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# Hepatitis B Vaccination Coverage among University Students in Sub-Saharan Africa: Systematic Review and Meta Analysis

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## Abstract

**Introduction:** Hepatitis B is an infectious disease that remains a real public health problem in Africa. Students represent a group at risk for this disease. The objective of this study was to estimate the hepatitis B vaccination coverage rate among students in sub-Saharan Africa. **Methods:** A systematic search of databases (PubMed, AJOL) and a manual search of Google Scholar was conducted to retrieve all published studies reporting hepatitis B vaccination coverage among students in sub-Saharan Africa. The pooled coverage rate was estimated with a 95% confidence interval (CI) in a random-effects meta-analysis. **Results:** A total of 35 studies were included and included 20,520 students. The mean age was 22.1 ± 5.1 years with a predominance of female sex (sex ratio F/M = 1.05). The vaccination coverage rate was 28.8% [95% CI: 22.9% - 34.7%]. Disaggregation allowed to estimate coverage rates of 29.8% [95% CI: 22.9% - 36.7%], 23.4% [95% CI: 9.4% - 37.4%] and 17.0% [95% CI: 14.4% - 19.5%] respectively in West Africa, East Africa and Central Africa. **Conclusion:** Less than a third of students in sub-Saharan Africa are protected against hepatitis B. However, the majority of this target group is at risk of infection. It would be relevant to screen and, if necessary, vaccinate all new students.

## Keywords

Hepatitis B, Vaccination Coverage, Students, Sub-Saharan Africa

## 1. Introduction

Hepatitis B is an infectious disease of viral origin that causes significant morbidity and mortality worldwide. It accounts for over 820,000 deaths annually, and approximately 296 million people live with a chronic form of the disease. As a leading cause of liver disease and primary liver cancer, hepatitis B poses a substantial

public health challenge [1]. The epidemiology of hepatitis B reveals high endemicity in sub-Saharan Africa, with prevalence rates exceeding 8% [2]. Despite the availability of an effective vaccine and its inclusion in vaccination programs in endemic countries [3], several populations, including university students, exhibit high prevalence rates [4] [5]. University students are at increased risk of hepatitis B infection due to certain behaviors such as unprotected sexual intercourse, acquisition of tattoos, piercings, shared use of sharp objects, and occasional use of injectable drugs [6]. Effective protection for this population is further limited by the reliance on individual initiatives [3]. Given the scarcity of comprehensive data on vaccination coverage among students in sub-Saharan Africa, this systematic review and meta-analysis aim to assess the extent of hepatitis B vaccination coverage in this demographic and provide insights into regional disparities and potential interventions.

## 2. Study Method

### 2.1. Research Strategy

Based on the guidelines of the Preferred reporting items for systematic reviews and meta-analyses (PRISMA) [7] this study is exhaustive and was done in databases such as PubMEd and African journal online (AJO). Key words such as "hepatitis B", "hepatitis B virus", "vaccination coverage", "vaccination", "students", "universities", "Sub-Saharan Africa" were used (**Table 1**). Several combinations of these words were used in French and English. On the Google Scholar search engine a manual search was also used. Furthermore, we verified the references of all eligible articles to find relevant publications. Studies published between January 1st, 2000 and December 31st 2023 were considered. The latest search was conducted on March 31, 2024.

**Table 1.** Search strategy.

| # | *Research* |
|---|---|
| 1 | (Hepatitis B or HBV or Hepatitis B Virus or Hepatitis B Antigen or Hepatitis B Antibodies or Anti-HBsAg or viral hepatitis or hepatitis) |
| 2 | (Vaccine* or immunization or vaccinat* or immuni* or Viral Hepatitis Vaccines or Viral Hepatitis Vaccines or Hepatitis B Vaccines or Immunotherapy or vaccination coverage*) |
| 3 | (Students* or Universities* or Campus* or) |
| 4 | "Africa South of the Sahara" [MeSH] |
| 5 | 1 and 2 and 3 and 4 |

### 2.2. Article Eligibility Criteria

**Inclusion Criteria**

Using the PICOS (Patient, Intervention, Comparison, Outcome, Study type) framework, the inclusion criteria were:

| | |
|---|---|
| Patients | adult university students regardless of their faculties or specialties; |
| Interventions | 3 doses of vaccine; |
| Comparison | none; |
| Outcomes | vaccination coverage rate; |
| Study type | quantitative studies (observational, randomized or not, prospective or retrospective studies) (English or French). |

**Exclusion Criteria**

We excluded studies that described the following:

Vaccine coverage was not completerly described;

Qualitative studies;

Incomplete outcomes reported.

Mixed cohorts with other populations where data on university students could not be extracted;

Letters to editors, literature reviews, and duplicated studies were also excluded.

## 2.3. Quality of Items Included

All included documents underwent a quality assessment based on 10 criteria [8] with the same rating. As shown in Table 2, these criteria are organized into external and internal validation criteria. After assessment, the quality of a document was classified as low, medium or high if it met 1 to 4 criteria, 5 to 7 criteria and 8 to 10 criteria respectively.

Table 2. Criteria used for the assessment of methodological quality [8].

| Internal validity |
|---|
| Description of methods |
| 1. Are important characteristics of the population specified? |
| 2. Is the study period specified? |
| 3. Is there a clear definition of hepatitis B vaccination status? |
| 4. Is the data collection method adequately described? |
| Collection tool |
| 5. Is the collection tool validated? |
| Prevalence data |
| 6. Are prevalence data reported for people who have received partial or full vaccination? |
| 7. Are prevalence data reported by demographic category? |
| **External validity** |
| 8. Is the participation rate greater than 70% or is the information on non-respondents sufficient to allow conclusions to be drawn on the representativeness of the population studied? |
| 9. Is the included population representative of the target/sub-national population? |
| 10. Is the population included representative of the national population? |

### 2.4. Data Collected

The following data were collected: authors' names, year of publication, country where the study took place, sample size, participation rate, gender of participants and their average ages, and vaccination coverage rate.

### 2.5. Data Analysis

Statistical analysis was performed using R software. Graphs were created using Microsoft Excel.

For qualitative variables, the absolute and relative frequencies were determined. For quantitative variables, the mean and standard deviation were calculated.

Jamovi software made it possible to estimate the combined vaccination coverage rate with the 95% confidence interval (CI) in sub-Saharan Africa. A meta-analysis estimated the pooled prevalence with the 95% confidence interval (CI) of hepatitis B vaccination coverage in Sub-Saharan Africa. A sub group analysis was done to evaluate the pooled prevalence according to the sub region (west, east and central Africa).

Heterogeneity between studies was tested by the $I^2$ test. A random-effects model was when $I^2 > 50\%$; and a fixed-effects model when $I^2 \leq 50\%$.

## 3. Results

### 3.1. Selection of Studies

Through databases and manual searching, 106 articles were found of which 35 were included for the study. The selection process is illustrated in Figure 1.

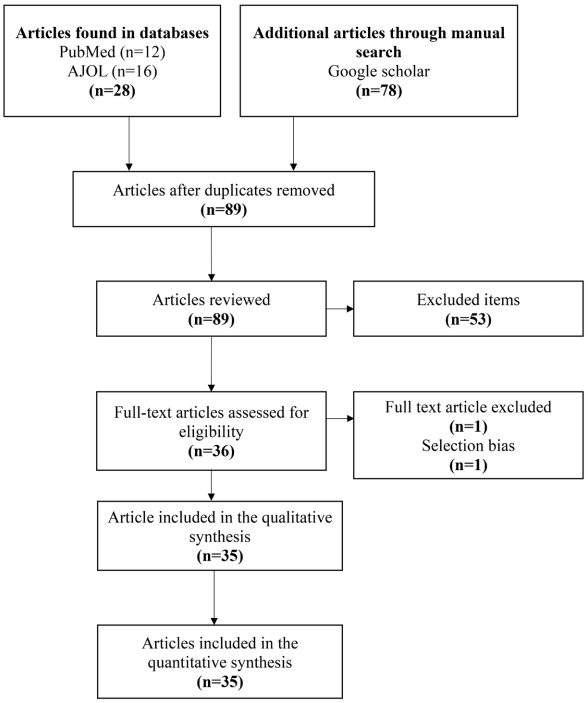


Figure 1. PRISMA diagram illustrating the study search and selection process.

### 3.2. Characteristics of Included Studies

All studies were cross-sectional studies involving a total of 20,520 students from universities in 15 countries in sub-Saharan Africa. The F/M sex ratio was 1.05 and the mean age of students was 22.1 ± 5.1 years.

The publications of these studies cover the period from 2005 to 2023. The evolution of the number of publications concerning the subject since 2005 shows a clear increase in the number of publications on the subject between 2018 and 2020. This evolution is illustrated by Figure 2.

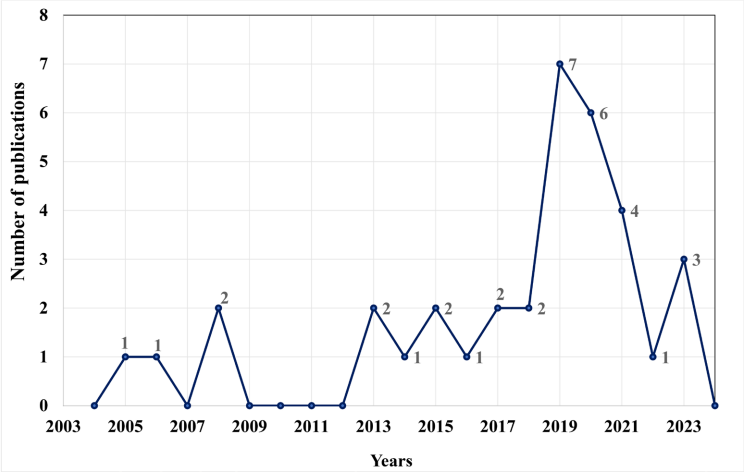


Figure 2. Evolution of the number of publications on vaccination coverage of students in ASS.

The countries of origin and the number of articles found are illustrated in Figure 3.

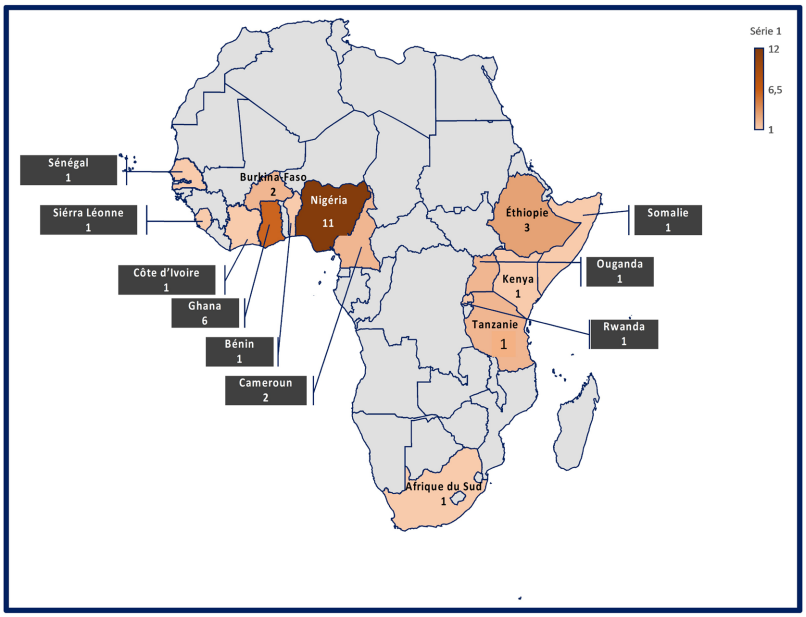


Figure 3. Number of articles found by country in Sub-Saharan Africa.

The majority of studies (63.9%) were conducted in West Africa. According to the qualitative assessment of the articles, 5.5% were of good quality while 66.7% had moderate quality and 27.8% had low quality.

Table 3 presents the results from the quality assessment of the included articles. The majority of studies (65.7%) had a quality judged to be moderate and most of the works were published in the period 2016-2020.

**Table 3.** Characteristics of studies following qualitative assessment.

| Features | | Frequencies n (%) | Number of studies where data were available |
|---|---|---|---|
| Sex | Women | 7916 (51, 3) | 33/35 |
| | Man | 7501 (48, 7) | |
| Quality of studies (NOS scale) | Good | 2 (5, 7) | 35/35 |
| | AVERAGE | 23 (65, 7) | |
| | Weak | 10 (28, 6) | |
| Year of publication | 2005-2010 | 4 (11, 4) | 35/35 |
| | 2011-2015 | 5 (14, 3) | |
| | 2016-2020 | 18 (51, 4) | |
| | ≥2021 | 8 (22, 9) | |
| Location of the study | West Africa | 23 (65, 7) | 35/35 |
| | East Africa | 9 (25, 7) | |
| | Central Africa | 2 (5, 7) | |
| | Southern Africa | 1 (2, 9) | |

All characteristics of the studies are shown in Table 4.

**Table 4.** Characteristics of the studies included in the systematic review.

| Author | Year | Country | Type of Study | Effective | Men | Women | Average age (year) |
|---|---|---|---|---|---|---|---|
| Abdela *et al.* [19] | 2016 | Ethiopia | Transversal | 246 | 187 | 59 | N/A |
| Adeleye *et al.* [20] | 2019 | Nigeria | Transversal | 207 | 112 | 95 | 25.65 |
| Adenlewo *et al.* [21] | 2017 | Nigeria | Transversal | 113 | 71 | 42 | 24.97 |
| Ali *et al.* [22] | 2023 | Somalia | Transversal | 247 | 71 | 176 | N/A |
| Aniaku *et al.* [23] | 2019 | Ghana | Transversal | 358 | 95 | 263 | 21.56 |
| Aroke *et al.* [24] | 2018 | Cameroon | Transversal | 714 | 329 | 385 | 22.03 |
| Atiba *et al.* [25] | 2014 | Nigeria | Transversal | 594 | N/A | N/A | N/A |
| Chingle *et al.* [26] | 2017 | Nigeria | Transversal | 1200 | 559 | 641 | 21.2 |
| Chukwkrah *et al.* [27] | 2020 | Nigeria | Transversal | 253 | 112 | 141 | 22.9 |

**Continued**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Balegha *et al.* [28] | 2021 | Ghana | Transversal | 402 | 183 | 219 | 23 |
| Déguénonvo *et al.* [29] | 2019 | Senegal | Transversal | 318 | 131 | 187 | 23 |
| Ejembi *et al.* [30] | 2019 | Nigeria | Transversal | 176 | 118 | 58 | 22 |
| Eward *et al.* [31] | 2023 | Tanzania | Transversal | 283 | 153 | 130 | N/A |
| Gebremeskel *et al.* [32] | 2019 | Ethiopia | Transversal | 200 | 115 | 85 | N/A |
| Gyimah *et al.* [33] | 2021 | Ghana | Transversal | 2712 | 1269 | 1443 | N/A |
| Haile *et al.* [34] | 2021 | Ethiopia | Transversal | 417 | 251 | 166 | 22.7 |
| Kachimanga *et al.* [35] | 2020 | Leone Series | Transversal | 157 | 100 | 57 | 26 |
| Kana *et al.* [36] | 2020 | Nigeria | Transversal | 133 | 85 | 48 | N/A |
| Kumah *et al.* [37] | 2021 | Ghana | Transversal | 262 | 180 | 82 | N/A |
| Lohouès-kouacou *et al.* [38] | 2013 | Ivory Coast | Transversal | 2557 | 859 | 1698 | 23.4 |
| Maina *et al.* [39] | 2020 | Kenya | Transversal | 487 | 240 | 247 | 22.5 |
| Makan *et al.* [40] | 2023 | South Africa | Transversal | 221 | 68 | 153 | 22.5 |
| Ni *et al.* [41] | 2015 | Nigeria | Transversal | 316 | 194 | 122 | N/A |
| Noubiap *et al.* [42] | 2013 | Cameroon | Transversal | 111 | 57 | 54 | 23.04 |
| Odusanyaa *et al.* [43] | 2006 | Nigeria | Transversal | 313 | 164 | 149 | 24.3 |
| Okeke *et al.* [44] | 2008 | Nigeria | Transversal | 346 | 228 | 118 | N/A |
| Osei *et al.* [45] | 2019 | Ghana | Transversal | 226 | 151 | 75 | 24.12 |
| Pido *et al.* [46] | 2005 | Uganda | Transversal | 182 | 106 | 76 | N/A |
| Sake *et al.* [47] | 2018 | Benign | Transversal | 265 | 140 | 125 | 18.9 |
| Sawadogo *et al.* [48] | 2022 | Burkina Faso | Transversal | 410 | 128 | 282 | 25.71 |
| Sofola *et al.* [49] | 2008 | Nigeria | Transversal | N/A | N/A | N/A | N/A |
| Sombié *et al.* [9] | 2015 | Burkina Faso | Transversal | 507 | 336 | 171 | 24 |
| Tawiah *et al.* [50] | 2020 | Ghana | Transversal | 178 | 139 | 39 | N/A |
| Umuhoza *et al.* [10] | 2020 | Rwanda | Transversal | 140 | 75 | 65 | 25 |

### 3.3. Hepatitis B Vaccination Coverage

The vaccination coverage rate of students in sub-Saharan Africa was 28.8% [95% CI: 22.9% - 34.7%]. It was highly variable and ranged from 1.4% in Burkina Faso [9] to 90.7% in Rwanda [10]. The results of the meta-analysis are presented in **Figure 4**.

Analysis of the sub-regions of the zone showed that the coverage rate was higher in West Africa (29.8% [95% CI: 22.9% - 36.7%]) than in East Africa (23.4% [95% CI: 9.4% - 37.4%]) and Central Africa (17.0% [95% CI: 14.4% - 19.5%]). The results of the meta-analyses are presented in **Figures 5-7**.

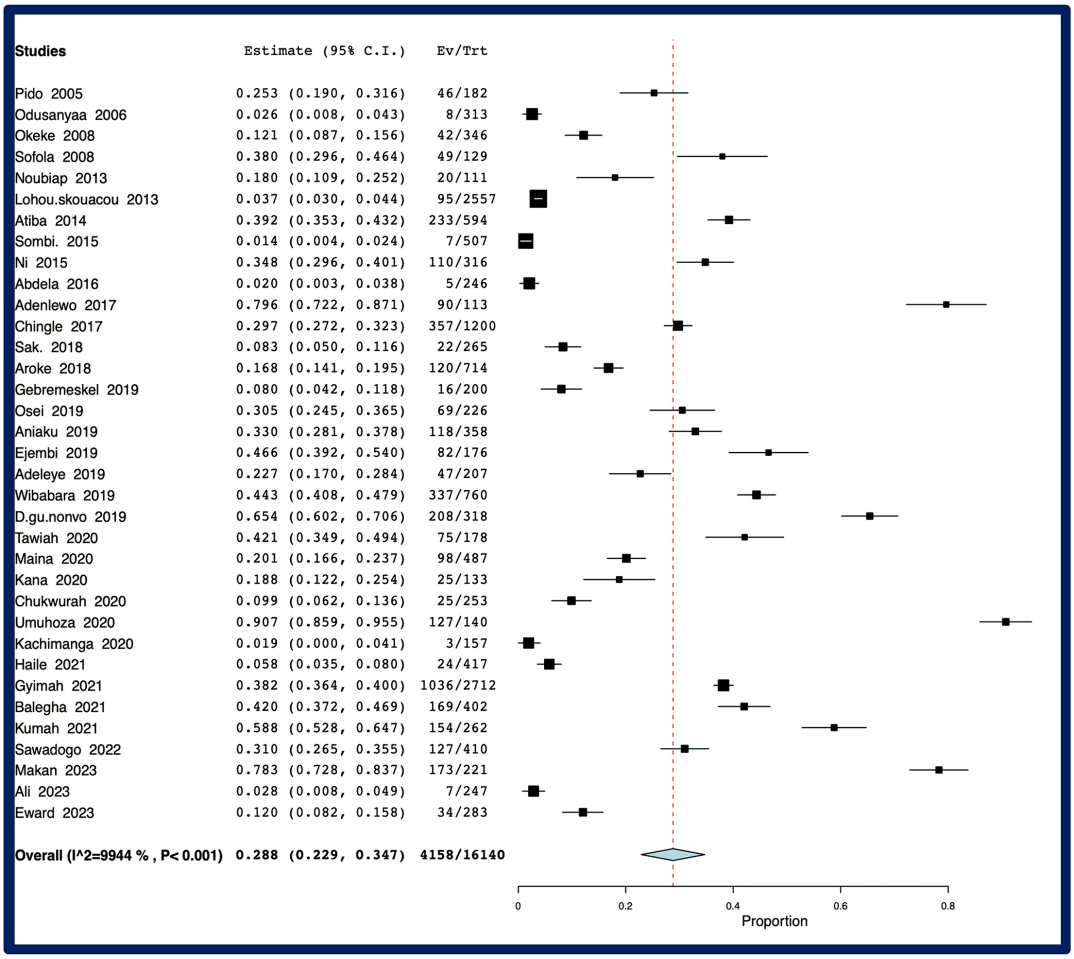


**Figure 4.** Meta-analysis of hepatitis B vaccination coverage among students in sub-Saharan Africa.

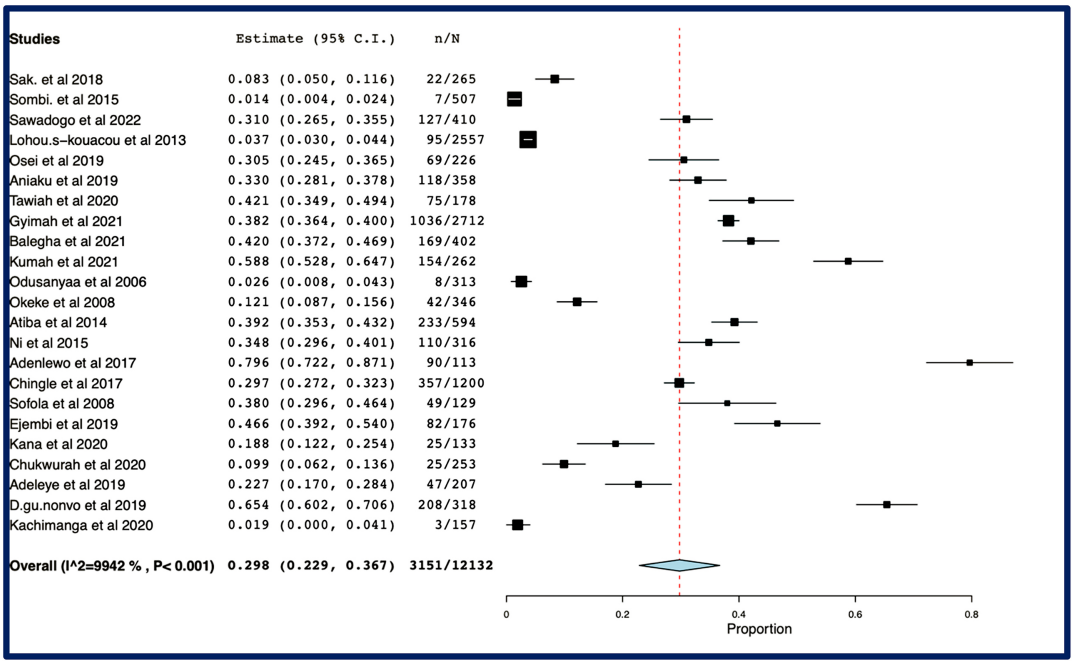


**Figure 5.** Meta-analysis of hepatitis B vaccination coverage among West African students.

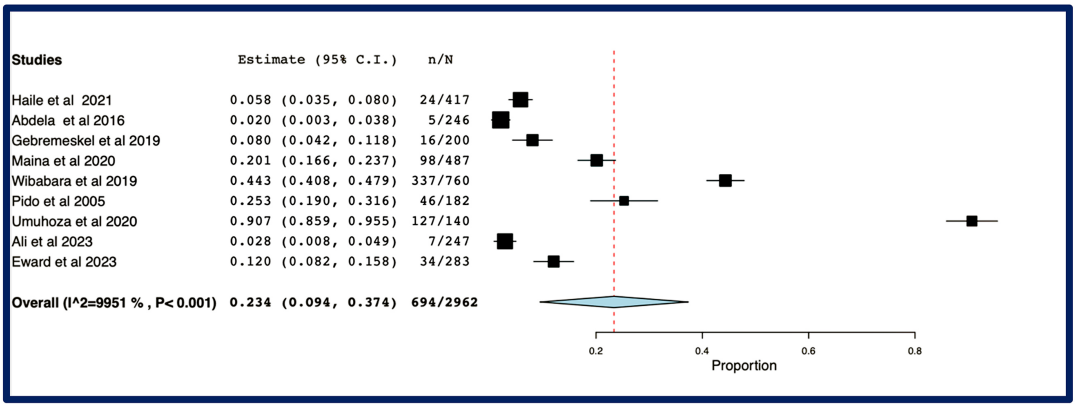


**Figure 6.** Meta-analysis of hepatitis B vaccination coverage among East African students.

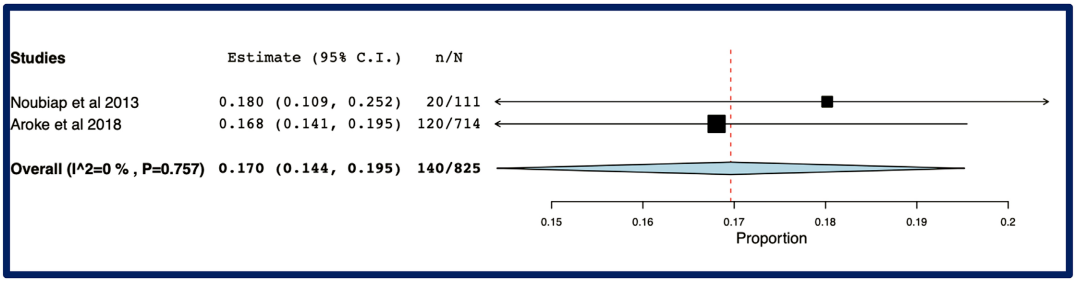


**Figure 7.** Meta-analysis of hepatitis B vaccination coverage among students in Central Africa.

## 4. Discussion

This systematic review estimates the vaccination coverage of students in sub-Saharan Africa. The coverage rate obtained (28.8% [95% CI: 22.9% - 34.7%]) shows that the majority of students in this geographical area are exposed to contamination by the hepatitis B virus. Auta's work in 2018 showed that 24.7% of healthcare professionals are protected against this virus [8]. It is, therefore, possible to say that students in sub-Saharan Africa are as exposed as healthcare professionals, even if we can agree that the risks are higher for healthcare professionals due to blood exposure accidents (BEAs). Nevertheless, it should not be forgotten that, according to several studies, young people, through risky behaviors to which they are more prone, can be highly exposed to this disease. Additionally, apart from students in health or related fields such as biology, the level of knowledge about this disease is often poor [11]-[13].

The World Health Organization (WHO) aims to eliminate hepatitis B by 2030 at the latest [14]. Reasonable doubts persist regarding this goal since, seven years later, barely a quarter of young people have been vaccinated, and resistance to vaccination is only increasing. Indeed, not only is the rise of anti-vaccine individuals real, but also disinformation campaigns are taking place on certain continents, making populations (especially young people) resistant to accepting vaccines [15] [16].

The vaccination coverage rate among students is not uniform in sub-Saharan Africa. Our study showed that coverage was higher in West Africa than in other

regions. Indeed, while 29.8% [95% CI: 22.9% - 36.7%] of students in West Africa were protected, only 23.4% [95% CI: 9.4% - 37.4%] and 17.0% [95% CI: 14.4% - 19.5%] were protected in East Africa and Central Africa, respectively. This disparity, although it could be due to the political and social realities of each region, may reflect the willingness of different states to combat hepatitis B. The fight against this disease has led to the creation of national programs in many countries. However, health priorities are dynamic, and in the context of developing countries, it is not surprising to see budgets redirected towards other health challenges. Some recent studies mention the impact of COVID-19 on health programs in these countries; this may explain the differences in coverage [17].

The hepatitis B vaccine is effective. Its financial accessibility for certain population groups could increase coverage across the continent. If this vaccine were made free for all students, the number of vaccinated individuals would increase. Additionally, through herd immunity, many other unvaccinated people would gain some protection. Furthermore, making vaccination mandatory upon university enrollment would be an effective way to protect students. In France, this approach is used and yields satisfactory results in the fight against this disease among students entering clinical training [18]. Given that most students live in close proximity to one another, vaccinating them all, regardless of their field of study, could be beneficial.

## 5. Conclusion

This systematic review reveals a low hepatitis B vaccination coverage among university students in sub-Saharan Africa, with significant regional disparities. Despite the World Health Organization's (WHO) target to eliminate hepatitis B by 2030, our findings suggest that reaching this goal may be challenging, given that only about a quarter of students are currently vaccinated. To enhance coverage, strategies such as providing free vaccines to students and mandating vaccination upon university entry could be considered. These interventions have been successfully implemented in other contexts, such as France, where mandatory vaccination policies have led to increased coverage among students in clinical training programs [12]. However, the feasibility of such strategies in sub-Saharan Africa requires careful consideration of factors such as healthcare infrastructure, funding, and public acceptance. Future research should explore context-specific barriers to vaccination and identify practical solutions to enhance hepatitis B vaccine uptake in this vulnerable population.

## Conflicts of Interest

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

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