE scores in male. These results gave us some hints that COVID-19 infection might have more psychometric properties impact in middle age and males, who need psychological management as early as possible.

The advantage of this study lies in the collection of information on patients diagnosed in all designated hospitals for the treatment of COVID-19 in Wenzhou. The medical information and changes are complete. The quality of data management is well controlled. At the same time, we must also acknowledge a few limitations. First of all, our lost to follow-up rate was high. Because the patients were scattered around, some of them were unable to be contacted or unwilling to participate in the follow-up studies. Second, we lacked a dedicated mental assessment scale, so only the four aspects SF, VT, MH and RE, were evaluated. However, in the data analysis, the relevant parts of interest were still found. Finally, through data analysis, we found that the positive nucleic acid duration was negatively correlated with psychometric properties, but this was only a preliminary result and needed to be further verified.

In summary, this study described for the first time, the psychometric properties of COVID-19 patients without comorbidities in the short term after recovery. Related factors affecting psychometric properties included age,

male sex, and the positive nucleic acid duration. Our findings are useful for early psychological intervention for such health emergencies in the future. Similarly, it is also recommended to measure relevant psychological scales in subsequent related studies.

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Disclosure

The authors report no conflicts of interest for this work.

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