


Assessment of Knowledge and Vaccination Coverage against Epidemic Meningitis among Students at the Université Peleforo Gon Coulibaly (UPGC) of Korhogo (Northern Côte d'Ivoire)

Tanoh Amany Serge Raymond N'Krumah^{1,2*}, Ellélé Aimé Marius Yapi³,
Dagnissé Denis Satognon¹, Ollo Kambiré¹, Ouattara Howélé¹, Issaka Tiembré^{3,4}

¹Unité de Formation et de Recherche des Sciences Biologiques, Université Peleforo Gon Coulibaly, Korhogo, Côte d'Ivoire

²Département Recherche et Développement, Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, Abidjan, Côte d'Ivoire

³Département d'Hygiène Général et Promotion de la Santé, Institut National d'Hygiène Publique, Abidjan, Côte d'Ivoire

⁴Unité de Formation et de Recherche des Sciences Médicales, Université Félix Houphouët Boigny d'Abidjan, Abidjan,

Côte d'Ivoire

Email: *nktanoh@gmail.com

How to cite this paper: N'krumah, T.A.S.R., Yapi, E.A.M., Satognon, D.D., Kambiré, O., Howélé, O. and Tiembré, I. (2025) Assessment of Knowledge and Vaccination Coverage against Epidemic Meningitis among Students at the Université Peleforo Gon Coulibaly (UPGC) of Korhogo (Northern Côte d'Ivoire). *Open Journal of Epidemiology*, 15, 802-817. <https://doi.org/10.4236/ojepi.2025.154052>

Received: July 13, 2025

Accepted: September 22, 2025

Published: September 25, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Background: In Côte d'Ivoire, meningitis is endemo-epidemic in the Korhogo region. The aim of this study was to assess knowledge and vaccination coverage against meningitis among students at the Université Peleforo Gon Coulibaly (UPGC) of Korhogo. **Methodology:** A descriptive cross-sectional survey was carried out from January to March 2024 on a sample of 404 students. Convenience sampling combined with simple random sampling was used for data collection. Univariate, bivariate and multivariate analyses were performed using R software 4.3.3. **Results:** The results showed that 67% (CI 95%: 62 - 71) of the students surveyed claimed to know about meningitis. Knowledge scores showed that more than half, 53% (CI 95%: 46.8 - 59.0) of students who claimed to know about meningitis had poor knowledge of this disease, with an average score of 6.4/20. The meningitis vaccination rate among students was 16% (CI 95%: 12.6 - 20.04). The final logistic regression model showed that meningitis vaccination among students was significantly associated with level of study (master's) [ORa = 0.71 (CI 95%: 0.51 - 0.98), p-value = 0.036] and student origin (native) [ORa = 2.28 (CI 95%: 1.13 - 4.63), p-value = 0.021]. The main reason given by the majority of unvaccinated students (84%) was ignorance of the existence of a meningitis vaccine, with a proportion of 72%. **Conclusion:**

Awareness-raising and information campaigns need to be stepped up to strengthen control and vaccination against meningitis in universities in Côte d'Ivoire.

Keywords

Meningitis, Knowledge, Vaccination, Students, Korhogo, Côte d'Ivoire

1. Introduction

Meningitis is a serious infection of the meninges, the membranes covering the brain and spinal cord. Despite remarkable progress in the fight against meningitis over the last 20 years, this devastating disease continues to pose a major public health problem worldwide [1]. Indeed, around 8.5 million new cases of meningitis and 463,000 deaths were reported worldwide in 2019, including 22,414 new cases and 1261 deaths in the countries of the African meningitis belt [2].

Meningitis has affected sub-Saharan Africa for centuries. Before the 1980s, it was irregular, but since the early 1980s it has become endemo-epidemic [3] [4]. In the 1980s and 1990s, the World Health Organization (WHO) recorded between 25,000 and 200,000 cases of meningitis per year in West Africa, including around 10% of deaths [5]. In 2020, the Member States of the African Meningitis Belt reported 19,552 new cases and 885 deaths from meningitis [2].

Meningitis can be caused by many different pathogens, including bacteria, fungi and viruses [2] [6]-[8]. However, it is bacterial meningitis that represents the greatest burden worldwide [6]. Acute bacterial meningitis is most often caused by four (4) pathogens: *Neisseria meningitidis* (meningococcus), *Streptococcus pneumoniae* (pneumococcus), *Haemophilus influenzae type b* (Hib) and Group B Streptococcus (GBS) [9] [10]. The route of transmission varies according to the pathogen. Meningococci, pneumococci and *Haemophilus influenzae type b* are transmitted via droplets of respiratory secretions, while group B streptococci are transmitted from mother to child at the time of delivery [6].

N. meningitidis, responsible for cerebrospinal meningitis, is the bacterium most likely to cause major epidemics. Twelve *N. meningitidis* serogroups have been identified, six of which (A, B, C, W, X and Y) can cause epidemics [11] [12]. Before 2010, *Neisseria meningitidis serogroup A* (NmA) was the main cause of meningitis epidemics, accounting for almost 90% of outbreaks. With the introduction of the *Neisseria meningitidis serogroup A* conjugate vaccine (MenAfriVac) between 2010 and 2020, more than 325 million people aged between 1 and 29 have been vaccinated in the African meningitis belt [13] [14]. This vaccination has considerably reduced the number of cases of *Neisseria meningitidis serogroup A* and changed the bacteriological profile of meningitis, which is now marked by a predominance of *Streptococcus pneumoniae* (50%), *Haemophilus influenzae type b* (15%), *Neisseria meningitidis serogroup X* (14%),

Neisseria meningitidis serogroup C (4%) and *Neisseria meningitidis* serogroup W (2.8%) [2] [15].

Recent research confirms that practical strategies such as offering vaccination directly on university campuses significantly improve meningococcal vaccine uptake rates. A UK study by Bell *et al.* [16] found that the majority of students preferred to receive the MenACWY vaccine on-site, not least because of frequent uncertainty about their vaccination status. Complementarily, Moore *et al.* [17] demonstrated that a campaign combining awareness and free on-campus vaccination led to a substantial increase in MenB vaccination initiation and completion rates in the USA. These results support the importance of targeted interventions combining physical accessibility and clear communication to promote vaccine acceptance in university settings.

Meningitis is endemo-epidemic in Côte d'Ivoire. The northern part of the country is located in the African meningitis belt stretching from Senegal to Ethiopia [18], where the incidence can reach 1000 cases per 100,000 inhabitants [19]. In 2020, 123 suspected cases of meningitis were recorded, with 30 confirmed cases, including 10 from the north of the country [20]. Despite the highly contagious nature of this disease, a study carried out among healthcare staff at Abidjan's university hospitals showed a meningitis vaccination coverage rate of less than 50% [21], revealing that the practice of vaccination is still of little concern to the population. In Côte d'Ivoire, MenAfriVac is the main meningitis A vaccine. This vaccine was introduced into the Expanded Program on Immunization (EPI) in August 2018 and is intended for children aged nine months in order to reduce meningitis epidemics. Other meningococcal ACWY and B vaccines are also used as part of routine vaccination for young people and adults [22].

The Korhogo region in northern Côte d'Ivoire, home to the Université Peleforo Gon Coulibaly (UPGC), is a meningitis-endemic area [23]. It experienced bacterial meningitis epidemics in 2012 and 2016, resulting in 11 and 14 deaths respectively [24] [25]. As young adults, students are a particularly vulnerable group, as they are often exposed to environments conducive to the transmission of infectious diseases (overcrowded lecture theaters and classrooms, crowded living conditions in university halls of residence). However, despite the availability of a meningitis vaccine, the practice of vaccination remains a worrying public health issue in Côte d'Ivoire. The aim of this study is to assess knowledge and vaccination coverage against epidemic meningitis among students at the Université Peleforo Gon Coulibaly in Korhogo, with a view to developing appropriate intervention strategies.

2. Methods

2.1. Study Area

The study was carried out at the Université Peleforo Gon Coulibaly (UPGC), located in the city of Korhogo, in northern Côte d'Ivoire (Figure 1). Created by decree no. 2012-985 of October 10, 2012, this university comprises one school

(Institut de Gestion Agropastoral) and three Training and Research Units (TRU), namely the TRU of Social Sciences, the TRU of Humanities, Arts and Languages and the TRU of Biological Sciences. With a surface area of around 12,500 km² and an estimated population of 748,393 [26], Korhogo is the fourth most populous city in Côte d'Ivoire, and the largest city in the north of the country. Located around 650 km from Abidjan, it lies between 10° 41' and 8° 53' north latitude and 5° 30' and 6° 31' west longitude. The Sudanese-type climate is hot and dry. Average annual rainfall is 1200 mm, with humidity between 40% and 50% and an average annual temperature of 27°C [27]. From December to February, the harmattan, a hot, dry wind from the southern Sahara, blows through the region. This sand- and dust-laden wind facilitates the transport of germs (bacteria) and is responsible for infectious diseases such as meningitis [23].

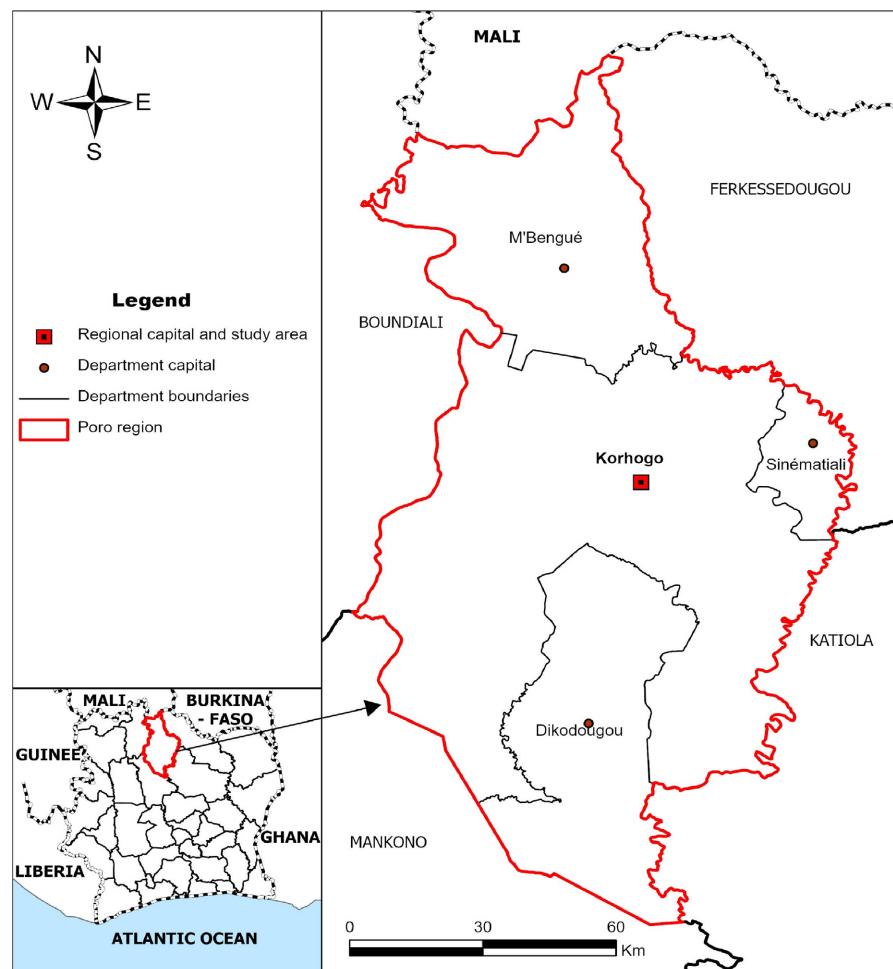


Figure 1. Map of the Poro region, including Korhogo, the study area.

2.2. Type of Study and Target Population

This was a descriptive cross-sectional study conducted from January 8 to March 7, 2024. The target population was made up of students at the UPGC Korhogo, with no exception in terms of gender, age, level of study or field of study.

3. Sampling

The sample size n for the survey was obtained using the following equation [28] [29]:

$$n = z^2 \cdot p(1 - p) / e^2$$

where, z , the confidence level deduced from the confidence interval. We generally take the value 1.96 for a confidence level of 95%. p , the estimated prevalence of meningitis. In Korhogo, as we do not know the prevalence of meningitis, we have assumed a maximum prevalence p of 50%. e , desired precision (margin of sampling error) traditionally set at 5%. Applying this formula, a minimum of 384 students must be surveyed. For reasons of non-response, this minimum size has been increased by 5%. Thus, a total of 404 students were surveyed.

3.1. Data Collection Tools

A physical questionnaire was drawn up and sent initially to a public health researcher at the Institut National d'Hygiène Publique (INHP) in Abidjan for corrections and validation of the questionnaire. Next, the survey form was put online using the Kobotoolbox application and exported to the Kobocollect application for electronic data collection. Finally, a pre-survey was carried out from December 13 to 15, 2023 on 40 students (10% of the sample size) from a private university in the town of Korhogo, with the aim of testing the electronic questionnaire, correcting any errors and familiarizing the interviewer with data collection using the KoboCollect application.

3.2. Variables Studied

The variables studied were divided into three main sections:

- Demographic and academic characteristics of students

The variables collected in this section were: gender, age, level of study, field of study, origin of the student in relation to the Korhogo region (autochthonous/allochthonous).

- Students' knowledge of meningitis

The variables collected in this section were: knowledge of meningitis as a disease, pathogens, vulnerable populations, symptoms, mode of transmission, risk factors, means of prevention.

- Vaccination coverage and reasons for non-vaccination

The variables collected in this section were: the student's vaccination status over the last three years and the reasons for non-vaccination.

3.3. Sampling Technique and Data Collection

The convenience sampling method combined with simple random sampling was used for data collection [30] [31]. A location at UPGC Korhogo where the majority of student's pass was chosen by the interviewer for data collection. Any student passing through this area in the morning (8 a.m. - 12 p.m.) and evening

(4 p.m. - 6 p.m.) who agreed to answer the questionnaire after obtaining oral informed consent was interviewed by the investigator. In the case of a group of students (two or more) who were passing through, only one person was randomly selected to answer the questionnaire. The questionnaire lasted between 7 and 10 minutes.

3.4. Data Processing and Analysis

Data collected with Kobocollect were first uploaded to the server, then exported as an Excel file and analyzed using R software (version 4.3.3). The proportions of the various study variables and their 95% confidence intervals (CI 95%) were calculated.

In terms of students' knowledge of meningitis, a two-point scale was assigned to each question out of a set of ten (10) questions put to respondents. A correct answer to each question on meningitis was scored 2. A wrong answer was scored zero (0). The meningitis knowledge section had a total score of 20 points. A score between 0 and 9 points was considered poor knowledge of meningitis. A score between 10 and 14 points was considered acceptable knowledge, and a score between 15 and 20 points was considered good knowledge of meningitis. The internal consistency of the students' meningitis knowledge scale was assessed using the Kuder-Richardson alpha 20 (KR-20). The coefficient obtained was $\alpha = 0.85$, indicating good internal consistency, and thus supporting the validity of the scale as a reliable tool for measuring UPGC Korhogo students' knowledge of meningitis.

The Chi-square test was performed at the 5% threshold to compare the different proportions of the univariate and bivariate analyses.

A multivariate analysis by logistic regression using the top-down stepwise method was performed to identify the factors explaining the practice of meningitis vaccination. Meningitis vaccination status was the dependent variable. The explanatory variables or covariates retained in the model were: gender, Training and Research Units (TRU)/School, level of study, field of study, respondents' place of origin and students' level of knowledge about meningitis. The presence of collinearity between explanatory variables was assessed using variance inflation factors (VIF), and no critical threshold was exceeded ($VIF > 10$). At each regression, factors associated with meningitis vaccination with a Wald test p-value (Z statistic) greater than 0.2 were eliminated from the model. Explanatory variables with a p-value between 0.05 and 0.2 were eliminated one by one, until the final model contained variables associated with meningitis vaccination, with a p-value less than or equal to 0.05 [32].

4. Ethical Considerations

The study was approved by the authorities of the Université Peleforo Gon Coulibaly (UPGC) in Korhogo. The study protocol was presented and approved at a validation workshop for Master's students initiated by the Department of Animal Biology of the Training and Research Units (TRU) of UPGC. Prior to the survey,

each student was informed of the objectives of the study and of the free and voluntary nature of his or her participation. Oral informed consent was obtained from each student before they completed the questionnaires. All students interviewed were assured that the information collected as part of this study would remain anonymous and strictly confidential.

5. Results

5.1. Demographic and Academic Characteristics of Students Surveyed at the Université Peleforo Gon Coulibaly (UPGC) in Korhogo

Table 1 provides information on the demographic and academic characteristics of the students surveyed.

there is no significant difference between the proportions of the demographic and academic characteristics of the students surveyed and those of the student population from which the sample was drawn.

The minimum and maximum ages of the students surveyed were 17 and 29 respectively, with an average age of 21.4 (± 2.21) years. The majority (61%) of respondents were aged between 20 and 23.

Table 1. Socio-demographic and academic characteristics of students surveyed at UPGC of Korhogo in 2024.

Variables	Students surveyed (n, %)	Student population (N, %)	p-value
Gender			
Male	273 (67.6)	5215 (62.4)	0.34
Female	131 (32.4)	3147 (37.6)	0.17
Total	404 (100)	8362 (100)	
Training and Research Unit (TRU)			
Institute of Agro pastoral Management	50 (12.4)	805 (9.6)	0.12
Biological Sciences	97 (24.0)	1659 (19.8)	0.11
Social and Economic Sciences	167 (41.3)	4057 (48.5)	0.10
Literature and Arts	90 (22.3)	1841 (22.0)	0.97
Total	404 (100)	8362 (100)	
Study level			
Licence 1	154 (38.1)	3083 (36.9)	0.77
Licence 2	103 (25.5)	2092 (25.0)	0.91
Licence 3	61 (15.1)	1525 (18.2)	0.20
Master 1	42 (10.4)	984 (11.8)	0.50
Master 2	44 (10.9)	678 (8.1)	0.09

Continued

Total	404 (100)	8362 (100)	
Fields of study			
Scientific	173 (42.8)	3545 (42.4)	0.95
Literacy	231 (57.2)	4817 (57.6)	0.96
Total	404 (100)	8362 (100)	

5.2. UPGC Korhogo Students' Knowledge of Meningitis

Table 2 summarizes the results of the univariate analysis of students' knowledge of meningitis. Nearly 67% (CI 95%: 62.1 - 71.4) of respondents said they knew about meningitis, compared with 33% (CI 95%: 28.6 - 38.0) who said they did not. The majority, 70% (IC 95%: 64.2 - 75.4) of those who said they knew about meningitis did not know the pathogens responsible for this disease. Also, 74% (CI 95%: 68.8 - 79.5) of those who said they knew about meningitis did not know the symptoms of the disease. 77% (IC 95%: 71.6 - 81.9) of respondents did not know how the disease is transmitted. More than half, 52% (IC 95%: 45.3 - 57.6) of respondents who said they knew about meningitis, were aware of the risk period for this disease, which is when the harmattan blows. Also, most, 65% (IC 95%: 59.6 - 71.2) of those who said they knew about meningitis, knew that vaccination is the most effective means of preventing the disease.

Table 2. Univariate analyses of surveyed UPGC Korhogo students' knowledge of meningitis in 2024.

Variables	Nmbers (n)	Proportion (%)	(CI 95%) of proportion	p-value
Do you know what epidemic meningitis is? (n = 404)				
Yes	270	66.8	62.1 - 71.4	<0.001 ^a
No	134	33.2	28.6 - 38.0	
What is the pathogen of epidemic meningitis? (n = 270)				
Bacteria	49	18.1	13.7 - 23.3	<0.001 ^a
Other microbes	32	11.9	8.2 - 16.3	
Don't know	189	70.0	64.2 - 75.4	
Is meningitis a serious disease?				
Yes	238	88.1	83.7 - 91.8	<0.001 ^a
No	21	7.8	4.9 - 11.6	
Don't know	11	4.1	2.1 - 7.2	
What are the symptoms of meningitis?				
High fever or hot body	25	9.3	6.1 - 13.4	<0.001 ^a
Severe headache	27	10.0	6.7 - 14.2	
Other symptoms	17	6.3	3.7 - 9.9	
Don't know	201	74.4	68.8 - 79.5	

Continued

Who can contract meningitis?					
Everyone	146	54.1	47.9 - 60.1	<0.001 ^a	
Newborns and children	10	3.7	1.8 - 6.7		
Adolescents and youth	73	27.0	21.8 - 32.8		
Adults and seniors	15	5.6	3.1 - 9.00		
Don't know	26	9.6	6.4 - 13.8		
Who is at risk of meningitis?					
Everyone	25	9.2	6.1 - 13.4	<0.001 ^a	
Newborns and children	11	4.1	2.1 - 7.2		
Adolescents and young people	150	55.6	49.4 - 61.6		
Adults and the elderly	43	15.9	11.8 - 20.8		
Don't know	41	15.2	11.1 - 20.0		
How is meningitis transmitted?					
Close, prolonged contact with an infected person	22	8.1	5.2 - 12.1	<0.001 ^a	
Living in close proximity to an infected person	30	11.1	7.6 - 15.5		
During large gatherings of people	10	3.8	1.8 - 6.7		
Don't know	208	77.0	71.6 - 81.9		
When is the risk period for meningitis transmission?					
Any time of year	23	8.5	5.5 - 12.5	<0.001 ^a	
During the cold dry season or harmattan period	139	51.5	45.3 - 57.6		
During the hot dry season	13	4.8	2.6 - 8.1		
During the rainy season	20	7.4	4.6 - 11.2		
Don't know	75	27.8	22.5 - 33.5		
How long does it take to die from the dangerous form of meningitis?					
24 hours	3	1.1	0.2 - 3.2	<0.001 ^a	
3 days	4	1.5	0.4 - 3.7		
7 days	10	3.7	1.8 - 6.7		
Don't know	253	93.7	90.1 - 96.3		
What is the most effective means of prevention against meningitis?					
Vaccination	177	65.5	59.6 - 71.2	<0.001 ^a	
Chemoprophylaxis	11	4.1	2.1 - 7.2		
Don't know	82	30.4	24.9 - 36.2		

CI: confidence interval a: statistically significant.

Table 3 shows the knowledge scores of respondents at UPGC Korhogo who claimed to know about meningitis. More than half, 53% (IC 95%: 46.8 - 59.0) of

students had poor knowledge of meningitis, with a mean score of 6.4/20. On the other hand, 44% (IC 95%: 38.4 - 50.6) of respondents who claimed to know about meningitis had acceptable knowledge of the disease, with an average score of 11.3/20. Less than 3% of respondents had good knowledge of meningitis, with an average score of 16/20. The Chi-square test showed that there was no statistically significant relationship between respondents' poor knowledge of meningitis and the demographic and academic variables: gender ($p = 0.63$), TRU/School ($p = 0.68$), level of study ($p = 0.59$), students' place of origin ($p = 0.09$) and course of study ($p = 0.36$).

Table 3. Knowledge scores of respondents from UPGC Korhogo who said they knew about epidemic meningitis in 2024 (n = 270).

Meningitis knowledge levels	Score classes	Average score	Numbers (n)	Proportion (%)	(CI 95%) of proportion	p-value
Poor	0 - 9	6.4	143	53.0	46.8 - 59.0	<0.001 ^a
Acceptable	10 - 14	11.3	120	44.4	38.4 - 50.6	
Good	15 - 20	16.0	07	2.6	1.04 - 5.3	

CI: confidence interval a: statistically significant.

5.3. Meningitis Vaccination Coverage among UPGC Korhogo Students and Reasons for Non-Vaccination

The meningitis vaccination rate among UPGC Korhogo students is 16% (IC 95%: 12.6 - 20.04). Among male and female students, the vaccination rate was 19% (IC 95%: 12.7 - 26.9) and 14% (IC 95%: 10.0 - 18.6) respectively. The main reasons given by unvaccinated students were lack of knowledge of the existence of a meningitis vaccine, with a proportion of 72%, and neglect of vaccination, with a proportion of 18% (**Table 4**).

Table 4. Meningitis vaccination rate and reasons for lack of vaccination cited by UPGC Korhogo students in 2024.

Variables	Numbers (n)	Proportion (%)	(CI 95%) of proportion	p-value
Have you been vaccinated against meningitis? (n = 404)				
Yes	65	16.1	12.6 - 20.04	< 0.001 ^a
No	339	83.9	80.0 - 87.4	
Reasons for not vaccinating against meningitis (n = 339)				
Lack of knowledge about meningitis and lack of information about the vaccine	244	72.0	66.9 - 76.7	< 0.001 ^a
Neglect of vaccination	61	18.0	14.1 - 22.5	
No financial means	20	5.9	3.6 - 9.0	
Other reasons	14	4.1	2.3 - 6.8	

CI: confidence interval a: statistically significant.

5.4. Factors Associated with the Practice of Meningitis Vaccination among Students at UPGC Korhogo

In the initial model, only students' Master 2 level of education [ORa = 0.30 (CI 95%: 0.10 - 0.80), p-value = 0.025] was significantly associated with meningitis vaccination. The final logistic regression model showed that meningitis vaccination among students was significantly associated with level of study (master 2) [ORa = 0.71 (CI 95%: 0.51 - 0.98), p-value = 0.036] and student origin (native) [ORa = 2.28 (CI 95%: 1.13 - 4.63), p-value = 0.021] (Table 5).

Table 5. Initial and final model of multivariate logistic regression analysis of factors associated with meningitis vaccination among UPGC Korhogo students in 2024.

Initial model for multivariate analysis			
Factors studied	OR	CI 95%	p-value
Intercept	0.27	0.0 - 2.29e+21	>0.999
Sex of students (Male)	0.59	0.33 - 1.07	0.081
Age of students	0.94	0.83 - 1.06	0.328
TRU of students (TRU Literature and Arts)	2.53e+08	0.0 - 7.61e+29	0.992
TRU of students (TRU Biological Sciences)	1.00	0.0 - 5.97e+14	>0.999
TRU of students (Social and Economic Sciences)	1.60e+08	0.0 - 2.31e+25	0.992
Level of study of students (Licence 2)	0.69	0.33 - 1.43	0.329
Level of study of students (Licence 3)	0.68	0.28 - 1.54	0.367
Level of study of students (Master 1)	0.65	0.23 - 1.62	0.371
Level of study of students (Master 2)	0.30	0.10 - 0.80	0.025^b
Field of study of students (Literary)	4.49e-09	0.0 - 2.24e+08	0.985
Student origin (native)	1.35	0.75 - 2.39	0.314
Level of knowledge about meningitis (Poor)	0.34	0.07 - 1.80	0.172
Level of knowledge about meningitis (Acceptable)	0.60	0.12 - 3.31	0.531
Final model of multivariate analysis			
Factors studied	aOR	IC95%	p-value
Intercept	0.54	0.36 - 0.81	0.003
Student origin (native)	2.28	1.13 - 4.63	0.021^b
Level of study of students (Master 2)	0.71	0.51 - 0.98	0.036^b

OR: Odds Ratio; aOR: adjusted Odds Ratio; CI: Confidence Interval; b: Statistically Significant; TRU: Training and Research Unit.

6. Discussion

Meningitis is a serious infection of the membranes surrounding the brain and spinal cord, the severe forms of which are in the majority of cases caused by bacteria [10]. It is a devastating disease that remains a major public health challenge. Despite the high lethality of this disease and the availability of preventive vaccines, the vaccination rate against meningitis remains low in Côte d'Ivoire [21]. The aim

of this study was to assess knowledge and vaccination coverage against epidemic meningitis among students at the Université Peleforo Gon Coulibaly (UPGC) in Korhogo, a town in northern Côte d'Ivoire located in the African meningitis belt.

The results of this study showed that two-thirds (66%) of the students surveyed claimed to know about meningitis. However, the knowledge score showed that more than half (53%) of the students surveyed who said they knew about meningitis had poor knowledge of the disease. Indeed, the general population's knowledge of meningitis, particularly meningococcal meningitis, is high in the countries of the meningitis belt, a geographical area of sub-Saharan Africa prone to epidemics [33] [34]. Students in meningitis belt countries in general, and those in Korhogo in particular, need to be informed and made aware of the risks, symptoms, modes of transmission, preventive measures and treatments of this devastating disease, as they are regularly in environments conducive to its transmission and spread (overcrowded lecture theaters and classrooms, crowded living conditions in university halls of residence).

The meningitis vaccination rate found among students at UPGC Korhogo was 16% (IC 95%: 12.6 - 20.04). The master's level of study among students was identified as a factor that favors the practice of meningitis vaccination. However, being a student from Korhogo (indigenous) is a risk factor for meningitis vaccination. The absence of vaccination among Korhogo's indigenous students could be explained by the use of traditional medicine, an endogenous practice widely used by Korhogo's indigenous populations to treat or prevent infectious diseases [35].

The main reasons given by non-vaccinated students for not vaccinating against meningitis were lack of information on the existence of a vaccine against this disease, and neglect of vaccination. The results obtained in this study should be brought to the attention of the Korhogo health authorities in general, and the head of the Korhogo branch of the Institut National de l'Hygiène Publique (INHP) in particular, where meningitis vaccination is carried out for young people and adults, with a view to organizing information and awareness campaigns in the public and private universities of the Korhogo region. Epidemiological studies, in particular those carried out by the Institut de Veille Sanitaire (InVS), have shown that effective awareness campaigns, providing a good understanding of diseases with epidemic potential, increase people's adherence to vaccinations against these diseases [36].

Lack of financial means was cited by less than 5% of unvaccinated students. Although this proportion is low, it highlights the need to make vaccination more accessible, in particular by providing free or subsidized vaccines for students, the majority of whom do not benefit from financial subsidies. In Côte d'Ivoire, the meningitis vaccine costs 6000 FCFA (around £9.2) and lasts for 3 years, renewable. This polyvalent vaccine protects against *N. Meningitidis serotypes A, C, Y and W135*. A study carried out in West Africa showed that the elimination of economic barriers significantly improved vaccination coverage rates [37].

The neglect of vaccination mentioned by 18% of students reflects a problem of

perceptions about vaccination. This neglect of vaccination could be resolved by more targeted communication campaigns, explaining the benefits of the vaccine. Studies have shown that clear messages, combined with the involvement of local health actors and community leaders, can reduce fears and increase vaccination rates [38] [39]. The results of this study are in line with those achieved in other countries of the “meningitis belt” in sub-Saharan Africa. In these regions, a combination of factors such as lack of awareness, cultural beliefs and economic barriers account for low vaccination rates [37]. Mass vaccination campaigns, combined with health education programs in universities, have often reversed this trend. A study carried out in Niger showed that a free vaccination campaign, combined with information sessions in universities, increased the vaccination coverage rate from 20% to 70% within six months [40].

Our study may have limitations linked to recall and information bias, due to certain answers calling on the memory of respondents, such as the meningitis vaccination status of students, which could affect our results. To minimize this bias, in our study we considered a student to have been vaccinated against meningitis if he or she stated that he or she had been vaccinated in a health facility of the Institut National d’Hygiène Publique (INHP) or by an INHP mobile team using an advanced vaccination strategy. Indeed, the INHP is the structure of the Ministry of Health and Public Hygiene and Universal Health Coverage (MSHP-CMU) in Côte d’Ivoire authorized to vaccinate young people, adults and the elderly against meningitis. Bias was also minimized by using a questionnaire corrected and validated by an INHP public health specialist, then pre-tested on 10% of the sample for questionnaire quality control. Finally, we carried out a multivariate analysis using logistic regression, which enabled us to identify the significant factors explaining meningitis vaccination coverage among UPGC Korhogo students, and to control for confounding factors.

However, despite the potential biases in this study, our results are valuable for informing public health actors at national level and in the Korhogo region in particular, to guide strategies for the prevention and control of meningitis in university settings in Côte d’Ivoire.

To improve students’ knowledge of meningitis, we recommend that the Institut National d’Hygiène Publique (INHP) in Korhogo organize information and awareness campaigns on meningitis at the Université Peleforo Gon Coulibaly, in collaboration with university departments and student associations. These campaigns are expected to include interactive sessions, visual teaching aids and testimonials from students vaccinated against meningitis. To promote meningitis vaccination, vaccination days should be organized on the university site in partnership with local health authorities. This vaccine should be free or subsidized to enable a large number of students to be vaccinated against meningitis. Finally, it is essential to combat misinformation about vaccination through awareness campaigns, by disseminating clear, scientifically-validated messages and training student ambassadors responsible for relaying this information to their community.

7. Conclusion

The assessment of knowledge and vaccination coverage against meningitis among students at the Université Peleforo Gon Coulibaly (UPGC) in Korhogo identified the main factors explaining the low rate of vaccination against this disease. These include students' poor knowledge of meningitis and lack of information on the vaccine against this disease. This study shows the need to intensify information and awareness campaigns on meningitis in university environments in Côte d'Ivoire in general, and in Korhogo in particular, to reinforce strategies to combat this potentially epidemic disease.

Conflicts of Interest

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

References

- [1] World Health Organization (2025) Meningitis. https://www.who.int/health-topics/meningitis#tab=tab_1
- [2] Organisation Mondiale de la Santé (2021) Cadre pour la mise en œuvre de la stratégie mondiale pour vaincre la méningite d'ici à 2030 dans la région africaine de l'OMS. <https://iris.who.int/bitstream/handle/10665/346629/AFR-RC71-8-fre.pdf?sequence=1&isAllowed=y>
- [3] Mohammed, I., Ilyasu, G. and Habib, A.G. (2017) Emergence and Control of Epidemic Meningococcal Meningitis in Sub-Saharan Africa. *Pathogens and Global Health*, **111**, 1-6. <https://doi.org/10.1080/20477724.2016.1274068>
- [4] Greenwood, B. (2006) Editorial: 100 Years of Epidemic Meningitis in West Africa—Has Anything Changed? *Tropical Medicine & International Health*, **11**, 773-780. <https://doi.org/10.1111/j.1365-3156.2006.01639.x>
- [5] World Health Organization (2000) Report on Global Surveillance of Epidemic-Prone Infectious Disease. Report No. WHO/CDS/CSR/ISR/2000.1, 127 p. <https://iris.who.int/handle/10665/66485>
- [6] World Health Organization (2025) Meningitis. <https://www.who.int/fr/news-room/fact-sheets/detail/meningitis>
- [7] Makoni, M. (2022) Improving Cryptococcal Meningitis Treatment in Africa. *The Lancet Microbe*, **3**, e406. [https://doi.org/10.1016/s2666-5247\(22\)00129-x](https://doi.org/10.1016/s2666-5247(22)00129-x)
- [8] Gundamraj, V. and Hasbun, R. (2023) Viral Meningitis and Encephalitis: An Update. *Current Opinion in Infectious Diseases*, **36**, 177-185. <https://doi.org/10.1097/qco.0000000000000922>
- [9] Zivich, P.N., Grabenstein, J.D., Becker-Dreps, S.I. and Weber, D.J. (2018) Streptococcus Pneumoniae Outbreaks and Implications for Transmission and Control: A Systematic Review. *Pneumonia*, **10**, Article No. 11. <https://doi.org/10.1186/s41479-018-0055-4>
- [10] Franklin, K., Kwambana-Adams, B., Lessa, F.C., Soeters, H.M., Cooper, L., Coldiron, M.E., *et al.* (2021) Pneumococcal Meningitis Outbreaks in Africa, 2000-2018: Systematic Literature Review and Meningitis Surveillance Database Analyses. *The Journal of Infectious Diseases*, **224**, S174-S183. <https://doi.org/10.1093/infdis/jiab105>
- [11] Borrow, R., Martínón-Torres, F., Abitbol, V., Andani, A., Preiss, S., Muzzi, A., *et al.* (2023) Use of Expanded *Neisseria meningitidis* Serogroup B Panels with the Serum

- Bactericidal Antibody Assay for the Evaluation of Meningococcal B Vaccine Effectiveness. *Expert Review of Vaccines*, **22**, 738-748. <https://doi.org/10.1080/14760584.2023.2244596>
- [12] Hollingshead, S. and Tang, C.M. (2019) An Overview of *Neisseria Meningitidis*. In: Seib, K.L. and Peak, I.R., Eds., *Neisseria meningitidis. Methods and Protocols*, Springer, 1-16. https://doi.org/10.1007/978-1-4939-9202-7_1
- [13] Aku, F.Y., Lessa, F.C., Asiedu-Bekoe, F., Balagumyetime, P., Oforu, W., Farrar, J., *et al.* (2017) Meningitis Outbreak Caused by Vaccine-Preventable Bacterial Pathogens—Northern Ghana, 2016. *MMWR. Morbidity and Mortality Weekly Report*, **66**, 806-810. <https://doi.org/10.15585/mmwr.mm6630a2>
- [14] Boisson-Walsh, A. (2024) Nigeria Leads Pentavalent Meningitis Vaccine Rollout. *The Lancet Infectious Diseases*, **24**, e421. [https://doi.org/10.1016/s1473-3099\(24\)00366-9](https://doi.org/10.1016/s1473-3099(24)00366-9)
- [15] Fernandez, K., Lingani, C., Aderinola, O.M., Goumbi, K., Bicaba, B., Edea, Z.A., *et al.* (2019) Meningococcal Meningitis Outbreaks in the African Meningitis Belt after Meningococcal Serogroup a Conjugate Vaccine Introduction, 2011-2017. *The Journal of Infectious Diseases*, **220**, S225-S232. <https://doi.org/10.1093/infdis/jiz355>
- [16] Bell, S., Moore, C., Dicks, S., Clayton, D., Whitaker, H. and Pebody, R. (2023) Cross-Sectional Study of University Students' Attitudes to "on Campus" Delivery of COVID-19, MenACWY and MMR Vaccines. *Vaccines*, **10**, Article No. 1287.
- [17] Richardson, E., Ryan, K.A., Lawrence, R.M., Harle, C.A., Desai, S.M., Livingston, M.D., *et al.* (2021) Increasing Awareness and Uptake of the MenB Vaccine on a Large University Campus. *Human Vaccines & Immunotherapeutics*, **17**, 3239-3246. <https://doi.org/10.1080/21645515.2021.1923347>
- [18] Lapeyssonnie, L. (1963) Cerebrospinal Meningitis in Africa. *Bulletin of the World Health Organization*, **28**, 1-114.
- [19] Organisation Mondiale de la Santé (2008) Méningococcie dans la Ceinture de la Méningite en Afrique. <https://reliefweb.int/report/burkina-faso/m%C3%A9ningococcie-dans-la-ceinture-de-la-m%C3%A9ningite-en-afrique>
- [20] Ministère de la Santé, de l'Hygiène Publique et de la Couverture Maladie Universelle (2021) Rapport Annuel sur la Situation Sanitaire (RASS) de la Côte d'Ivoire en 2020. 593 p.
- [21] Kouamé, A.A.B., Bremi, A.A.P., N'Guessan, L.M.A., Ouattara, Y.M., Kinimo, N.R., Kra, A.A.C., *et al.* (2024) Evaluation de la couverture vaccinale du personnel soignant des centres hospitaliers et universitaires d'Abidjan en 2020. *Mali Médical*, **39**, 22-27.
- [22] Boni-Cisse, C., Jarju, S., Bancroft, R.E., Lepri, N.A., Kone, H., Kofi, N., *et al.* (2019) Etiology of Bacterial Meningitis among Children < 5 Years Old in Côte D'ivoire: Findings of Hospital-Based Surveillance before and after Pneumococcal Conjugate Vaccine Introduction. *Clinical Infectious Diseases*, **69**, S114-S120. <https://doi.org/10.1093/cid/ciz475>
- [23] N'Krumah, T.A.S.R., Koné, B., Tiembré, I., M'Baye, I., Tanner, M. and Cissé, G. (2014) Variabilité climatique et incidence de la méningite cérébro-spinale dans le district sanitaire de Korhogo (Nord de la Côte d'Ivoire). *Environnement, Risques & Santé*, **13**, 144-152.
- [24] Ministère de la Santé et de la Lutte contre le Sida (2012) Apparition d'épidémie de méningite en Côte d'Ivoire: le gouvernement apporte des précisions.
- [25] Agence France Presse (2018) Méningite: Vaccination d'un million d'enfants en Côte d'Ivoire.

- https://www.sciencesetavenir.fr/sante/maladie-enfant/meningite-vaccination-massive-des-enfants-en-cote-d-ivoire_130135
- [26] Institut National de la Statistique (2022) Synthèse des résultats définitifs du Recensement Général de la Population et de l'Habitat de la Côte d'Ivoire (RGPH-2021): Résultats globaux.
- [27] M'Bra, R.K., Kone, B., Soro, D.P., N'krumah, R.T.A.S., Soro, N., Ndione, J.A., *et al.* (2018) Impact of Climate Variability on the Transmission Risk of Malaria in Northern Côte D'ivoire. *PLOS ONE*, **13**, e0182304. <https://doi.org/10.1371/journal.pone.0182304>
- [28] Bouyer, J., Hénom, D., Cordier, S., Derriennic, F., Stücker, I., Stengel, B., *et al.* (1995) *Epidémiologie: Principes et méthodes quantitatives*. Ed. Inserm, 498 p.
- [29] Vaughan, J.P. and Morrow, R.H. (1991) *Manuel d'Epidémiologie pour la Gestion de la Santé au Niveau du District*. Ed. Jouve: OMS, 187 p.
- [30] Elfil, M. and Negida, A. (2017) Sampling Methods in Clinical Research; an Educational Review. *Emergency*, **1**, e52.
- [31] Teddlie, C. and Yu, F. (2007) Mixed Methods Sampling: A Typology with Examples. *Journal of Mixed Methods Research*, **1**, 77-100. <https://doi.org/10.1177/1558689806292430>
- [32] El Sanharawi, M. and Naudet, F. (2013) Comprendre la régression logistique. *Journal Français d'Ophthalmologie*, **36**, 710-715. <https://doi.org/10.1016/j.jfo.2013.05.008>
- [33] Cooper, L.V., Kristiansen, P.A., Christensen, H., Karachaliou, A. and Trotter, C.L. (2019) Meningococcal Carriage by Age in the African Meningitis Belt: A Systematic Review and Meta-Analysis. *Epidemiology and Infection*, **147**, e228. <https://doi.org/10.1017/s0950268819001134>
- [34] Kaboré, L., Galetto-Lacour, A., Sidibé, A.R. and Gervais, A. (2021) Pneumococcal Vaccine Implementation in the African Meningitis Belt Countries: The Emerging Need for Alternative Strategies. *Expert Review of Vaccines*, **20**, 679-689. <https://doi.org/10.1080/14760584.2021.1917391>
- [35] Dramane, S., Yao, K. and Gnelé, M.L.O. (2023) Plantes médicinales utilisées en médecine traditionnelle pour le contrôle des maladies fongiques dans le département de Korhogo (Côte d'Ivoire). *TJS*, **1**, 47-59. <https://www.tanganyikajournalofscience.org/index.php/tjs/article/view/61>
- [36] Institut de Veille Sanitaire (2011) Rapport annuel 2011. <https://www.vie-publique.fr/rapport/32835-rapport-annuel-2011-institut-de-veille-sanitaire>
- [37] Chopra, M., Campbell, H. and Rudan, I. (2016) Déterminants de la couverture vaccinale en Afrique subsaharienne: Un examen systématique. *Journal de la Santé Mondiale*, **3**, 305-319.
- [38] Ward, J.K. and Peretti-Watel, P. (2020) Comprendre la méfiance vis-à-vis des vaccins: Des biais de perception aux controverses. *Revue Française de Sociologie*, **61**, 243-273. <https://doi.org/10.3917/rfs.612.0243>
- [39] Colombini, A., Bationo, F., Zongo, S., Ouattara, F., Badolo, O., Jaillard, P., *et al.* (2009) Costs for Households and Community Perception of Meningitis Epidemics in Burkina Faso. *Clinical Infectious Diseases*, **49**, 1520-1525. <https://doi.org/10.1086/644623>
- [40] Sani, R., Idi, I., Amadou, I. and Diiori, S. (2017) Impact des campagnes de vaccination de masse contre la méningite au Niger: Étude de cas. *Revue Africaine de la Santé Publique*, **2**, 142-150.