

Research Article

Epidemiological, Clinical, Evolutionary, and Therapeutic Profile of Patients with COVID-19 at Mohamed V Hospital in Tangier (Morocco) from July 20 to September 20, 2021

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Abstract

COVID-19 is an emerging infectious disease of zoonotic type, caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) strain. This disease, benign in most affected individuals, can in certain situations progress to a severe form with organ failure that may lead to the patient's death. The objective was to describe the sociodemographic, clinical, therapeutic, and evolutionary characteristics of the disease in the study population, as well as to determine predictive factors of mortality. This was a retrospective cross-sectional study with descriptive and analytical purposes, conducted over a 2-month period from July 20 to September 20, 2021, among patients with COVID-19 diagnosed at Mohammed V Hospital in Tangier. The study population consisted of 670 patients. The mean age was 49 years ± 18.1 and the sex ratio (M/F) was 1.47. COVID-19 diagnosis was essentially based on RT-PCR (87.46%). The majority of patients (67%, n=449) were fully vaccinated at the time of diagnosis. Outpatient follow-up concerned 79.1% (n=530) of patients and hospitalization 20.9% (n=140). The comorbidity rate was 42.5% (n=285), and the most frequent pathologies were diabetes (17.9%) and arterial hypertension (13.43%). The evolution was favorable for the majority of patients (93.58%, n=627) and the death rate was 6.42% (n=43). Factors associated with death were advanced age ($p < 0.001$), diabetes ($p < 0.001$), arterial hypertension ($p = 0.007$), cardiovascular history ($p = 0.006$), neurological disorders ($p = 0.012$), and non-vaccination ($p = 0.008$). The severity of SARS-CoV-2 infection varies considerably among individuals and populations. Identification of severity factors could help define COVID-19 patients at higher risk, thus enabling a more targeted and specific approach to prevent deaths.

Keywords

COVID-19, Clinic, Treatment, Progression, Hospital, Tanger, Morocco

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1. Introduction

COVID-19 is an infectious disease caused by the SARS-CoV-2 virus. It was first identified in 2019 in the city of Wuhan, Hubei Province, China, and subsequently spread worldwide, becoming a global pandemic [1]. Severe acute respiratory syndrome corona-virus 2 (SARS-CoV-2) posed a considerable threat to public health and the global economy, with more than 767 million confirmed cases and more than 6.9 million deaths worldwide in 2021. In Morocco, 1,274,733 cases including 16,297 deaths were reported [2]. Although most people infected with COVID-19 develop a mild to moderate form of the disease and recover without hospitalization, some individuals are at higher risk of serious complications and death. This variability makes disease management complex and raises many questions about the underlying factors that determine disease mortality in each individual. The objective of our work was to describe the epidemiological, clinical, evolutionary, and therapeutic profile of patients with Covid-19 at Mohamed V Hospital in Tangier from July 20 to September 20, 2021, and to determine predictive factors of mortality.

2. Patients and Materials

2.1. Study Setting

Built in 1973, Mohamed V Hospital in Tangier, Morocco, is currently located in the heart of the city in a highly populated area. It is the most important hospital among the components of the RHC (Regional Hospital Center) of Tangier. It offers medical-surgical and exploratory care. The bed capacity of this hospital is 250 beds, serving a population exceeding 1,270,000 inhabitants, according to 2025 statistics, considering only the populations of Tangier-Assilah prefecture and Fahs-Anjra province. However, its catchment area for certain specialized services extends over a large part of the Tangier-Tetouan-Al Hoceima region (3,157,075 inhabitants). Regarding human resources, they numbered 326 people in 2025, comprising 83 physicians, 02 pharmacists, 280 nurses, and 73 managerial and administrative staff.

2.2. Methodology

Type, location, and study period: This was a retrospective cross-sectional study with descriptive and analytical purposes, conducted over a 2-month period from July 20, 2021, to September 20, 2021, at Mohammed V Hospital in Tangier.

Study population: It consisted of all patients with confirmed SARS-CoV-2 infection at Mohammed V Hospital (outpatient or hospitalized).

Inclusion criteria: Patients with a positive COVID-19 diagnosis confirmed by RT-PCR or thoracic CT scan compatible with SARS-CoV-2 infection, followed as outpatients or hospitalized in COVID-19 isolation wards or intensive care units.

Exclusion criteria: Patients without proof of SARS-CoV-2

infection, patients with phone numbers not found, unreachable patients, non-consenting patients, and patients whose files were incomplete or not found.

Data collection and entry: A form was established on the "Google Forms" platform and pre-tested. Data collection was performed from patient files supplemented by telephone interviews with patients whose numbers were recorded in the follow-up file. Collected variables included sociodemographic, clinical, therapeutic, and evolutionary data. Data were exported as an Excel spreadsheet.

Statistical analysis: Descriptive analysis consisted of presenting qualitative variables as frequencies and percentages, while quantitative variables were presented as means or medians, depending on their distribution. Bivariate analysis was conducted using Fisher's exact test for comparing percentages and Student's t-test for comparing means. The statistical significance threshold was set at $p < 0.05$ for all tests. All statistical analyses were performed using SPSS software, version 22.0.

Ethical considerations: Data were collected and analyzed anonymously, ensuring confidentiality and protection of patients' personal information. Prior authorization from the management of Mohamed V Hospital was obtained before accessing medical records.

3. Results

3.1. Descriptive Results

Socio-epidemiological Characteristics

Distribution by study period: In total, 670 patients were included in our study. The highest weekly peak was reached during the period from August 2 to 8 (206 cases), followed by the period from July 26 to August 1 (120 cases), and the period from August 9 to 15 (114 cases).

Distribution by age: The mean and median age of our patients was 49 years and 50 years ± 18.1 , respectively, with extremes ranging from 11 to 95 years. The age group 60 to 69 was most affected (19.70%) followed by 50 to 59 years (18.51%).

Distribution by sex: The predominance was male 59.55% ($n=399$) with a sex ratio M/F = 1.47.

Comorbidity: The proportion of patients with one or more comorbidities was 42.5% ($n=285$). The most frequent comorbidities were diabetes (17.90%) and hypertension (13.43%). The proportion of smoking was 9.10%.

Clinical Characteristics

Distribution by diagnostic method: COVID-19 diagnosis was essentially based on RT-PCR (87.46%) but also on thoracic CT scan (12.54%).

Distribution of patients by vaccination status: The majority of patients (67%, $n=449$) were vaccinated, and 33% ($n=221$) were unvaccinated or incompletely vaccinated at the time of

diagnosis. Among the vaccinated, 83.5% had received the AstraZeneca vaccine and 16.5% the Sinopharm vaccine.

Evolutionary Characteristics

Outpatient management with favorable evolution concerned 79.1% of patients (n=530). However, 20.9% of patients (n=140) were hospitalized, of which 6.74% (n=10) in intensive care.

Overall, the evolution was favorable for the majority of patients (93.58%, n=627), and the death rate was 6.42% (n=43). In contrast, hospital mortality was 30.7% (n=140) at Mohamed V Hospital.

3.2. Analytical Results

Risk factors for death were advanced age ($p < 0.001$), diabetes ($p = 0.006$), arterial hypertension ($p = 0.007$), heart diseases ($p = 0.016$), neurological pathologies ($p = 0.011$), and vaccination status ($p=0.008$). Moreover, the AstraZeneca vaccine appears statistically more protective than the Sinopharm vaccine ($p < 0.001$).

In contrast, death was statistically independent of sex ($p = 0.177$), chronic pleuro-pulmonary diseases ($p = 0.400$), neoplasms ($p = 0.900$), nephropathies ($p = 0.610$), hepatopathies ($p = 0.069$), history of COVID-19 infection ($p = 0.054$), immunosuppression ($p = 0.201$), and smoking ($p=0.08$).

4. Discussion

Frequency: The general aspect of the curve of confirmed COVID-19 cases shows an increase in numbers during July with a peak frequency in the first week of August, followed by a consequent decrease toward September. Comparing the pattern of this curve with epidemiological data during the same period in Morocco, we observe a similar aspect between the two curves, corresponding to the second wave of the pandemic in Morocco.

Age: It appears that all age groups of the population are exposed to the risk of contracting COVID-19 [3]. In our study, patients' ages ranged from 11 to 95 years with a median of 49 years. The study by Mousavi et al [4] reported that the median age of patients with COVID-19 during the 5th peak occurring from July to September 2021 was 52.5 years. A comparative study conducted in Germany [5] among all confirmed SARS-CoV-2 cases in an administrative district in the south of the country found a median age of 47 years, the same age was identified by the Chinese study by Guan et al [6] and that conducted by Inokushi et al [7]. Two studies conducted in America during the Delta variant predominance period found a median age of 60, the first in New York by Tandon et al [8], the second in California by Modes et al [9].

Sex: The results of this study revealed a male predominance (59.6%) with an M/F sex ratio of 1.47. This trend, also found in the majority of international studies with a sex ratio varying from 1.08 to 2.41, could be explained by several factors. Men, more often professionally active in exposed sectors (transport,

commerce, industry, etc.), were probably at greater risk of contracting the virus due to frequent travel, less recourse to teleworking, or increased exposure in the workplace. Several studies concluded that men were more likely to contract SARS-CoV-2 infection [10-12], while others reported no gender difference in infection incidence. However, when infected, men appear to have a higher risk of developing a severe form of the disease [13, 14]. This increased vulnerability could be explained by biological differences (such as a less effective immune response), hormonal factors (potential protective effect of estrogens in women), or behavioral factors (delayed consultation, more frequent smoking, or comorbidities such as hypertension and cardiovascular diseases more prevalent in men).

Comorbidities: Comorbidities are recognized as risk factors for severe forms and mortality related to COVID-19 [6]. In our study, 42.5% of patients had at least one comorbidity. Similar rates were reported in Morocco [4], Germany [5], and China, at 45.5%, 46.6%, and 48%, respectively. The most frequent comorbidities in our population were diabetes and arterial hypertension, consistent with literature data [11, 15-22]. Analyzing the relationship between comorbidity and disease severity, we found that severe or critical forms were more frequent in patients with at least one comorbidity. Similarly, mortality was significantly higher in these patients compared to those without comorbidity. These results confirm the aggravating role of chronic pathologies in the clinical evolution of COVID-19.

Vaccination status: Consequently, two-thirds of patients in our series (67%) were fully vaccinated at the time of diagnosis, a rate higher than various international studies conducted during the same period [1, 2, 16, 23, 24].

Mortality: The case fatality rate observed in our study (outpatient and hospitalized patients) was 6.4%. This index depends on the sampling strategy applied in the study. It will be lower in a study identifying people without severity criteria, while it will be higher in targeted sampling among patients with symptoms and risk factors for severe disease or hospitalization criteria. This gap could be explained by organizational factors related to patient flow management. Indeed, faced with the rapid increase in cases, the hospital stopped systematic screening of asymptomatic contact cases, testing only symptomatic patients. This likely modified the clinical profile of patients included in the study and contributed to an overestimation of the observed case fatality rate. This difference could also be due to sampling bias related to the data collection method; during the study period, approximately 1,000 people were diagnosed with COVID-19, however, 330 were not included in our study due to lack of phone numbers or unreachability. Furthermore, significant variations in the mortality rate of hospitalized patients have been observed in literature data [16, 20-22, 24].

Mortality Factors

Age: Advanced age is considered the most important risk factor for severity and mortality from COVID-19 [10, 25]. In

our study, the median age of deceased and recovered individuals was 68.79 ± 11.73 years and 47.69 ± 17.68 years, respectively, this age difference being statistically significant. This finding is similar to literature data. In the study conducted by Chen et al [26], the median age of deceased patients (68 years) was significantly higher than that of recovered patients (51 years). A report on COVID-19-related deaths published by the Centers for Disease Control and Prevention (CDC) showed that the mortality rate among people aged ≥ 65 years was 65 times higher than that of patients aged 18 to 29 years [27]. Advanced age was also a risk factor for severity and mortality in patients infected with SARS and MERS [28, 29].

Advanced age is generally associated with a high prevalence of comorbidities, which can lead to increased frailty. Moreover, weaker immune defense and higher SARS-CoV-2 viral load in elderly people can expose them to unfavorable evolution and higher mortality risk when infected with COVID-19 [30].

Comorbidities: Several studies have shown that comorbidities are predictors of death or severe COVID-19 [25, 30]. Additionally, the risk of death increased significantly with an increasing number of comorbidities [31]. Analysis of the link between comorbidities and COVID-19-related mortality allowed us to identify increased vulnerability for several pathologies.

Arterial hypertension: Our study revealed a high prevalence of arterial hypertension in the group of patients who died from Covid-19 and identified a statistically significant association between hypertension and Covid-19-related mortality ($p=0.007$). A literature review suggested that this association does not seem surprising and does not necessarily imply a causal link, given the high prevalence of hypertension worldwide, affecting 25% of the adult population with a peak prevalence $> 60\%$ in the elderly population [22]. However, a meta-analysis including 24 articles with 99,918 patients found that hypertension was an independent risk factor for COVID-19 mortality (OR: 2.17; 95% CI: 1.67 - 2.82 and $p < 0.001$) [32]. In a French cohort of 66,050,090 patients, arterial hypertension was associated with excess risk of hospitalization and hospital mortality related to COVID-19 [33]. Similarly, Abayomi et al found that after adjustment for confounding factors, patients with arterial hypertension still had twice the mortality risk compared to patients without hypertension [19]. This result was observed by other studies in China [1, 23], with mortality risks estimated at 4.7 times higher [34]. Among possible explanations for such an association, ACE2 could very likely be involved. First, hypertension itself leads to increased activation of the renin-angiotensin system (RAS). Second, regular use of antihypertensive medications such as angiotensin II receptor blockers (ARBs) and ACE inhibitors increases ACE2 expression. These two mechanisms can interact synergistically in a hypertensive patient taking such antihypertensive medications. Such increased viral absorption promotes respiratory infections, significantly increasing the severity and mortality rate of COVID-19 in hypertensive patients, leading to a

hypercoagulable state and rupture of atherosclerotic plaques, potentially resulting in thrombotic events. Third, treatment priorities favoring limitation of nosocomial viral transmission while neglecting other medical problems could predispose patients with vascular cardiovascular diseases to unfavorable clinical evolution. Furthermore, several drugs used to treat COVID-19 infection have been shown to have deleterious cardiovascular effects [35].

Diabetes: Diabetes mellitus has been widely recognized as a major comorbidity negatively influencing the prognosis of patients with COVID-19. According to a retrospective study by Zhou et al. (2020) on 191 patients hospitalized in Wuhan, the mortality rate among diabetic patients with COVID-19 was 22%, compared to 6% among non-diabetics. This significant difference is notably explained by impaired immune response, chronic low-grade inflammation, and increased risk of multi-organ dysfunction in diabetics. Thus, the presence of diabetes requires particular vigilance, with strict monitoring and rigorous glycemic control to improve clinical outcomes [28].

Neurological pathologies: The frequency of neurological pathologies in deceased patients in our study was 11.6%. Bivariate analysis showed a significant correlation between neurological pathologies and Covid-19-related mortality ($p=0.012$). A cohort of 576 patients hospitalized for Covid-19 concluded that the presence of pre-existing chronic neurological disorders was an independent predictor of mortality from Covid-19 (HR 2.13, 95% CI: 1.382–3.280, $p = 0.001$) [36].

Pleuro-pulmonary diseases: In our study, the mortality rate was higher in patients with pleuro-pulmonary diseases compared to those without this comorbidity (9.5% vs 6.3%). However, this difference was not significant ($p=0.396$). According to Lohia et al [38], patients with pre-existing respiratory disease were associated with higher mortality compared to those without pre-existing respiratory disease (OR = 1.29; 95% CI, 1.05-1.58; $p = 0.02$). Having pre-existing respiratory disease was also associated with a higher rate of admission to the Intensive Care Unit (OR, 1.33; 95% CI, 1.08-1.64; $p = 0.007$) as well as increased need for mechanical ventilation (OR, 1.40; 95% CI, 1.13–1.74; $p = 0.002$).

Smoking: No statistically significant association was found between smoking and Covid-19-related mortality in our study. Several previous studies showed that active smoking was not significantly associated with the severity of Covid-19 disease [38]. A study of 402,978 patients revealed differences in Covid-19 mortality in smokers by age. In patients aged 69 years and older, mortality was twice as high as in non-smokers, while in patients under 69 years, there was no difference in death between smokers and non-smokers. However, larger meta-analyses with various patient populations revealed that smoking globally increased Covid-19-associated mortality.

Vaccination status: According to our results, an elevated mortality rate was noted in unvaccinated patients (10%) compared to those fully vaccinated (4.7%) ($p=0.008$). A statistically significant association was noted between vaccine type and death occurrence ($p < 0.001$); patients vaccinated with

AstraZeneca had a lower mortality rate than those vaccinated with Sinopharm (2.9% vs 13.9%). In the study by Baker et al [37], statistically adjusted mortality rates for unvaccinated and vaccinated patients were 8.3% (95% CI, 8.1 to 8.5) and 5.1% (95% CI, 4.8 to 5.4), respectively. Vaccination was associated with a significant decrease in mortality, particularly in elderly patients. The study by Aslam et al reported that disease progression to death or mechanical ventilation was significantly associated with decreased probability of vaccination. Another study conducted in Los Angeles [37] showed that fully vaccinated individuals were less likely than unvaccinated individuals to be hospitalized, admitted to an intensive care unit, require mechanical ventilation, or die from SARS-CoV-2 infection during the Delta variant predominance period [37]. Similarly, a study demonstrated that COVID-19 vaccination was significantly associated with reduced case fatality rates across all age groups in a municipality in southern Brazil [18]. Although vaccinated individuals may still be infected, they develop milder symptoms and have a lower death risk than unvaccinated subjects. Thus, vaccination has demonstrated its effectiveness in combating this infection [18].

5. Conclusion

The COVID-19 pandemic has profoundly disrupted health systems globally, highlighting structural and organizational vulnerabilities while accelerating research, innovation, and coordination of health responses. This local study constitutes a contribution to understanding COVID-19 in our context while highlighting lessons to be learned for the future. It reminds us that in facing a pandemic, the response can only be multidimensional, combining prevention, detection, effective management, continuous research, and intersectoral coordination. These pillars are essential to strengthen our preparedness and limit the impact of future health crises.

Abbreviations

COVID 19	COroNaVirus Disease 2019
OR	Odds Ratio
RT-PCR	Reverse Transcription Polymerase Chain Reaction
SARS COV 2	Severe Acute Respiratory Syndrome Coronavirus 2

Conflicts of Interest

The authors declare no conflicts of interest.

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