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A Comparison of the Severity of Pulmonary Involvement in Hospitalized COVID-19 Patients between the Arab and Bakhtiari Ethnic Groups

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ABSTRACT

Background and Objective: Coronavirus disease 2019 (COVID-19), as recognized by the World Health Organization (WHO), is influenced in terms of symptom severity and complication development by a range of risk factors, including age, sex, race and ethnicity, genetics, obesity, and underlying comorbidities. Among these, race is considered a fundamental risk determinant. The present study aimed to compare the severity of pulmonary involvement in hospitalized patients with COVID-19 between the Arab and Bakhtiari ethnic groups.

Methods: A cross-sectional design was employed, enrolling 396 patients diagnosed with COVID-19 who exhibited pulmonary manifestations during the sixth wave (Omicron variant) and belonged to either the Arab or Bakhtiari ethnic groups, irrespective of their final hospitalization outcomes. All participants had been referred to Razi Hospital in Ahvaz in 2021. In this research, the severity of pulmonary involvement, as assessed on CT scans of COVID-19 patients, was categorized as mild, moderate, or severe, and its association with patient ethnicity was evaluated and compared.

Findings: A total of 396 patients were enrolled, comprising 198 Bakhtiari and 198 Arab individuals. A statistically significant association was found between ethnicity and the degree of pulmonary involvement. The frequencies of mild, moderate, and severe CT-based involvement in the Bakhtiari cohort were 81, 49, and 68, respectively, compared to 78, 70, and 50 in the Arab cohort ($p=0.03$). The corresponding mean ages for mild, moderate, and severe involvement were 40.91±16.18, 47.95±16.53, and 48.33±16.24 years, respectively ($p<0.001$).

Conclusion: Our results revealed that patients of Bakhtiari ethnicity exhibited a greater prevalence of severe pulmonary involvement attributable to COVID-19 when compared with their Arab counterparts.

Keywords: *Ethnicity, Pulmonary Involvement, COVID-19 Patients, Arab Ethnicity, Bakhtiari Ethnicity.*

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Introduction

In December 2019, an outbreak of pneumonia cases attributable to an unidentified pathogenic agent emerged in Wuhan, China (1). Subsequent etiological investigations conclusively established that the underlying cause was a previously unrecognized coronavirus strain. This novel pathogen, subsequently termed SARS-CoV-2, belongs to the family Coronaviridae and is now documented as the seventh distinct coronavirus species known to infect human hosts, joining the ranks of HCoV-NL63, HCoV-229E, HCoV-OC43, HCoV-HKU1, the severe acute respiratory syndrome coronavirus (SARS-CoV), and the Middle East respiratory syndrome coronavirus (MERS-CoV) (2, 3).

The International Committee on Taxonomy of Viruses (ICTV), upon completing full genetic sequencing of the viral genome, officially adopted the nomenclature SARS-CoV-2. Concurrently, on February 11, 2020, the World Health Organization (WHO) formally designated the clinical condition caused by this virus as coronavirus disease 2019, abbreviated as COVID-19. The disease rapidly transcended geographic boundaries, evolving into a global health crisis with a considerable death toll across affected nations. In light of these developments, the WHO first declared COVID-19 a Public Health Emergency of International Concern on January 30, 2020, and, given its sustained global transmission, subsequently upgraded its status to a pandemic on March 11, 2020 (4).

The most frequently reported clinical features of COVID-19 include fever (81-94%), cough (65-78%), myalgia or fatigue (21-65%), respiratory failure, and acute respiratory distress syndrome (ARDS) (4-29%), along with other symptoms (5). A variety of diagnostic approaches are being employed in ongoing studies, including RT-PCR, chest radiography, ultrasound, and CT imaging. Nevertheless, the diagnostic accuracy and clinical utility of these modalities remain incompletely established (6, 7), and their sensitivity and specificity profiles differ substantially (8). Moreover, cost and availability are critical determinants in diagnostic selection (9).

Chest CT is utilized as a minimally invasive and accessible imaging tool for COVID-19 diagnosis (10). Several risk determinants, including age, sex, racial and ethnic background, genetic factors, obesity, and pre-existing medical conditions, have been shown to modulate symptom severity and pulmonary involvement (11). Ethnic-specific genetic variations—for instance, in endothelial ACE2 expression, vitamin D status, and cardiovascular risk profiles—may underlie differential susceptibility to severe respiratory infection and related complications (12, 13). Accordingly, the severity of COVID-19 and the incidence of pulmonary sequelae may vary across ethnicities. Numerous international studies have investigated these associations and documented significant interethnic differences in disease severity, attack rates, and adverse outcomes (14-16).

Given the scarcity of available data concerning ethnic disparities in COVID-19 outcomes within the Iranian population, the present study was designed to compare the degree of pulmonary involvement—as assessed by computed tomography (CT) imaging—between hospitalized patients of Arab and Bakhtiari descent diagnosed with COVID-19.

Methods

This cross-sectional study was conducted after obtaining ethical approval from the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (approval code: IR.AJUMS.REC.1401.156). A total of 396 patients diagnosed with COVID-19 during the sixth wave

(Omicron variant) were enrolled. All participants had been admitted to Razi Hospital in Ahvaz in 2021 due to pulmonary complications, irrespective of their final clinical outcome (discharge or death), and were free of major underlying conditions including cancer and diabetes. Patients whose medical records lacked CT imaging performed at our facility or who did not belong to either the Arab or Bakhtiari ethnic groups were excluded. The medical records of all hospitalized, PCR-confirmed COVID-19 cases were meticulously reviewed, and relevant clinical and demographic data were extracted using a standardized data collection form. Chest CT images obtained at the time of initial admission were independently and simultaneously evaluated by two experienced radiologists to ensure consistency. Only baseline CT scans were utilized for grading pulmonary involvement severity; any follow-up scans were not re-assessed for the purposes of this study. The variables analyzed included age, sex, CT-based pulmonary involvement severity (categorized as mild, moderate, or severe), and patient ethnicity.

Upon enrollment, chest CT images were evaluated for characteristic COVID-19 findings, including diffuse ground-glass opacities, consolidations, irregular crazy paving patterns, and ancillary radiological signs. A standardized 25-point semi-quantitative scoring system was employed to assess the extent of pulmonary involvement across the five lung lobes (17, 18). Each lobe received a score from 1 to 5 based on the percentage of involvement: 1 for <5%, 2 for 5%-25%, 3 for 26%-49%, 4 for 50%-75%, and 5 for >75%. The cumulative score ranged from 0 (no involvement) to 25 (maximal involvement), as established by the Iranian Society of Radiology (19). Individual lobe scores were recorded separately, and the total score was computed. Based on total scores, patients were stratified into three severity groups: mild (<8), moderate (8-12), and severe (>12), a classification previously validated in the literature (20). Age subgroups were also defined as <30 years, 30-59 years, and >60 years. Sample size determination was performed using G*Power software (21).

The normality of continuous variables was verified using the Kolmogorov–Smirnov test. Statistical analyses were conducted with SPSS version 27, utilizing chi-square tests and one-way analysis of variance (ANOVA), with a significance threshold set at $p<0.05$.

Results

A total of 396 patients were enrolled, comprising 198 Bakhtiari and 198 Arab individuals. A statistically significant association was found between ethnicity and the degree of pulmonary involvement. The frequencies of mild, moderate, and severe CT-based involvement in the Bakhtiari cohort were 81, 49, and 68, respectively, compared to 78, 70, and 50 in the Arab cohort ($p=0.03$) (Table 1). The corresponding mean ages for mild, moderate, and severe involvement were 40.91±16.18, 47.95±16.53, and 48.33±16.24 years, respectively ($p<0.001$).

The age range of the participants was 28.75 to 73.61 years. Of the total cohort, 239 patients (60.4%) were male and 157 (39.6%) were female. In the Arab ethnic group, the age range was 27.31 to 60.75 years, with 125 males (63.1%) and 73 females (36.9%). In the Bakhtiari group, the age range was 29.92 to 62.96 years, with 114 males (57.6%) and 84 females (42.4%).

Furthermore, when participants were categorized by age into subgroups of <30, 30-59, and >60 years, a statistically significant difference in pulmonary involvement severity was observed across these subgroups ($p=0.01$) (Table 2).

Table 1. Comparison of pulmonary involvement between both ethnic groups based on severity of pulmonary involvement

	Severity of pulmonary involvement			p-value
	Mild	Moderate	Severe	
Ethnicity				
Bakhtiari	81	49	68	0.03
Arab	78	70	50	
Comparisons between groups				
Bakhtiari	81	49	-	0.10
Arab	78	70	-	0.27
Bakhtiari	81	-	68	0.01
Arab	78	-	50	0.01
Bakhtiari	-	49	68	0.01
Arab	-	70	50	0.01

Table 2. Comparison of pulmonary involvement severity across the three main age groups

Age Groups	Severity of Pulmonary Involvement			p-value
	Mild	Moderate	Severe	
<30	43	15	15	0.01
30-59	92	69	73	0.01
>60	24	35	30	0.01

A statistically significant association was found between ethnicity and the degree of pulmonary involvement (p=0.039). Pairwise comparisons between ethnic groups across severity categories revealed no significant differences for mild versus moderate, or mild versus severe involvement. However, when comparing moderate versus severe involvement, a significant intergroup difference emerged between the Bakhtiari and Arab cohorts (p=0.011), with Bakhtiari patients exhibiting a higher proportion of severe involvement. Moreover, a significant sex-based difference in pulmonary involvement severity was also observed (p<0.001) (Table 3).

Table 3. Comparison of pulmonary involvement between both sexes, based on severity of pulmonary involvement

Pulmonary Involvement	Gender (count)		p-value
	Male	Female	
Severity of Pulmonary Involvement			
Mild	121	38	<0.001
Moderate	56	63	<0.001
Severe	62	56	<0.001
Between affected groups			
Mild-Moderate	-	-	<0.001
Mild-Severe	-	-	<0.001
Moderate-Severe	-	-	0.39

Discussion

The current study demonstrated a statistically significant disparity in pulmonary involvement severity between the Bakhtiari and Arab ethnic cohorts. Our results indicate that severe pulmonary involvement attributable to COVID-19 was substantially more prevalent among Bakhtiari patients than among their Arab counterparts.

Throughout the course of human history, various ethnic populations have been subjected to markedly different epidemiological environments, encountering a wide array of infectious pathogens that have, in turn, shaped the evolutionary trajectory of their immune systems. These historical exposures have resulted in the emergence of distinct immunological phenotypes that are characteristic of specific populations (22). As a consequence, individuals from different ethnic backgrounds exhibit unique immune profiles that not only govern their humoral and cellular responses to vaccines but also modulate their predisposition to autoimmune conditions and their susceptibility to infectious diseases such as tuberculosis (23, 24). The clinical significance of these interethnic immunological differences is underscored by findings from an influenza study conducted in New Zealand, which revealed pronounced disparities in mortality rates across ethnic groups: specifically, mortality among Māori and Pacific populations was reported to be twice that observed in individuals of European descent and other ethnicities (25). In a parallel observation from the United States, pediatric data indicated that Black children were hospitalized at significantly higher rates for acute respiratory infections and influenza when compared to White children (26). This disparity has been posited to be at least partially attributable to differences in cutaneous pigmentation, which directly influence the efficiency of sunlight-mediated vitamin D biosynthesis—a critical modulator of innate and adaptive immunity. In light of these established immunobiological differences, it is plausible that individuals belonging to different racial or ethnic groups may elicit quantitatively and qualitatively different immune responses upon exposure to SARS-CoV-2, thereby influencing clinical outcomes. Furthermore, ecological observations have noted that countries with longstanding universal BCG vaccination policies experienced a comparatively slower rate of COVID-19 transmission, suggesting potential non-specific protective effects of this vaccine against the novel coronavirus (27).

Cultural, behavioral, and socioeconomic disparities between ethnic groups may play a significant role in viral transmission dynamics. Black, Asian, and other ethnic minority populations differ substantially from White populations with respect to multigenerational household structures, educational levels, occupational exposures, socioeconomic status, and health-seeking behaviors. These differences are thought to partially account for the elevated incidence of certain infectious respiratory diseases, including tuberculosis, as socioeconomic inequalities have been consistently linked to increased disease susceptibility (28). In addition, cultural variations across ethnic groups influence the degree of compliance with public health interventions, including quarantine measures, vaccination uptake, and adherence to personal hygiene recommendations (29). Studies indicate that Black, Asian, and Hispanic individuals are at higher risk of SARS-CoV-2 infection relative to White individuals, with Black populations exhibiting the greatest vulnerability (30).

A key strength of this study is that it provides the first comparative analysis between Arab and Bakhtiari populations specifically regarding the severity of pulmonary involvement following COVID-19 infection. Given that these two ethnic groups constitute a substantial proportion of the population in southwestern Iran, understanding such differences is critical for the equitable distribution of healthcare resources and the delivery of culturally and ethnically responsive medical care. The relatively large sample size further enhances the robustness of our findings. Nevertheless, several limitations should be acknowledged, including inadequate patient follow-up and the inherent inability to assess long-term outcomes, both of which stem from the cross-sectional nature of the study design. Future investigations should focus on

COVID-19 cohorts with particular attention to the degree and severity of pulmonary involvement. Additionally, assessing hospitalization duration and clinical outcomes is strongly recommended. It is also essential that subsequent studies account for the variable impact of pre-existing comorbidities across different ethnic groups, especially within the Arab and Bakhtiari populations.

In conclusion, the findings of the present study reveal a statistically significant difference in pulmonary involvement between Arab and Bakhtiari patients, underscoring the considerable interethnic variability in COVID-19 disease severity. Frequency distribution data further demonstrate that Bakhtiari patients experienced a higher incidence of severe pulmonary involvement attributable to COVID-19 when compared to their Arab counterparts.

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