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Original Article

Dynamics of Covid-19 Spreading During the First Five Months of The Pandemic in Mali

Dynamique de la Propagation de la COVID-19 au Cours des Cinq Premiers Mois de la Pandémie au Mali

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ABSTRACT

Introduction. The COVID-19 outbreak, began in China at the end of December 2019, rapidly spread around the world. The two first imported cases in Mali were recorded on March 25, 2020. This study describes the epidemiology of COVID19 cases during the first five months of the pandemic in Mali. **Methodology**. The data was extracted from the official linear list of COVID-19 cases, the national reference laboratory register and the national daily outbreak situation report, for the period from March 25 until August 24, 2020. The analysis was focused on data from all affected regions and health districts including the capital Bamako. The variables studied were the cases detected, region, district, age and sex. The most affected regions, districts, age groups and sex were obtained by calculating the attack rate in relation to these different parameters. **Results**. Started simultaneously in Kayes and Koulikoro regions with imported cases on March 25, 2020 in Mali, the first month's spread of COVID-19 outbreak was characterized by fast exponential growth and fast spatial expansion. It Most of the first imported cases arrived by air. Bamako, the capital of the country, rapidly became the epicenter since the first week of the epidemic. During the first five months of the outbreak, the highest number of cases were recorded in Bamako. Subjects in the 70-79 age groups were the most affected. The first confirmed cases that occurred in compromised security regions (Timbuktu, Gao, Kidal and Mopti) were ex-patriots. the number of tests was not significantly correlated with the confirmed cases. **Conclusion**. This study reviews available data from the first five months of the epidemic and describes early tends of COVID-19 pandemic in Mali. An irregular evolution of cases in time with more cases notified in cities was observed. The male sex and the 70-79 age group are the most affected. Our results provide information on areas and age groups that could be priorities for response actions.

RÉSUMÉ

Introduction. L'épidémie de COVID-19, apparue en Chine fin décembre 2019, s'est rapidement propagée à travers le monde. Les deux premiers cas importés au Mali ont été enregistrés le 25 mars 2020. Cette étude décrit l'épidémiologie des cas de COVID-19 au cours des cinq premiers mois de la pandémie au Mali. **Méthodologie.** Les données ont été extraites de la liste linéaire officielle des cas de COVID-19, du registre du laboratoire national de référence et du rapport de situation quotidien national sur l'épidémie, pour la période du 25 mars au 24 août 2020. L'analyse a porté sur les données de toutes les régions et districts sanitaires touchés, y compris la capitale Bamako. Les variables étudiées étaient les cas détectés, la région, le district, l'âge et le sexe. Les régions, districts, groupes d'âge et sexes les plus touchés ont été identifiés en calculant le taux d'attaque par rapport à ces différents paramètres. **Résultats**. Ayant débuté simultanément dans les régions de Kayes et de Koulikoro avec des cas importés le 25 mars 2020 au Mali, la propagation des premiers mois de l'épidémie de COVID-19 a été caractérisée par une croissance exponentielle rapide et une expansion spatiale accélérée. La plupart des premiers cas importés sont arrivés par voie aérienne. Bamako, la capitale du pays, est rapidement devenue l'épicentre dès la première semaine de l'épidémie. Au cours des cinq premiers mois, le nombre de cas le plus élevé a été enregistré à Bamako. Les sujets des tranches d'âge 70-79 ans ont été les plus touchés. Les premiers cas confirmés survenus dans les régions à sécurité compromise (Tombouctou, Gao, Kidal et Mopti) étaient des expatriés. Le nombre de tests n'était pas significativement corrélé aux cas confirmés. **Conclusion.** Cette étude passe en revue les données disponibles des cinq premiers mois de l'épidémie et décrit les tendances précoces de la pandémie de COVID-19 au Mali. L'évolution temporelle irrégulière des cas, marquée par une prédominance urbaine, masculine et affectant principalement la tranche d'âge des 70-79 ans, souligne la nécessité de prioriser ces zones et populations dans les futures stratégies de riposte.

HIGHLIGHTS

The question this study addressed. This study analyzed national surveillance data from the first five months of the pandemic in Mali to describe the epidemiological profile of cases, identify most affected regions and age groups, and examine the relationship between testing and case detection.

What this study adds to our knowledge. It documents 2,708 cases and 125 deaths during the first five months, with Bamako accounting for the highest burden. The 70-79 years age group had the highest attack rate, and males were predominantly affected. Imported cases originated mainly from France, and first cases in northern regions occurred among expatriates. Testing volume did not significantly correlate with case detection (p = 0.058).

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) or coronavirus disease-19 (COVID-19), is an emerging infection responsible for a pandemic, which began in late December 2019 in the Chinese city of Wuhan [1]. It quickly spread around the world and was recognized by the World Health Organization (WHO) as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 and a pandemic on March 11, 2020 [2,3].

Indeed, SARS-Cov-2 first affected Asia, then spread to Europe and the American continent to then arrive in Africa whose last affected country was Lesotho (May 13, 2020) [4]. Air travel has favored the speed of this propagation [5]. On August 24, 2020, there were a cumulative total of 23 million cases and more than 800,000 deaths worldwide with heavy tolls in the United States, Southeast Asia and Europe [6].The epidemic curves of SARS-Cov-2 can be different depending on the country [7]. The toll in Africa so far is still lower than the prediction or forecasts of some experts, which predicted the worst given the weakness of health systems [8]. In contrast, the demographic pyramid, population distribution and the lower prevalence of chronic diseases were cited by some authors to explain this trend.[9].

Mali is one of the last countries affected by the pandemic in West Africa [10]. The first cases were imported by plane, then the transmission quickly evolved in time and space [11]. The initial management of the COVID-19 epidemic faced major challenges, including delays in testing and case management, as well as fragile healthcare systems. These difficulties were compounded by unsafe socio-cultural gatherings that generated new chains of transmission. The early months of the crisis were also marked by low public trust, fueled by misinformation spread on social media, necessitating increased coordination and innovations such as the incident management system to overcome these obstacles.

Initially the epicenter was in the district of Bamako with an average of 11 cases daily during the first two months, it then moved to Timbuktu with 13 cases on average per day in June. Timbuktu is a region of difficult access for security reasons, which raises fears of the evolution of the epidemic in Mali.

This study aims to characterize the dynamics of the outbreak by reviewing the trends of COVID-19 cases in time and space and by identifying the areas and groups most affected or at highest risk. Our objective was to understand the dynamics of the spread of COVID-19 infections at the national and subnational levels, to inform intervention and mitigation strategies needed by decision-makers to quickly control the epidemic.

METHODOLOGY

The study took place in Mali, a vast landlocked country in West Africa located between 10th and 25th degrees north latitude and between 4th degree east longitude and 12th degree west longitude. It covers an area of 1,241,238 km² for a human population of 20,305,478 inhabitants.

A cross-sectional study was carried out by performing a secondary analysis of the line list of COVID-19 cases recorded over the period of March 25 to August 24, 2020, covering the first five months of the outbreak. The study was approved by the Faculty of Medicine, Pharmacy and Odontostomatology (FMPOS) Institutional Review Board (IRB).

An exhaustive sampling of all cases from the linear list of cases was carried out, that had tested positive by RT-PCR and were recorded in laboratory registers in Mali. The analysis focused on cases that tested positive for COVID-19 during the period. By a collection sheet, the variables of interest were extracted via the laboratory register and the descriptive list of cases.

The variables studied were weekly cases, cases detected, region, district, age and sex.

Data were entered into Excel and analyzed on R software version 3.5.2. The thematic maps were produced using QGIS software version 2.18.15. Quantitative variables were summarized in mean and standard deviation and the qualitative variables, in numbers and percentage.

The cases and deaths were aggregated by epidemiological week to obtain the weekly curve. Weekly lethality was estimated by dividing the number of deaths per week over the number of positive cases in the same period.

The attack rate by age group was calculated by relating the number of cases in each age group to the estimated population by age group.

The daily positivity rate was calculated by the ratio between the number of daily positive cases over the total number of daily screenings.

Spearman's test was used to determine a correlation between screened and confirmed cases. The conditions of linearity and equality of variances were verified before performing the Spearman test. A significance level of 5% for the alpha risk was adopted.

RESULTS

As of March 25, 2020, the date of notification of the first two cases in Mali, West Africa had 1,576 cases and all countries bordering Mali were affected [10]. These first cases were imported by plane, then the transmission rapidly evolved in time and space with more than 82% of regions and 41% of health districts affected for a total of

2,708 confirmed cases, 120 which were imported, and 125 deaths on August 24, 2020 [11].

Socio-demographic characteristics of COVID-19 cases in Mali

Age group 70-79 years old was the most affected (Figure 1). The male sex was the most affected overall. The average age was 40,5 17,7 years.

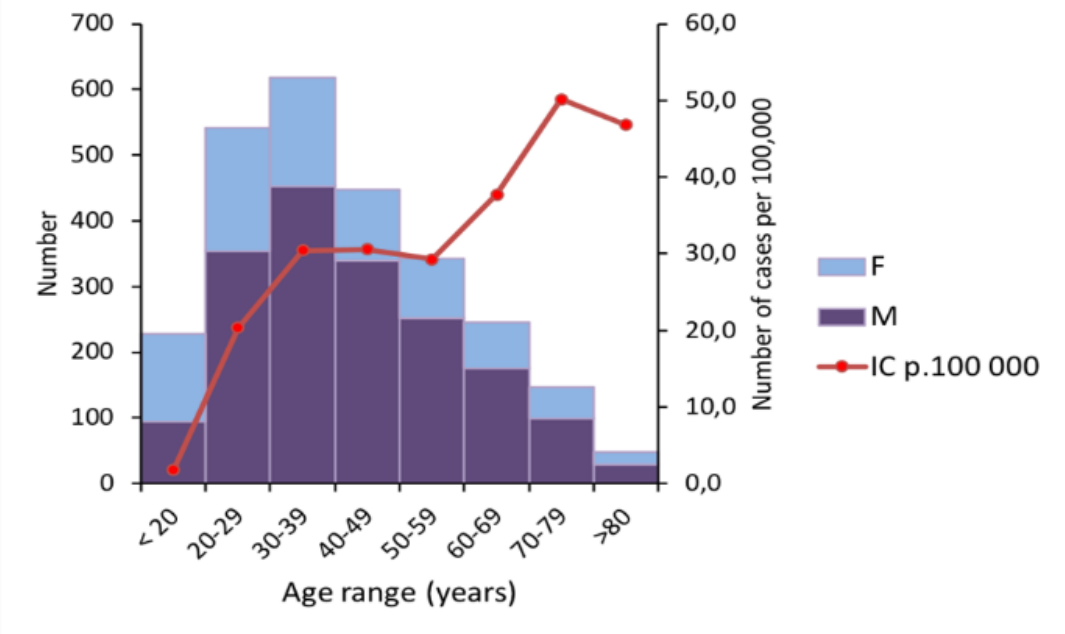

Figure 1: Distribution of COVID-19 cases by sex and age from March 25 to August 24, 2020 in Mali

The daily Covid-19 confirmed cases evolves irregularly, sometimes high and sometimes low with the greatest number detected on June 10, with 81 cases (Figure 2). The average daily incidence was17 cases.

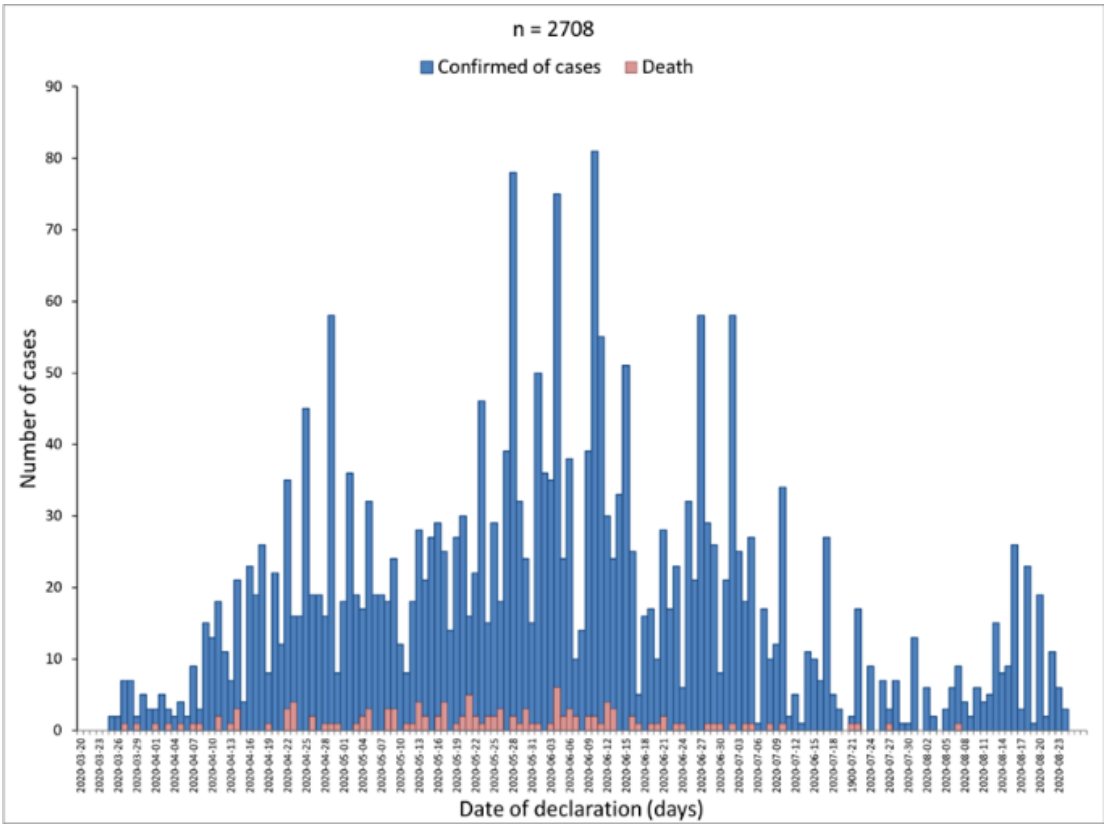

Figure 2: Daily trend in confirmed cases and COVID-19 deaths from March 25 to August 24

Since the start of the Covid-19 epidemic in Mali, during the 13th epidemiological week, the cumulative epidemic curve has been characterized by a gradual evolution, reaching its highest level 9 weeks later, i.e. week 22nd week. Lower case fatatliy rates were recorded as the weekly numbers of cases decreased (Figure 3). The average weekly incidence was 123 cases.

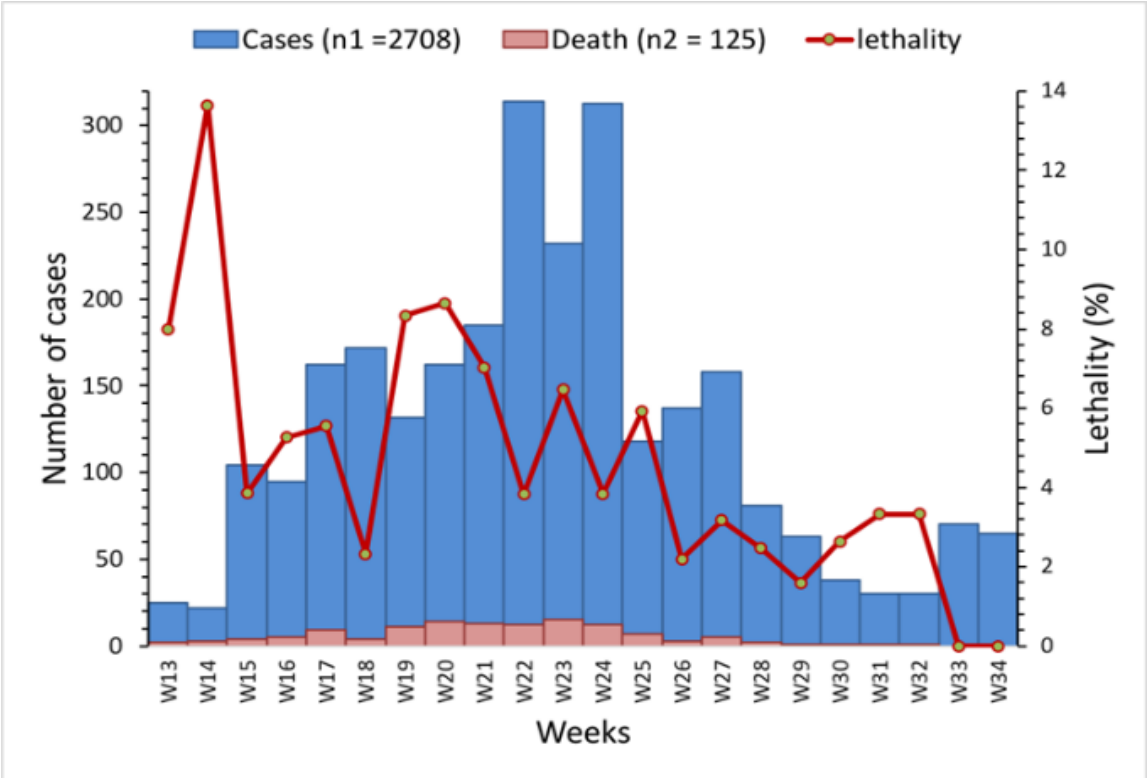

Figure 3: Weekly evolution of cases and fatalities linked to COVID-19 from March 25 to August 24 in Mali

Of the first two cases confirmed in Bamako, one had no history of travel nor epidemiological link to any known positive case. The majority of imported cases originated in France and air travel was the most common mode of transportation. The first confirmed cases in insecure areas (Timbuktu, Gao, Kidal, and Mopti) were ex-patriots (Table 1).

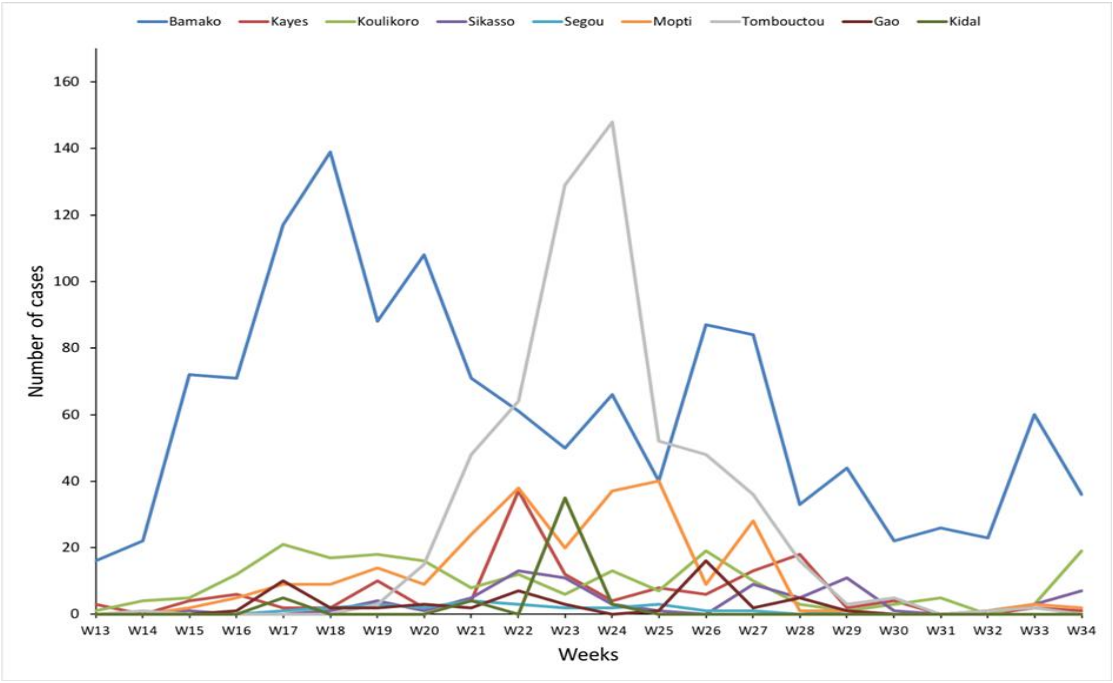

Figure 4: Weekly trend of confirmed cases of COVID-19 by region from March 25 to August 24 in Mali

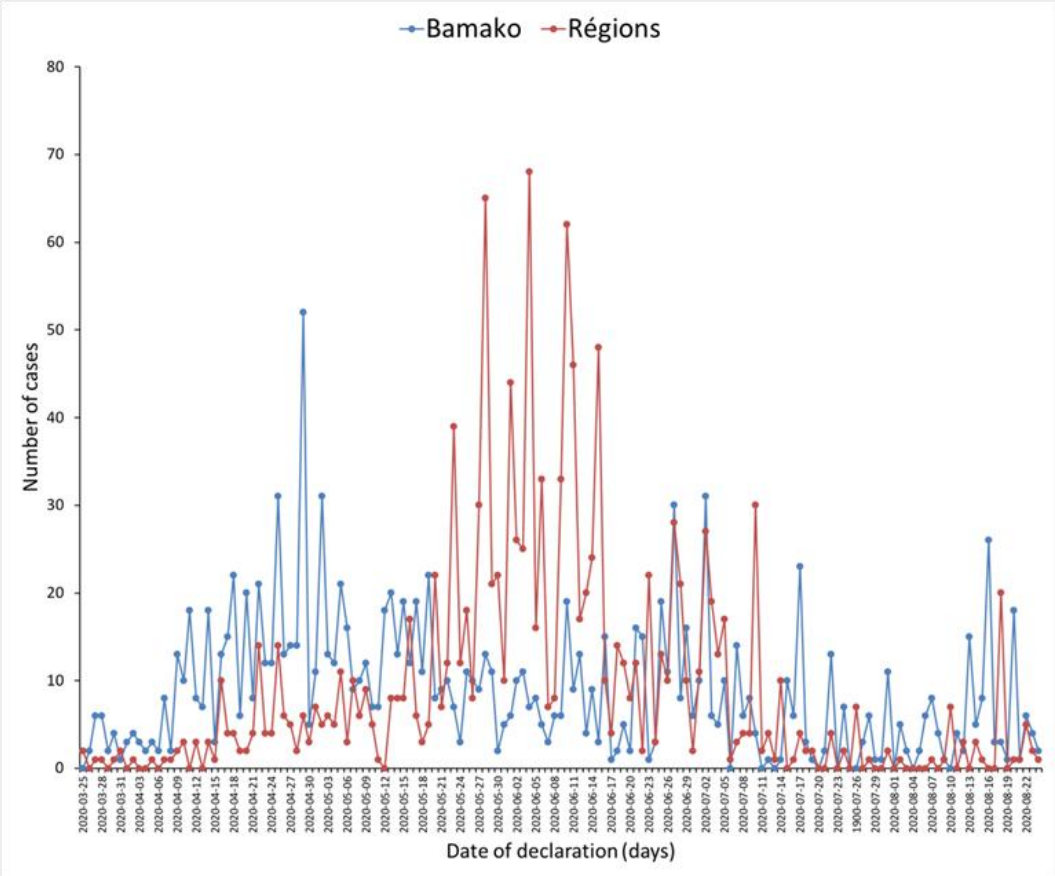

Figure 5: Daily trend of confirmed cases of COVID-19 in Bamako versus regions from March 25 to August 24 in Mali

Table 1: Characteristics of the first cases notified in the regions

Regions	Confirmation Date of first cases	Number	Arrival date	Departure of the 1st covid-19 cases	Means of transport used by the 1st cases
Bamako	26/03/2020	1	17 march	France via Ouagadougou	Plane and Bus (1)
Bamako	26/03/2020	1	-	No travel notion	-
Kayes	25/03/2020	1	16 march	France via Bamako	Plane and Bus
Koulikoro	25/03/2020	1	12 march	France	Plane
Sikasso	10/04/2020	1	27 march	Mopti	Bus
Ségou	24/04/2020	1	-	**No travel notion**	-
Mopti	07/04/2020	1	-	Humanitarian	Plane
Tombouctou	05/04/2020	1	-	Humanitarian	Plane
Gao	16/04/2020	1	-	Humanitarian	Plane
Kidal	22/04/2020	5	-	Humanitarian	Plane

The epidemic in Mali began with imported cases in two regions, Kayes and Koulikoro, followed by Bamako, which became the epicenter. The largest number of cases was recorded in week 18 in Bamako, (Supplementary Figure 1). The epicenter shifted to the Timbuktu region with the peak recorded in week 24 to 6 weeks after the outbreak began.
From the beginning of the epidemic until May 20, the number of confirmed cases of COVID-19 was higher in Bamako than in the regions as a whole. A trend reversal was observed from May 21 onwards.
At the beginning of the epidemic, the positivity rate was high, then it started to decrease after 9 weeks of evolution (Figure 6).

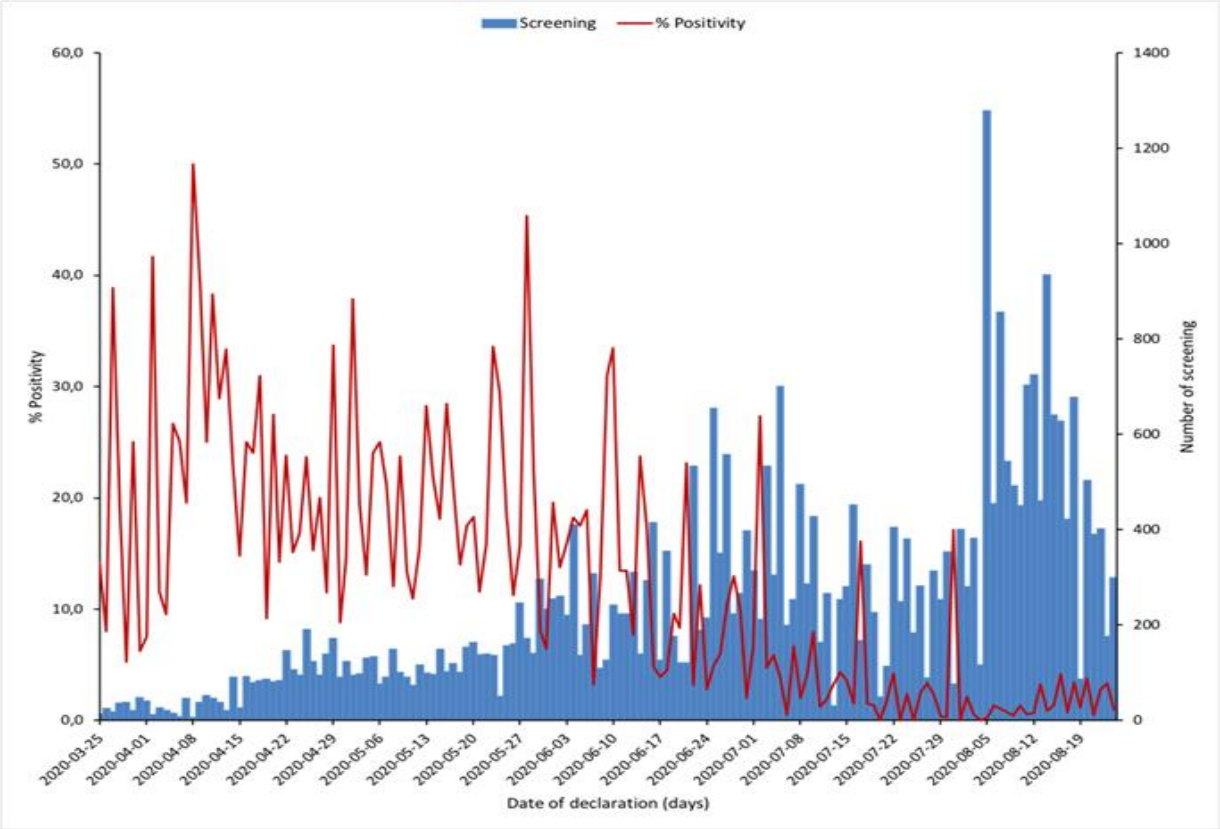

Figure 6: Daily evolution of tests performed and positivity by region from March 25 to August 24 in Mali

The epidemic began in Mali in the southern regions, including Kayes, Bamako, and Koulikoro in week 13. It moved to the north in week 14 and then to the center in week 15. During the first four weeks, no health district had more than 50 cases. From week 17 to week 22, the epidemic progressed rapidly, particularly in the districts of Bamako and Timbuktu. By the end of week 21, four of Bamako's six health districts had passed the 100-case mark.

The number of confirmed cases is not linearly related to the number of tests performed. The correlation coefficient between the two variables was 0.15 and not statistically significant (p = 0.058) on the spearman test.

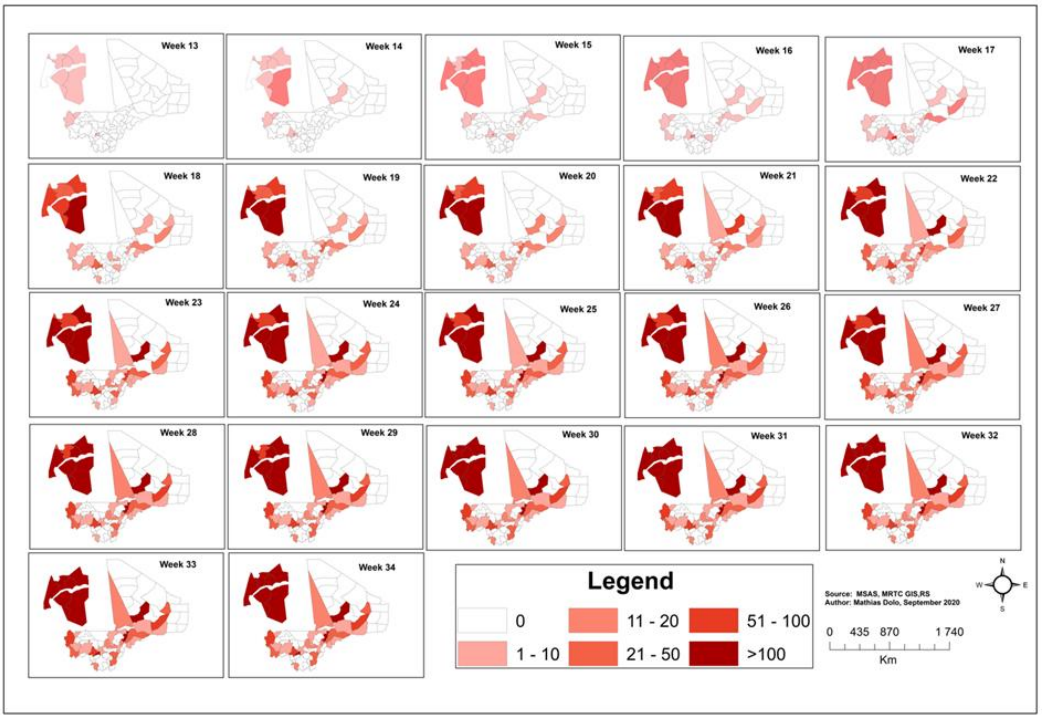

Figure 7: Map of Cumulative Weekly Incidence by District of Confirmed Cases from S13 to S34

Table 2 : Correlation number of screenings and number of confirmed cases

	Coefficient de correlation (R)	P
Test de spearman	0,15	= 0,058

DISCUSSION

The present study, mainly based on the analysis of data collected in real time from the case linear list and laboratory registries, allowed the characterization in time and space of the cases of COVID-19 in Mali during the first five months. On a daily basis, a sawtooth evolution has been observed, showing a plurimodal epidemiological curve. The 70 to 79 age group was the most predominant. The predominance of positive cases at these ages could be explained by the fact that they are the most active, making more movements, thus increasing the risk of contact with other people and contamination of the disease. The predominance of subjects under 40 could also be explained by the demographic structure of the population of Mali, they represent more than 80% of the population [12]. On the other hand, the attack rate of the disease is higher in the oldest from 70 years. This result of the attack rate is similar to those of Bulut C, Kato Y. on the epidemiology of COVID-19 in China who observe that susceptibility to COVID-19 increases with age [13].

Males were the most affected overall. This factor was also observed by Li Q and Zhang JJ in their studies on "Early Transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia" and "Clinical characteristics of 140 patients infected with CoV-2-CoRSA in Wuhan, China", respectively [14,15]. The male predominance of COVID-19 cases, as well as higher incidences in males for most diseases, may be correlated with a general demographic fact of shorter life expectancy in males compared to females worldwide [16].

In the under-20 age group, women appear to be as affected as men. This could be explained by the fact that in Mali there are more unmarried women in this age group, and activities in terms of movement may be comparable to those of men at these ages.

At the beginning of the epidemic and during the first eight weeks, the only cases in Bamako were higher than those recorded in all affected areas. This situation of the capital, Bamako, being the epicenter of the epidemic is comparable to that of most countries affected by COVID-19. It could be explained on the one hand by a population factor where the capital is the most populated city in the country, on the other hand the largest airport, ensuring more movement of people between Mali and other countries or continents is located in Bamako and the means used by the first imported cases was by plane.

The reversal of this trend and the shift of the epicenter of the epidemic in the Timbuktu region towards the end of the second month could be explained by the adoption of the strategy of systematic screening of all contact cases in Timbuktu through the deployment of the mobile laboratory.

The identification of a first case in Bamako early in the epidemic without any notion of travel or epidemic link with a known positive case, raises the hypothesis of the introduction and circulation of the virus in Mali well before March 25, 2020, the date of confirmation of the first cases.

The high rate of positivity at the beginning of the epidemic was due to the fact that the first tested cases were symptomatic. Over time, the positivity decreased due to the adoption of the strategy of systematic screening of contacts and or the increase in the number of test seekers beyond just symptomatic cases with the reopening of borders. The regions were affected through the regional capitals or regional capitals.

The number of tests was not significantly correlated with the number of confirmed cases in the first five months. This could be explained by the repatriation program followed by screening Malians stranded outside. This program had enabled 3,707 screenings, including 79 positive cases during the first five months.

Insufficient completeness of information around each case in the linear list was a limitation to better characterize some cases in real time, even though additional information was obtained from some patients by phone.

CONCLUSION

The dynamics of the COVID-19 outbreak in the first five months in Mali was marked by a high concentration of cases in cities, especially in Bamako and Timbuktu. The male sex and the 70-79 age group years seem to be the most affected. The number of tests performed is not significantly correlated with the number of confirmed cases.

A regular update and a seroprevalence survey or a mass screening would be necessary to better monitor and understand the dynamic of the Covid-19 outbreak in Mali.

DECLARATIONS

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Competing Interests

The authors declare that there is no conflict of interests.

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Manuscript writing and or correction: Souleymane S. Diarra, Ibrhima Berthe, Celia Wood Fill and All authors
Final approval of manuscript: All authors

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