Original Research Article

Factors associated with COVID-19 vaccination among pregnant women in the health district of Thies, Senegal, in 2023

Abstract

Introduction: The COVID-19 pandemic has disproportionately impacted global health systems, and vaccination remains a critical strategy to mitigate its effects. However, vaccination rates among pregnant women, particularly in low- and middle-income countries, remain understudied. This study aimed to identify factors influencing COVID-19 vaccination among pregnant women in the Thies health district, Senegal.

Methodology: This cross-sectional study involved 736 pregnant women attending antenatal care in public health facilities in Thies. They were then exhaustively recruited.Data were collected using a structured questionnaire and analyzed using R software. Descriptive statistics, bivariate analyses, and logistic regression models were used to identify factors associated with vaccination.

Results: Participants had a mean age of 28.36 ±6.7 years, with most being married (88.0%), educated (79.1%), and lacking income-generating activities (66.1%). Awareness of COVID-19 vaccination was reported by 67.0%, yet only 28.5% expressed confidence in the vaccines. While 76.4% believed in the importance and usefulness of vaccination, 58.0% perceived it as risky. Vaccine coverage was 54.2%. Factors significantly associated with vaccination included advanced age, decision-making autonomy (AOR=4.24), knowledge of vaccines (AOR=15.3), and perceptions of the vaccine's importance (AOR=3.26) and usefulness (AOR=2.98). However, perceived risk of vaccination was also associated with uptake (AOR=4.50).

Conclusion: Improving COVID-19 vaccination among pregnant women requires tailored interventions addressing knowledge gaps, decision-making autonomy, and risk perceptions. These findings highlight the importance of context-specific strategies to enhance vaccine acceptance and coverage in similar settings.

Keywords:COVID-19vaccine,Pregnancy,Associatedfactors,Thies,Senegal

Introduction

The COVID-19 pandemic emerged in 2020, profoundly impacting global health systems. Characterized by rapid transmission, high mortality, treatment challenges, and socio-economic disruptions, it became a major public health crisis with over 79.2 million cases and 1.7 million deaths by December 2020(1). In response, countries implemented emergency measures, including curfews, gathering bans, border closures, and mandatory mask policies in public spaces.

To mitigate healthcare disruptions and reduce disease severity, COVID-19 vaccination campaigns were launched globally in December 2020. Indeed, China, the United States, Canada and European Union countries initiated their vaccination campaigns during this period(2–4). On December 31, 2020, the World Health Organization (WHO) approved the first COVID-19 vaccine for emergency use(5).MostAfricancountriesbeganvaccinationin2021. The Seychelles archipelago was the first to launch the campaign in January (6). South Africa began in February, as did Senegal (7,8). Others, such as Mauritius, started later in March (9).

Vaccination coverage varied significantly across continents. In Europe and the Americas, several countries achieved 70% coverage within the first year (3,4,10). In Africa, only Seychelles and Mauritius reached this benchmark(11). In Senegal, as of February 21, 2022, only 6.2% of the population was fully vaccinated. Priority groups included individuals over 60 years old, those with comorbidities, and frontline healthcare workers (12).

Notably, pregnant women were initially excluded from COVID-19 vaccine clinical trials. Subsequent studies demonstrated that the benefits of vaccination outweighed potential risks(13,14), prompting the WHO's Strategic Advisory Group of Experts on Immunization (SAGE) to recommend vaccination for pregnant women(14).Pregnant women are a priority group for vaccination due to their increased risk of severe COVID-19 outcomes and the potential for maternal-fetal protection.

A systematic review of 11 studies from the USA, England, Scotland, Japan and Israel showed that advance age, ethnicity, race, confidence inCOVID-19 vaccines andfearof COVID-19 duringpregnancy were associated with COVID-19 vaccination (15). Research has been carried out in Senegal to measure the level of knowledge and beliefs about COVID-19, as well as adherence to measures taken by health authorities to combat COVID-19, including vaccination (16–18). However, these studies focused on the general population and did not

specifically address pregnant women. To our knowledge, no studies have assessed vaccination coverage among pregnant women in Senegal. This gap motivated our investigation into the factors influencing COVID-19 vaccination among this group in the Thies health district.

Methodology

Studysetting:ThiesHealthDistrict

This study was conducted in the Thies health district, strategically located at a regional crossroads with a high population density.One of five districts in the Thies region, it encompasses six communes and 12 arrondissements.Thedistrictcoversanareaof1,033km²andfollowsthesamecontoursasthedepartment of thesame name. It isbordered to the east by theKhombole district, to thewest bythe Pout district, tothenorth by the Tivaouane district and to the south by the Mbour and Thiadiaye districts.

Home to 533,999 people and with a population density of 517 inhabitants per km², it is the most densely populated district in the Thies region.Itsgeographicalpositionatthecrossroadsanditspopulationdensitygivesthisdistrictastrategic position in the region. The district includes 33 health posts, 02 health centers and 03 level 2 Public Health Establishments (EPS), in line with the health pyramid in terms of healthcare provision (19).

Typeandperiodofstudy

This analytical cross-sectional study was conducted between January 1 and February 28, 2023, in the Thies health district.

Studypopulation

Thestudyinvolvedpregnant women receiving antenatal care (ANC) at health facilities in the Thies health district.

Sampling

Selection criteria

Inclusion criteria

AllpregnantwomenundergoingANCinthedistrictareawereincludedinthestudyandprovidingtheir freeand informed consent to participate.

Non-inclusioncriteria

Pregnant women receiving ANC exclusively in private healthcare facilities were excluded from the study.

Samplingprocedures

Areasonedchoice,takingintoaccounttheaccessibilityoffacilitiesofferingANC,ledtotheselectiono f4 (Centre de santé Mamadou Bathily, Poste de santé de Nguinth, Poste de santé de Diakhao and Poste de santé de Medina fall 1). Pregnant women were then exhaustively recruited. They were selected as and when they came for their ANC visits, and enrolled only once.

Collectingdata

Collection tool and method

Datawerecollectedusingaquestionnairedesignedforthispurpose.Itwasthenrecordedonanelectro nicterminal using Kobocollect software, which was synchronized with a server via the Internet connection. The application wasusedtodesignthedataentrymaskandofferthepossibilityofcollectingandtransferringthedatato aserver. The questionnaire was administered through individual face-to-face interview with pregnant women attending ANC.

Seven interviewers, supervised by the coordinator, conducted data collection after completing a two-day training session to standardize procedures. Each interviewer then visited the health facilities assigned to them. Independent variables were defined and structured according to the Brewer et al. model of factors associated with vaccination (20). Variables included socio-demographic characteristics (age, level of education, income- generating activity), opinions and feelings about COVID-19 vaccines (knowledge of the vaccine, confidence, importance and usefulness of the vaccine), social processes (marital status and decision-making autonomy) and practical aspects (knowledge of vaccination sites, transport, time taken, cost of transport).

Operational definition of variables

The independent variable in this study was COVID-19 vaccination. Participants were queried about their COVID-19 vaccination status.Responses were recorded as either "Yes" or "No."

Data analysis

At the end of the survey, the data were extracted, compiled and cleaned before being analyzed using R 4.2.2 software. Quantitative variables were summarized using means (± standard deviation), medians, and ranges, while qualitative variables were reported as frequencies and percentages. Group comparisons for quantitative data were conducted using Student’s t-test. Associations between qualitative variables were assessed using Chi-squared or Fisher's exact tests, as appropriate. Binary logistic regression was used to model factors associated with

COVID-19 vaccination. All variables with a p-value < 0.25 were retained for the initial models. The top-down stepwise selection procedure was used in each model to build the final model. Variables that did not improve the model were removed one by one. The likelihood ratio test was used to compare the nested models. Variables associated with the acceptability of vaccination were included in the model. Model robustness of the model was studied by removing individuals one by one (leave-one-out) and applying the model. The Hosmer-Lemeshow test was employed to assess model goodness-of-fit.

Ethics

District officials were informed of the study's progress. Women's participation was voluntary, and informed consent was obtained beforehand. To ensure confidentiality, no identifying information was collected. Anonymity was respected, and all information that could be traced back to the women was deleted.

The study did not involve any remuneration or compensation for the women surveyed. The main benefit of this study will be a better understanding of the factors associated with vaccination. This knowledge base should ultimately enable strategies to be put in place to improve vaccination coverage.

Results

Descriptive results

A total of 736 pregnant women participated in the survey. Their average age was 28.34 years, with a standard deviation of 6.7 years. Of these, 88% were married and 79.1% were educated (Table 1).

Table 1: Distribution of women by personal characteristics, Thies district (N=736), February 2023

Variables	Absolutefrequency(N)	Relativefrequency(%)
Instruction		
Yes	582	79.1
No	154	20.9
Educationlevel		
Primary	135	18.3
Medium	194	26.4
Secondary	201	27.3
Superior	52	7.1
Uninstructed	154	20.9
Maritalstatus		
Bride	648	88.0
Single	56	7.6
Divorced	25	3.4
Widow	7	1.0

Income-generatingactivity		
Yes	294	39.9
No	442	60.1

Just over two-thirds of the participants (67.0%) were aware of the COVID-19 vaccination campaign, and among them, 91.7% knew the vaccination sites. More than 2/5 of women (46.7%) could name at least one available vaccine, and 28.5%ofparticipantssaidtheytrustedthevaccines.Themajorityofpregnantwomen(79.8%)feltitwa simportant to be vaccinated, and 76.4% recognized its usefulness.

Regarding access to vaccination facilities, motorized transport was the primary mode of travel for 70.9% of participants, while 26.5% walked.The average journey time was 21 minutes, deemed too long by 61.1% of participants. Additionally, 26.5% found the cost of transportation to be prohibitive. Lastly, 42.9% of the women reported having received a vaccine at some point in the past (Table 2).

Table2: Distribution of women according to their opinionsand practicalaspectsregarding COVID-19 vaccines, Thies district (N=736), February 2023

Variables	Absolutefrequency(N)	Relativefrequency(%)
Campaign knowlege		
Yes	685	93.1
No	51	6.93
Knowledge of vaccination sites		
Yes	675	91.7
No	61	8.29
Examplesof vaccines		
Yes	349	47.4
No	387	52.6
Trust in the Vaccine		
Confident	210	28.5
Noconfident	526	71.5
Importance of getting vaccinated		
Yes	587	79.8
No	149	20.2
Utility of the vaccine		
Yes	562	76.4
No	174	23.6
Risk associated with the vaccine		
Yes	427	58.0
No	309	42.0
Desirability of getting vaccinated		
Yes	546	74.2
No	190	25.8
Decision-making autonomy		
Yes	251	34.1
No	485	65.9
Transport		
Feet	195	26.5
Carts	19	2.58
Motorized	522	70.9

Travel time		
Short	286	38.9
Long	450	61.1
Transport costs		
Expensive	195	26.5
No expensive	541	73.5
Vaccine in the past		
Yes	420	42,9
No	316	65,9

Overhalfthewomensurveyedhadreceivedthevaccine(54.2%).Ofthosevaccinated,mosthadreceivedJohnson and Johnson (36%) (Figure 1).

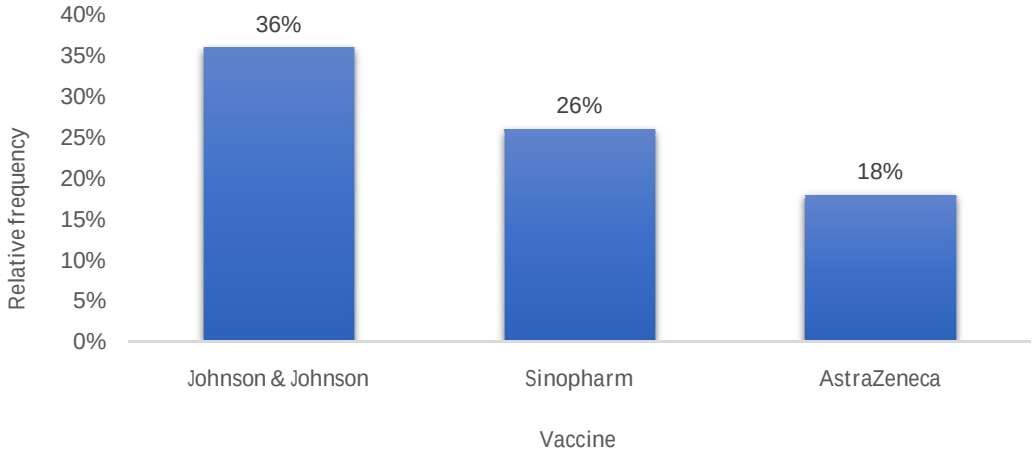

Figure 1: Distribution of vaccinated pregnant women according to COVID-19 vaccine received, Thies district (N=736), February 2023

Bivariateanalysis

Among women aged 35 years and older, 57.4% were vaccinated, compared to 53.4% of those under 35. This difference was not statistically significant (*P* = 0.445). The proportion of educated women vaccinated was 58.8%, while that of uneducated women was 37.0%. The relationship between vaccination and education was statistically significant (*P*<0.001). Women engaged in income-generating activities had a higher vaccination rate (59.2%) compared to those without such activities (50.9%). Therewasastatisticallysignificantlinkbetweenvaccinationandincome-generatingactivity (*P*=0.033).

In terms of options and feelings, the proportion of women who were informed about the vaccination campaign was 58.8%, while the proportion of those who were not informed was 37.0%. This difference was statistically significant(*P*=0.008).Vaccination rates were significantly higher among women who expressed confidence in the vaccine (88.6%)

compared to those who lacked confidence (40.5%). The relationship between vaccination and confidence was statistically significant (P=0.008).

Regardingsocialprocesses,theproportionofvaccinatedwomenamongthosewhowereself-sufficientwas64.5%, while that among non-self-sufficient women was 48.9%. This difference was statistically significant (P<0.001).

With regard to practical aspects, the proportion of vaccinated women among those who walked to the facility was 45.6%, while it was 57.9% among those who used carts and 57.3% among those who used motorized transport. This relationship was statistically significant (P = 0.020).

Table3:COVID-19vaccinationstatusamongpregnantwomen,Thiesdistrict,February2023

Variables	Vaccination COVID-19		*P*-value
	Yes, *N=399 (%)*	No, *N=337 (%)*	
Age group			0.445
35 and over	81 (57.4)	60 (42.6)	
Under 35	318 (53.4)	277 (46.6)	
Instruction			<0.001
Oui	342 (58.8)	240 (41.2)	
Non	57 (37.0)	97 (63.0)	
Income-generating activity			0.033
Oui	174 (59.2)	120 (40.2)	
Non	225 (50.9)	217 (49.1)	
Opinions and feelings			
Campaign knowlege			0.008
Yes	381 (55.6)	304 (44.4)	
No	18 (35.3)	33 (64.7)	
Knowledge of vaccination sites			<0.001
Yes	115 (29.7)	272 (70.3)	
No	284 (81.4)	65 (18.6)	
Examplesof vaccines			<0.001
Yes	186 (88.6)	24 (11.4)	
No	213 (40.5)	313 (59.5)	
Trust in the Vaccine			<0.001
Confident	371 (63.2)	216 (36.8)	
Noconfident	28 (18.8)	121 (81.2)	
Importance of getting vaccinated			<0.001
Yes	360 (64.1)	202 (35.9)	
No	39 (22.4)	135 (77.6)	
Usefulness of vaccines			<0.001
Yes	284 (66.5)	143 (33.5)	
No	115 (37.2)	194 (62.8)	
Vaccinesrisk			<0.001
Yes	339 (62.1)	207 (37.9)	
No	60 (31.6)	130 (68.4)	
Social process			
Marriage			0.004
Yes	338(52.2)	310 (47.8)	
No	61(69.3)	27 (30.7)	
Decision-making autonomy			<0.001
Yes	162(64.5)	89 (35.5)	
No	237(48.9)	248 (51.1)	
Practicalaspects			

Transport			0.020
Feet	89(45.6)	106 (54.4)	
Carts	11(57.9)	8 (42.1)	
Motorized	299(57.3)	223 (42.6)	
Travel time			1.000
Short	155(54.2)	131 (43.8)	
Long	244(54.2)	206 (43.8)	
Transport costs			0.013
Expensive	121(62.1)	74 (37.9)	
No expensive	278(51.4)	263 (48.6)	
Vaccine in the past			0.188
Yes	237(56.4)	183 (43.6)	
No	162(51.3)	156 (48.7)	
Transport			<0.001
Feet	393(58.2)	282 (41.8)	
Carts	6 (9.8)	55 (90.2)	

Multivariateanalysis

In multivariateanalysis,thefactorsassociated with COVID-19 vaccination were age [AOR = 1.04;IC96%=1.01- 1.08], autonomy indecision-making [AOR=4.24;IC96%=2.40-7.75],costoftransport[AOR= 0.57;IC95%= 0.36-0.91],knowledgeofvaccines[AOR=15.3;IC95%=9.58-25.2],knowledgeoftheimportanceofvaccines[AOR=3.26; IC96%=1.19- 8.98], thinking the vaccine was useful [AOR= 2.98; IC95%= 1.17-7.79] and thinking the vaccine was risky had [AOR= 4.5; IC95%=2.62-7.93], (Table 4).

Table4:Factorsassociatedwithvaccinationamongpregnantwomen,Thiesdistrict,February 2023

Variable	AOR[1]	95%CI[1]	*P*-value
Age	1,04	1,01- 1,08	0,008
Instruction			
No	Ref	Ref	
Yes	1,60	0,98-2,66	0,064
Decision-makingautonomy			
No	Ref	Ref	
Yes	4,24	2,40-7,75	<0,001
Transportcosts			
Dear	Ref	Ref	
Not expensive	0,57	0,36-0,91	0,019
Knowledgeofvaccines			
No	Ref	Ref	
Yes	15,3	9,58- 25,2	<0,001
Importanceofvaccines			
No	Ref	Ref	
Yes	3,26	1,19-8,98	0,021
Usefulnessofvaccines			
No	Ref	Ref	
Yes	2,98	1,17-7,79	0,023
Vaccinerisk			
No	Ref	Ref	

Yes	4,50	2,62-7,93	<0,001

[1]AOR=AdjustedOddsRatio,CI=ConfidenceInterval

Discussion

The general aim of this study, conducted in a population of pregnant women in the Thies health district, was to identify factors associated with vaccination among pregnant women. Using a methodology based on statistical principles,itidentifiedriskfactorsforvaccinationinpregnantwomen,suchasage,autonomy,transport coststo the facility, knowledge of vaccines, their perceived importance, usefulness and perceived risk of the vaccine.

Among pregnant women in the Thies health district, vaccination coverage was 54.2%. This rate is significantly higher than that observed for the national population as a whole (12). This situation can be explained by the fact that ANCs provide an additional opportunity for health-care staff to raise women's awareness of vaccination and to administer the vaccine. In Senegal, the rate of ANC use is very high (98%)(21). Vaccination coverage in our study is also higher than that reported in a systematic review of 11 studies from the USA, England, Scotland, Japan and Israel, which found a rate of 27.5%(15). In Ethiopia(22)vaccination coverage among pregnant women was very low at 14.4%. This variability in vaccination coverage among pregnant women in different parts of the world is not surprising. It was to be expected from the results of studies on intention and acceptability, which were not uniform (23–26).

Agewasafactorassociatedwithvaccinationinourstudy.Thissituationissimilarinotherresearchcarriedoutin Ethiopia,wherevaccinatedwomenweretheoldest(22).Thesameistrueofthemeta-analysisbytheGreekPétros Galanis(15).Severalfactorscouldexplainthisphenomenon.Ontheonehand,olderwomen tendtohaveabetter perceptionoftherisksassociatedwithCOVID-19,bothforthemselvesandfortheirfetus,whichwouldencourage them to opt for vaccination. On the other hand, young pregnant women could be influenced by mistaken beliefs, concerns about vaccine safety or a lack of trust in health authorities.A global review found similar results, emphasizing the importance of age and risk perception in determining vaccine uptake among pregnant women and young mothers(27).

Knowledge of vaccines was associated with vaccination in our study. These data corroborate those found in Ethiopia(22) where vaccinated women were those who understood the benefits.

This similarity underlines the importanceofknowledgeasaleverforimprovingvaccineadherence,bydispellingthedoubtsandmisconceptions oftenassociatedwithvaccination(28).Indeed,ithasbeenshownthatgoodknowledgeofadiseasepredisposesto good practice in combating it (29).

Risk perception was not found to be a barrier to vaccination in our study. The same was true in Wales(23). This shows that the fear of COVID-19 during pregnancy(15) and the safety of the vaccine(26) are factors that can weigh in favor of vaccinationdespite the perception ofrisk. In contrast, themeta-analysisby Luigi Carbone et al,and the study byRikard-BellMetal, showed thattheperceptionofrisktothehealthofthemotherandfetusdidnotencourage vaccination(25,30).Thissuggeststhattheperceptionofriskasafactorassociatedwithvaccinationmaybemixed.

Nevertheless, our study showed that autonomy in decision-making increased the risk of vaccination by at least a factorof4.This result aligns with a study conducted in India in 2020, which showed that high autonomy was associated with greater use of maternal health services (31). In general, women's autonomy in healthcare decision-making in Senegal is relatively low (6.26%)(32). Hence the importance of implementing strategies to empower women.

In the Thies health district, the high transport costs did not significantly hinder vaccination uptake. This could possibly be explained by a strong willingness to do so, despite the high cost of transport. In addition to the availability of vaccines, it is important that the population has access to them. The geographical and financial accessibility of vaccination sites must be taken into account to ensure that all social strata are reached.A study conducted in African countries found that improving access to vaccination sites is important for reaching all social strata (33).

Despite the relevance of this study, it has some limitations. There may be selection bias, as the pregnant women weresurveyedinhealthfacilities.Theremayalsobeasocialdesirabilitybias,aswewereunabletocheckwomen's vaccination status in their diaries. A systematic survey with a sampling step that is the best choice could not be carried out due to the strikes that were shaking the district. Furthermore, to improve the results and generalize them,itwouldbeinterestingtoextendthestudytoallpregnantwomeninthedistrict.A qualitative approach would be valuable to better understand pregnant women's views on vaccination.

Conclusion

The availability of vaccines against COVID-19 marked a turning point in the fight against the disease. Vaccination campaigns were immediately launched on all five continents, initially excluding pregnant women. Pregnant women were included only after the vaccines were proven safe for use during pregnancy and in newborns.

The vaccinationofapopulation dependsonanumberoffactors that canvaryfromonecountry to another.In the Thies health district, the vaccination coverage rate among pregnant women was higher than that of the national population, reaching 54.2%. Factors associated with vaccination of pregnant women included age, education, autonomy in decision-making, and perception of the importance and usefulness of the vaccine. To achieve optimal COVID-19 vaccination coverage,itisveryimporttanttounderstandandtakeintoaccountthefactorsassociatedwith vaccination prior to launch.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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