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**COVID-19 vaccination coverage among travellers at Lomé international airport
(Togo), in 2022**

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Authors' contributions:

Conceptualization: AA, PMA and DKE. Data collection: AA, RMT and TG. Data analysis: YRK and MKT; results validation: AJS and FAGK; Writing - original draft: AA, LKA and KAA; Writing – review and editing: all authors. All authors have read and agreed to the published version of the manuscript.

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Abstract

Introduction: COVID-19 pandemic management leads to new health policies including the requirement of a vaccination pass or a negative Polymerase Chain Reaction (PCR) test for cross-border flights. The objective of this study was to estimate COVID-19 vaccination coverage among travellers, as well as factors associated with a full vaccination.

Materials and Methods: A cross sectional study was conducted in July 2022 at the Gnassingbé Eyadema International Airport (LFW) in Lomé. Travellers met at LFW, aged 12 years or above, and who agreed to participate in the study have been submitted a questionnaire. Logistic regression analysis was performed to identify factors associated with full vaccination defined as having received at least two doses of COVID-19 vaccine according to a validated vaccine schedule.

Results: A total of 847 travellers were included. 67% were men The median age was 40 years, Interquartile Range [31-48]. The main health document presented by travellers was the vaccination pass (69.1%). The majority (84.4%) of travellers had received at least one dose of COVID-19 vaccine and 63.9% had received at least two doses. Being 40 years of age or above (aOR=1.42; p=0.046), and travelling from a country outside Africa (aOR=2.18, p=0.003), were positively associated with full vaccination.

Conclusion: Vaccination coverage among travellers at the LFW was relatively high. Travellers from a region outside Africa and aged 40 years or above were more likely to be full vaccinated. Better communication and strengthening of the vaccination strategies in Africa could help reduce these gaps.

Introduction

The absence of highly effective clinical treatments at the beginning of COVID-19 pandemic led to a variety of public health and social measures globally in order to limit the spread of SARS-CoV-2.^{1,2} These interventions included mask wearing, physical distancing, partial and complete lockdown (school closures, curfews, etc.), extensive use of the "find-test-trace-and-isolate" approach, and travel-related control measures (border closures, travel restrictions, border controls, and traveller quarantine).³⁻⁷ Border closures had emerged as one of the spatial containment strategies for all countries to restrict population movements in order to limit the spread of the pandemic.⁸ Biomedical research triumphed rapidly with the development of several COVID-19 vaccines, and billions of doses of vaccine were administered worldwide.⁹ The priority targets for COVID-19 vaccination were healthcare professionals, people aged 50 years and older, and those living with at least one comorbidity (hypertension, diabetes, heart disease etc.).² These groups were targeted because they are at higher risk of exposure to SARS-CoV-2.¹⁰ However, despite the vaccine strategies in place, many countries have failed to achieve acceptable vaccine coverage.¹¹ COVID-19 vaccines have also been indicated in other settings. Indeed, the use of vaccination pass, which certify that a person has been fully vaccinated against SARS-CoV-2, or a proof of negative test for SARS-CoV-2, has been adopted by countries to ease travel restrictions.^{9, 10, 11}

Togo launched its COVID-19 vaccination campaign on March 10, 2021.¹² As of December 26, 2021; the vaccination coverage rate was 25% for those who received more than two doses among people aged 18 years and older. As this rate was low compared to the national objective of vaccinating at least 67% of the population in order to achieve herd immunity,¹³ the Togolese government then expanded the vaccination target to adolescents aged 12 to 17 years. Since June 2021, the

vaccination pass has been introduced as a required health document at the Gnassingbé Eyadema International Airport (LFW) in Lomé, Togo. To our knowledge, since the implementation of this new guideline, no data have been published on the proportion of travellers who have been following this strategy and who have been vaccinated against COVID-19. Also, there is a lack of information on factors associated with adherence to vaccination against COVID-19 among travellers.

The objective of the present study was to estimate COVID-19 vaccination coverage and to describe the factors associated with full vaccination among travellers at the LFW in Lomé (Togo).

Materials and Methods

Ethical considerations

This study was authorized by the Director of the “*Société Aéroportuaire de Lomé Tokoin*” (SALT) and the Director of the “*Autorité de Régulation de la Sécurité de l’Aéroport*” (ASAIGE). These authorizations allowed access to the different areas of the airport during our study.

Informed consent was obtained from each participant before inclusion. Parental consent has been obtained for travellers aged below 18 years old. To ensure privacy and confidentiality, participants first and last names were not collected, but a code was generated to serve as an identifier.

Study design and framework

A cross-sectional study was conducted in July 2022 at the LFW. The airport terminal has three sectors: departures, arrivals, and the mezzanine which is used to separate the flow of travellers between arrivals and those in transit. The study was performed within these three sectors.

Study population and sampling

The study population consisted of all travellers seen at LFW at the time of the study.

All travellers aged 12 years or above, who gave consent to participate in the study and who were traveling to, from, or in transit through Lomé were included. The choice of LFW was rational, as it is the only international airport in the country. A non-probability

accidental sampling method was used to recruit travellers.¹⁴ Thus, all travellers, who met the inclusion criteria were selected to participate in the study.

The number of subjects required was calculated based on the following estimates: assuming a vaccine coverage for at least one dose of 75% (as estimated by the Vaccine Tracker of the Bloomberg organization),¹⁵ with a margin of error of 3% and a first order risk of 5%, a minimum of 800 participants had to be included assuming that 10% of the data will be missing including refusals.

Operational definitions

- **A vaccinated traveller** is any traveller boarding, departing, or transiting through LFW who had presented a health document with proof of vaccination against COVID-19.

- **A fully vaccinated traveller** is any traveller with proof of vaccination of at least two doses of COVID-19 vaccine.

- **One-dose (or two-dose) vaccination coverage:** this is the proportion of travellers with at least one dose (or two doses).

- Pfizer, AstraZeneca, Johnson & Johnson, Sinovac and Moderna are used to name vaccines produced by these laboratories.

Data collection and analysis

In addition to the traveller's vaccination status, other informations were collected, including age, gender, education level, place of origin, and medical history.

The data were collected using a digitalized questionnaire developed in "KoBoToolbox" and implemented on smartphones. The questionnaire was pre-tested before data collection by interviewers who were distributed in the three areas of the airport

(boarding, departure and transit). The questionnaire was administered by sixteen trained interviewers.

Descriptive statistics were presented in tables of numbers and proportions with confidence intervals for categorical variables, and median with interquartile range (IQR) for quantitative variables.

Binary logistic regression was performed to describe factors associated with full vaccination. Factors with a value of $p < 0.20$ after univariate analysis were considered for the full multivariable model, which was then finalized using a top-down stepwise approach. The significance level of "p" was set at 5%. All analyses were performed using the statistical software R © version 4.2.1.

Results

Sociodemographic characteristics and travel document

A total of 847 travellers (67.0% of men), were included in this study. The median age of the travellers was 40 years [IQR: 31 - 48] and 77.5% had a university education level. Of the 847 travellers surveyed, 312 (36.8%) were travelling to Lomé (arrivals), 222 (26.3%) were departing from Lomé (departures), and the rest were in transit. The majority of travellers departing from or arriving at LFW had West Africa as their final destination or region of origin (Table 1).

Health travel document

The vaccination pass was the main health document held by travellers. Slightly more than half (51.6%) had a vaccination pass with a QR code and 17.5% had a vaccination pass without QR code. For 20.1% and 6% of the travellers, the travel document was a negative PCR test and a negative antigen test, respectively. Nearly 5% of the travellers had no travel health document (Figure 1).

Vaccination coverage

Among recruited participants, 715 (84.4%) had received at least one dose of COVID-19 vaccine. The number of travellers who received two doses of COVID-19 vaccine was 542 (63.9%). Among those who received at least one dose of COVID-19 vaccine, the proportion of those who received four, three, two, and one dose were 1.4%, 23.5%, 50.9%, and 24.2%, respectively.

Pfizer vaccine was the most administered vaccine whether as the first (34.7%), second (47.8%), or third dose (64.6%) (Figure 2). Reasons given by those who did not receive

any dose of COVID-19 vaccine (15.6%) were the lack of confidence in the vaccines, the speed of their discovery, and doubts about the existence of COVID-19 disease.

Factors associated with complete vaccination

Age and region of origin were significantly associated with full vaccination in both univariate and multivariate analyses. In multivariate analysis, being aged over 40 years (aOR=1.46; p=0.028) and travelling from a region outside Africa (aOR=2.14; p=0.004) were associated with COVID-19 full vaccination. (Table 2).

Discussion

The objectives of the present study were to estimate COVID-19 vaccination coverage and to describe factors associated with full vaccination among travellers at the airport of Lomé in Togo. The median age of the travellers was 40 years. The main health travel document was the vaccination pass for 69.1% and 4.8% had no health document. Vaccination coverage was 84.4% for one dose of vaccine and 63.9% for two doses. Travellers from Africa country and those aged below 40 years were less likely to be fully vaccinated.

The present study reported a vaccine coverage of 84.4% for one dose and 63.9% for two doses. In a Canadian study, the overall vaccine acceptance for two doses was 81% in the total population and 86% of the eligible population aged five years or above.²⁰ The overall acceptance of the booster dose was 55% for the adult population.²⁰ In Africa, according the World Health Organization (WHO), 18.5% of the population was fully vaccinated by the end of July 2022. In Togo, vaccination coverage as of July 24, 2022 was 34%. Studying of the origin and destination of travellers allowed for identification of possible regional disparities in terms of vaccination coverage.

The reasons given by those who did not receive any dose of vaccine were the lack of confidence in vaccines, the speed of their discovery, and doubts about the existence of COVID-19 disease. These reasons are corroborated by a study conducted in Cameroon in the cities of Bafoussam, Douala and Yaoundé in May 2022 which reported that more than 65% of the respondents did not support vaccination, and the reasons cited included the reliability of the vaccine.²¹ The COVID-19 vaccine has been the subject of several contradictory debates; the obvious desire to impose the vaccine to the population when there are pre-existing diseases that are "more dangerous" than

SARS-CoV-2 infection; the controversy observed within the medical profession; and the speed with which the vaccine was made available.²¹

The present study reported that the most widely administered vaccines to travellers were Pfizer and AstraZeneca, respectively, regardless of dose. This could be explained by the fact that these are the first two vaccines with license. In addition, the Pfizer vaccine, because of the technology used -messenger RNA- was strongly recommended both for initial vaccination or for booster doses. In addition, it is the only m-RNA vaccine available for children aged 12 to 18 years. In a publication explaining how Mauritius became COVID free, it was noted that all travellers entering and leaving Mauritius were fully vaccinated with three doses of Pfizer at Plaisance Airport.²²

The education level is an important factor in health promotion activities and a fundamental social determinant of health.¹⁶ According to a study in Canada, having a low level of education increased the risk of having low vaccination coverage.¹⁷ According to another study in France, social criteria such as level of education, standard of living or occupation are determinants that influence the chances of reaching the required levels of vaccine coverage.¹⁸ In the present study, 77.5% of the travellers had a university education level. This finding, which is higher than the overall education rate in Togo (64.0%),¹⁹ reflects the cosmopolitan nature of the population encountered at the Lomé airport, and could explain the vaccine coverage recorded in the present study. The majority of passengers departing from or arriving at the LFW had West Africa as their final destination or region of origin, respectively. This result could be explained by the fact that LFW is a sub-regional hub that mainly hosts airlines serving West Africa.

In our study, in multivariate analysis, the factors associated with COVID-19 full vaccination were age over 40 years and region of origin (outside Africa). Considering

age, one of the reasons of this result is that 80% of deaths in Togo and Africa occurred in elderly patients with comorbidities.²³ Our results are similar to those of Roeder *et al.*, who reported in their study in 2022 that access to primary vaccination was correlated with age (>65 years vs 18-25 years; aOR=2.4; CI95%:1.5-3.9).²⁴ This same study noted many individual factors potentially associated with access to primary vaccination, including: gender, country of origin, age, administrative status, opinion on vaccination, fear of vaccination, household composition, financial status, certain support systems, sources of information on COVID, and trust in the authorities.²⁴ In addition, a multicentre cross-sectional study conducted in August 2022 among all hospital staff in 11 hospitals and clinics in a French region reported that creating herd immunity and protecting relatives and patients were the main motivations for vaccination.²⁵

People from countries outside Africa were more likely to be fully vaccinated compared to those from Africa, which may be explained by the high vaccine hesitancy recorded on the African continent, doubt about the existence of the disease or insufficient access to COVID-19 vaccines.²⁶

Limitations

The main limitation of this study is the choice of the definition of full vaccination. Indeed, full vaccination was defined as having received at least 2 doses of vaccine. This is a strong assumption that does not take into account the specificity of each country and the type of vaccine administered. This definition may vary according to the type of vaccine administered and the country.²⁷ For example, some countries may consider a previous COVID-19 infection as one dose on vaccine. This may have induced a classification bias, resulting in an overestimation or underestimation of the proportion

of fully vaccinated persons. Furthermore, as this survey was carried out in a dynamic population of travellers, it is difficult to generalize the results and to validate them over time. The estimated coverage should be regularly updated according to the evolution of the epidemiological context and access to the COVID-19 vaccine. However, the results of this study are in line with data available in the literature.

Conclusion

From our knowledge, this study is one of the first in Togo and in sub-Saharan Africa to estimate vaccination coverage and to describe the factors associated with COVID-19 full vaccination among travellers. This study found that one-dose vaccination coverage was relatively high among travellers at the LFW. The vaccination pass with QR code was the main health travel document.

Those who were younger and from Africa were less likely to have full vaccination coverage. Outreach targeting those under 45 years of age living in sub-Saharan Africa could help improve COVID-19 vaccination coverage.

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Table 1: Description of traveller’s characteristics according to their trip information’s

| | Women n = 279 | Men n = 568 | Total N = 847 |
|-----------------------------|--------------------------|------------------------|--------------------------|
| flight information | | | |
| Arrival | 108 (38.7) | 204 (36.0) | 312 (36.9) |
| Departure | 100 (35.8) | 122 (21.6) | 222 (26.3) |
| Transit | 71 (25.5) | 240 (42.4) | 311 (36.8) |
| Missing | 0 | 2 | 2 |
| Region of origin | | | |
| Centrale Africa | 24 (8.9) | 61 (11.1) | 85 (10.4) |
| Western Africa | 186 (68.6) | 398 (72.6) | 584 (71.3) |
| Northern Africa | 1 (0.4) | 2 (0.4) | 3 (0.4) |
| Southern and Eastern Africa | 2 (0.7) | 13 (2.4) | 15 (1.8) |
| America | 16 (5.9) | 27 (4.9) | 43 (5.3) |
| Asia | 4 (1.5) | 10 (1.8) | 14 (1.7) |
| Europe | 38 (14.0) | 37 (6.8) | 75 (9.2) |
| Missing | 8 | 20 | 28 |
| Final destination | | | |
| Centrale Africa | 26 (9.4) | 100 (17.7) | 126 (15.0) |
| Western Africa | 174 (63.0) | 381 (67.4) | 555 (66.0) |
| Northern Africa | 3 (1.1) | 1 (0.2) | 4 (0.5) |
| Southern and Eastern Africa | 3 (1.1) | 14 (2.5) | 17 (2.0) |
| America | 21 (7.6) | 20 (3.5) | 41 (4.9) |
| Asia | 3 (1.1) | 10 (1.8) | 13 (1.5) |
| Europe | 46 (16.7) | 39 (6.9) | 85 (10.1) |
| Missing | 3 | 3 | 6 |

Table 2 : Factors associated with completion of a full vaccination, using univariate and multivariate logistic regression

| | Univariate model | | | Multivariate model | | |
|---------------------------------|------------------|-------------|-------|--------------------|-------------|-------|
| | OR | 95%CI | p | aOR | 95%CI | p |
| Age groups (years) | | | 0.039 | | | |
| <40 | 1.00 | — | | 1.00 | — | |
| 40+ | 1.44 | 1.02 – 2.04 | 0.040 | 1.42 | 1.01 – 2.05 | 0.046 |
| Sex | | | 0.406 | | | |
| Women | 1.00 | — | | 1 | | |
| Men | 1.17 | 0.81 – 1.68 | 0.404 | 1.20 | 0.83 – 1.71 | 0.324 |
| Flight information | | | 0.127 | | | |
| Arrival | 1.00 | — | | | | |
| Departure/Transit | 0.74 | 0.49 – 1.09 | 0.131 | | | |
| Region of origin | | | 0.009 | | | |
| Africa | 1.00 | — | | 1 | — | |
| Other | 1.96 | 1.18 – 3.44 | 0.013 | 2.18 | 1.34 – 3.76 | 0.003 |
| Difficulties encountered | | | 0.978 | | | |
| No | 1.00 | — | | | | |
| Yes | 1.01 | 0.64 – 1.63 | 0.978 | | | |
| Level of education | | | 0.478 | | | |
| Non University | 1.00 | — | | | | |
| University | 1.16 | 0.77 – 1.73 | 0.475 | | | |

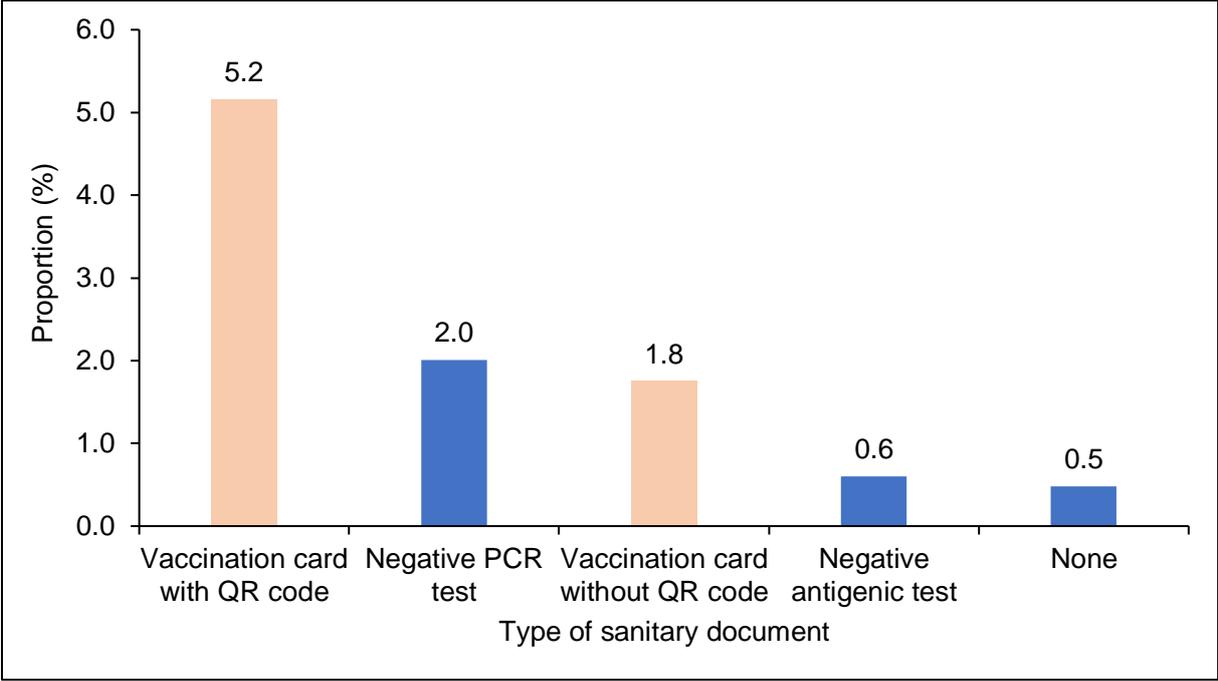


Figure 1: Bar plot of passengers distribution according to the type of travel document presented (N = 806)

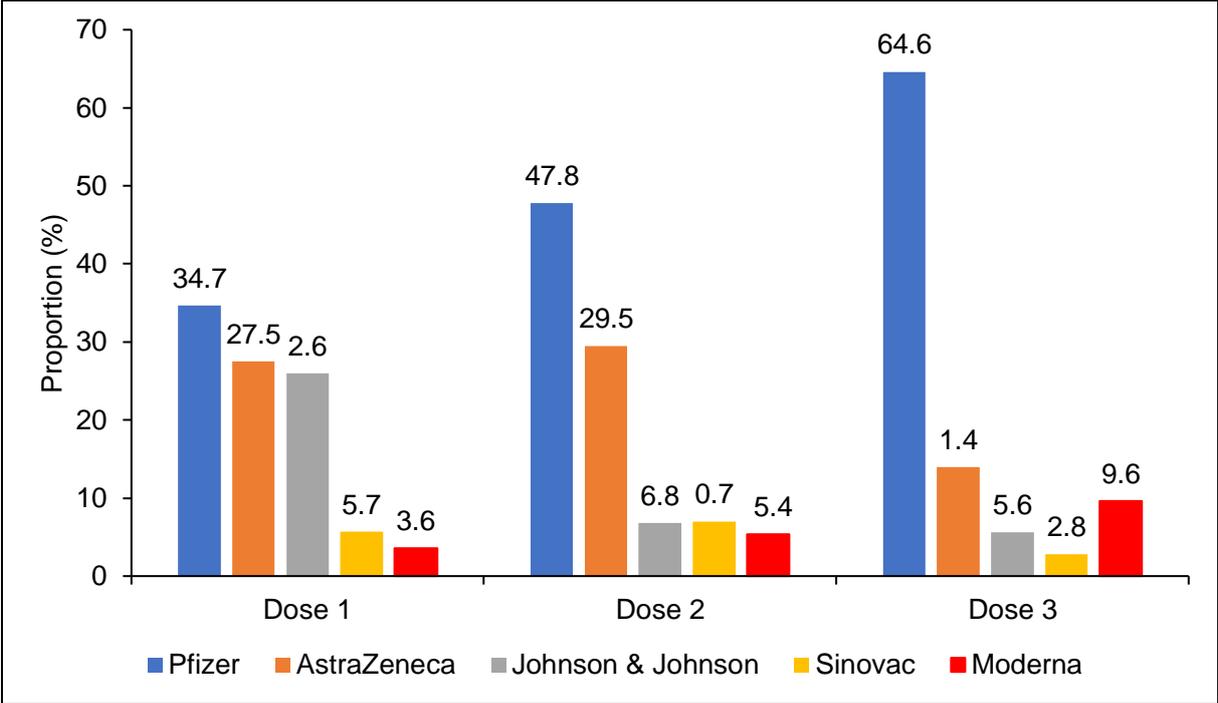


Figure 2: Distribution of passengers by number of COVID vaccine doses received (N = 715)