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Research Article

Factors Associated with Belief in Vaccine Protection Against COVID-19 in Côte d'Ivoire, 2022

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Abstract

Background. Coronavirus 2019 or COVID-19 is an emerging respiratory disease caused by a new human coronavirus first detected in December 2019, in Wuhan, China. Beliefs and perceptions play an important role in the adoption of health behaviors. *Objective.* The objective of this study is to identify factors associated with belief in vaccine protection against COVID-19 in Côte d'Ivoire. *Method.* We carried out a cross-sectional survey for analytical purposes. We conducted a two-stage cluster survey. The first stage involved selecting 40 clusters in each district, by systematic random sampling. The second stage consisted in selecting the households. In each household, the person surveyed was the head of household. In his absence, the head of household's representative was interviewed. The dependent variable was the belief in COVID-19 vaccine protection. Factors associated with the dependent variable were identified using logistic regression. The measure of association was the Adjusted Odds Ratio (ajOR) with a 95% confidence interval (95% CI). Data were analyzed using PASW Statistics 18. *Result.* A total of 3,611 people were surveyed including 53% of females, 87 of individuals aged 18 to 59 years, 48% of Christian, 47% of Muslim, and 49% of vaccinated individuals. Factors associated with belief in COVID-19 vaccine protection were cohabitation (ajOR 1.71 [1.27 – 2.31]), religion (ajOR 0.58 [0.43 – 0.79]) and age (ajOR [ajOR 0.37 [0.16 – 0.86]). *Conclusion.* Socio-demographic factors associated with belief in vaccine protection against COVID-19 in our study were marital status, religion, and age. Health authorities should take into account these factors in developing strategies to increase COVID-19 vaccine acceptance. Qualitative studies could be carried out to understand the underlying reasons behind the belief in vaccine protection against COVID-19 or the reasons for COVID-19 vaccination hesitancy or refusal.

Keywords

COVID-19 Vaccine, Belief, Associated Factors, Cote d'Ivoire

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1. Introduction

Coronavirus 2019 or COVID-19 is an emerging respiratory disease caused by a new human coronavirus first detected in December 2019, in Wuhan, China. Clinical manifestations of the disease are typically fever, dry cough, fatigue, myalgia and dyspnea [1]. Highly contagious, the disease spread rapidly across all continents [2]. The World Health Organization (WHO) declared the COVID-19 a public health emergency of international concern on January 30, 2020, and called for collaborative efforts by all countries to curb its rapid spread [3]. Despite the efforts of countries to limit the spread of the disease, the COVID-19 pandemic was declared on March 11, 2020, with 121,000 confirmed cases including 4,583 deaths worldwide [4]. Having started in Asia, the disease spread to Europe, then America, and reached the African continent on February 14, 2020 [5].

Côte d'Ivoire recorded its first case on March 11, 2020 [4]. As a result, the country adopted a national response plan, aimed at responding effectively to this pandemic. This response plan aimed to limit the spread of the Coronavirus in Côte d'Ivoire, detect infection and treat patients. Within this framework, eight (08) strategic axes of intervention were identified, among which the protection of the population and health workers occupies an important place [6].

With the development of new vaccines, Côte d'Ivoire joined the COVAX initiative [7]. To this end, a " COVID-19 National Deployment and Vaccination Plan " was drawn up [8].

The country received 504,000 doses of AstraZeneca vaccine on February 26, 2021, and began vaccination on March 1, 2021, in Treichville health district, in Abidjan, targeting front-line staff (health workers, defense and security forces and teachers) [6]. After one-week vaccination in Treichville health district, the vaccination offer was gradually rolled out to other health districts of Abidjan and across the country. In September 2021, the COVID-19 vaccination acceptance survey carried out in Côte d'Ivoire, and including 3,565 participants, revealed that 21% of respondents claimed to have been vaccinated against COVID-19. Those who had not been vaccinated cited a variety of reasons, including the non-existence of the disease [9].

Beliefs and perceptions play an important role in the adoption of health behaviors [10, 11]. They vary according to individual and environmental characteristics. In the current context of the COVID-19 pandemic, individuals' beliefs and perceptions may influence the adoption of recommended preventive measures [11], including vaccination.

In order to guide health authorities in making decisions and developing strategies for optimal vaccination coverage against COIVD-19 in Côte d'Ivoire, we carry out the present study. The objectives were to describe the socio-demographic characteristics of respondents, to estimate the proportion of respondents believing in vaccine protection against COVID-19 in Côte d'Ivoire, and to identify factors associated with belief in vaccine protection against COVID-19 in Côte d'Ivoire.

2. Materials and Methods

2.1. Type, Location, Duration and Population of Survey

We carried out a cross-sectional survey for analytical purposes. It took place in the cities of Abidjan and Bouaké and lasted two months. The survey population included people who had or had not received the COVID-19 vaccine.

1. Inclusion criteria:
   a. Be at least 12 years old on October 1er, 2022;
   b. Resident in Côte d'Ivoire for at least 6 months.
2. Exclusion criteria:
   a. Refuse to take part in the survey;
   b. Be absent from the household during data collectors' visit.

2.2. Sampling and Sample Size

For the city of Abidjan, the districts surveyed were selected by a simple random sampling, while for the city of Bouaké, all 3 districts were surveyed.

The sample size calculation formula in each health district is as follows:

$$n = eg \times \frac{\varepsilon_\alpha^2}{i^2} \times p(1-p) \tag{1}$$

with

eg: cluster effect = 1

ε_α: reduced deviation of the normal distribution at the error threshold of α = 1,96

i: estimation accuracy = 0.05

p: percentage of expected acceptability = 50%.

This gives a sample size of 384 people (vaccinated or unvaccinated). This sample size was rounded up to 400 people (40 clusters of 10 people) with a non-response rate of 4%.

The minimum sample size was 3,600 people, with 400 people (1 person per household) in each of the following health districts: Abobo West, Adjame-Plateau-Attecoube, Anyama, Cocody-Bingerville, Treichville-Marcory, Yopougon East, Bouake South, Bouake North East and Bouake North West.

In each district, 40 clusters of 10 people were surveyed, using a WHO-type two-stage cluster survey. The first stage involved selecting the 40 clusters in each district, by a systematic random sampling based on the list and demographic weight of all the localities (villages / neighborhoods / sub-neighborhoods) in the district. The second stage consisted in selecting the households. In each cluster, the first household to be visited was selected at random, starting from the cluster's geographic center. A pen was thrown, and the first household was indicated by the tip of the pen as it fell. Subsequent households were visited clockwise, one after the other, until the number of targets expected in the cluster (10 people) was

reached. In each household, the person surveyed was the head of household. In his absence, the head of household's representative was interviewed.

2.3. Data Collection

Data were collected during a face-to-face interview using a specially designed paper questionnaire. A pre-test of the questionnaire was carried out prior to data collection. This pre-test was used to estimate the length of an interview, to assess understanding of the questions and to make corrections to the questionnaire when needed.

Several types of variables were collected:

1. Socio-demographic variables (age, gender, place of residence, level of education, socio-professional category, religion);
2. Experience with COVID-19 (history of the disease, parent, family member or friend who had the disease or died of the disease);
3. Belief in vaccination (belief in vaccination as a means of preventing disease, COVID-19 vaccination status).

2.4. Data Analysis

Data analysis was carried out in two phases: a descriptive phase and an analytical phase. In the descriptive phase, categorical variables were shown as proportions. In the analytical phase, a Chi-square test of independence (X^2) was performed between the dependent variable (belief in COVID-19 vaccine protection) and the independent variables (living with a partner, religion, age, level of education, gender, carrying a chronic disease, knowledge of a person who died of COVID-19 and knowledge of a person tested positive for COVID-19). The Chi-square test of independence was followed by a search for factors associated with the dependent variable, using logistic regression. The measure of association was the Adjusted Odds Ratio (ajOR) with a 95% confidence interval (95% CI) and a significance level of p-value < 0.05. Data were analyzed using PASW Statistics 18.

2.5. Ethical Considerations

The survey was carried out in accordance with the ethical rules for surveys involving human beings in force in Côte d'Ivoire. The protocol and all other official documents of the survey were sent to the national ethics committee for authorization to carry out the survey. Data collection began when authorization had been obtained from the national ethics committee.

The purpose of the survey was explained to all those selected to take part. Each participant was informed that his or her participation in the survey was voluntary and he or she was free to withdraw, without justification, from the survey at any time, and this withdrawal would have no consequences or affect his or her professional responsibilities. Written informed consent was obtained from participants prior to the administration of the anonymous questionnaire.

The survey was carried out in strict compliance with preventive measures against COVID-19 in force in Côte d'Ivoire. All persons involved in data collection for this survey have:

1. Worn an approved mask;
2. Observed social distancing;
3. Applied hand hygiene measures using hydro-alcoholic gel.

2.6. Risks and Benefits for Participants

This survey entailed minimal risk for the respondents, since the investigators observed COVID-19 prevention measures. The main benefit was indirect: the data collected helped guide efforts to protect the population against COVID-19.

2.7. Confidentiality

Confidentiality of participant information was maintained throughout the survey. Each individual participating in the survey was assigned a unique study number by the survey coordination team, which was used to identify their questionnaire. No data on the survey form could be used to identify the respondents.

3. Results

3.1. Descriptive Results

Table 1. Distribution of respondents according to socio-demographic variables, Côte d'Ivoire, 2022.

Variables	N	n	%
Gender			
Female		1919	53
Male	3611	1692	47
Age range			

Variables	N	n	%
12-17 years		161	05
18-59 years	3611	3138	87
≥ 60 years		312	08
Education level			
None		785	22
Primary	3611	866	24
Secondary		1257	35
Superior		703	19
Religion			
Christian		1715	48
Muslim	3611	1706	47
No religion		190	05
Living with a partner			
Yes	3611	1981	55
No		1630	45
Belief in vaccine protection			
Yes	3611	3395	94
No		216	06
Vaccination status against COVID-19			
Vaccinated	3611	1781	49
Unvaccinated		1830	51
Reasons for not vaccinating			
No confidence in the vaccine		619	38
Fear of side effects		589	37
Lack of time	1606	238	15
Lack of information		87	5
Vaccine unavailability		73	5

A total of 3,611 people were surveyed in 9 health districts (6 in Abidjan and 3 in Bouake).

3.2. Analytical Results

Table 2. Chi-square of belief in vaccine protection against COVID-19 according to selected independent variables, Côte d'Ivoire, 2022.

Independent variables	Belief in vaccine protection against COVID-19			
	N	Yes n (%)	X^2	p-value
Living with a partner	3611			
Yes	1981	1896 (96)	22,31	0,0001

Independent variables	Belief in vaccine protection against COVID-19			
	N	Yes n (%)	X^2	p-value
No	1630	1499 (92)		
Religion	3611			
Christian	1715	1586 (92)		
Muslim	1706	1634 (96)	17,88	0,0001
No religion	190	175 (92)		
Age	3611			
12 to 17 years	161	144 (89)		
18 to 59 years	3138	2949 (94)	10,28	0,006
60+ years	312	302 (97)		
Education level	3611			
No	785	742 (95)		
Primary	866	823 (95)	3,87	0,27
Secondary	1257	1177 (94)		
Superior	703	653 (93)		
Gender	3611			
Female	1692	1597 (94)	0,76	0,38
Male	1919	1798 (94)		
Carrying a chronic illness	3611			
Yes	424	401 (95)	0,26	0,61
No	3187	2994 (94)		
Knowing a person deceased from COVID-19	3611			
Yes	259	242 (93)	0,17	0,68
No	3352	3153 (94)		
Knowing a person tested positive for COVID-19	3611			
Yes	538	504 (94)	0,13	0,72
No	3073	2891 (94)		

There was a relationship between belief in vaccine protection and marital status, religion, and age.

***Table 3.** Adjusted Odds Ratio of belief in vaccine protection against COVID-19, Côte d'Ivoire, 2022.*

Independent variables	Belief in vaccine protection against COVID-19		
	ajOR	95% CI	p-value
Living with a partner			
Yes	1		
No	1,71	1,27 - 2,31	0,0001***

Independent variables	Belief in vaccine protection against COVID-19		
	ajOR	95% CI	p-value
Gender			
Male	1		
Female	1,16	0,87 - 1,56	0,31
Religion			
Christian	1		
Muslim	0,58	0,43 - 0,79	0,001**
No religion	1,15	0,65 - 2,03	0,63
Knowing a person tested positive for COVID-19			
Yes	1		
No	0,99	0,65 - 1,54	0,99
Carrying a chronic illness			
Yes	1		
No	0,97	0,61 - 1,54	0,90
Education level			
No	1		
Primary	0,80	0,52 - 1,24	0,32
Secondary	0,87	0,58 - 1,30	0,49
Superior	0,92	0,58 - 1,46	0,73
Knowing a person deceased from COVID-19			
Yes	1		
No	0,91	0,51 - 1,63	0,75
Age			
12 to 17 years	1		
18 to 59 years	0,68	0,39 - 1,17	0,16
60+ years	0,37	0,16 - 0,86	0,02*

*p < 0.05, **p < 0.005, ***p < 0.0001

Factors associated with belief in COVID-19 vaccine protection were living with a partner, religion and age.

4. Discussion

The majority of respondents were aged between 18 and 59 (87%). The predominance of this age group could be explained by the age of maturity in Côte d'Ivoire. In fact, in the country, the age of maturity is 18 [12]. A person aged 18 or over can therefore make decisions, including founding a household.

Concerning gender, 53% of respondents were female. This predominance of female respondents could be explained by the absence, for the most part, of male heads of household for professional reasons when the data collectors visited households, even though the population in Côte d'Ivoire is made up mostly of men according to the results of the 2021 general population and housing census [13].

Regarding educational level, most respondents had secondary education (35%), followed by primary education (24%), no education (22%) and higher education (19%). The Demographic and Health Survey (DHS) carried out in Côte d'Ivoire in 2021 showed a predominance of respondents with no education (49% women and 34% men) [14]. The predominance of secondary education in our study could be

explained by the (urban) place of residence of respondents. Indeed, the respondents in our study lived in urban areas, where the percentages of women and men with secondary or high education are higher than in rural areas [14].

As far as religion is concerned, most respondents were Christian (48%), followed by Muslim (47%). The predominance of these two religions was also mentioned in the final results of the general population and housing census carried out in Côte d'Ivoire in 2021 [13].

A total of 94% of respondents said that a vaccine can protect against a disease. The health belief model predicts that a specific health behavior is based on an individual's perceptions of disease severity and personal susceptibility to disease, combined with perceived benefits and barriers to that behavior [15, 16]. These perceptions are influenced by psychological (personality, pressure group, etc.) and socio-demographic (age, gender, etc.) factors, and have been shown to influence people's compliance with COVID-19 prevention measures [17]. Thus, despite the high proportion of respondents (94%) who stated that a vaccine can protect against a disease, it was only about half (49%) of the respondents who declared having been vaccinated against COVID-19 in our study. The main reasons for non-vaccination were lack of confidence in the vaccine (17%) and fear of side effects (16%). Other studies have shown that the main barriers to belief in vaccine protection against COVID-19 are safety, fear of side effects, vaccine efficacy and the rapid pace of vaccine development, which calls into question vaccine safety [18, 19]. Some research reports that the low vaccination rate can be attributed to a lack of trust in those who recommend the vaccine. In a study by Gerretsen et al (2021), participants cited distrust of COVID-19 vaccine development and suspicions of commercial gain of the government and vaccine manufacturers [20].

The source of information plays a major role in the belief in vaccination and the decision to be vaccinated against COVID-19. Many studies investigating sources of information about COVID-19 vaccines mentioned television and social media as frequent sources of information [21-24]. Although television news can be screened to avoid misinformation, social media are generally not, making them a preferred channel for anti-vaccine movements spreading misinformation about COVID-19 vaccines [21]. An analysis of social media identified that 39% of online rumors about the COVID-19 pandemic related to COVID-19 vaccines, with 76% of such rumors reported as false [21]. Social media influenced the decision to vaccinate against COVID-19. Exposure through social media to information motivating vaccination would encourage exposed individuals to get vaccinated. On the other hand, misinformation induced hesitation or refusal to vaccinate [25].

Factors associated with belief in COVID-19 vaccine protection were living with a partner, religion, and age in our study.

As for living with a partner, the likelihood of believing in COVID-19 vaccine protection was higher among those not living with a partner than among those living with a partner. This result is comparable to that of Wake who reported in a study carried out in Uganda that single status was associated with intention to receive the COVID-19 vaccine [26]. Single people's intention to receive the COVID-19 vaccine could be explained by the absence of support in the event of a health emergency. Thus, a single person would be more inclined to adopt preventive measures (including vaccination) to avoid the occurrence of the disease.

With regard to religion, Muslim had a lower probability (minus 42%) of believing in vaccine protection against COVID-19 than Christians. Although the Muslim religion does not prohibit vaccination, this finding could be due to rumors of the presence of pig gelatin in the composition of COVID-19 vaccines, which favors the refusal of COVID-19 vaccines by some Muslims [27]. It should be noted that WHO-approved COVID-19 vaccines, including Sinovac, Sinopharm, AstraZeneca, Johnson & Johnson, Pfizer and Moderna, do not contain pork gelatin [28].

Concerning age, subjects aged 60 and over had a reduced probability (minus 63%) of believing in COVID-19 vaccine protection compared with respondents under 18 in our study. Previous studies have identified age as a socio-demographic factor associated with acceptance of COVID-19 vaccination [26, 29, 30]. However, it should be emphasized that the results are heterogeneous from one study to another. Indeed, while some studies indicate a higher propensity for young people to be vaccinated against COVID-19, others show that adults and the elderly are more inclined to accept this vaccination [26, 29, 30].

The results of our study should be used in the light of its limitations.

Firstly, the respondents were heads of household or their representatives, which may lead to differences in their beliefs about COVID-19 vaccine protection compared with other household members. In addition, our survey was conducted mainly in urban areas, which may influence perceptions of vaccination against COVID-19 compared with populations living in rural areas.

With regard to methodology, our cross-sectional approach limits our ability to establish causal relationships between the variables studied. Although statistical associations were identified, other unmeasured factors could also influence the results. Furthermore, the concentration of our sample in the cities of Abidjan and Bouake restricts the generalizability of findings to the entire Ivorian population, particularly in rural areas where socio-demographic characteristics may differ.

Despite our efforts to ensure a representative sample using probability sampling methodology, there is a risk of selection bias due to the potential non-participation of some households. In addition, data collection by direct interview could introduce a response bias, particularly for sensitive questions such as religious beliefs or personal experiences with COVID-19.

Despite these limitations, our study provides valuable information on the social determinants of belief in vaccine

protection against COVID-19 in Côte d'Ivoire, offering directions for future interventions aimed at improving vaccine acceptance in the population.

Public health implications:

1. Understanding the behavioral and social determinants of immunization, in line with the WHO Behavioral and Social Determinants of Immunization (BeSD) Framework [31], reveals the importance of social processes in our context. Recommended policy interventions should therefore focus on community mobilization, the engagement of vaccine activists and advocates, and the dissemination of positive messages about social norms.

2. The predominance of respondents aged 18 to 59 in our study underlines the importance of targeting this age group in awareness campaigns. Most female respondents also highlights the need to adapt communication strategies to include women, particularly by taking into account constraints linked to family roles.

3. In terms of educational level, the high proportion of respondents with secondary education suggests that awareness messages need to be formulated in such a way as to be accessible to a wide range of educational levels. In addition, the importance of religion in the belief in vaccine protection highlights the need for collaboration with religious leaders to dispel rumors and myths surrounding COVID-19 vaccines.

4. Findings indicating a lower likelihood of believing in vaccine protection among people living with partners, Muslims, and the elderly underscore the need for personalized approaches to address the specific concerns of these demographic groups.

5. Conclusion

At the end of our study, we can say that most respondents believed in protection against COVID-19, although around half of them claimed to have been vaccinated against the disease. Hesitation or refusal to vaccinate against COVID-19 was mainly due to lack of confidence in the vaccine and fear of side effects. Socio-demographic factors associated with belief in vaccine protection against COVID-19 in our study were marital status, religion, and age. In many countries, including Côte d'Ivoire, the trend is towards introducing the COVID-19 vaccine as part of routine immunization. The removal of barriers to hesitation and refusal to vaccinate must be given particular attention by health authorities, to avoid unprofitable investment in the purchase and implementation of this vaccine. Since our study is a quantitative study, qualitative studies could be carried out to understand the underlying reasons behind the belief in vaccine protection against COVID-19 or the reasons for COVID-19 vaccination hesitancy or refusal.

Abbreviations

ajOR	Adjusted Odds Ratio
CI	Confidence Interval
WHO	World Health Organization
X^2	Chi-square Test

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Author Contributions

Alfred Douba: Conceptualization, Formal Analysis, Methodology, Writing – original draft,

Nicaise Bernadin Lépri Aka: Conceptualization, Methodology, Writing – review & editing

Christian Bangaman Akani: Data curation, Methodology, Writing – review & editing

Eric Martial Kouakou Ahoussou: Supervision, Writing – review & editing

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Daniel Kouadio Ekra: Validation, Writing – review & editing

Tiembre Issaka: Funding acquisition, Validation, Writing – review & editing

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Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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