



Research Article

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# Sero-Epidemiological Survey and Profile of SARS-Cov-2 Infection in Cabo Verde

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## Abstract

**Importance:** Carrying out this sero-epidemiological study on the COVID-19 pandemic will make it possible to know the extent of the SARS-CoV-2 infection in the Cape Verdean population and its current dynamics in Cape Verde.

**Objective:** Determine the seroprevalence and the profile of SARS-CoV-2 infection in the Cabo Verdean population.

**Design, Settings, and Participants:** Population study national range, stratified by municipalities, carried out for a probabilistic sample of all individuals between 10 and 80 years of age who habitually reside in the family household. All participants will take a rapid test (TDR) to detect total antibodies and a questionnaire that contains information on sociodemographic characteristics, behavior and symptoms related to COVID-19.

**Main Outcomes and Measures:** The seroprevalence of SARS-CoV-2 will be determined through the cumulative incidence and the information obtained from the questioner will be analyzed stratified by sex, age and municipality.

**Results:** Seroprevalence was 0.4%, being higher in females and in the younger age group (10 to 20 years). The municipalities with positive TDR results were Sal, Maio, Praia, São Domingos and Ribeira Brava. Taking trips outside the municipalities, during the state of emergency, in public transport and failure to comply with the correct use of a mask whenever one is in place with crowds of people are some risk factors associated with transmission.

**Conclusion and Relevance:** The Cape Verdean population is susceptible to the SARS-CoV-2; there may be an increase in cases in the near future.

## Introduction

The pandemic caused by the SARS-CoV-2 virus, first identified in China [1], is responsible, until 29 December of 2020, for more than 61.8 million confirmed cases and almost one million deaths worldwide [2]. COVID-19 constitutes a public health concern globally and especially in small island states [3].

Thus, the accuracy of the laboratory diagnosis of COVID19 is an essential aspect for controlling the pandemic. Although only the reverse transcription polymerase chain reaction (RT-PCR) molecular test has diagnostic validity, rapid tracking tests based on host antibody detection against SARS-CoV-2 are used as a



complementary measure to identify recent, convalescent, recovered and asymptomatic cases, providing more details on the prevalence of COVID-19 in the population [4].

The first confirmed case of COVID-19 in Cabo Verde was notified on March 19, 2020, and, since then, the epidemic has evolved moderately. As of September 30, 2020, only one of the nine inhabited islands had yet to be affected, and the country had an accumulated number of 6024 confirmed cases and 59 deaths [5].

This first national sero-epidemiological survey aims, on the one hand, to estimate the exposure to SARS-CoV-2, in the Cape Verdean population by determining the presence of antibodies against the virus in blood samples and, on the other hand, to characterize the epidemiological profile of infection in Cabo Verde through the application of a questionnaire. The results obtained will subsidize decision-making and the implementation of appropriate measures at national level, by municipalities and regions.

## Methods

### Design of the Study

The study was designed to respond to the government's request, in May 2020, which launched the initiative to carry out a first COVID-19 sero-epidemiological survey that could provide subsidies to improve the prevention and control measures against SARS-CoV-2 in Cabo Verde. The planned survey consisted of a cross-sectional nationwide population study, nationwide, covering all municipalities/islands regardless of whether or not they had reported confirmed cases of COVID-19. The experimental approach was based on two strategies: estimation of the seroprevalence of the COVID-19 in the population through the presence of antibodies against SARS-CoV-2 and collection and analysis of information from the study participants, from a questionnaire, relevant to characterize the epidemiological profile of the disease in the country.

### Geographic and Demographic Context

Cabo Verde is a small island country, with a combined land area of 4033 km<sup>2</sup>, formed by ten islands and five islets. It is located 560 km west of the coast of Senegal and is made up of a group of islands located to the north, Barlovento Islands and a group of islands located to the south, Sotavento Islands. The largest and most populated island is Santiago (990 km<sup>2</sup> and 155252h) while the island with the smallest area, and the only uninhabited island, with the smallest surface area, is Santa Luzia (35 k m<sup>2</sup>) [6]. According to the 2010 Census, the country has a population of 491575 inhabitants, distributed in 62% in urban areas and 38% in rural areas. Children under 15 years old represent 31.7% of the general population and the average age is 22 years old. The average family size is 4.2 people per household [7].

### Target Population and Sampling Modeling

The target population of this survey are individuals from 10 to 80 years old, residents and in the family household at the time of interview. The following exclusion criteria were defined: individuals present in the household who were not part of the household or who refused to give informed consent (IC) (eAppendix1 in the Supplement), or who had contraindications for the collection of a biological sample, or who had physical and / or health limitations that make it impossible to understand the IC. The sampling model was a probabilistic type, with a bi-phase structure stratified by municipalities / islands as the domain of analysis, with the selection of households by random.

### Data collection and analysis

Data collection was carried out by direct interview and using a tablet to apply and fill out the COVID-19 sero-epidemiological electronic questionnaire. The collection period was ten days: from June 25<sup>th</sup> to July 4<sup>th</sup>.

For descriptive analyses and data presentation, the software SPSS vr.22 was used.

### COVID-19 Sero-Epidemiologic Questionnaire

The survey data were collected using a structured questionnaire, developed and parameterized electronically through the Integrated Management System (IMS) of the National Institute of Statistics (INE). The COVID -19 sero-epidemiological questionnaire was organized into four thematic blocks (eAppendix 3 in the Supplement):

- Part I; Identification of the questionnaire.
- Part II; Characteristics of the accommodation and the living conditions of the household, to be answered by the representative of the household.
- Part III; Individual questions to be answered by each member of the household, from 10 to 80 years old.
- Part IV; Control of the Sars-CoV-2 antibody detection rapid test.

### Detection of Sars-CoV-2 Antibodies

For this study, the point-of care rapid Kit *SARS-CoV-2 Antibody Test (Lateral Flow IgG/IgM)* manufactured by Guangzhou Wondfo Biotech Co LTD (China) was used. The sensitivity and specificity of this test, recorded by the manufacturer, are 86.43% (95% CI: 82.51-89.58%) and 99.57% (95% CI: 97.63% -99.92, respectively). All samples collected were capillary blood. For those who had a positive result, the meaning of the result was explained, and they were referred to the health service after a previous contact.

## Ethical Considerations

The study was submitted to the Cabo Verde National Health Research Ethics Committee (colocar código de aprovação) and the National Data Protection Commission (colocar código de aprovação). It received approval from both institutions and is therefore bound by a code of ethics and strict laws that protect participants' confidentiality. Each participant was assigned a specific code when conducting the interview and collecting samples and only the responsible researchers had access to the associated name. The use of the information and samples for this study was authorized by the participant, by signing the IC, in the case of individuals over 18 years of age, and the Informed Assent for minors (in addition to the

signature of the IC by the legal guardian of the child / adolescent) (eAppendix 2 in the Supplement).

## Results

In this study, 5348 individuals aged between 10 to 80 years old were interviewed, from an estimated sample of 5000-6000 individuals. The team interviewed 2020 complete households out of an estimated 2750 were interviewed (Table 1). Epidemiological characterization of participants in the COVID-19 sero-epidemiological survey characterizing the sample by sex and age, 57% of the participants are female, the average age is 35 years old, and the median is 32 years old. 63% of the participants are between 10 and 40 years old and 13.7% are elderly people aged 60 or over.

**Table 1:** Population and sample of the COVID-19 sero-epidemiological survey stratified by municipalities.

	Population size and distribution $N_0 / N_0 \cdot (\%)$	Estimated sample size	Sample size and distribution $N_0 / N_0 \cdot (\%)$
Ribeira Grande	18890/491875 (3.8)	264	244/5348 (4.6)
Paul	6997/491875 (1.4)	214	200/5348 (3.7)
Porto Novo	18028/491875 (3.7)	260	250/5348 (4.7)
São Vicente	76140/491875 (15.5)	498	350/5348 (6.5)
Ribeira Brava	7580/491875 (1.5)	217	167/5348 (3.1)
Tarrafal de São Nicolau	5237/491875 (1.1)	207	181/5348 (3.4)
Sal	25779/491875 (5.2)	291	233/5348 (4.4)
Boa Vista	9162/491875 (1.9)	221	205/5348 (3.8)
Maio	6952/491875 (1.4)	214	196/5348 (3.7)
Tarrafal	18565/491875 (3.8)	262	171/5348 (3.2)
Santa Catarina	43297/491875 (8.8)	367	285/5348 (5.3)
Santa Cruz	26617/491875 (5.4)	298	285/5348 (5.3)
Praia	131719/491875 (26.8)	728	607/5348 (11.4)
São Domingos	13808/491875 (2.8)	242	256/5348 (4.8)
Caleta São Miguel	15648/491875 (3.2)	250	177/5348 (13.3)
São Salvador do Mundo	8677/491875 (1.8)	221	193/5348 (3.6)
São Lorenzo dos Órgãos	7388/491875 (1.5)	216	252/5348 (4.7)
R. Grande de Santiago	8325/491875 (1.7)	264	246/5348 (4.6)
Mosteiros	9524/491875 (1.9)	225	157/5348 (2.9)
São Filipe	22248/491875 (4.5)	278	231/5348 (4.3)
Santa Catarina de Fogo	5299/491875 (1.1)	207	225/5348 (4.2)
Brava	5995/491875 (1.2)	210	237/5348 (4.4)
National Country	491875/491875 (100.0)	6110	5348/5348 (100.0)

### 2010 population census

Analyzing the employment status of the interviewed population before the start of the mandatory lockdown, it is observed that only 36% carried out some type of economic activity, of which 67% belong to the group of professions considered to be potentially

vulnerable to infection by COVID-19. During the lockdown, 43.1% of workers interviewed remained active, 33% through on-site work (Table 2).

**Table 2:** Work profile, housing characteristics and living conditions of the participating in the COVID-19 sero-epidemiological survey.

	Quantification of categorized information N <sub>0</sub> / N <sub>0</sub> (%)
Employment status before mandatory lockdown:	
Unemployment	1135/5348 (21.2)
Student	1428/5348 (26.7)
Housewife	790/5348 (14.8)
Self-employment	594/5348 (11.1)
Part-time work	396/5348 (7.4)
Full-time work	990/5348 (18.5)
Not determined	15/5348 (0.3)
Employment status before mandatory lockdown:	
Working	850/1980 (42.9)
Without working	1121/1980 (56.6)
Not determined	9/1980 (0.5)
In-person work during mandatory lockdown	
Yes	741/850 (87.2)
Not	107/850 (12.6)
Not determined	2/850 (0.2)
Activity in high-risk professions for Covid-19:	
Transport	38/850 (4.5)
Cleaning	71/850 (8.4)
Security forces, fireman	85/850 (10.0)
Health	40/850 (4.7)
Dependent person caregiver	12/850 (1.4)
Agriculture and fishing	94/850 (11.1)
Customer service	8/850 (0.9)
Other sector	244/850 (28.7)
Not determined	16/850 (1.9)
Average household size (number of rooms) = 3.5	5348 (32.5)
Average housing density per bedroom (number of individuals) =1.77 (s= 0.99) a	1738/5348 (32.5)
Overcrowding in the bedroom (number of individuals)	≥ 2.1 (16.8)
Piped water supply (IN)	3876/5348 (72.5)
Individuals satisfied with the amount of water supply	3876/5348 (72.5)
Access to flush toilet (IN)	2945/5348 (55.1)
Evacuation of solid waste in container or garbage truck (IN)	4541/5348 (84.9)

**Abbreviation:** Number of individual

Indicator for estimating overcrowding per bedroom that relates the number of individuals in the household and the number of bedrooms. Values  $\geq 2.1$  are considered overcrowding.

This study showed an average household size of 3.5 and an average housing density per bedroom of less than two people (1.8). Taking 2.1 as a reference for overcrowding in bedrooms/household, it was observed that 17% of households were overcrowded and of these, 57% were households formed almost entirely by female individuals (Table 3). Regarding water supply conditions, most have tap water (93%), however 22% of the interviewed population considers that the volume of water is insufficient to satisfactorily account for the preventive measures for COVID-19. Regarding sanitation, 58% of individuals live in households with access to a flush toilet and 10% do not have a safe way to evacuate their garbage, and dispose the garbage by burning, burying or spreading it around the house (Table 3).

Regarding community behavior during the state of mandatory lockdown, 81% of respondents said that they would go out to do

shopping. Almost all respondents answered positively, to carrying out the main preventive measures recommended for COVID-19 in outings and meetings in public, such as; hand hygiene (98.8%), social distancing (97%) and wearing masks in public places (74.6%). Analyzing the frequency with which these measures were carried out, it was observed that less than two-thirds of the interviewed population put them into practice correctly (Table 3).

Regarding mobility to other municipalities, including during the mandatory lockdown period, 26% of the individuals reported having traveled, especially to the main urban centers: Praia, Santa Catarina, São Filipe and São Vicente (considering Mindelo as a population center of this island/municipality). Public transport was the main means of mobility being used by 59.7% of individuals who had traveled during the lockdown.

**Table 3:** Characterization of the participants in relation to preventive measures, mobility, contacts, diagnosis, comorbidities, smoking and alcoholism.

	Quantification of categorized information $N_0 / N_0 \cdot (\%)$
Going out for shopping during lockdown	3401 (81.1)
Going out to meet with friends or family during lockdown	836 (19.9)
Frequent use of masks	2729 (68.5)
Use of certified masks	1228 (30.8)
Frequent hand hygiene	3465 (65.6)
Frequent social distancing	3073 (57.5)
Travel outside the municipality of residence	1118 (20.9)
Travel by collective transport a	667 (59.7)
Contact with people infected with SARS-CoV2	106 (2.0)
Contact with people with flu-like symptoms	171 (3.2)
Participants with previous diagnosis of COVID-19	6 (0.1)
Participants with symptoms for COVID-19	488 (9.1)
Comorbidities	966 (18.1)
Smoking	418 (7.8)
Alcohol consumption	1200 (22.4)

Indicator calculated from the total number of individuals who travelled outside the municipality of residence.

Of the survey participants, 2% reported having contacted people with COVID-19 and only 0.1% had already been diagnosed for the disease. Regarding the presence of symptoms for COVID-19, 9.1% of participants reported having at least one of the symptoms. The most frequent were headache, cough and sore throat. The demand for health services was mainly directly with the doctor (97.7%). Regarding the presence of chronic diseases in the population interviewed, 18% of the participants pointed out at least one health problem, with hypertension and diabetes, especially the former, being the most frequent. Regarding risky lifestyle habits for COVID-19; 7.8% of individuals were smokers and 22.4% reported using alcoholic beverages in the last 30 days.

Detection of Sars-CoV-2 antibodies in the participants of the COVID-19 sero-epidemiological survey of a total of 5348 respondents, twenty-one (0.4%) tested positive for COVID-19, using the rapid IgG/IgM immunoglobulin detection test. Positive results were reported in only 5 of the 22 municipalities across the country and were mainly from the island of Sal (67% of the positive cases). Disaggregating the total of positive tests by sex and age group, it was observed that 86% of the individuals were female (cumulative incidence of 0.6%) and that 52.4% of these were in the age group

of 10 to 30 years, the highest cumulative incidence found, of 0.6%, was in individuals aged 10 to 20 years.

## Discussion

The prevalence of TDR positive cases for detection of IgG/IgM for Covid-19 was 0.4%. The result shows a representative image of the SARS-CoV-2 infection in Cabo Verde, in the period in which this survey was carried out (from 26 June to 4 July 2020). During this period, of the nine inhabited islands that make up the national territory, confirmed cases of COVID-19 had already appeared on six of them, with a more recent active focus/epicentre on the island of Sal, and a seventh island had suspected cases. The result obtained in this study has internal validity, as it shows the reality with the highest distribution and cumulative incidence of positive cases at the island of Sal, as expected, considering the recent active focus on this island. Thus, when comparing the results of this study with the national epidemiological bulletins for COVID-19, released from one week before the survey to one week after, there is a relationship between the positive cases found and local outbreaks of COVID-19 in Ribeira Brava (8 cases on 5 July 2020), São Domingos (1 case on 3 July and a second case on 8 July 2020) and May (2 suspected cases on 28 June 2020). It also allows us to take stock of the development of the infection by municipality, making it possible to both detect and predict potential new outbreaks of infection at the local level. Seroprevalence studies of SARS-CoV-2 in different populations confirm that seroprevalence is related to the local infection burden at the time of the study. Thus, low load sites have low seroprevalence rates and high load sites have high rates [8].

An interesting result of the seroprevalence analysis by municipalities is the detection of the most recent outbreak of coronavirus on the island of Sal, which had zero cases of Covid-19 at the beginning of the mandatory lockdown. Some arguments that help to explain this fact are difficulty in typifying where the first cluster of cases could start, due to the high level of asymptomatic cases in the country and the impossibility to track the virus in the different susceptible populations of each island due to isolating, a consequence of lockdown. Reinforcing factors like poor housing conditions and limited access to health care could contribute to the appearance of the Covid-19 outbreak in Sal [9].

Regarding the interpretation of data obtained for the city of Praia, the focus of SARS-CoV-2 infection in the country, several limitations could justify the low prevalence found as; the cluster propagation model of SARS-CoV-2 in the population, which could not be estimated from the random sample of this study, as well as the number of respondents was lower than projected (Table 1). Nevertheless, as expected, Praia was one of the five with positive tests in the study, but with a percentage of only 10%. A more complex analysis of this result, alongside information from the rest

of the epidemiological indicators in this survey, collected for Praia, may explain it more accurately. Some of the issues to be taken into account when interpreting the results are related to the limitations of the technique and to the current scientific evidence regarding the production of antibodies after infection by SARS-CoV-2.

Regarding the immunity resulting from infection by the SARS-CoV-2 virus in humans, there are still many unanswered questions. Current published evidence suggests that this immunity is not long-lasting, and that the main immune response is not always the production of antibodies, with increasing evidence being found for a relevant role of cellular immunity in the body's response to the virus [10-12]. Also, there is evidence that other immunoglobulins, such as IgA, would have a more significant role than IgM in the antibody response to SARS-CoV-2 [13].

Regarding the limitation of the technique, antibody testing is not recommended for diagnosis and its use is limited to the investigation of an ongoing or extent of an outbreak [4,14,15]. Tests for anti-SARS-CoV-2 antibodies are in abundance on the international market, with wide variations in their effectiveness [16,17]. The SARS-CoV-2 Antibody Test used in this study was one of the first to obtain the National Medical Product Administration (NMPA) and Conformité Européenne (CE) mark certifications.

Other interesting characteristics of the first SARS-CoV-2 infection in Cabo Verde, are its predominance in females (86% of positive tests in females) and mainly affected the uppermost layer of the youth (cumulative incidence of 60% in the 10 to 20 age group), with no positive tests in the older strata (50-over 70 years).

Some information obtained from the other epidemiological indicators of as: higher percentage of female respondents and in the 10-20 years old age group, 25% of the respondents over 50 years old, no statistically significant relationship between comorbidities and TDR seropositivity.

Regarding the external validity of this study, there is already published evidence on the good accuracy of the commercial Wondfo TDR for detecting IgG/IgM antibodies against SARS-CoV-2, in population seroprevalence studies [18]. The methodological approach used, and the general results obtained in this first national sero-epidemiological survey COVID-19 are in line with what has already been reported in studies carried out elsewhere [19], biphasic random sampling, with final sampling unit the individual and the aggregate as the base unit. The low percentage of antibodies obtained in this study is in line with the results obtained in other studies, where the percentage of the population detected with antibodies is too small to assume the existence of community immunity, confirming the susceptibility of the Cape Verdean population to a second infection or COVID-19 epidemic [20,21].

Another observation already evidenced in published studies is that the infection occurs by activating outbreaks, in the same period, with different intensity by location or municipality of study [19].

## Limitations

Due to the lack of robust scientific evidence to date, TDR has been used, which simultaneously detect IgM and IgG and have greater sensitivity and specificity.

As there was little information available on the problem of COVID- in Cabo Verde, and few similar studies in Africa, there being no updated sampling base, there was an adaptation of the method and sampling plan used, to carry out a stratification a priori/prior to carrying out the study, in order to improve estimates and reduce costs.

## Conclusion

With this investigation, we intend to better understand the extent of the epidemic and to add existing knowledge about the COVID-19 in Cabo Verde. Study findings could be used to subsidize government strategies, programs and public health policies for an adequate response to the pandemic, to adopt more assertive and effective prevention and contingency measures, to support processes of lifting coronavirus restrictions and identify important socioeconomic, epidemiological, demographic and clinical factors in the transmission and dynamics of the epidemic.

## Acknowledgment

None.

## Conflict of Interest

The authors declare that there is no conflict of interest in carrying out the present study.

## Question

What is the sero-epidemiological profile of the population in the first wave of the COVID-19 pandemic in Cape Verde?

## Findings

In this population survey, nationwide, that included 5348 individuals from 10 to 80 years old, stratified at the level of municipalities, the seroprevalence of SARS-CoV-2 was 0.4%, being higher in females and in the younger age group (10 to 20 years).

## Meaning

The Cape Verdean population is susceptible to SARS-CoV-2 and, in the near future, there may be an increase in cases of COVID-19.

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