

Association of Measles IgG Antibody Titers with Thoracic CT Severity in Hospitalized Patients with COVID-19

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Abstract

Background

Coronavirus disease 2019 (COVID-19) has a broad clinical spectrum ranging from mild respiratory symptoms to severe pneumonia and death. Previous studies have suggested that pre-existing immunity against measles may influence immune responses during SARS-CoV-2 infection; however, the clinical significance of anti-measles IgG titers in COVID-19 remains unclear. Therefore, we aimed to investigate the association between anti-measles IgG titers, clinical severity, COVID-19 Mortality Rate (CMR) score, intensive care unit (ICU) requirement, and mortality in hospitalized COVID-19 patients.

Material and Methods

This cross-sectional study included 153 hospitalized COVID-19 patients (86 males and 67 females). Disease severity was classified according to the NIH COVID-19 Treatment Guidelines. Anti-measles IgG levels were measured using an indirect ELISA assay. Mortality risk was assessed using the COVID-19 Mortality Rate (CMR) score.

Results

Higher anti-measles IgG titers were observed in patients with severe COVID-19 and severe thoracic CT involvement compared with patients with milder disease. Anti-measles IgG titers were significantly higher in patients with severe CT involvement compared with those with non-severe involvement and remained independently associated with severe thoracic CT involvement after adjustment for clinical and laboratory parameters. However, anti-measles IgG levels were not independently associated with mortality or ICU admission. Non-survivors were older, had longer hospital stays, higher CMR scores, and lower admission SpO₂ levels compared with survivors. Similarly, patients requiring ICU admission had higher CMR scores and more severe thoracic CT involvement.

Conclusion

Higher anti-measles IgG titers were independently associated with severe thoracic CT involvement in hospitalized COVID-19 patients. These findings suggest that anti-measles IgG levels may represent a potential immunological marker associated with pulmonary disease severity rather than a direct marker of mortality risk. Further prospective studies with larger populations are needed to clarify the clinical significance of anti-measles IgG responses in COVID-19.

Introduction

Coronavirus Disease 2019 (COVID-19), caused by SARS-CoV-2, remains an important global health concern despite the transition from the acute pandemic phase to the endemic phase. Its clinical course is highly heterogeneous, ranging from asymptomatic infection and mild disease to severe pneumonia, respiratory failure, and death, particularly among high-risk individuals (1). Despite advances in vaccination strategies, antiviral treatments, and clinical care, identifying hospitalized patients at risk of severe disease remains challenging. A better understanding of clinical, radiological, laboratory, and immunological features may facilitate early risk assessment and

individualized patient management. Therefore, the development of practical and reliable prognostic models remains an important area of clinical research (2, 3).

Cohort studies conducted in hospitalized patients with COVID-19 have identified various clinical and laboratory markers associated with poor outcomes. Advanced age, male sex, comorbidities, and severe clinical findings at presentation, as well as biomarkers reflecting inflammation and organ dysfunction, including CRP, ferritin, neutrophil count, creatinine, LDH, glucose, and D-dimer, have been associated with disease severity and mortality (4–10). Among the available prognostic tools, the COVID Mortality Risk (CMR) score is a practical model used to estimate mortality risk in hospitalized patients with COVID-19. However, incorporating novel immunological biomarkers into existing clinical scoring systems may provide additional prognostic information.

Recently, increasing attention has been directed toward the potential effects of pre-existing immunity against other viral infections on the clinical course of COVID-19. Measles-containing vaccines (MCVs) have been suggested to induce heterologous immune responses and trained immunity, potentially providing partial protection against unrelated viral infections, including SARS-CoV-2 (11, 12). In this context, anti-measles IgG levels have emerged as a potential immunological biomarker reflecting host immune responses. However, studies investigating the association between anti-measles IgG levels and COVID-19 severity or clinical outcomes remain limited, and the available findings are inconsistent. Therefore, the prognostic significance of anti-measles IgG in COVID-19 has not yet been established.

In the present study, we aimed to investigate whether anti-measles IgG levels are associated with severe pulmonary involvement and clinical severity in hospitalized patients with COVID-19. In addition, the associations between anti-measles IgG levels, COVID Mortality Risk (CMR) scores, ICU requirement, and mortality were evaluated to determine the potential clinical relevance of this immunological marker.

Material and Methods

This cross-sectional study included 153 adult patients hospitalized with COVID-19 in the Internal Medicine Clinic of Istanbul Health Sciences University Bağcılar Training and Research Hospital between June 2020 and June 2021. Patients with laboratory-confirmed COVID-19 based on nasopharyngeal RT-PCR testing, as well as those with negative RT-PCR results but compatible thoracic CT findings, were included. Diagnosis was established based on clinical, epidemiological, and radiological findings. Disease severity was classified as mild, moderate, or severe according to the NIH COVID-19 Treatment Guidelines (13).

Patients younger than 18 years, pregnant or breastfeeding women, and patients who died due to causes unrelated to COVID-19 were excluded. The study protocol was approved by the Institutional Ethics Committee (approval protocol no. 2020.06.1.06.077). Written informed consent was obtained from all participants. All experiments were performed in accordance with relevant guidelines and regulations (such as the Declaration of Helsinki).

Laboratory assessments included complete blood count, coagulation parameters, biochemical analyses, inflammatory markers, plasma D-dimer, and anti-measles IgG levels. Complete blood count parameters, including leukocyte, neutrophil, lymphocyte, and platelet counts, as well as red cell distribution width (RDW), were analyzed from EDTA-anticoagulated blood samples using the XN-900 analyzer (Sysmex, Japan). Serum biochemical parameters, including renal and liver function tests, myocardial enzymes, total protein, albumin, and inflammatory markers, were measured using AU480 and UniCel DxI 800 analyzers (Beckman Coulter, USA). Coagulation

parameters, including D-dimer, were assessed from citrate plasma samples using the SF-8200 analyzer (Succeder, China).

Serum samples were collected at hospital admission before treatment initiation and stored at – 80°C until analysis. Anti-measles IgG levels were measured in an external central laboratory using an indirect ELISA assay (Anti-Measles Virus ELISA IgG, Euroimmun, Lübeck, Germany) according to the manufacturer’s instructions. Results were categorized as negative (< 0.8), borderline (0.8–1.1), or positive (> 1.1).

Chest radiographs and thoracic CT scans were evaluated by the same radiologist. CT scans obtained within one day before or after hospital admission were reviewed and scored according to predefined criteria. Lobar involvement was graded for each lobe as follows: 0, no involvement; 1, 1–50% involvement; 2, 51–75% involvement; and 3, 76–100% involvement (14).

The COVID Mortality Risk (CMR) score was calculated using clinical and laboratory parameters obtained at hospital admission before treatment initiation. The score incorporates demographic characteristics, vital signs, laboratory findings, and comorbidities, including age, sex, temperature, heart rate, SpO₂, blood glucose, blood urea nitrogen, creatinine, liver function tests, electrolytes, hematological parameters, inflammatory markers, prothrombin time, cardiac dysrhythmias, heart disease, chronic kidney disease, and diabetes mellitus. CMR scores were calculated using the online COVID Analytics Mortality Calculator (15).

Statistical Analysis

Statistical analyses were performed using NCSS (Number Cruncher Statistical System) 2007 software (Kaysville, Utah, USA). Descriptive statistics, including mean, standard deviation, median, frequency, percentage, minimum, and maximum values, were used to summarize the data. The Shapiro–Wilk test was used to assess the normality of continuous variables. Comparisons of quantitative variables between two groups were performed using the Mann–Whitney U test, while comparisons among three or more groups were performed using the Kruskal–Wallis test. Associations between categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

Results

Table 1 presents the demographic, clinical, and radiological characteristics of 153 hospitalized COVID-19 patients according to mortality status. Among the study population, 141 patients (92.2%) survived, whereas 12 patients (7.8%) died during hospitalization. Deceased patients were significantly older than survivors (70.6±14.2 vs. 56.1±16.9 years; p=0.004). The duration of hospital stay was also significantly longer among deceased patients compared with survivors (10.2±4.2 vs. 7.8±7.43 days; p=0.024). Furthermore, deceased patients had significantly higher CMR scores (42.5±29.5 vs. 15.8±16.9; p=0.001) and lower admission SpO₂ levels (91.67±2.7 vs. 94.3±3.3; p=0.006). No statistically significant differences were observed between survivors and deceased patients regarding sex distribution, anti-measles IgG titers, thoracic CT severity scores, ICU admission status, or disease severity classification at admission, indicating that anti-measles IgG levels were not directly associated with in-hospital mortality.

Table 1: Demographic, clinical and radiographic characteristics related to mortality

Variables	Survivor (n = 141) n (%) or mean $\pm$ SD or median (IQR 25–75)	Non-survivor (n = 12) n (%) or mean $\pm$ SD or median (IQR 25–75)	p
Age (years)	56.1 $\pm$ 16.9	70.6 $\pm$ 14.2	0.004^a
Gender			
male	80 (93%)	6 (7%)	0.882 ^b
female	61 (91%)	6 (9%)	
Duration of hospital stay (days)	7.8 $\pm$ 7.43	10.2 $\pm$ 4.2	0.024^a
Anti-measles IgG (ratio)	2.82 $\pm$ 1.03	3 $\pm$ 0.73	0.833 ^a
COVID-19 mortality rate (CMR) score (%)	15.8 $\pm$ 16.9	42.5 $\pm$ 29.5	0.001^a
Radiologic severity in thorax CT (computed tomography)			
none	27 (96.4%)	1 (3.6%)	0.705 ^b
mild	35 (92.1%)	3 (7.9%)	
moderate	39 (92.9%)	3 (7.1%)	
severe	40 (88.9%)	5 (11.1%)	
Oxygen saturation (SpO ₂ %)	94.3 $\pm$ 3.3	91.67 $\pm$ 2.7	0.006^a
ICU admission			
Non-ICU patients	124 (99.2%)	1 (0.8%)	0.055 ^b
ICU patients	17 (60.7%)	11 (39.3%)	
Degree of disease severity on admission			
mild	27 (96.4%)	1 (3.6%)	0.195 ^b
moderate	77 (93.9%)	5 (6.1%)	
severe	37 (86%)	6 (14%)	

Values are presented as mean $\pm$ standard deviation (SD), median (interquartile range [IQR]), or number (%), as appropriate. a Mann–Whitney U test; b Chi-square test.

Statistically significant p-values (<0.05) are indicated in bold. CMR, COVID-19 Mortality Risk; CT, computed tomography; ICU, intensive care unit; SpO₂, peripheral oxygen saturation.

Table 2 presents the demographic, clinical, and radiological characteristics of patients according to disease severity at admission. Disease severity was significantly associated with hospitalization duration, CMR scores, admission SpO₂ levels, body temperature, thoracic CT severity, and ICU admission status. The mean duration of hospital stay increased significantly across mild, moderate, and severe disease groups (4.1 $\pm$ 3.07, 7.5 $\pm$ 7.1, and 11.3 $\pm$ 7.9 days, respectively; p=0.001). Similarly, CMR scores increased significantly with increasing disease severity (8.1 $\pm$ 9.9, 14.01 $\pm$ 15.3, and 31.9 $\pm$ 23.5, respectively; p=0.001). Admission SpO₂ levels decreased progressively with increasing disease severity (96.3 $\pm$ 1.7%, 95.5 $\pm$ 2.07%, and 89.8 $\pm$ 2.1%, respectively; p=0.001). Body temperature was significantly higher in patients with severe disease compared with mild and moderate groups (36.6 $\pm$ 0.5°C, 37.1 $\pm$ 0.7°C, and

37.4±0.8°C, respectively; p=0.001). Severe thoracic CT involvement and ICU admission were significantly more frequent among patients with severe disease (p=0.001 and p=0.002, respectively). Anti-measles IgG titers also differed significantly among severity groups, with the highest titers observed in patients with severe disease (p=0.023). However, age, sex distribution, and mortality status did not differ significantly among disease severity groups (p=0.106, p=0.397, and p=0.195, respectively).

Table 2: Demographic, clinical and radiographic characteristics related to the degree of clinical severity of disease on admission

Variables	Degree of disease severity on admission			
	Mild (n=28)	Moderate (n=82)	Severe (n=43)	p
	n (%) or mean ± SD or median (IQR 25–75)			
Age (years)	52.6±19.4	56.3±16.1	61.9±16.8	0.106 ^a
Gender				
male	13 (15.1%)	46 (53.5%)	27 (31.4%)	0.397 ^b
female	15 (22.4%)	36 (53.7%)	16 (23.9%)	
Duration of hospital stay (days)	4.1±3.07	7.5±7.1	11.3±7.9	0.001^a
Anti-measles IgG (ratio)	2.4±1.02	2.8±1.05	3.1±0.82	0.023^a
COVID-19 mortality rate (CMR) score (%)	8.1±9.9	14.01±15.3	31.9±23.5	0.001^a
Radiologic severity in thorax CT (computed tomography)				
none	28 (100%)	0 (0%)	0 (0%)	0.001^b
mild	0 (0%)	28 (73.7%)	10 (26.3%)	
moderate	0 (0%)	34 (81%)	8 (19%)	
severe	0 (0%)	20 (44.4%)	25 (55.6%)	
Oxygen saturation (SpO ₂ %)	96.3±1.7	95.5±2.07	89.8±2.1	0.001^a
ICU admission				
Non-ICU patients	27 (%21.6)	70 (%56)	28 (%22.4)	0.002^b
ICU patients	1 (%3.6)	12 (%42.9)	15 (%53.6)	
Mortality status				
survivor	27 (%19.1)	77 (%54.6)	37 (%26.2)	0.195 ^b
non-survivor	1 (%8.3)	5 (%41.7)	6 (%50)	
Fever (°C)	36.6±0.5	37.1±0.7	37.4±0.8	0.001^a

Values are presented as mean ± standard deviation (SD), median (interquartile range [IQR]), or number (%), as appropriate. a Kruskal–Wallis test; b Chi-square test. Statistically significant p-values (<0.05) are indicated in bold.

CMR, COVID-19 Mortality Risk; CT, computed tomography; ICU, intensive care unit; SpO₂, peripheral oxygen saturation.

When patients were categorized according to anti-measles IgG seropositivity status, no statistically significant association was observed between anti-measles IgG positivity and thoracic CT involvement severity (Table 3). These findings suggest that quantitative anti-measles IgG titers may provide more clinically relevant information than seropositivity status alone.

Table 3. Distribution of anti-measles IgG seropositivity according to thoracic CT involvement severity in patients with COVID-19

		n	Anti-measlesIgG		p
			negative	positive	
Classifications of COVID-19 PneumonicInfiltrationon chest CT	0-none (0%)	28	3 (33%)	25 (17%)	0.491
	1-mild (1–50%)	38	2 (22%)	36 (25%)	
	2-moderate (51–75%)	42	3 (33%)	39 (27%)	
	3-severe (76–100%)	45	1 (11%)	44 (30%)	

Values are presented as number (%). Comparisons were performed using the Chi-square test. Anti-measles IgG seropositivity was defined according to the manufacturer’s recommended cut-off values. A p-value <0.05 was considered statistically significant. CT, computed tomography; IgG, immunoglobulin G.

In pairwise comparisons of anti-measles IgG titers according to thoracic CT severity categories (Table 4), no significant differences were found between the severe involvement group and the mild or moderate involvement groups (p=0.306 and p=0.189, respectively). However, when patients with severe thoracic involvement were compared with those without severe involvement (none, mild, and moderate combined), anti-measles IgG titers were significantly higher in the severe group (p=0.040). In addition, patients without radiological involvement had significantly lower IgG titers compared with those with severe involvement (p=0.005).

Table 4. Comparison of anti-measles IgG titers according to thoracic CT involvement severity

Group 1	n	Mean IgG	Median	Group 2	n	Mean IgG	Median	U	p
Mild	38	2.86	3.11	Severe	45	3.11	3.39	742.5	0.306
Moderate	42	2.78	3.03	Severe	45	3.11	3.39	790.0	0.189
Nonsevere	108	2.72	2.99	Severe	45	3.11	3.39	1917.0	0.040
None	28	2.45	2.61	Severe	45	3.11	3.39	384.5	0.005

Values are presented as mean and median values. Comparisons were performed using the Mann–Whitney U test.

Table 5: Demographic, clinical and radiographic characteristics related to ICU admission

Variables	Non-ICU patients (n = 125) n (%) or mean $\pm$ SD or median (IQR 25–75)	ICU patients (n = 28)	p
Age (years)	56.1 $\pm$ 17.4	62.3 $\pm$ 15.5	0.093 ^a
Gender			
male	69 (80.2%)	17 (19.8%)	0.748 ^b
female	56 (83.6%)	11 (16.4%)	
Duration of hospital stay (days)	7.4 $\pm$ 6.7	10.3 $\pm$ 8.7	0.001^a
Anti-measles IgG (ratio)	2.78 $\pm$ 1.03	3.09 $\pm$ 0.85	0.183 ^a
COVID-19 mortality rate (CMR) score (%)	15.5 $\pm$ 17.3	29 $\pm$ 24.4	0.001^a
Radiologic severity in thorax CT (computed tomography)			
none	27 (96.4%)	1 (3.6%)	0.024^b
mild	31 (81.6%)	7 (18.4%)	
moderate	36 (85.7%)	6 (14.3%)	
severe	31 (68.9%)	14 (31.1%)	
Oxygen saturation (SpO ₂ %)	94.5 $\pm$ 3.1	92.0 $\pm$ 3.5	0.001^a
Total mortality rate (number) (%)	1 (0.8%)	11 (39.2%)	0.001^b

Values are presented as mean $\pm$ standard deviation (SD), median (interquartile range [IQR]), or number (%), as appropriate. a Mann–Whitney U test; b Chi-square test.

Statistically significant p-values (<0.05) are indicated in bold. CMR, COVID-19 Mortality Risk; CT, computed tomography; ICU, intensive care unit; SpO₂, peripheral oxygen saturation.

Table 5 presents the demographic, clinical, and radiological characteristics of patients according to ICU admission status. No statistically significant differences were observed between ICU and non-ICU patients regarding age or sex (62.3 $\pm$ 15.5 vs. 56.1 $\pm$ 17.4 years, p=0.093; and p=0.748, respectively). The duration of hospital stay was significantly longer in ICU patients compared with non-ICU patients (10.3 $\pm$ 8.7 vs. 7.4 $\pm$ 6.7 days; p=0.001). CMR scores were significantly higher among ICU patients (29.0 $\pm$ 24.4 vs. 15.5 $\pm$ 17.3; p=0.001). In addition, thoracic CT severity scores were significantly higher (p=0.024), while admission SpO₂ levels were significantly lower in ICU patients (p=0.001). In-hospital mortality was significantly higher among ICU patients compared with non-ICU patients (p=0.001).

In univariable logistic regression analysis, anti-measles IgG titers were not significantly associated with mortality or ICU admission. However, higher anti-measles IgG titers were significantly associated with severe thoracic CT involvement. Each one-unit increase in anti-measles IgG titer was associated with a 53% increase in the odds of severe CT involvement (OR=1.53; 95% CI: 1.03–2.25; p=0.033) (Table 6).

Table 6. Univariable logistic regression analysis of the association between anti-measles IgG titers and clinical outcomes

Outcome	n	Event number	OR	%95 GA	p
Mortality	153	12	1.21	0.64-2.26	0.557
ICU admission	153	28	1.40	0.89-2.20	0.148
Severe CT involvement	153	45	1.53	1.03-2.25	0.033

OR, odds ratio; CI, confidence interval; ICU, intensive care unit; CT, computed tomography.

In multivariable logistic regression models adjusted for age, sex, CMR score, and SpO₂, anti-measles IgG titers were not independently associated with mortality or ICU admission. CMR score was independently associated with mortality (OR=1.04; 95% CI: 1.01–1.07; p=0.014), whereas SpO₂ was independently associated with ICU admission (OR=0.85; 95% CI: 0.74–0.98; p=0.024). In the model evaluating severe thoracic CT involvement, anti-measles IgG titer remained independently associated with severe thoracic CT involvement (OR=1.68; 95% CI: 1.08–2.63; p=0.022). Additionally, SpO₂ was negatively associated with severe CT involvement (OR=0.75; 95% CI: 0.65–0.86; p<0.001) (Table 7).

Table 7: Multivariable logistic regression analysis for mortality, ICU admission and severe CT involvement

Outcome	Variable	OR	%95 GA	p
Mortality	Measles IgG titers	1.10	0.55-2.20	0.794
Mortality	Age	1.02	0.98-1.07	0.325
Mortality	Gender	1.19	0.32-4.38	0.791
Mortality	CMR score	1.04	1.01-1.07	0.014
Mortality	SpO ₂	0.91	0.75-1.11	0.351
ICU admission	Measles IgG titers	1.34	0.81-2.20	0.252
ICU admission	Age	1.00	0.97-1.03	0.887
ICU admission	Gender	0.71	0.29-1.74	0.453
ICU admission	CMR score	1.02	1.00-1.05	0.094
ICU admission	SpO ₂	0.85	0.74-0.98	0.024
Severe CT involvement	Measles IgG titers	1.68	1.08-2.63	0.022
Severe CT involvement	Age	0.97	0.94-1.00	0.030
Severe CT involvement	Gender	0.63	0.28-1.38	0.247
Severe CT involvement	CMR score	0.99	0.96-1.01	0.269
Severe CT involvement	SpO ₂	0.75	0.65-0.86	<0.001

OR, odds ratio; CI, confidence interval; CMR, COVID-19 Mortality Risk; ICU, intensive care unit; CT, computed tomography; SpO₂, peripheral oxygen saturation.

Discussion

In our study, the association between anti-measles IgG titers and COVID-19 mortality and disease severity was investigated. Higher anti-measles IgG titers were observed in patients with severe clinical disease and severe

thoracic CT involvement compared with patients with milder disease. Although anti-measles IgG titers were higher in non-survivors than in survivors, this difference was not statistically significant, and anti-measles IgG levels were not independently associated with mortality. However, a significant association was observed between anti-measles IgG levels and disease severity assessed by thoracic CT. Furthermore, after adjustment for clinical and laboratory parameters, anti-measles IgG titers were shown to be independently associated with severe thoracic CT involvement in patients with COVID-19. These findings suggest that anti-measles IgG levels may reflect an immunological response associated with radiological disease severity rather than mortality risk. Although anti-measles IgG titers were not independent predictors of mortality or ICU admission, they were independently associated with severe thoracic CT involvement. Therefore, anti-measles IgG may represent a potential immunological marker of severe pulmonary involvement rather than a direct prognostic marker of adverse clinical outcomes.

Older age and male gender have been well-established risk factors associated with mortality in COVID-19 infection. In our study, non-survivors were significantly older than survivors; however, no significant association was observed between mortality and male gender. Similar findings have been reported in previous studies, suggesting that the impact of sex differences on COVID-19 outcomes may vary depending on demographic and socioeconomic factors (16). Furthermore, CMR scores were significantly higher and the duration of hospitalization was longer among deceased patients, consistent with previous reports (17). Although anti-measles IgG titers tended to be higher among non-survivors and ICU patients, these differences did not reach statistical significance. These findings indicate that increased anti-measles IgG levels may be associated with the severity of pulmonary involvement rather than fatal outcomes.

In the present study, higher anti-measles IgG titers were observed in patients with severe COVID-19 compared with those with mild or moderate disease. This finding may suggest the involvement of enhanced immune activation, including polyclonal B-cell activation and recall of pre-existing immunity. Systemic inflammation associated with SARS-CoV-2 infection has been suggested to promote B-cell activation and may increase antibody secretion from memory B cells without requiring new measles virus exposure (18). However, although anti-measles IgG titers differed significantly among mild, moderate, and severe COVID-19 groups, the proportion of patients with positive anti-measles IgG results did not differ significantly according to disease severity. This finding may be explained by a ceiling effect and highlights the importance of evaluating antibody titers rather than simply assessing seropositivity or seronegativity.

Several previous studies have investigated the potential relationship between measles-mumps-rubella (MMR) vaccination and COVID-19 severity. In contrast, Mysore et al. demonstrated a possible protective role of MMR memory T-cell responses against SARS-CoV-2 infection (19). However, the primary aim of our study was not to evaluate the effect of vaccination but rather to investigate the association between anti-measles antibody titers and COVID-19 clinical outcomes. In our cohort, anti-measles IgG titers were significantly associated with severe thoracic CT involvement. Similarly, Salamony et al. reported higher measles antibody titers among patients with clinical deterioration, suggesting that elevated antibody levels may not prevent COVID-19 progression (20). They also suggested that MMR antibody responses may have potential prognostic implications for severe systemic outcomes, although further validation is required. In contrast to a potential protective role of pre-existing MMR immunity suggested in some studies, our findings indicate that higher anti-measles IgG titers were associated with increased risk of severe pulmonary involvement. Each one-unit increase in anti-measles IgG titer was associated with a 1.53-fold increased risk of severe pulmonary involvement in patients with COVID-19.

COVID-19 mortality is a complex and multifactorial outcome influenced by differences in mortality reporting systems, demographic characteristics, and population-level factors across countries (21). In hospitalized patients

with COVID-19, older age, comorbidities, and clinical deterioration during hospitalization have been identified as important predictors of mortality (22). Therefore, several prognostic models have been developed to evaluate the risk of mortality, disease severity, and intensive care unit (ICU) requirement in patients with COVID-19. Among these models, the COVID Mortality Risk (CMR) score was developed as a practical tool to estimate mortality risk using demographic characteristics, clinical findings, laboratory parameters, and comorbidities (23). In the present study, we evaluated the association between the CMR score and clinical outcomes, including mortality risk, disease severity, and ICU admission. The CMR score was significantly higher in patients requiring ICU care compared with non-ICU patients (29.0% vs. 15.5%, respectively) and in patients with more severe clinical presentations at admission (8.1% in mild, 14.0% in moderate, and 31.9% in severe disease groups). These findings suggest that the CMR score may be useful for the early identification of patients at increased risk of adverse COVID-19 outcomes, particularly mortality (23).

To our knowledge, few studies have evaluated the association between anti-measles IgG titers, clinical severity, and CMR scores in hospitalized COVID-19 patients. However, several limitations should be acknowledged. First, the relatively small sample size and limited follow-up period may have reduced the statistical power to detect significant associations between anti-measles IgG levels and certain clinical or laboratory parameters. Second, anti-measles IgG levels were measured only once at hospital admission. Serial measurements during the disease course may provide additional information regarding dynamic changes in antibody levels and their relationship with clinical outcomes.

Despite these limitations, our study provides evidence that anti-measles IgG titers are independently associated with severe thoracic CT involvement in patients with COVID-19. We observed that higher anti-measles IgG levels were associated with an increased risk of severe radiological pulmonary involvement. Further prospective studies with larger populations and serial antibody measurements are required to clarify the clinical significance of anti-measles IgG responses and their potential role as an immunological marker of disease severity.

Conclusion

Although COVID-19 has transitioned from the pandemic phase to a more sporadic pattern, identifying risk factors associated with severe disease remains important for optimizing patient management and preparing for potential future outbreaks. In this study, the CMR score calculated at hospital admission was associated with mortality risk and disease severity, suggesting its potential utility in early risk stratification of hospitalized COVID-19 patients. Furthermore, higher anti-measles IgG titers were independently associated with severe thoracic CT involvement, indicating that higher anti-measles antibody levels may reflect an immune response associated with severe pulmonary involvement. Further prospective studies with larger populations are required to clarify the clinical significance of anti-measles IgG titers and their potential role in COVID-19 prognostic assessment.

Declarations

Funding: This research received no external funding.

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References

1. Phelan AL, Katz R, Gostin LO. The Novel Coronavirus Originating in Wuhan, China: Challenges for Global Health Governance. *JAMA*. 2020;323(8):709–710. 10.1001/jama.2020.1097. PMID:31999307.
2. Worldometer. Coronavirus Cases. Available from: <https://www.worldometers.info/coronavirus>. Accessed July 28, 2026.
3. Rosenthal N, Cao Z, Gundrum J, Sianis J, Safo S. Risk Factors Associated With In-Hospital Mortality in a US National Sample of Patients With COVID-19. *JAMA Network Open*. 2020;3(12):e2029058. 10.1001/jamanetworkopen.2020.29058. PMID:33301018.
4. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*. 2020;323(11):1061–1069. 10.1001/jama.2020.1585. PMID:32031570.
5. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020;382:1708–20. 10.1056/NEJMoa2002032. . PMID:32109013.

6. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet*. 2020;395(10229):1054–62. 10.1016/S0140-6736(20)30566-3. . PMID:32171076.
7. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA*. 2020;323(20):2052–2059. 10.1001/jama.2020.6775. PMID:32320003.
8. Liang WH, Guan WJ, Li CC, Li YK, Liang HR, Zhao Y, Liu XQ, Sang L, Chen RC, Tang CL, Wang T, Wang W, He QH, Chen ZS, Wong SS, Zanin M, Liu J, Xu X, Huang J, Li JF, Ou LM, Cheng B, Xiong S, Xie ZH, Ni ZY, Hu Y, Liu L, Shan H, Lei CL, Peng YX, Wei L, Liu Y, Hu YH, Peng P, Wang JM, Liu JY, Chen Z, Li G, Zheng ZJ, Qiu SQ, Luo J, Ye CJ, Zhu SY, Cheng LL, Ye F, Li SY, Zheng JP, Zhang NF, Zhong NS, He JX. Clinical characteristics and outcomes of hospitalised patients with COVID-19 treated in Hubei (epicentre) and outside Hubei (non-epicentre): a nationwide analysis of China. *Eur Respir J*. 2020;55(6):2000562. 10.1183/13993003.00562-2020. . PMID:32269086. PMCID:PMC7144336.
9. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L et al. Features of 20,133 UK patients in hospital with COVID-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. *BMJ*. 2020;369:m1985. 10.1136/bmj.m1985. PMID:32449279.
10. Kim T. Improving preparedness for and response to coronavirus disease 19 (COVID-19) in long-term care hospitals in Korea. *Infect Chemother*. 2020;52(2):133–41. PMID:32406211; PMCID:PMC7335647.
11. Shrivastava J, Narang M, Gomber S. Measles, mumps and rubella vaccine and heterologous immunity: a way out of the COVID-19 crisis? *Sudan J Paediatr*. 2022;22(1):10–8. 10.24911/SJP.106-1621869672. . PMID:35958081; PMCID:PMC9361497.
12. Mysore V, Cullere X, Settles ML, Ji X, Kattan MW, Desjardins M, et al. Protective heterologous T cell immunity in COVID-19 induced by the trivalent MMR and Tdap vaccine antigens. *Med (N Y)*. 2021;2(9):1050–e10717. 10.1016/j.medj.2021.08.004. . PMID:34414383.
13. World Health Organization. Technical guidance–Coronavirus disease (COVID-19): Naming the coronavirus disease (COVID-19) and the virus that causes it. Geneva: World Health Organization. 2020 [cited 2026 Jul 28]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance>
14. 14, Pan F, Ye T, Sun P, Gui S, Liang B, Li L, et al. Time course of lung changes on chest CT during recovery from 2019 novel coronavirus (COVID-19) pneumonia. *Radiology*. 2020;295(3):715–21. 10.1148/radiol.20200370. . PMID:32191587.
15. COVID Analytics. COVID-19 Mortality Risk Calculator. [Internet]. COVID Analytics; 2020 [cited 2026 Jul 28]. Available from: https://www.covidanalytics.io/mortality_calculator
16. Beegle K, Demombynes G, de Walque D, Gubbins P, Veillard J. COVID-19 increased existing gender mortality gaps in high-income more than middle-income countries. *Int J Infect Dis*. 2024;148:107167. 10.1016/j.ijid.2024.107167. PMID:39233048.
17. Bertsimas D, Lukin G, Mingardi L, Nohadani O, Orfanoudaki A, Stellato B, Hellenic COVID-19 Study Group, et al. COVID-19 mortality risk assessment: An international multi-center study. *PLoS ONE*. 2020;15(12):e0243262. 10.1371/journal.pone.0243262. . PMID:33296405; PMCID:PMC7725386.
18. Sette A, Crotty S. Adaptive immunity to SARS-CoV-2 and COVID-19. *Cell*. 2021;184(4):861–80. 10.1016/j.cell.2021.01.007. . PMID:33497610; PMCID:PMC7803150.
19. Mysore V, Cullere X, Settles ML, Ji X, Kattan MW, Desjardins M, et al. Protective heterologous T cell immunity in COVID-19 induced by the trivalent MMR and Tdap vaccine antigens. *Med (N Y)*. 2021;2(9):1050–e10717.

PMID:34414383; PMCID:PMC8363466.

20. Salamony A, Shamikh Y, Amer K, Elnagdy T, Elnakib M, Yehia AA, et al. Are Measles-Mumps-Rubella (MMR) Antibodies Friends or Foes for Covid-19 Disease? Arch Immunol Ther Exp (Warsz). 2023;71(1):15. 10.1007/s00005-023-00680-1. . PMID:37341786; PMCID:PMC10284972.
21. Kontis V, Bennett JE, Rashid T, et al. Magnitude, demographics and dynamics of the effect of the first wave of the COVID-19 pandemic on all-cause mortality in 21 industrialized countries. Nat Med. 2020;26:1919–28.
22. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020;395(10229):1054–62. 10.1016/S0140-6736(20)30566-3. . PMID:32171076; PMCID:PMC7270627.
23. Bertsimas D, Lukin G, Mingardi L, Nohadani O, Orfanoudaki A, Stellato B, Hellenic COVID-19 Study Group, et al. COVID-19 mortality risk assessment: An international multi-center study. PLoS ONE. 2020;15(12):e0243262. 10.1371/journal.pone.0243262. . PMID:33296405; PMCID:PMC7725386.