

Retrospective Analysis of Factors Associated with a Prolonged Nucleic Acid Conversion Time in Patients with COVID-19 at Fangcang Shelter Hospital

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Objective: The aim of this study was to explore the related factors for prolonged nucleic acid conversion time (NCT) in patients with SARS-CoV-2 Omicron variant, so as to help to prevent and control the epidemic.

Methods: This study retrospectively included 307 patients diagnosed with mild to moderate COVID-19 who were hospitalized in Shanghai International Exhibition Fangcang Shelter Hospital. Nucleic acid amplification detection method was used to detect 2019-nCoV nucleic acid in nasopharyngeal swab samples. Binary logistic regression models were developed to identify independent risk factors associated with the time to nucleic acid conversion, utilizing the Kaplan-Meier test for survival analysis.

Results: In total, 307 patients were included in the study, with the median of NCT was 8 (6, 10) days, ranging 2 to 24 days, by which patients were divided into early NCT (<8 days) and late NCT (≥8 days). There was no difference between early and late NCT groups in gender, nationality, diabetes, previous sleep disorder, dyssomnia and depression ($P = 0.222, 0.552, 0.118, 0.501, 0.133$ and 0.603 , respectively). There was a statistically significant difference between the two groups at different age levels, hypertension, anxiety ($P=0.002, 0.001, 0.034$). In the late NCT group, compared to early NCT, more patients with symptoms (37.5 vs 19.0%; $P < 0.001$), only cough and expectoration (29.4 vs 14.3; $P=0.001$), myodynia (13.8 vs 4.1; $P=0.014$) and fatigue (13.8 vs 4.1; $P=0.003$) were statistically different. There was no significant difference in the presence or absence of vaccination and the number of vaccination between the two groups ($P=0.340$ and 0.435).

Conclusion: Our study showed that age, hypertension, and anxiety were independent risk factors associated with the NCT in patients with COVID-19. Potential risk factors should be taken into consideration for the strategy of quarantining infected patients.

Keywords: COVID-19, SARS-CoV-2 Viral, risk factors, negative conversion

Introduction

Coronavirus disease 2019 (COVID-19), caused by *severe acute respiratory syndrome coronavirus 2* (SARS-CoV-2), is spreading rapidly throughout the world and burdening health care systems across the globe.¹ Cities have been particularly affected by the COVID-19 pandemic. At the end of February 2022, a wave of SARS-CoV-2 infection quickly emerged in Shanghai, China. Phylogenetic characterization of the SARS-CoV-2 viral genomes of 129 patients during this period and their relationship with the GISAID database revealed that all new viral genomes in Shanghai-infected individuals were clustered in the SARS-CoV-2BA.2.2 subline.²

In late 2021, the Omicron variant (B.1.1.529) of SARS-CoV-2 emerged in South Africa, causing a spike in COVID-19 cases. The World Health Organization labeled it a variant of concern on November 26, 2021. The previous study found Omicron to be 10 times more contagious than the original virus and twice as contagious as Delta, with double the immune evasion capability.² The accumulation of mutations in the Spikes (S) gene specifically could alter the viral pathogenicity and immunogenicity. S gene mutations are also present in the highly transmissible South African variant.³ By February 2022, Shanghai, China, experienced a surge in infections, despite over 90% overall vaccination coverage. However, only 62% of those over 60 were vaccinated, and just 38% had booster shots.⁴ The main circulating Omicron sub-variants were BA1, BA2, and BA3, with all new cases in Shanghai linked to the BA.2.2 subline. Although vaccination continues worldwide, the impact of the vaccine on mutations in the SARS-CoV-2 genes is unclear. It has been suggested that combating covid-19 is to control its source-isolating patients.⁵

According to the current diagnosis and treatment plan for novel coronavirus pneumonia, a positive nucleic acid test for novel coronavirus is the primary criterion for diagnosis and release from isolation.⁶ Therefore, understanding RNA shedding dynamics could help inform preventing the spread of the disease, and intervening in the factors that prolong NCT can shorten the isolation time. At present, there have been many clinical studies of SARS-CoV-2 virus nucleic acid conversion to negative, but the results show that the NCT is very different.⁷ Age, hypertension, D-dimer level, bacterial co-infection and disease severity are associated with viral shedding time.^{8–11} However, data regarding the potential factors associated with the NCT in patients with COVID-19 caused by omicron are limited. In this study, we analyzed the situation in non-severe COVID-19 patients and explored the related factors prolonged NCT, so as to help to prevent and control the epidemic.

Method

Study Design

This study retrospectively included 307 patients diagnosed with COVID-19 who were hospitalized in Shanghai International Exhibition Fangcang Shelter Hospital from April 15, 2022 to May 21, 2022. According to the World Health Organization COVID-19 disease severity classification, mild disease is described as patients who meet the COVID-19 case definition but do not have viral pneumonia or hypoxia. Moderate disease is defined as clinical symptoms of pneumonia (fever, cough, dyspnea, and shortness of breath) and pulse oximetry (SpO₂) $\geq$ 90% (in room air) but no symptoms of severe pneumonia (someone in the Clinical symptoms: respiratory rate >30 /min, severe respiratory distress or SpO₂ $<90\%$, room air). This study was approved by the Ethics Committee of the First Affiliated Hospital of Army Military Medical University (approval no. (B)KY2022160), and was exempt from informed consent.

Although mild cases do not require hospitalization, all nucleic acid-positive patients require centralized isolation management, so all patients are from Fangcang shelter hospitals. Exclusion criteria included a previously diagnosed severe psychiatric illness (eg schizophrenia or bipolar disorder) or severe cognitive impairment, incomplete data records, and those vaccinated with adenovirus and recombinant vaccine.

Existing evidence shows that the diagnostic accuracy of Omicron is not affected by the PCR test routinely used in our country.⁶ At present, nucleic acid amplification detection methods are often used to detect new coronavirus nucleic acid in nasal, oropharyngeal swabs, sputum and other lower respiratory tract secretions, feces and other specimens. Therefore, in this study, the nucleic acid amplification detection method was used to detect the nucleic acid of novel coronavirus in nasopharyngeal swab samples. In instances where the values for positive, negative, and internal controls satisfied the established criteria, a cycle threshold (Ct) value of less than 35 was considered indicative of a positive result.

Measures and Data Collection

The electronic questionnaire was made through the questionnaire star platform. The participants scanned the quick response code of the questionnaire through their mobile phone to complete the questionnaire. The study questionnaire collected basic information including demographic characteristics (gender, age, nationality), admission number, previous sleep status, clinical symptoms (cough, expectoration, rhinobyon, fever, pharyngalgia, fatigue, loss of taste and smell, Myodynia, headache, dizziness, burning ribs).

The Chinese version of the Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. The Chinese version of the PSQI has sufficient reliability, with an internal consistency Cronbach's α of 0.77 to 0.84.¹² The PSQI consists of 18 entries in 7 dimensions: sleep quality, sleep duration, sleep latency, habitual sleep efficiency, sleep disturbance, use of sleeping medications, and daytime dysfunction.¹³ Each item is scored from 0 to 3, with the total score ranging from 0 to 21. A higher score indicates a lower sleep quality. Poor sleep quality was defined as a total score >5 .¹⁴ The Patient Health Questionnaire-9 (PHQ-9) and the General Anxiety Disorder-7 (GAD-7) was used to evaluate the anxiety and depression. PHQ-9 consists of 9 items with a total score of 27. GAD-7 consists of 7 items with a maximum score of 21. Each item is scored from 0 to 3. Higher scores indicate a greater severity of depression / anxiety. A cut-off value of 10 was used to measure the binary outcomes of depression and anxiety.¹⁵

Obtain the participants' admission number via the electronic questionnaire, and collect the participants' case data, including hypertension, diabetes history, Ct value of SARS-CoV-2, and NCT. The Ct values included the first positive nucleic acid and the lowest open reading frames 1ab (ORF 1ab) gene values and nucleocapsid gene (N gene) values during hospitalization. NCT is defined as the duration from the first day of positive RT-PCR result till the first day showing negative on nucleic acid testing successively.¹⁶

Statistical Analysis

Statistical analysis was performed for all data using SPSS 17.0. Categorical variables and ranked data were described as the quantity (n) and percentage (%), non-normally distributed measurement data are represented as the median (M: P25, P75). The Mann-Whitney *U*-test was used to compare the differences between two groups for quantitative variables. In this study, negative conversion of viral RNA during the communicable period, as time-to-event data, was the outcome measure. Covariates with a *p*-value of less than 0.10 in the univariate analysis were subsequently included in the multivariate analysis. Binary logistic regression models were developed to identify independent risk factors associated with the time to nucleic acid conversion, utilizing the Kaplan-Meier test for survival analysis. $p < 0.05$ were considered statistically significant differences.

Results

Demographic Characteristics of Patients

In total, 307 patients were included in the study, with the median of NCT was 8 (6, 10) days, ranging 2 to 24 days, by which patients were divided into early NCT (<8 days) and late NCT (≥ 8 days). The median of early NCT was 6 (4, 7) days (47.88%, $n=147$). The median of late NCT was 10 (8, 13) days (52.12%, $n=160$). Of all patients, 211 were male (68.7%) and 96 were female (31.3%), 299 were Han (97.4%) and 8 were minority (2.6%). There was no difference between early and late NCT groups in gender and nationality ($P = 0.222$ and 0.552 , respectively). There was a statistically significant difference between the two groups at different age levels ($P=0.002$). Detailed demographic characteristics of the patients included in this study are presented in [Table 1](#).

Comorbidity, Sleep Quality, and Psychological Status

There was no difference between early and late NCT groups in diabetes, previous sleep disorder, dyssomnia and depression ($P = 0.118$, 0.501 , 0.133 and 0.603 , respectively). In the late NCT group, compared to early NCT, hypertension are more common (10.6 vs 1.4%; $P = 0.001$), and more patients with symptoms (37.5 vs 19.0%; $P < 0.001$). Anxiety was statistically significant in the early NCT and late NCT groups (3.4 vs 9.4%; $P = 0.034$) ([Table 2](#)).

Clinical Symptom

The clinical symptoms of the patients mainly included 68 cases of cough and expectoration (22.1%), 30 cases of Myodynia (9.8%), 29 cases of fever (9.4%) and 28 cases (9.1%) of fatigue. In the late NCT group, compared to early NCT, only cough and expectoration (29.4 vs 14.3; $P=0.001$), Myodynia (13.8 vs 4.1; $P=0.014$) and fatigue (13.8 vs 4.1; $P=0.003$) were statistically different ([Table 3](#)).

Table 1 Sociodemographic Characteristics

Demographic Characteristics	All Patients (n=307)		Early NCT Group (n=147)		Late NCT Group (n=160)		
	N	%	N	%	N	%	P
Gender							0.222
Male	211	68.7	106	72.1	105	65.6	
Female	96	31.3	41	27.9	55	34.4	
Age (years)							0.002
≤17	7	2.3	4	2.7	3	1.9	
18–30	100	32.6	56	38.1	44	27.5	
31–40	84	27.4	50	34.0	34	21.3	
41–50	59	19.2	13	8.8	46	28.8	
51–60	38	12.4	15	10.2	23	14.4	
≥61	19	6.2	9	6.1	10	6.3	
Nationality							0.552
Han nationality	299	97.4	144	98.0	155	96.9	
Minority	8	2.6	3	2.0	5	3.1	

Abbreviation: NCT, nucleic acid conversion time.

Table 2 Past History, Sleep Quality and Psychological Status in the Two Groups

Characteristics	All Patients (n=307)		Early NCT Group (n=147)		Late NCT Group (n=160)		
	N	%	N	%	N	%	P
Hypertension							0.001
Yes	19	6.2	2	1.4	17	10.6	
No	288	93.8	145	98.6	143	89.4	
Diabetes							0.118
Yes	9	2.9	2	1.4	7	4.4	
No	298	97.1	145	98.6	153	95.6	
Previous sleep disorder							0.501
Yes	57	18.6	25	17.0	32	20.0	
No	250	81.4	122	83.0	128	80.0	
Symptom							<0.001
Yes	88	28.7	28	19.0	60	37.5	
No	219	71.3	199	81	100	62.5	
Dyssomnia							0.133
Yes	108	35.2	58	39.5	50	31.3	
No	199	64.8	89	60.5	110	68.8	
Depression							0.603
Yes	19	6.2	8	5.4	11	6.9	
No	288	93.8	139	94.6	149	93.1	
Anxiety							0.034
Yes	20	6.5	5	3.4	15	9.4	
No	287	93.5	142	96.6	145	90.6	

Abbreviation: NCT, nucleic acid conversion time.

Table 3 Comparison of Clinical Symptoms

	All Patients (n=307)		Early NCT Group (n=147)		Late NCT Group (n=160)		
	N	%	N	%	N	%	P
Symptoms							
Cough, expectoration	68	22.1	21	14.3	47	29.4	0.001
Rhinobyon	11	3.6	6	4.1	5	3.1	0.653
Fever	29	9.4	9	6.1	20	12.5	0.057
Fatigue	28	9.1	6	4.1	22	13.8	0.003
Myodynia	30	9.8	8	5.4	22	13.8	0.014
Dizziness	8	2.6	4	2.7	4	2.5	0.903
Headache	3	1.0	0	0	3	1.9	0.096
Pharyngalgia	17	5.5	8	5.4	9	5.6	0.944
Burning rib	1	0.3	1	0.7	0	0	0.297
Loss of taste and smell	5	1.6	2	1.4	3	1.9	0.722

Abbreviation: NCT, nucleic acid conversion time.

Vaccination Status and Ct Value

In the late NCT group, compared with the early NCT group, the median of the first-time nucleic acid-positive ORF 1ab gene, the first-time nucleic acid-positive N gene, the minimum ORF 1ab gene and the minimum N gene were lower (28.02 vs 31.10, $P=0.002$; 26.22 vs. 29.38, $P=0.001$; 26.45 vs.29.31, $P<0.001$; 24.57 vs. 27.60, $P<0.001$). There was no significant difference in the presence or absence of vaccination and the number of vaccination between the two groups ($P=0.340$ and 0.435)(Table 4).

Sleep Quality

Among the sleep quality indicators, only hypnotics were statistically different in the two groups ($P=0.039$), with the median score of 0.00 (0.00, 0.00) in the overall patient, early NCT and late NCT groups (Table 5).

Table 4 Comparison of Vaccination Status and Ct Values

	All Patients (n=307)		Early NCT Group (n=147)		Late NCT Group (n=160)		
	N	%	N	%	N	%	P
Vaccination							0.340
Yes	279	90.9	136	92.5	143	89.4	
No	28	9.1	11	7.5	17	10.6	
Number of vaccinations							0.435
0	28	9.1	11	7.5	17	10.6	
1	3	1.0	1	0.7	2	1.3	
2	112	36.5	54	36.7	58	36.3	
3	164	53.4	81	55.1	83	51.9	
	M(P25, P75)		M(P25, P75)		M(P25, P75)		P
Ct values							
First-time nucleic acid-positive ORF 1ab gene	29.51(26.05, 33.93)		31.10(26.91, 34.59)		28.02(25.62, 32.48)		0.002
First-time nucleic acid-positive N gene	28.03(24.29, 31.89)		29.38(25.08, 32.48)		26.22(23.65, 30.55)		0.001
Minimum ORF 1ab gene	27.27(24.11, 30.97)		29.31(25.43, 32.52)		26.45(23.87, 28.63)		<0.001
Minimum N gene	25.76(22.72, 29.04)		27.60(24.15, 30.57)		24.57(22.29, 26.96)		<0.001

Abbreviations: NCT, nucleic acid conversion time; Ct values, Cycle threshold values; ORF 1ab, open reading frames 1ab; N gene, nucleocapsid gene.

Table 5 Comparison of Sleep Quality Indicators Between the Two Groups

PSQI Component	All Patients (n=307)	Early NCT Group (n=147)	Late NCT Group (n=160)	Z Value	P
	M(P25, P75)	M(P25, P75)	M(P25, P75)		
Subjective sleep quality	1.00(1.00, 2.00)	1.00(0.00, 2.00)	1.00(1.00, 1.75)	0.116	0.908
Sleep latency	1.00(0.00, 2.00)	1.00(0.00, 2.00)	1.00(0.00, 2.00)	0.729	0.466
Sleep duration	0.00(0.00, 1.00)	1.00(0.00, 1.00)	0.00(0.00, 1.75)	0.636	0.525
Habitual sleep efficiency	0.00(0.00, 1.00)	0.00(0.00, 1.00)	0.00(0.00, 1.00)	1.362	0.173
Sleep disturbance	1.00(1.00, 1.00)	1.00(1.00, 1.00)	1.00(1.00, 1.00)	0.188	0.851
Use of sleep medication	0.00(0.00, 0.00)	0.00(0.00, 0.00)	0.00(0.00, 0.00)	2.063	0.039*
Daytime dysfunction	0.00(0.00, 1.00)	0.00(0.00, 1.00)	0.00(0.00, 1.00)	0.949	0.342

Notes: P < 0.05 was considered to indicate a statistically significant difference (indicated by *).

Abbreviations: PSQI, Pittsburgh Sleep Quality Index; NCT, nucleic acid conversion time.

Table 6 Multivariate Analysis of the Independent Risk Factors for Advanced NCT

	Late NCT Group		
	P	OR	95% C.I. for EXP(B)
Age	0.009*	1.325	1.072–1.636
Hypertension	0.034*	5.571	1.140–27.219
Anxiety	0.042*	3.355	1.043–10.791
Clinical symptoms	0.894	0.913	0.239–3.486
Specific clinical symptoms			
Cough and expectoration	0.162	2.565	0.684–9.618
Fever	0.360	0.573	1.174–1.890
Fatigue	0.025*	5.039	1.226–20.714
Myodynia	0.517	0.664	0.192–2.291
Ct values			
First-time nucleic acid-positive ORF 1ab gene	0.140	1.272	0.924–1.749
First-time nucleic acid-positive N gene	0.360	0.858	0.619–1.190
Minimum ORF 1ab gene	0.388	0.903	0.715–1.139
Minimum N gene	0.250	0.863	0.672–1.109

Notes: P < 0.05 was considered to indicate a statistically significant difference (indicated by *).

Abbreviations: NCT, nucleic acid conversion time; Ct values, Cycle threshold values; ORF 1ab, open reading frames 1ab; N gene, nucleocapsid gene; OR, odds ratio.

Covariate Screening Results

We used $P < 0.10$ to filter covariates, identifying age, hypertension, anxiety, clinical symptoms, cough, expectoration, fever, fatigue, muscle pain, hypnotic drugs, and CT value as factors linked to NCT (Table 1–5). Hypnotic drugs were excluded because they were one of the indicators for judging sleep quality, and the overall difference in sleep quality between the two groups was not statistically significant.

Multivariate Analysis of Independent Risk Factors Associated with the Prolonged NCT of SARS-CoV-2 RNA

Multivariate analysis revealed that older age (OR=1.325, 95% confidence interval [CI]: 1.072–1.636, $P=0.009$), hypertension (OR=5.571, 95% CI: 1.140–27.219, $P=0.034$), anxiety (OR=3.355, 95% CI: 1.043–10.791, $P=0.042$), anxiety (OR=3.355, 95% CI: 1.043–10.791, $P=0.042$), and fatigue (OR=5.039, 95% CI: 1.226–20.714, $P=0.025$) independently increase the risk of prolonged NCT. However, there was no significant difference in the clinical symptoms, cough and expectoration, fever, Myodynia and Ct values (Table 6).

Survival Analysis of Independent Risk Factors for Late NCT

The Kaplan Meier survival curves of 307 COVID-19 patients with SARS-CoV-2 RNA overall negative transformation revealed that the median time for SARS-CoV-2 RNA clearance was 8 days (Figure 1).

We employed the Log rank test to evaluate the various factors on the duration of nucleic acid conversion in patients with COVID-19. The analysis revealed that age is associated with the rate of viral RNA clearance, with a p-value of 0.002 (refer to Figure 2A). Specifically, patients aged 17 years or younger exhibited the most rapid conversion to viral RNA negativity, with a median time of 6 days (95% CI: 4.717–7.283). In contrast, patients aged 41 to 50 years demonstrated the slowest conversion rate, with a median time of 9 days (95% CI: 8.324–9.676). Patients with a history of hypertension exhibited a significantly slower rate of viral RNA negative conversion, as indicated by a median duration of 12 days (95% CI: 9.939–14.061), compared to 7 days (95% CI: 6.562–7.438) for those without hypertension ($P=0.004$, Figure 2B). Anxiety also has been showed associated with the rate of viral RNA negative conversion, with a median duration of 9 days (95% CI: 7.569–10.431) for patients with anxiety, compared to 8 days (95% CI: 7.565–8.435) for those without anxiety ($P=0.008$, Figure 2C). In contrast, fatigue did not present a significant difference in the duration of SARS-CoV-2 RNA negative conversion ($P=0.181$, Figure 2D).

Discussion

Although COVID-19 has disseminated extensively worldwide, there remains considerable debate regarding the factors associated with the timing of viral clearance. It has been reported that increased NCT is an independent risk factor for long-term hospital stay.¹⁷ We hypothesize that intervention with factors that prolong NCT may shorten hospital stay. A nomogram based on predictors influencing persistent viral infection can be used as predictive tools to guide treatment and isolation strategies.¹⁸

Therefore, we performed a retrospective cohort study of 307 confirmed patients with SARS-CoV-2 at Shanghai International Exhibition Fangcang Shelter Hospital. Until now, there is no uniform international definition of NCT, and in this study the definition is consistent with that used in other high-quality studies as described in the Methods section.¹⁶ The median time to viral conversion observed in our study cohort was 8 days (IQR 6–10 days) from the first positive RT-PCR test, similar to the results of the study by Ling et al.¹⁹ Other studies have demonstrated a longer median duration of viral shedding of 12 days (IQR 10–14 days) and 15 days (IQR 12–18 days).^{20,21} The discrepancies might be attributed to the severity of disease, nucleic acid collection, and nucleic acid positive criteria in these studies.

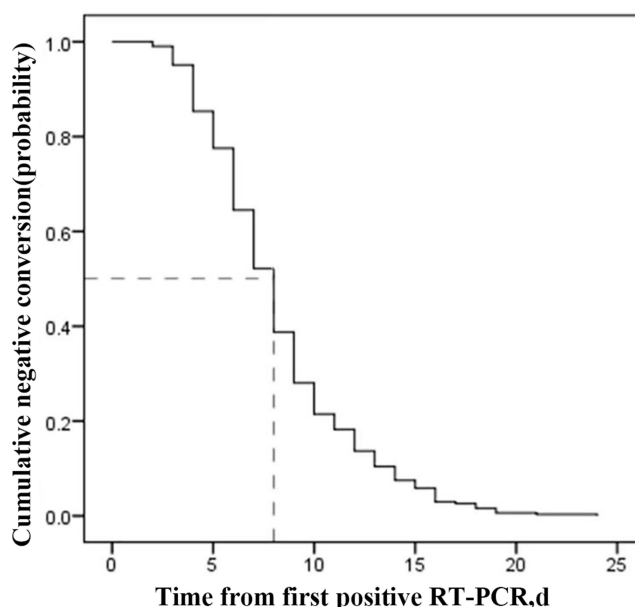


Figure 1 The Kaplan Meier survival curves of 307 COVID-19 patients with SARS-CoV-2 RNA overall negative transformation.

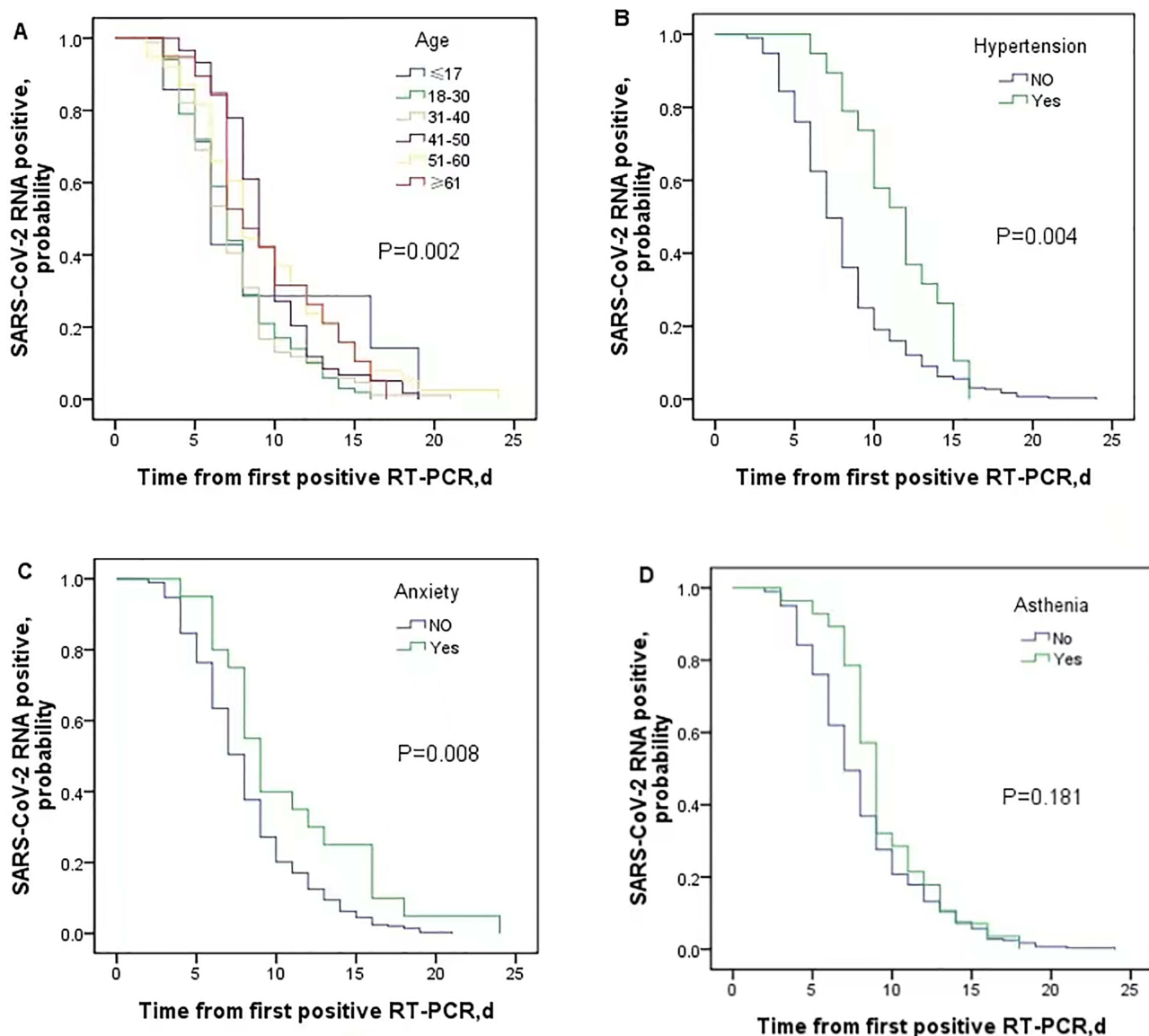


Figure 2 Age was positively associated with NCT of viral RNA in patients (A) Hypertension was positively associated with NCT of viral RNA in patients (B) Anxiety was positively associated with NCT of viral RNA in patients (C) Fatigue had no significant difference in the duration of SARS-CoV-2 RNA negative conversion (D).

In our study, 307 patients were included with a median of 8 (6,10) days of NCT ranging from 2 to 24 days. We divided the patients into early NCT group and late NCT group based on this median. The trough of ORF 1ab gene and N gene was lower in the late NCT group, and the trough of N gene and ORF 1ab gene was negatively correlated with the time of first negative transformation of the virus. Based on this, it is speculated that the lower the Ct value of N gene and ORF 1ab gene (ie the higher the viral load), the longer the time for the virus to turn negative for the first time. Our study showed that age, hypertension, and anxiety were independent risk factors associated with the NCT in patients with COVID-19, but not in terms of clinical symptoms, cough and expectoration, fever, Myodynia and Ct values.

Older individuals are the most vulnerable group in the pandemic.²² The Omicron-predominant wave led to a significant increase in mortality, particularly among the elderly population.²³ Overall, older adults have a substantially higher case fatality rate as compared to younger individuals affected by COVID-19 (42% for those <65 vs 65% > 65 years).²⁴ The results of this study showed that age was related to the duration of viral shedding. There was a significant positive correlation between disease duration and patient age in the asymptomatic group.²⁵ It has been

shown that nasopharyngeal/pharyngeal virus RNA shedding increases with age, whereas fecal virus RNA shedding decreases with age.²⁶ These differences may be related to the age distribution of the included study population, and whether older age prolongs the NCT in covid-19 patients still needs further investigation.

Furthermore, at the time of a covid-19 outbreak, poor prognosis was related with having a comorbid factor. Hypertension is one of the most common risk factors for COVID-19 clinical progression. The possible key biological pathways include oxidative stress, ascorbate and aldarate metabolism, lipid metabolism, immune system and inflammation.²⁷ Hypertension in our study was statistically different in the early NCT and late NCT group. By incorporating multivariate logistic regression equations with multivariate, we found hypertension was independent risk factor associated with the duration of SARS-CoV-2 clearance. This is consistent with current studies.^{11,28}

Participants who were infected with SARS-CoV-2 during the first year of the pandemic were more likely to experience poorer mental health.²⁹ The prevalence of anxiety and depression is high among applicants in the Covid-19 pandemic.³⁰ Interestingly, in this study, anxiety was associated with prolonged NCT, while depression was not. Recent studies have shown that pre-existing mental illness is a major risk factor for depression, anxiety and insomnia.³¹ Therefore, we suggest that while treating the respiratory symptoms of patients with new coronary pneumonia, attention should be paid to the patient's mental health.

Furthermore, we analyzed Ct values for the first and lowest RT-PCR test (negatively associated with viral load). A high viral load at the time of first sampling was a predictor of severe infection and/or death in SARS-CoV-2 infected individuals of all age groups.³² Although we did not find the Ct value as an independent risk factor for prolonged NCT, the first nucleic acid ORF 1ab gene value and the N gene value were lower in the late NCT group compared with the early group ($P = 0.002, 0.001$). This suggests that the higher the viral load, the longer the conversion time may be.

Our study has several limitations. First, this study was a single-center retrospective study, so the results may have been affected by population bias. Secondly, confounding factors were not controlled for in the subgroups of this study. Consequently, the findings of the study suggest an association between risk factors and prolonged NCT, but they do not provide unequivocal evidence to substantiate a causal relationship. Finally, some of the risk factors are not amenable to intervention. However, the real strength of this study lies in the sleep and mood studies conducted when examining clinical data in the Fangcang Shelter population.

Conclusions

This study demonstrated that age, hypertension, and anxiety were independent risk factors prolong the NCT in patients with COVID-19. Potential risk factors should be taken into consideration for the strategy of quarantining infected patients.

Ethical Approval

The authors confirm that all procedures undertaken in this study adhere to the ethical standards set by the appropriate national and institutional committees on human experimentation, as well as the Helsinki Declaration of 1975, with its 2008 revisions. The Ethics Committee of the Faculty of the First Affiliated Hospital of Army Military Medical University approved the protocol of this study (Approval number: (B)KY2022160). To maintain the principle of confidentiality, the data used were anonymized. A waiver of informed consent was granted as all anonymized data was collected retrospectively in accordance with the ethics approval.

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Disclosure

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