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Study of Factors Associated with the Practice of Vaccination against COVID-19 among Medical Science Students in Dakar (Senegal)

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Abstract

Introduction: Almost a year after the start of the COVID-19 pandemic, Senegal embarked on a vaccination campaign to protect its population. The objective of this study was to identify the factors influencing the COVID-19 vaccination practices within a health training university in Dakar. **Methodology:** This was a cross-sectional, descriptive and analytical study carried out from October 21 2021 to February 21 2022 among students at the Elhadj Ibrahima Niass private University in Dakar, Senegal. A 28-question online questionnaire was sent to all students enrolled at the university during this period. **Results:** Of the 576 students who responded, the average age was 22.60 years, with females predominating (57.81%). Medical students accounted for 66.14% of participants, pharmacy 22.40% and dental surgery 11.46%. Of these, 42.01% were bachelor's students, 29.51% master's students and 28.47% doctoral students. Vaccination coverage was 50.35%. Students who considered COVID-19 to be very dangerous were more likely to be vaccinated (OR = 5.05 [2.24 - 11.9]). Those with poor knowledge of vaccines were less likely to be vaccinated (OR = 0.07 [0.03 - 0.18]), as were those with poor knowledge of contraindications to vaccination (OR = 0.49 [0.28 - 0.86]). No association was found between vaccination status and socio-demographic or educational characteristics. **Conclusion:** In view of the importance of knowledge about COVID-19 vaccination, our results suggest that it is important to involve health students in the Ministry of Health's awareness-raising strategies, because their support is necessary for better public awareness.

Keywords

COVID-19, Vaccination, Health Students, Senegal

1. Introduction

The disease known as COVID-19 is a respiratory infection discovered in late 2019. On March 2, 2020, Senegal declared its first case of COVID-19 [1]. On March 23, 2020, the President of the Republic announced a nationwide state of emergency. From the outset of the COVID-19 pandemic, many scientists have argued that the most effective means of protection would be the development of a vaccine. Effective vaccine coverage should help to halt the spread of the disease. Almost a year after the start of the pandemic, December 2020 marked the start of the vaccination campaign in many countries [2]. On February 17, 2021, Senegal received its first vaccine, and the vaccination campaign was launched on February 23, 2021 [3]. However, the Senegalese population, like those in other countries, had mixed feelings about vaccination. The fact that the vaccines were brought to market in less than a year was seen as precipitate. The information provided by pharmaceutical companies and laboratories after clinical trials on efficacy and side effects was less reassuring for some, who remained reluctant to be vaccinated [4]. Numerous awareness-raising campaigns were carried out by governments to encourage people to be vaccinated. Vaccination being the first preventive measure, but also a sensitive subject for the population, we thought it relevant to evaluate the adherence of health students to this practice. We therefore decided to carry out our study in Senegal, more specifically at the Université Elhadj Ibrahima Niass (UEIN), a private health university based in Dakar. The objective was to study the risk factors of the practice of COVID-19 vaccination among students at the Elhadj Ibrahima Niass University (Dakar) in 2021.

2. Methodology

The study was conducted in Dakar, the political, economic, and administrative capital of Senegal. It is located at the western tip of the Cape Verde Peninsula, along the Atlantic Ocean, and covers an area of 550 km^2, which represents 0.28% of the national territory. It is bordered to the east by the Thiès region and to the north, west and south by the Atlantic Ocean. This study was a cross-sectional, descriptive and analytical study. Data were collected from October 21, 2021 to February 21, 2022. The population was represented by all students enrolled at UEIN during the study period. All students enrolled at UEIN during the study period were included. The exclusion criteria for this study included participants' non-consent or inaccessibility to the online questionnaire.

Calculation of required sample size

Calculated using the following formula [5]:

$$n = Z^2 \times P(1-P) \times N / Z^2 \times P(1-P) + (N-1) \times i^2$$

- n: sample size required;
- N: size of target population = 1980;
- P: expected proportion of a population response set at 50%;
- Z: sampling confidence interval estimated at 95% = 1.96;

- *i*: margin of sampling error estimated at 5%;
- $n = [(1.96 * 1.96) * 0.5 * (1 - 0.5) * 1980]/[(1.96 * 1.96) * 0.5 * (1 - 0.5) + (1980 - 1) * (0.05 * 0.05)] = 322$. The minimum size calculated was 322 students. This gave us the minimum number of students needed to make a successful statistical inference.

Our initial aim was to survey all students in medicine, pharmacy and dentistry, but in the context of the pandemic, most courses were taken online, so there was a significant risk of non-attendance. Even if we did not reach exhaustiveness, we did reach at least 322 students.

Data collection

The questionnaire was created on Google Forms and shared with students via the various class groups by WhatsApp and e-mail.

This method, while far from perfect, is currently a rapidly developing research tool that appears very promising if its methodological limitations are considered and it is used with rigor and discernment [6].

A questionnaire comprising 28 questions divided into four sections:

- Sociodemographic and educational section: age, gender, field of study, level of education;
- Knowledge of COVID-19 disease: nature of the coronavirus, incubation period of the virus, mode of transmission of the virus, symptoms of the disease, preventive measures, people most at risk of developing the disease, existence of a specific treatment, danger of the disease;
- Knowledge of COVID-19 vaccines: types of vaccines, known vaccines, who can be vaccinated, side effects and contraindications to vaccination.
- Practical attitude to vaccination section: vaccination status, reasons for vaccination, side effects and post-vaccination treatment.

Data analysis

Data were collected and analyzed using R software.

Description was achieved by calculating or determining positional parameters (frequencies for categorical variables and mean values for quantitative variables) and dispersion parameters (standard deviation). Data were presented in frequency tables and graphs.

As regards the analytical part, cross-tabulation between the "vaccinated" and "non-vaccinated" variables and the other variables was carried out to reflect certain concerns expressed in the objectives, and linked to the search for determinants. The Chisq-2 test and Student test were used, considering a difference to be significant when the p was less than 0.05. Simple logistic regression was used to identify factors associated with vaccination status, taking into account adjustment and confounding factors. The Hosmer Lemeshow test validated the model.

Ethics: Free and informed consent was respected by all participants. All participants were volunteers. Data were collected anonymously and confidentially. Administrative authorization for the survey was provided by the school.

3. Results

A response rate of 576 students was obtained, improving the reliability of our study with a margin of error reduced to 3%, with a confidence level of 95%.

3.1. Socio-Demographic Characteristics

The average age of respondents was 22.60 years, with a standard deviation of 3.34 years. The median age was 23 [16 - 47]. Respondents were classified into two age groups: those aged under 23 (48.61%) and those aged 23 or over (51.39%). The predominant sex was female with 57.81% (333), against 42.19%. Participation by medical students was 66.14%, pharmacy 22.40% and dental 11.46%. Bachelor's students were the most involved (41.67%) (242), compared with 29.51% of Master's students and 28.47% of Doctoral students.

3.2. Knowledge of COVID-19 Disease

Knowledge of the nature of the coronavirus

36.11% claimed to know the nature of COVID-19, against 63.89% who said they did not. Responses concerning knowledge of the nature of the coronavirus varied from one student to another. 24.83% thought it was SARS-CoV-2; 24.65% said it was mRNA virus and SARS-CoV-2; (19.62%) mRNA virus; (11.28%) disease, mRNA virus and SARS-CoV-2; (6.60) disease and SARS-CoV-2, (5.55%) disease, (2.5%) disease and mRNA virus; (2.60%) said they didn't know; 0.87% answered DNA virus; (0.35%) SARS-CoV-2 and DNA virus; (0.35%) mRNA and DNA virus; (0.17%) disease and DNA virus; and finally (0.17%) disease, mRNA and DNA virus, SARS-CoV-2.

Knowledge of coronavirus incubation period

79.86% of respondents were familiar with the incubation period. Of those who were not familiar with the incubation period (20.14%), 11.46% answered 0 - 5 days, 7.46% 14 - 23 days, 0.69% more than 23 days.

Knowledge of modes of coronavirus transmission

The majority of students (80.03%) (461) had a good knowledge of coronavirus transmission, some (15.10%) had a fair knowledge, and 4.86% had a poor knowledge. (95.31%) had ticked sneeze droplets as the mode of transmission, (87.85%) had ticked direct contact with infected people, (37.15%) had chosen contact with contaminated animals, (13.72%) had chosen sexual contact and finally for (6.77%), it was by transfusion.

Knowledge of COVID-19 symptoms

Students had a good level of knowledge of COVID-19 symptoms, (92.88%) (535). These included fever (96.88%), anosmia (95.66%), breathing difficulties (95.31%), agueusia (94.79%), cough (91.49%), headache (82.99%), shortness of breath (76.56%), sore throat (71.35%), myalgia (66.67%), diarrhea (50.17%), Asthenia (1.38%), conjunctivitis (1.04%), nausea (0.52%), (0.17%) had ticked symptoms, vomiting, anorexia, hiccups, altered consciousness, arthralgia, chest pain, discoloration of fingers and finally rash.

Level of knowledge of preventive measures against COVID-19

The results showed a good level of knowledge of preventive measures at 99.13% (571), and showed that 82.81% of the study population (477) considered vaccination to be a preventive measure. The various preventive measures known by our study population were wearing a mask (99.48%), washing hands regularly with soap and water (99.13%), using hydro-alcoholic gel (98.96%), keeping a safe distance in public (96.70%), Avoid gatherings (96.18%), Cover your mouth and nose when coughing or sneezing (94.44%), Get vaccinated (82.81%), Avoid close contact with anyone with a fever or cough (80.90%), Check your temperature regularly (43.23%).

Knowledge of people most at risk of contracting COVID-19

This was divided into three categories: good (71.53%), average (21.70%) and poor (6.77%). As for the distribution of these people at risk, for the respondents, there were the elderly (95.83%), people with pathologies (90.10%), health workers (63.89%), pregnant women (57.46%), newborns (32.46%), infants (24.48%), adults (14.76%), children (11.98%), young people (7.46%), teenagers (6.77%), everyone (0.35%), unvaccinated people (0.17%), family of a person at risk (0.17%).

Knowledge of the existence of a specific treatment for COVID-19

Only 48.26% were aware of the existence of a Covid19-specific treatment, versus 51.74% who were not.

Dangerousness of COVID-19

57.29% (330) considered the coronavirus more or less dangerous, 35% considered it very dangerous and 8% thought it was not dangerous.

3.3. Knowledge of COVID-19 Vaccines

Level of knowledge of COVID-19 vaccine types

Knowledge of vaccine types was good for 20.49% of respondents, average for 24.13% and poor for 55.38%.

In terms of the different types of vaccine known to respondents, there was the mRNA vaccine (64.41%), the live attenuated vaccine (54.51%), the inactivated vaccine (50.35%), the protein subunit vaccine (24.65%), the viral vector vaccine (23.96%), the DNA vaccine (4.34%), the toxoid vaccine (3.47%), and finally there were those who didn't know (2.60%).

Knowledge of COVID-19 vaccines

62.50% of respondents had a good level of knowledge of COVID-19 vaccines, 25.35% had an Average level and 12.15% had a poor level.

Knowledge of COVID-19 vaccine types

91.49% knew AstraZeneca, 91.94% knew Johnson Johnson, 82.12% knew Pfizer from BioNtech, 74.65% knew Sinopharm, 62.67% knew Moderna, 41.49% knew Sinovac, 41.14% knew Sputnik V, 24.65% knew Novavax, 0.35% knew Bharat and 0.69% said they didn't know.

Level of knowledge of those to whom the vaccine can be administered

There were three ways of assessing the level of knowledge of those to whom

the vaccine could be administered: Good (95.83%), Fair (1.91%), Poor (2.26%).

Level of knowledge of vaccine recipients

Among those to whom the vaccine can be administered, there were adults (96.01%), the elderly (94.97%), young people (86.28%), adolescents (64.76%), people with other pathologies (diabetes, hypertension, kidney failure, etc.) (60.94%), pregnant women (41.67%), children (31.08%), infants (3.30%), newborns (2.43%), (0.69%) said they didn't know, and (0.34%) thought the vaccine could be given to everyone.

Level of knowledge of COVID-19 vaccination side effects

There were three modalities for assessing the level of knowledge of the side effects of COVID-19 vaccination, good, average and poor. 35.76% of respondents had a good level, 34.55% had an average level and 29.69% had a poor level.

Side effects of COVID-19 vaccination

With regard to the various side effects of vaccination, the respondents thought that there was fever (82.46%), pain at the injection site (80.90%), asthenia (77.95%), headache (69.62%), myalgia (64.58%), chills (61.80%), thrombosis (42.53%), malaise (39.58%), arthralgia (36, 28%), nausea (29.17%), diarrhea (28.99%), menstrual disorders (27.08%), pruritus (26.56%), vomiting (23.26%), myocarditis (20.49%), pericarditis (18, 58%), facial paralysis (18.05%), angioedema (16.14%), insomnia (13.19%), anorexia (7.46%), 1.21% didn't know, and 0.35% ticked allergies.

Knowledge of contraindications to COVID-19 vaccination

More than half the respondents had a good level of knowledge (56.94%) of the contraindications to COVID-19 vaccination, 23.61% had an average level, and 19.44% had a poor level.

Contraindications to COVID-19 vaccination

According to respondents, there were allergies to one of the vaccine components (84.72%), allergy after a first dose (67.71%), having COVID-19 (46.88%), having had COVID-19 in the last three months (35.42%), pregnancy (33.33%), being under 18 (29.00%), breast-feeding (20.49%), myocarditis (21.18%), pericarditis (19.44%), comorbidities (hypertension, diabetes, renal failure, etc.) (13.72%), having contracted COVID-19 (5.38%), being over 70 (5.21%), and finally 2.08% of respondents claimed not to know the contraindications to vaccination against COVID-19.

3.4. Vaccination Practice

Out of a total of 576 respondents, half had been vaccinated (50.35% versus 49.65%).

Several reasons for accepting vaccination were listed, the most frequent being to avoid a severe form of COVID-19 (77.24%) and to protect those around them (71.38%). Other reasons included the reliability of the vaccine (24.83%), being able to travel (11.03%), personal responsibility (2.76%), and those who did not wish to answer (1.03%).

For those who were not vaccinated, the two main reasons were lack of belief in

the reliability of the vaccine (44.9%), fear of side effects (44.15%), and then there were those who felt no need (20.75%), those who didn't wish to answer (20%), inaccessibility of the vaccine (6.41%), medical contraindications (4.53%), negligence (3.02%), parental refusal (1.13%).

With regard to post-vaccination reactions, out of a total of 290 vaccinated subjects, 65.52% felt protected after vaccination, and 34.48% still felt unprotected.

As for side effects, 64.48% said they had experienced them, compared with 35.52% who had not. The most commonly reported side effects were fever and chills (48.13%), followed by asthenia, anorexia, malaise and insomnia (39.04%), muscle pain and arthralgia (27.27%), injection site pain (25.13%), headache (22.99%), diarrhea, nausea and vomiting (11.23%), menstrual disorders (4.81%), pruritus (1.60%), sore throat (0.53%) and hair loss (0.53%).

Concerning the duration of side-effects, the most frequent was 72 hours (34.22%), while 29.41% had side-effects lasting 48 hours, 28.34% had side-effects lasting 24 hours, and 8.02% had side-effects lasting less than 24 hours.

Following these side effects, 52.41% reported that they had not taken any treatment, compared with 47.59% who had taken treatment.

Treatments taken following side-effects were mostly antipyretics (89.88%), followed by vitamins (7.86%), antibiotics (Azithromycin, amoxicillin-clavulanic acid) (4.49%), antidiarrheals and antiemetics (3.37%), NSAIDs and corticoids (3.37%), muscle relaxants (1.2%), antihistamines (1.2%) and migraine medications (1.2%) (Table 1).

3.5. Search for Factors Associated with COVID-19 Vaccination Practice

Factors associated with vaccination status were influenced by gender, knowledge of the nature of the virus, knowledge of the symptoms of the disease, knowledge of who was most at risk of the disease, consideration of the danger of the disease, knowledge of the types of vaccine against the disease, knowledge of the vaccines against the disease, knowledge of the targets of vaccination, knowledge of post-vaccination side effects and knowledge of contraindications to vaccination.

Gender was a protective factor. Males were 0.003 times more likely to be vaccinated than females. Knowledge of the nature of the coronavirus was statistically linked to encouragement to vaccinate, with a significant p-value of 0.021. Students with good knowledge of the nature of coronavirus were more likely to be vaccinated than students with average and poor knowledge. Students with good knowledge of the disease's symptomatology were 51.03% vaccinated and 48.97% non-vaccinated. Those with average knowledge were 53.57% vaccinated and 46.43% non-vaccinated, while those with poor knowledge were 84.62% non-vaccinated and 15.38% vaccinated. Knowledge of the symptoms of the disease was statistically linked to vaccination, with a p-value of 0.0343. Students with good knowledge of the people most at risk of the disease 53.64% were vaccinated and 46.36% were not. Those with average knowledge of those most at

Table 1. Descriptive results for students surveyed (n = 576).

Student characteristics	Frequencies absolute (n)	Relative frequencies (%)
Age group		
<23 years old	280	48.61
≥23 years old	296	51.39
Sex		
Female	333	57.81
Male	243	42.19
Subsidiaries		
Medicine	381	66.14
Pharmacy	129	22.40
Dental	66	11.46
Study level		
Bachelor's degree	242	42.01
Master	170	29.51
Doctorate	164	28.47
Knowledge of the nature of the virus		
Yes	208	36.11
No	368	63.89
Nature of the coronavirus		
A SARS-CoV-2	143	24.83
An mRNA virus and SARS-CoV-2	142	24.65
An mRNA virus	113	19.62
A disease, an mRNA virus and SARS-CoV-2	65	11.28
A disease and SARS-CoV-2	38	6.60
A disease	32	5.55
A disease and an mRNA virus	7	2.95
I don't know	15	2.60
A DNA virus	5	0.87
SARS-CoV-2 and a DNA virus	2	0.35
One disease and one DNA virus	1	0.17
One disease, one mRNA and one DNA virus, one SARS-CoV-2	1	0.17
Knowledge of virus incubation period		
Yes	460	79.86
No	116	20.14

Continued

Incubation time		
5 - 14 days	460	79.86
0 - 5 days	66	11.46
14 - 23 days	46	7.99
More than 23 days	4	0.69
Knowledge of modes of transmission		
Good	461	80.03
Fair	87	15.10
Poor	28	4.86
COVID-19 transmission modes		
Sneeze droplets	549	95.31
Direct contact with infected persons	506	87.85
Touching contaminated objects or surfaces	503	87.33
Contact with contaminated animals	214	37.15
Sexual contact	79	13.72
Transfusion	39	6.77
Knowledge of COVID-19 symptoms		
Good	535	92.88
Fair	28	4.86
Poor	13	2.26
COVID-19 symptoms		
Fever	558	96.88 95.66
Anosmia	551	95.31
Difficulty breathing	549	94.79
Agueusia	546	91.49
Cough	527	82.99
Headache	478	76.56
Shortness of breath	441	71.35
Sore throat	411	66.67
Myalgias	384	50.17
Diarrhea	289	1.38
Asthenia	8	1.04
Conjunctivitis	6	0.52
Nausea	3	0.17
Vomiting	1	0.17

Continued

Anorexia	1	0.17
Hiccups	1	0.17
Altered consciousness	1	0.17
Arthralgias	1	0.17
Chest pain	1	0.17
Discoloration of fingers	1	0.17
Skin rash	1	
Level of awareness of preventive measures against COVID-19		
Good	571	99.13
Fair	4	0.69
Poor	1	0.17
Preventive measures against COVID-19		
Wear a mask	573	99.48
Wash hands regularly with soap and water	571	99.13
Use hydroalcoholic gel	570	98.96
Keep a safe distance in public	557	96.70
Avoid gatherings	554	96.18
Cover your mouth and nose when coughing or sneezing	544	94.44
Get vaccinated	477	82.81
Avoid close contact with anyone with a fever or cough	446	80.90
Check your temperature regularly	249	43.23
Level of knowledge of those most at risk from COVID-19		
Good	412	71.53
Fair	125	21.70
Poor	39	6.77
Knowledge of those most at risk		
Seniors	552	95.83
People with pathologies	519	90.10
Healthcare workers	368	63.89
Pregnant women	331	57.46
Newborns	187	32.46
Infants	141	24.48
Adults	85	14.76
Children	69	11.98

Continued

Youth	43	7.46
Teenagers	39	6.77
Everyone	2	0.35
Unvaccinated	1	0.17
Family of an infected person	1	0.17
Knowledge of the existence of a specific treatment for COVID-19		
Yes	278	48.26
No	298	51.74
Dangerousness of COVID-19		
Not dangerous	46	8
More or less dangerous	330	57.29
Very dangerous	200	35
Knowledge of vaccine types		
Good	118	20.49
Fair	139	24.13
Poor	319	55.38
Types of COVID-19 vaccines		
mRNA vaccine	371	64.41
Live attenuated vaccine	314	54.51
Inactivated virus vaccine	290	50.35
Protein subunit vaccine	142	24.65
Viral vector vaccine	138	23.96
DNA vaccine	25	4.34
Toxoid vaccine	20	3.47
Don't know	15	2.60
Knowledge of COVID-19 vaccines		
Good	360	62.50
Fair	146	25.35
Poor	70	12.15
Vaccine against COVID-19		
AstraZeneca	527	91.49
JonhsonJonhson	525	91.14
Pfizer de BioNtech	473	82.12
Sinopharm	430	74.65

Continued

Moderna	361	62.67
Sinovac	239	41.49
Spoutnik VNovavax	237	41.14
Novavax	142	24.65
Bharat	2	0.34
I don't know	4	0.69
Level of knowledge of people to whom the vaccine can be administered		
Good	552	95.83
Fair	11	1.91
Poor	13	2.26
Persons to whom the vaccine may be administered		
Adult	553	96.01
Seniors	547	94.97
Youth	497	86.28
Teenagers	373	64.76
People with other pathologies (diabetes, hypertension, kidney failure, etc.)	351	60.94
Pregnant women	240	41.67
Children	179	31.08
Infants	19	3.30
Newborns	14	2.43
I don't know	4	0.69
Everybody	2	0.34
Level of awareness of COVID-19 vaccination side effects		
Good	206	35.76
Fair	199	34.55
Poor	171	29.69
COVID-19 vaccination side effects		
Fever	475	82.46
Pain at injection site	466	80.90
Asthenia	449	77.95
Headache	401	69.62
Myalgias	372	64.58
Chills	356	61.80

Continued

Thrombosis	245	42.53
Malaise	228	39.58
Arthralgia	209	36.28
Nausea	168	29.17
Diarrhea	167	28.99
Menstrual disorders	156	27.08
Pruritus	153	26.56
Vomiting	134	23.26
Myocarditis	118	20.49
Pericarditis	107	18.58
Facial paralysis	104	18.05
Angioedema	93	16.14
Insomnia	76	13.19
Anorexia	43	7.46
I don't know	7	1.21
Allergies	2	0.35
Knowledge of contraindications to vaccination against COVID-19		
Good	328	56.94
Fair	136	23.61
Poor	112	19.44
Contraindications to vaccination against COVID-19		
Allergy to one of the vaccine's components	488	84.72
Allergy after a first dose	390	67.71
Being infected with COVID-19	270	46.88
Have been infected with COVID-19 last three months	204	35.42
Pregnancy	192	33.33
Under 18 years of age	167	29.00
Breast-feeding	118	20.49
Myocarditis	122	21.18
Pericarditis	112	19.44
Comorbidities (hypertension, diabetes, renalfailure, etc.)	79	13.72
Have had COVID-19	31	5.38
Over 70 years of age	30	5.21
Don't know	12	2.08

Continued

Vaccination practice		
Vaccinated	290	50.35
Non-vaccinated	286	49.65
Reason for vaccination		
Avoiding severe forms of COVID-19	224	77.24
Protect those around you	207	71.38
Vaccine reliability	72	24.83
Ability to travel	32	11.03
Personal responsibility	8	2.76
Do not wish to answer	3	1.03
Reasons not to be vaccinated		
Does not believe in the reliability of the vaccine	119	44.91
Fear of side effects	117	44.15
No need to be vaccinated	55	20.75
Don't wish to answer	53	20
Vaccine inaccessible	17	6.41
Medical contraindication	12	4.53
Neglect	8	3.02
Parental refusal	3	1.13
Feelings of protection after vaccination (n = 290)		
Yes	190	65.52
No	100	34.48
Side effects after vaccination (n = 290)		
Yes	187	64.48
No	103	35.52
Types of side effects after vaccination		
Fever, chills	90	48.13
Asthenia, anorexia, malaise, insomnia	73	39.04
Muscle pain, arthralgia	51	27.27
Pain at injection site	47	25.13
Headache	43	22.99
Diarrhea, nausea, vomiting	21	11.23
Menstrual disorders	9	4.81
Pruritus	3	1.60
Sore throat	1	0.53
Hair loss	1	0.53

Continued

Duration of side effects		
72 h and more	64	34.22
48 h	55	29.41
24 h	53	28.34
Less than 24 h	15	8.02
Taking treatment for side effects		
Yes	89	47.59
No	98	52.41
Treatment for side effects		
Antipyretics	80	89.88
Vitamins	7	7.86
Antibiotic (Azithromycin, amoxicillin-clavulanic acid)	4	4.49
Antidiarrheal, antiemetic	3	3.37
NSAIDs, corticoids	3	3.37
Muscle relaxant	1	1.12
Antihistamine	1	1.12
Anti-migraine	1	1.12

risk 56.80% were unvaccinated and 43.20% were vaccinated, while among those with poor knowledge of those most at risk 61.54% were unvaccinated versus 38.46% vaccinated. Knowledge of people at risk was statistically significantly associated with vaccination, with a p-value of 0.0379. 72.92% of respondents who considered COVID-19 non-hazardous were unvaccinated, while 27.08% were vaccinated. Those who considered it more or less dangerous were vaccinated 52.42% and 47.58% were not. 52.52% of students who answered that COVID-19 was very dangerous were vaccinated, compared with 47.48% who were not.

There was a statistically significant link between consideration of the danger of the disease and the practice of vaccination, with a significant p value of 0.003. Students with a good knowledge of the types of vaccines against the disease were vaccinated at 57.63% and non-vaccinated at 42.37%; those with an average level of knowledge were vaccinated at 56.83% and non-vaccinated at 43.17%; those with a poor knowledge of the types of vaccines were non-vaccinated at 55.17% and vaccinated at 44.83%. Knowledge of vaccine types had a statistically significant relationship with vaccination, p value at 0.0129. Participants with good knowledge of disease vaccines had vaccinated 58.61% versus 41.39% who had not. Among those with average knowledge, 50.68% were non-vaccinated versus 49.32% vaccinated. Those with poor knowledge were 90% unvaccinated versus 10% vaccinated. There was a statistically significant relationship between knowledge of COVID-19 vaccines and being vaccinated, p-value < 0.001. Stu-

dents with a good knowledge of vaccination targets were vaccinated at 51.81% vs. 48.19%; those with an average level of knowledge were non-vaccinated at 90.91% vs. 9.09%. Among those with poor knowledge of vaccination targets, 76.92% were unvaccinated versus 23.08%. Knowledge of vaccination targets was statistically significantly associated with vaccination practice, with a p-value of 0.0021.

Respondents with good knowledge of the side effects of vaccination were vaccinated 53.40% versus 46.60%; those with average knowledge 57.29% were vaccinated, 42.71% were not; those with poor knowledge were not vaccinated 61.40% versus 38.60%. Good knowledge of the side effects of vaccination had a statistically significant relationship with the practice of vaccination, with a p value < 0.001. More than half the respondents had a good level of knowledge of the contraindications to vaccination against the disease 57.01%, versus 42.99%; those with a medium level of knowledge were not vaccinated 52.94% versus 47.06% who were; 65.18% of respondents with poor knowledge were non-vaccinated versus 34.82%. There was a statistically significant link between knowledge of contraindications to vaccination and being vaccinated, with a p value < 0.001 (Table 2).

Multivariate analysis by simple logistic regression showed that the risk factors associated with the practice of COVID-19 vaccination were: consideration of the dangerousness of the disease, poor knowledge of vaccines, poor knowledge of vaccine contraindications.

Consideration of the dangerousness of the disease was a protective factor: students who considered the disease to be dangerous were more likely to be vaccinated than others (OR = 5.05 [2.24 - 11.9]).

Poor knowledge of vaccines was an exposure factor: students with poor knowledge of vaccines were less likely to be vaccinated (OR = 0.07 [0.03 - 0.18]). The same was true for poor knowledge of vaccine contraindications, which was also an exposure factor, because students who were not aware of vaccine contraindications vaccinated less than others (OR = 0.49 [0.28 - 0.86]) (Table 3).

4. Discussion

We conducted a cross-sectional, descriptive and analytical study to assess the factors associated with the practice of vaccination against COVID19 among students at the UEIN in Dakar.

The mean age of those included in the study was 22.60 years, with a standard deviation of 3.34 years, and the median age was 23. Females predominated at 57.81%. Yassine Samouh found a mean age of 22.9 [±2], with females also predominating at 58% [7]. However, Tavolacci and Loraillere found a mean age of 20.3 years, but still with a female predominance of 71.4% [8]. The young median age could be explained by the fact that undergraduates participated most in the study (42.01%), and the predominance of women by the availability and interest of female students during the survey.

Table 2. Vaccination status by socio-demographic and educational characteristics.

Socio-demographic and educational characteristics	Vaccinated		p-value
	Yes N (%)	No n (%)	
Age groups			
<23 years old	139 (49.64)	141 (50.36)	**0.742**
≥23 years old	151 (51.01)	145 (48.99)	
Sex			
Female	155 (46.55)	178 (53.45)	**0.033**
Male	135 (55.56)	108 (44.44)	
Subsidiaries			
Medicine	187 (49.08)	194 (50.92)	**0.216**
Pharmacy	63 (48.84)	66 (51.16)	
Dental	40 (60.61)	26 (39.39)	
Studylevel			
Bachelor's degree	117 (48.35)	125 (51.65)	**0.699**
Master	87 (51.18)	83 (48.82)	
Doctorate	86 (52.44)	78 (47.56)	
Level of knowledge about COVID-19			
Nature of the virus			
Good	118 (56.73)	90 (43.27)	**0.021**
Poor	196 (53.26)	172 (46.74)	
Virus incubation period			
Good	232 (50.43)	228 (49.57)	**0.933**
Poor	58 (50)	58 (50)	
Disease transmission			
Good	235 (50.98)	226 (49.02)	**0.651**
Fair	40 (45.98)	47 (54.02)	
Poor	15 (53.57)	13 (46.43)	
Diseasesymptoms			
Good	273 (51.03)	262 (48.97)	**0.0343**
Fair	15 (53.57)	13 (46.43)	
Poor	2 (15.38)	11 (84.62)	
Diseasepreventionmeasures			
Good	287 (50.26)	284 (49.74)	**0.496**

Continued

Fair	3 (75)	1 (25)	
Poor	0	1 (100)	
People most at risk of disease			
Good	221 (53.64)	191 (46.36)	**0.0379**
Fair	54 (43.20)	71 (56.80)	
Poor	15 (38.46)	24 (61.54)	
Existence of specifictreatment			
Good	144 (51.80)	134 (48.20)	**0.501**
Poor	146 (48.99)	152 (51.01)	
Perception of COVID-19's hazardousness			
Not dangerous	13 (27.08)	35 (72.92)	**0.003**
More or less dangerous	173 (52.42)	157 (47.58)	
Very dangerous	104 (52.52)	94 (47.48)	
Types of vaccine against COVID-19			
Good	68 (57.63)	50 (42.37)	**0.0129**
Fair	79 (56.83)	60 (43.17)	
Poor	143 (44.83)	176 (55.17)	
Vaccines against COVID-19			
Good	211 (58.61)	149 (41.39)	**<0.001**
Fair	72 (49.32)	74 (50.68)	
Poor	7 (10)	63 (90)	
Vaccination targets			
Good	286 (51.81)	266 (48.19)	**0.0021**
Fair	1 (9.09)	10 (90.91)	
Poor	3 (23.08)	10 (76.92)	
Vaccination sideeffects			
Good	110 (53.40)	96 (46.60)	**<0.001**
Fair	114 (57.29)	85 (42.71)	
Poor	66 (38.60)	105 (61.40)	
Vaccination contraindications			
Good	187 (57.01)	141 (42.99)	**<0.001**
Fair	64 (47.06)	72 (52.94)	
Poor	39 (34.82)	73 (65.18)	

Table 3. Multivariate analysis (simple linear regression).

	Practice of COVID-19 vaccination (Yes)		
	Odds ratio	**95% CI**	**p-value**
Dangerousness of disease			
Not dangerous	-	-	
More or less dangerous	3.93	1.84 - 8.84	<0.001
Very dangerous	5.05	2.24 - 11.9	<0.001
Knowledge of vaccines			
Good	-	-	
Fair	0.61	0.38 - 0,98	0.042
Poor	0.07	0.03 - 0.18	<0.001
Level of knowledge of vaccination targets			
Good	-	-	
Fair	0.08	0.00 - 0,48	0.022
Poor	0.49	0.09 - 2.17	0.4
Knowledge of contraindications to vaccination			
Good	-	-	
Fair	0.66	0.41 - 1.06	0.088
Poor	0.49	0.28 - 0.86	0.013
Age			
23 and over	-	-	
Under 23	1.26	0.70 - 2.29	0.4
Sex			
Female	-	-	
Male	1.32	0.90 - 1.94	0.2
Subsidiaries			
Dental	-	-	
Medicine	0.78	0.42 - 1.44	0.4
Pharmacy	0.72	0.37 - 1.41	0.3
Studylevel			
Doctorate	-	-	
Bachelor's degree	1.14	0.54 - 2.42	0.7
Master's degree	1.08	0.64 - 1.84	0.8

Half of the students were vaccinated against COVID-19 (50.35%). The study by Orok [9] in Nigeria revealed that only 41.2% of participants agreed to be vaccinated, while that by Saied [10] in Egypt revealed that 34.9% of students were

vaccinated and 19.4% refused to be vaccinated. The same was true of interns at the CHU in Mali, 66.67% of whom were not vaccinated at the time of the study [11]. In contrast, Kelekar's study [12] in the USA showed that 55% of dental students and 77% of medical students agreed to be vaccinated.

Knowledge of the nature of the virus was rated poor at 63.89%. Knowledge of the incubation period of the coronavirus was rated good at 79.86%, as were modes of coronavirus transmission at 80.03%, symptoms of COVID-19 at 92.88%, preventive measures at 99.13%, and people most at risk of developing COVID-19 at 71.53%. These results are in line with those of studies carried out among medical students in Egypt [13], Sudan [14], Indonesia [15] and Iraq [16] [17]. This high level of knowledge could be explained by the fact that students in the health professions were already fairly well informed about COVID-19, but also by the fact that there was a high level of awareness of COVID-19 preventive measures through the media (television, radio, social networks), posters, etc., which inevitably reached all populations. A study carried out on 100 healthcare professionals, with more than half of those surveyed (55%) having received no training on COVID-19, showed that participants had sufficient knowledge of COVID-19, with a 72% rate of correct answers [18]. Nevertheless, knowledge of the existence of a specific treatment for COVID-19 was rated as poor at 51.74%. This could be explained by the presence of SARS-Cov-2 variants, for which each mutation may call for an adapted treatment. In the same vein, a study in Nigeria [9] revealed that 76.8% of medical students at a university had poor knowledge.

Students who perceived the disease as dangerous were more likely to be vaccinated than others, with an OR = 5.05. This could be explained by the fact that this perception of the disease would fuel this increased need for protection against what they consider to be dangerous.

Knowledge of vaccines was judged to be good by 62.50%, and those with a poor level of knowledge were less likely to vaccinate, OR = 0.07. This is totally obvious, as there is a lack of awareness of the disease due to misinformation. Knowledge of vaccine types was rated as poor at 55.38%. Slightly less so in the Nigerian study by Orok [9], which showed that 43.27% of medical students did not know the types of COVID-19 vaccine.

Knowledge of whom the vaccine can be administered to was rated as good at 95.83%, and knowledge of side effects was good at 35.76%. Knowledge of contraindications to vaccination was rated good at 56.94%, with students who had a poor level of knowledge of contraindications vaccinating less than others, with an OR = 0.49. Following their vaccination, 62.91% were more serene in the face of the pandemic, and 64.48% had developed side effects, the most frequent of which were fever and chills (48.13%). A good level of public confidence in vaccines was also found in the study by Fall *et al.* in Senegalese communities [19].

The most common reasons for vaccination were to avoid developing a severe form of COVID-19 (77.24%) and to protect family and friends (71.38%), as in the Fall *et al.* study [19] and the Nigerian study by Orok *et al.* [9]. Among the reasons for not getting vaccinated, the most frequent were lack of belief in the

vaccine's reliability (44.91%) and fear of side effects (44.15%).

These reasons were also the most common in Egypt [10], Nigeria [9] and India [20], where vaccine-induced morbidity and mortality were reported to be high. In Senegal, the non-vaccination of health personnel close to the respondents was also a non-negligible factor in their hesitation and/or non-vaccination [19].

5. Conclusion

For nearly four years now, COVID-19 has appeared in our lives, causing a high morbidity and mortality rate throughout the world. Several vaccines have been developed in record time, one after the other, making populations reluctant to accept them, not to mention the side effects which have made their acceptance even more difficult. It is important that medical and paramedical employees are well informed, so that they can positively influence the acceptance of vaccines in their environment through their opinions and attitudes.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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