# Seroprevalence against Sars-Cov-2 among blood donors in Niamey, Niger, from October 2021 to March 2022

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**Research Article**

**Keywords:** SARS-CoV-2, Seroprevalence, Blood donors, Prevention, Public health, Surveillance, Sentinel

**Posted Date:** July 27th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-10270078/v1



**Additional Declarations:** No competing interests reported.

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# Abstract

During the COVID-19 pandemic, conventional surveillance systems faced critical limitations : PCR testing capacity constraints, asymptomatic transmission blind spots, and ascertainment biases skewed toward symptomatic or high-risk populations. In this context, blood donor populations emerged not merely as convenient sample sources, but as scientifically strategic epidemiological sentinels. Our objectives were to fill surveillance gaps in Niger and validate blood donors as sentinels for tracking population-level spread.

A cross-sectional study was conducted from October 2021 to March 2022 among the whole population of donors attending the CNTS selected by systematic random sampling (k = 6). At all, 3656 blood donors were selected. Questionnaires collected data on socio-demographic characteristics, exposure risks to SARS-CoV-2, and prevention practices. Blood samples were analyzed for serology. Chi² and Fisher's exact tests were used for categorical variables.

Among the 3656 selected blood donors, sex ratio (M/F) was 4.1 and 12% were vaccinated with at least one dose. The overall seroprevalence of SARS-CoV-2 among vaccinated and non-vaccinated was respectively 65% and 53% (p-value < 0.01). In vaccinated group, seropositivity rate was statistically higher in more 50 years age group (87%,) and no difference was shown in non-vaccinated group (p-value = 0.54). Among vaccinated, according with blood groups, $0^-$ group was less positive than other groups (46%) and among unvaccinated group $0^+$ group was less positive than other groups (48%)).

In multivariate analysis, headache and anorexia were associated to SARS-CoV-2 seropositivity.

Blood donor seroprevalence studies provide an rapid, scalable, and ethically deployable surveillance necessary to track an respiratory virus with high asymptomatic carriage, make the control of virus circulation possible in healthy people and help implement strategies to reduce virus transmission.

# Introduction

During COVID-19 pandemic, surveillance suffered from a fundamental statistical flaw : testing was indication-based, targeting symptomatic individuals, contacts of confirmed cases, or healthcare workers. This created massive ascertainment bias that rendered crude case counts epidemiologically meaningless.

Blood donor studies offered a population-based denominator that was independent of symptomatology or healthcare-seeking behavior. By testing residual plasma from routine donations, researchers captured asymptomatic and mild infections that never entered clinical surveillance systems. During the first wave, when up to 40–50% of SARS-CoV-2 infections were estimated to be asymptomatic, blood donor serosurveys provided the only unbiased estimates of community penetration, revealing the true iceberg of infection beneath the visible tip of hospitalized cases.

The COVID-19 pandemic, in countries like Niger, revealed vulnerabilities in the healthcare system and highlighted the need for increased surveillance of transmissible infections [1]. Blood donors, play a crucial role in surveillance. In pandemic context, the study of the seroprevalence of SARS-CoV-2 infection among blood donors at the Centre National de Transfusion Sanguine in Niamey was of the utmost importance to evaluate the risk and to shape public health policies [3,4].

This study aims to explore the factors associated with sero-positivity for SARS-CoV-2 among blood donors in Niger. Systematic screening of a large asymptomatic population is also an efficient approach to obtain valuable information on the effectiveness of public health interventions implemented to control the spread of the virus, and to draw lessons for future.

## METHODOLOGY

# Study design and location

The study was carried out at the CNTS as a cross-sectional, descriptive and analytical survey to assess the seroprevalence of SARS-CoV-2 infection in blood donors. Blood donors were recruited over a 6-month period from October 2021 to March 2022. Sampling strategy was defined using data collected in 2019, during which 23,000 blood donations were recorded. To ensure a homogeneous distribution of our sample and to save time and resources, we chose a sampling step of 6 was applied. a sampling step of 6. After selecting a random starting point (the first individual in the sample), the other participants were chosen by adding the sampling step exclusively. In this way, a total of 3,656 candidates for blood donation were clinically and biologically screened, in accordance with the criteria set by the CNTS i.e. (i) age ≥ 18 years; (ii) weight ≥ 50 kg; (iii) be in good health; (iv) negative test for HIV, HBsAg, HBc and syphilis. Donors finally selected were those who signed informed consent form and who agree to answer the questionary. Donors who gave their consent but refused to answer the questionnaire or to be sampled were excluded from the study.

## Data collection and sampling

Information concerning participants' identity, blood type, exposure to SARS-CoV-2, clinical symptomatology, and control and prevention measures were collected using a paper questionnaire, after informed consent to participate. In addition to epidemiological and clinical data, the questionnaire included the eligibility criteria for blood donation, ensuring that only donors meeting the established standards were included in the study. For each participant, a blood sample of 2 ml was taken on a dry tube. Particular attention was paid to compliance with the laboratory's recommendations concerning the transport of samples, to guarantee their integrity and the reliability of the results.

Team members involved in specimen collection and transportation were trained in safe handling practices and procedures for decontaminating biological fluids in the event of accidental leakage during transport.

## Serological analysis

Analyses were performed on serum using the Thermo Fisher ELISA kit according to manufacturer recommendations. Samples and kit were left at room temperature before processing. Samples were diluted 1:100 with sterile water.

## Epidemiological data analysis

Data were collected and entered into an anonymized database to guarantee confidentiality. Statistical analyses were performed using R software version 3.6.1. Descriptive analysis was used to determine the socio-demographic and clinical characteristics of blood donors (gender, age, occupation, blood group, vaccination status, use of masks, frequency of hand washing, etc.). Quantitative variables were presented as means, standard deviations and 95% confidence intervals. Qualitative variables were expressed as absolute frequencies and percentages. The SARS-CoV-2 seropositivity rate was calculated as a proportion of the total number of donors included. Stratification was performed by gender, age group, occupation, vaccination status and preventive behaviors (wearing masks, hand washing). Explanatory variables (such as occupation, age, vaccination status) were compared with positive or negative serological status using Chi-square test or Fisher's exact test for qualitative variables and Student's t-test or Mann-Whitney test for quantitative variables.

Multi-variate analysis was performed to identify factors associated with increased SARS-CoV-2 seropositivity. Variables significant in the bivariate analysis ($p < 0.2$) were included in a backward logistic regression model to identify independent determinants of seropositivity. Results are presented as adjusted odds ratios (ORa) with their 95% confidence intervals.

## Ethical considerations

Ethical clearance was obtained from the National Ethics Committee for Health Research (CNERS) with reference N° 572021/CNERS (16/09/2021). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Donors received clear and appropriate information on the study procedures from the team including objectives, procedures, risks and benefits of the study, and data confidentiality management.. A unique identification number was assigned to each donor to ensure anonymity.

# RESULTS

A total of 3656 blood donors were included during the period study. Sex ratio (M/F) was 4.1. The median age was 29 years (IQR: [24–39 yrs], age group [20–30 yrs) was the most frequent (46%). The most of them were married (52%) and 30% were student. The dominant blood groups were O+ (23%), and A+ (23%). (Table 1).

Vaccinal status was known for 3647 blood donors, 12% received at least one dose of vaccine (Table 1). There is no difference between sex, marital status and blood groups. The younger age group less than 20 years was the less vaccinated (5%). Foreigners and civil servants were more vaccinated, respectively 28% and 24%.

Donors wore masks at home in 18.1% of cases, and 29.5% wore masks outdoors. Hand washing was done with alcohol-based products for 49.2% of them and with soap in 61.2%.

The overall seroprevalence of SARS-Cov2 among blood donors was 54%. And was different according with vaccine status, 65% in vaccinated versus 53% in unvaccinated group ( p-value-<0.001).Among vaccinated group (Table 2), there was no difference according with gender, matrimonial status, nationality, occupation. There is a significant difference according with age groups (87% for the most aged) and according with blood groups ($0^{-}$ group was less positive than other groups (46%)). Among unvaccinated group (Table 2), there was no difference according with gender, age groups, matrimonial status, nationality, occupation. There is a significant difference according with blood groups ($0^{+}$ group was less positive than other groups (48%)).

No difference about serology results was found concerning preventive and barriers measures (data not shown).

Among all the blood donors, 158 (4%) declared past clinical symptoms (Table 3). Headache (51%), general malaise (42%) and cough (33%), are manifestations the most frequently reported by symptomatic blood donors. Headache, anorexia, cough and loss of taste were significantly more - frequent among positive symptomatic blood donors, respectively 70% (p-value = 0.006), 77%, (p-value = 0.02), 71% (p-value = 0.02) and 72% (p-value = 0.04). In multivariate analysis including all the variables with p-vale < 0.20, only headache and anorexia remained in the final model, adjusted OR were respectively 1.7 and 2.2.

# DISCUSSION

The present study was conducted at the end of the first wave of COVID in Niger, on asymptomatic healthy blood donors coming as voluntary blood donors in the national transfusion center of Niamey. The majority of blood donors were young men. This is in line with other studies in Africa, which highlighted good health, cultural and social factors [5] as factors of willingness to participate in altruistic initiatives [6]. This willingness was supported by national awareness campaigns as pointed out by other studies [7]. Half of the donor were married, in line with their social stability and involvement in the community [8]. Blood groups O + and A+ were predominant in line with the distribution of blood groups in the African population [9]. These groups are particularly valuable for blood banks, due to their relative universal compatibility.

In this study, a higher proportion of seropositive cases was observed among A+ donors, which aligns with findings suggesting a possible association between ABO blood groups and susceptibility to COVID-19[10],[11], although this relationship remains controversial and requires further investigation.

During this study, a preponderance of positive cases among A+ donors was also found, which is consistent with other studies, but requires further investigation[13].

Wearing a masks at home or outdoors was poorly done which reflects partial adherence to recommendations and a low perception of risk. Similar studies have shown that the adoption of preventive behaviors is often supported by awareness and by the feeling of severity of the pandemic in a given region[12]. Wearing masks has shown variable effectiveness depending on practices and contexts, with studies arguing that regular wearing significantly reduces the risk of infection by respiratory viruses [13]. With regard to hand hygiene, washing with alcohol-based products and soap, this study showed a substantial but still insufficient effort in the adoption of recommended hygiene measures indicates. Soap was the best-off in line with better accessibility and lower costs, as previously reported [14], even if alcohol-based products are more efficient [15]. In this context, sero-positive donors were often occasional mask wearers outdoors but rarely alcoholic handwash, reflecting a partial or inadequate adherence to recommended preventive measures.

In terms of vaccination, only 12% of donors had received at least one dose of anti-COVID-19 vaccine, reflecting extremely low vaccination coverage. This rate is well below the world average for vaccination over the same period[16].

The symptoms reported during this study, including headache, myalgia and general malaise are frequently reported in SARS-CoV-2 infections, although they are non-specific and may be observed in other viral diseases. Interestingly, and in line with other studies, the presence of certain symptoms (headache and anorexia) were statistically associated with seropositivity, and are thus important as infection indicators [17,18]. Symptoms such as loss of taste and smell, although more frequent in positive subjects, were not significantly associated in our univariate or multivariate model, suggesting that the prevalence of these symptoms may vary according to the specific characteristics of the population studied [19]. With regard to gastrointestinal symptoms, such as vomiting and anorexia, the results showed a slight univariate association with positivity, without this being significant in multivariate. According to a systematic review and meta-analysis, gastrointestinal symptoms are often present but less predominant than respiratory symptoms in positive cases, which could explain these results [20].

There was significantly higher seropositivity for SARS-CoV-2 antibodies in the voluntary healthy blood donors indicating community spread and large number of asymptomatic cases in Niamey, Niger Higher seroprevalence in all age groups indicated increased exposure to the virus and lack of COVID appropriate behavior.

This study acknowledges some limitations Firstly, the blood donner cohort focused on healthy individuals. Consequently, the seroprevalence observed may not accurately reflect the seroprevalence in populations Furthermore, the study did not include children. The geographical representation of the data is another limitation the study was limited to Niamey, the capital of Niger.

## CONCLUSION

Blood donor seroprevalence studies during COVID-19 should not be viewed as surrogate or secondary surveillance, but as complementary sentinel systems that filled critical gaps left by clinical testing infrastructure. For future pandemic preparedness, blood transfusion services should be formally integrated into national epidemic intelligence frameworks—not as blood suppliers alone, but as strategic biobanks for population immunity monitoring, offering a window into the subclinical epidemiology that drives pandemic dynamics. The COVID-19 experience demonstrated that when the healthcare system is overwhelmed, the blood banking infrastructure offers a lifeline not just for transfusion medicine, but for epidemiological clarity itself.

Table 1
Socio-demographic characteristics of blood donors in regard of vaccine status

| Characteristics | Total Population | | Vaccinated | | Unvaccinated | | |
|---|---|---|---|---|---|---|---|
| | N | (%) | N = 440 | (%) | N = 3207 | (%) | P-value |
| **Sex** | | | | | | | |
| Male | 2943 | (80) | 355 | (12) | 2583 | (88) | 0.99 |
| Female | 713 | (20) | 85 | (12) | 624 | (88) | |
| **Age Group** | | | | | | | |
| < 20 | 169 | (5) | 9 | (5) | 160 | (95) | < 0.001 |
| 20 to 30 | 1673 | (46) | 185 | (11) | 1487 | (89) | |
| 30 to 40 | 970 | (26) | 115 | (12) | 850 | (88) | |
| 40 to 50 | 641 | (17) | 100 | (16) | 507 | (84) | |
| > 50 | 203 | (6) | 31 | (13) | 203 | (87) | |
| **Nationality** | | | | | | | |
| Nigerien | 3604 | (99) | 427 | (12) | 3174 | (88) | 0.001 |
| Foreigner | 52 | (1) | 13 | (28) | 33 | (72) | |
| **Marital Status** | | | | | | | |
| Married | 1888 | (52) | 242 | (13) | 1643 | (87) | 0.38 |
| Single | 1646 | (45) | 185 | (11) | 1459 | (89) | |
| Divorced | 81 | (2) | 7 | (9) | 74 | (91) | |
| Widowed | 29 | (1) | 4 | (14) | 25 | (86) | |
| **Occupation** | | | | | | | |
| Student | 1093 | (30) | 114 | (10) | 978 | (90) | |
| Merchant | 586 | (16) | 51 | (9) | 535 | (91) | |
| Civil Servant | 566 | (15) | 138 | (24) | 427 | (76) | |
| Housewife | 209 | (6) | 16 | (8) | 192 | (92) | |
| Seamstress | 131 | (4) | 8 | (6) | 123 | (94) | |
| Farmer | 124 | (3) | 12 | (10) | 112 | (90) | |
| Mechanic | 110 | (3) | 3 | (3) | 106 | (97) | |

| Characteristics | Total Population | | Vaccinated | | Unvaccinated | | |
|---|---|---|---|---|---|---|---|
| | N | (%) | N = 440 | (%) | N = 3207 | (%) | P-value |
| **Sex** | | | | | | | |
| Others | 837 | (23) | 98 | (12) | 734 | (88) | < 0.001 |
| **Blood Group** | | | | | | | |
| O+ | 826 | (23) | 107 | (13) | 716 | (87) | 0.28 |
| A+ | 823 | (23) | 93 | (11) | 729 | (92) | |
| B+ | 511 | (14) | 35 | (13) | 249 | (87) | |
| AB+ | 501 | (14) | 51 | (10) | 448 | (90) | |
| O- | 185 | (5) | 28 | (15) | 157 | (85) | |
| A- | 343 | (9) | 48 | (14) | 295 | (86) | |
| B- | 285 | (8) | 35 | (12) | 249 | (88) | |
| AB- | 167 | (5) | 13 | (8) | 154 | (92) | |

Table 3
Distribution of clinical symptoms according to serology result.

| Clinical symptoms | COVID-19 Serology | | Uni varied | | Multi varied | | |
|---|---|---|---|---|---|---|---|
| | Effectif (%) | Positive (N) | (%) | p-value | ORa | IC95% | p-value |
| Headache | 80 (51) | 56 | (70) | 0.006 | 1.7 | [1.03–2.85] | 0.04 |
| Anorexia | 35 (22) | 27 | (77) | 0.01 | 2.2 | [1.01–5.38] | 0.05 |
| Cough | 52 (33) | 37 | (71) | 0.02 | | | |
| Loss of taste | 36 (23) | 26 | (72) | 0.04 | | | |
| Shivering | 24 (15) | 18 | (75) | 0.07 | | | |
| Rhinorrhea | 39 (25) | 27 | (69) | 0.09 | | | |
| Epistaxis | 14 (9) | 11 | (79) | 0.12 | | | |
| Sore throat | 40 (25) | 26 | (65) | 0.23 | | | |
| Dyspnea | 20 (13) | 14 | (70) | 0.24 | | | |
| Malaise | 67 (42) | 41 | (61) | 0.31 | | | |
| Sweat | 61 (39) | 29 | (47) | 0.33 | | | |
| Loss of smell | 64 (41) | 31 | (48) | 0.40 | | | |

# Declarations

### Conflicts of interest

The authors declare no conflicts of interest.


### Funding

This study was funded by the French Development Agency at the Institut Pasteur de Paris.

### Acknowledgements

To all the staff of the Centre National de Transfusion Sanguine (CNTS).


### Contribution to the study:

RJ. VR. HLR. ZM. KD. SHS participated in the conception and design of the study.

HLR. AADO. RJ participated in the data analysis.

GIO. AM. FCAS. AKAZ. BAS. AKAZ. FHB. ZDA. EYYMA collected the field data.

KDI. FCAS. FHB. ZSD have done the Laboratory analysis.

HLR. JT. LA. SO. ZM. RJ contributed to the writing of the text.

RJ. VR. JT. SHS critically revised the manuscript.

All authors have read and approved the final version of this manuscript.

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# Table 2

Table 2 is available in the Supplementary Files section.

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