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Research Article

Risk Factors for COVID-19 Mortality in Epidemic Treatment Centres A Case-Control Study from Senegal's Decentralised Regions

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Abstract

Introduction: The COVID-19 pandemic is an emerging viral zoonotic disease caused by SARS-CoV2. It causes a systemic infection in humans, mostly respiratory. Senegal's Thiès Region announced their first case on March 14, 2020. The second epidemic wave, which occurred in 2021, was marked by high fatality, necessitating our investigation of the parameters linked with deaths among COVID-19 patients hospitalised at the Epidemic Treatment Centres (CTE) of the Regional Health Directorate of Thiès. **Patients and Methods:** One case for every two controls in an unmatched case-control study of COVID-19 deaths that were reported in the Thiès Regional Health Directorate between January 1 and December 31, 2021. All patients admitted to CTEs who had positive COVID-19 PCR/antigenic test results were included. All confirmed COVID-19 patients who passed away were called "cases," while all patients who recovered were called "controls." Standardised sociodemographic, clinical, therapeutic, and evolutionary data were gathered from patient files following a pilot study with quality control, and an extensive sampling of deaths was used. Kobo Collect was used to enter the data, and Epi Info7 was used for analysis. both qualitative (proportions) and quantitative (mean, standard deviation) variables. The following metrics were employed: chi2 or Fisher exact test, odds ratio, and significance level set at p¡0.05. **Results:** 348 individuals in all, 116 of whom died and 232 of whom recovered, were enrolled in the study. The average age of the deceased patients was 68.9 years +/- 14.24, while the average age of the recovered patients was 61.5 +/- 14.24. Both groups were primarily male. Asthenia (57.8/65.4%), fever (71.5/68.1%), and dyspnoea (98.3/84.49%) were the most prevalent clinical symptoms (cases/controls). in addition to cough (52.6/58.1). Acute respiratory distress (87.9/3.8%), pulmonary embolism (03.5/0%), and acute respiratory distress (11.2/0.4%) were the most common complications. Following multivariate analysis using logistic regression, the following factors were linked to deaths: male sex (OR: 4.11, 95% CI: 1.45 – 11.61 and p = 0.0076); patients older than 60 (OR=1.77, 95% CI: 1.0018-3.1438, p=0.049); complications like stroke (OR=31.00; 95% CI: 5.69-168.73 and p=0.0001), Acute respiratory distress syndrome (OR: 204.09 95% CI: 70.44-591.30 and p = 0.000) and shock (OR22.61; 95% CI: 1.44-353.67 and p=0.026). **Conclusion:** Age, male gender, the presence of complications; stroke in particular, the state of Shock and ARDS; these are the elements linked to COVID-19 deaths in the CTEs of Thiès Region.

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1. Introduction

Emerging and re-emerging pathogenic agents pose global public health challenges. Coronaviruses are enveloped RNA viruses widely distributed among humans, other mammals and birds [1].

In March 2020, the World Health Organization (WHO) declared the infection with the novel coronavirus "SARS-CoV-2" known as COVID- 19, a public health emergency of international concern. Senegal declared its first case of COVID-19 on March 2, 2020. The Thiès Region recorded its first case twelve days later. In the context of patient care, four centers have been set up in the Thiès region.

Clinically, SARS-CoV-2 infection can present as either asymptomatic or symptomatic cases, most commonly involving respiratory tract infections such as severe pneumonia, resulting in respiratory distress and evolving or not towards systemic involvement, which could lead to the death of patients [2].

The different attack and mortality rates of COVID-19 could be influenced by various factors such as different national isolation policies, the time taken to diagnosis and treatment as well as virus mutations [3]. This is how the advent of new SARS-CoV-2 variants in December 2020 led to a resurgence of the pandemic marking the 2nd wave in Senegal with a fatality rate of 2.4% [4]. The Thiès Region recorded a higher fatality rate of 6.8% during the same period.

This study aims to determine the factors associated with the fatality of COVID-19 in epidemic treatment centers (ETCs) in the Thiès Region during this 2nd wave.

2. Methodology

This is an unmatched case-control study with one case to two controls relating to the deaths of COVID-19 patients recorded in the CTEs of the Thiès Regional Health Directorate for the period from January 1 to December 31, 2021.

The study population was composed of registered COVID-19 infected patients at the CTEs of the Thiès Region during the study period. People who tested positive for COVID-19 and were hospitalized at the CTEs were included. People who were declared positive for COVID-19 and did not have records or did not appear in the CTE hospitalization register were excluded.

Any person with a positive nucleic acid amplification test (RT-PCR) or a person with a positive SARS-CoV-2 antigen RDT who died at the CTE was considered a case and was considered as a control, any person hospitalized in the CTE and declared cured during the study period and whose laboratory test or swab taken had confirmed the presence of COVID-19.

We conducted a review of the death register to identify cases and then we verified the cause of death in the patient's file and report. As for the controls, they were recruited from the CTE discharge register.

The Sociodemographic, clinical and therapeutic characteristics of COVID-19 patients, their vaccination status, medical history and comorbidities were collected.

The data was entered on a kobo collect model developed for this purpose. The database analysis was carried out on Epi info7.

Quantitative data were summarized as mean and median, and qualitative data as proportions. The measure of association used is the odds ratio. For the comparison of proportions, the Chi2 or Fisher's exact test will be used depending on the conditions of applicability. The significance threshold is set at $p<0.05$. For the comparison of quantitative variables, an Analysis of Variance (ANOVA), will be performed.

We conducted a pilot trial and data quality control. The questionnaire was tested in a health center not involved in the study, located in the buffer zone of the health district of Thiès. Investigators who were qualified health care providers were selected and trained on the survey methodology.

The investigators were responsible for correctly filling in the data on the already prepared questionnaire. Supervisors ensured the correct entry of information into the kobo collect software. The survey coordinator was responsible for ensuring data quality control.

The study was submitted for approval to the competent authorities of the Region after transmission of correspondence. The electronic database created did not in any way make it possible to make a link with the patient's identity.

3. Results

A total of 348 patients were recruited in this study including 116 cases (deaths) and 232 recovered (controls). The average age was 68.9 years $\pm$ 14.24 among the cases and 61.5 years $\pm$ 14.24 among the controls.

Cases of death were most frequent in the age group of 65 years and over with a percentage of 70.6%. A predominance of males 66.4% was found among the cases, with a sex ratio of 1.9 compared to a female predominance among the controls with a sex ratio 0.8.

The most frequent clinical signs were dyspnea (98.3%) among the deceased compared to (84.9%) among the recovered; fever (71.5%) among the deceased and (68.1%) among the recovered; Cough (52.6%) among the deceased and (58.6%) among the recovered; and headaches (26.7%) among the deceased and (71.4%) among the recovered.

Only 2.7% of deceased patients were vaccinated, compared to 1% of recovered patients. It should be noted that vaccination of the population started in April 2021, but also that the vaccination status was not verified in 25.6% of the cases reviewed.

The most frequent complications were acute respiratory distress syndrome (87.9%) in deceased patients and (3.9%) among those who recovered. Stroke-related complication was (11.2%) among the deceased and (1.3%) among those who recoverd as shown in Table 1.

The risk of mortality from COVID-19 is 1.77 times greater for individuals aged 60 and older compared to those under 60. Men face a 4.11-fold increased risk of mortality from COVID-19 compared to women. Individuals with a history of hypertension exhibited a 2.18-fold increased risk of mortality from the condition relative to those without high blood pressure. Multivariate research indicates that patients with comorbidities such as shock, stroke, and acute respiratory distress syndrome (ARDS) have an increased mortality risk from COVID-19 in the CTEs. Age, male gender, hypertension, stroke, shock, and ARDS are substantial predictors of mortality, as indicated in Table 2.

4. Discussion

The results of our study show that male gender [OR: 1.69, 95% CI: 1.06 – 2.68] and age over 60 years [OR: 2.16, 95% CI: 1. 27 - 3.68] are risk factors for death. Our results are supported by several studies such as that of M. Jaspard et al in Burkina and Guinea, which showed that

Table 1: Characteristics of COVID-19 deaths and recoveries recorded in the CTEs of Thiès in.

Features		**Deaths n (%)**	**Recovery n (%)**
	Sociodemographic characteristics		
Age	15 - 34 years old	2(1.72)	13(6.0)
	35 - 54 years old	13(11.4)	33(15.3)
	55 - 64 years old	19(18.8)	67(31.0)
	65 years and over	82(70.6)	103(47.7)
Gender	M	**77 (66.4)**	107 (46.1)
	F	39 (33.6)	125 (53.9)
	Clinical features		
Fever	Yes	83 (71.5)	158 (68.1)
Dyspnea	Yes	114 (98.3)	197 (84.9)
Headache	Yes	31 (26.7)	66 (28.5)
Cough	Yes	61 (52.6)	136 (58.6)
Diarrhea	Yes	4 (3.5)	10 (4.3)
Asthenia	Yes	67 (57.8)	151 (65.4)
Sore throat	Yes	2 (1.7)	12 (5.2)
Rhinorrhea	Yes	10 (8.6)	18 (8.1)
Ageusia	Yes	3 (2.6)	17 (7.4)
Anosmia	Yes	5 (4.3)	18 (7.8)
Vaccination status	Yes	3 (2.7)	2 (1)
	Therapeutic characteristics		
Azithromycin	Yes	101 (87.1)	219 (94.4)
Zinc	Yes	102 (87.9)	220 (94.8)
Corticotherapy	Yes	106 (91.4)	198 (86.5)
Anticoagulants	Yes	102 (87.9)	200 (86.2)
	Complications		
Oxygen therapy	Yes	115 (99.1)	188 (81)
ARDS	Yes	102 (87.9)	9 (3.9)
State of shock	Yes	13 (11.2)	1 (0.4)
IRA	Yes	5 (4.3)	0
Stroke	Yes	13 (11.2)	3 (1.3)
Pulmonary embolism	Yes	4 (3.5)	0

IRA: ACUTE RENAL FAILURE - ARDS : ACUTE RESPIRATORY DISTRESS SYNDROME

Table 2: Factors Associated with COVID-19 Fatality in CTEs of the Thiès Region in 2021 in Multivariate Analysis.

Variables	**Odds Ratio**	**95% CI**		**P-Value**
Age (Under 60/60 and over)	1.77	1.0018	3.1438	**0.049**
Gender (M/F)	4.1129	1.4569	11.6108	**0.0076**
HTA (yes/no)	2.1853	1.8659	5.5154	**0.0097**
Stroke (yes/no)	31.0034	5.6967	168.7305	**0.0001**
State of shock (yes/no)	22.6146	1,446	353.6796	**0.0262**
ARDS (yes/no)	204.0904	70.4419	591.3084	**0.0000**

men [OR: 2.1, 95% CI: 1.1 - 3.6] and elderly people $\geq$ 60 years [OR: 2.9, 95% CI: 1.7 – 4.8] were more exposed to COVID-19 death [5]. This risk factor is also found in Diop's study with a higher risk of 11.2% in patients over 60 years old versus 3.8% in patients under 60 years old (p = 0.00098) [6]. Similar observations are made by Kombila in Gabon and Sy in Ségou who found that advanced age (>65 years) is associated with ARD and death [7].

Age over 60 years as a factor associated with death could be explained by the fragility of the immune system (immunosenescence) and also the presence of comorbidities.

Among patients with comorbidities, those with high blood pressure were more likely to die than non-hypertensive patients [OR: 1.8, 95% CI: 1.15-2.83] but in multivariate analysis, this association was not significant. In the study by Myriam Diarra and colleagues, the relative risk of mortality due to COVID-19 is higher for patients with hypertension and cardiovascular diseases [ARR = 20.23, 95% CI: 11.68-35.04], followed by diabetic patients [ARR = 1.31, 95% CI: 0 .77- 2.23] [8]. While in our study diabetes was not statistically associated with deaths, diabetes is literarily described as a factor associated with COVID-19 death as shown in the study by Ousmane Sy in Ségou Who found that diabetes and chronic obstructive pulmonary disease have a statistically significant link with COVID-19 deaths [9].

Only 2.7% of deceased patients were vaccinated, compared to 1% of cured patients. During the study period, a low percentage of the population was vaccinated due to the unavailability of vaccines, particularly in decentralized areas. A high vaccination rate will have allowed us to minimize deaths, serious illnesses and the overall disease burden [1].

The average length of hospitalization for cases was 10 $\pm$ 4 days and 12 $\pm$ 7 days for controls. The team from the Principal Hospital of Dakar in Senegal found an average length of hospitalization of 10 days $\pm$ 5 days in deceased patients, a figure similar to our study [6].

Clinically, dyspnea (98.3% vs 89.9%), fever (71.5% vs 68.1%), asthenia (57.8% vs 65.4%), cough (56.0% vs 58.6%) and headache (26.7% vs 28.4%) were the most common symptoms among COVID-19 patients hospitalized in the region's CTEs. The Ouédraogo study in Burkina found cough (46.3%) and fever (43.9%) as predominant symptoms, respiratory distress was present in 23.2% of cases with 44.3% death [5]. Other signs such as diarrhea, odynophagia, anosmia, ageusia and rhinorrhea were present but less frequent in both populations. Dyspnea was the only independent symptom associated with death [OR: 10.1, 95% CI: 2.3 – 42.6].

When dyspnea was associated with desaturation (SpO295%) [OR: 3.6, 95% CI: 2.06-6.58] patients were more exposed to death from COVID-19. The Aouameura study in Algeria demonstrated that dyspnea and respiratory distress are significantly higher in deceased patients compared to living patients [OR: 10.8; 95% CI: 1.33-96.69] [10].

From a therapeutic perspective, our patients received anticoagulation theraphy (87.9% vs 86.2%), Azithromycin 500mg (87.1% vs 94.4%), Zinc (87.9% vs 94.8%). %), corticosteroid therapy (91.38% vs 86%), and oxygen therapy (99.1% vs 81%). Treatments with Azithromycin 500mg [OR: 0.39; IC95%: 0.18-0.87] and Zinc [OR: 0.39; 95% CI: 0.17-0.88] were found to be protective factors against death. However, the Minerva study concluded that azithromycin has little or no effect on all-cause mortality at day 28 compared to standard of care alone [RR 0.98; 95% CI: 0.90 to 1.06] [3, 11–13].

5. Conclusion

Our study aimed to determine the risk factors associated with COVID-19 deaths in CTEs in the Thiès region. Our results showed that advanced age over 60 years, male gender and the presence of complications such as ARDS, stroke, shock are prognostic factors for death.

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