

Original Article

Hepatitis B Vaccination Coverage among Nursing Students: A Systematic Review

Anastasia Statiri, RN, MSc, PhD(c)

Faculty of Nursing, University of West Attica, Athens, Greece

Theodoula Adamakidou, PhD

Associate Professor, Faculty of Nursing, University of West Attica, Athens, Greece

Nikoleta Margari, PhD

Associate Professor, Faculty of Nursing, University of West Attica, Athens, Greece

Eleni Dokoutsidou, PhD

Associate Professor, Faculty of Nursing, University of West Attica, Athens, Greece

Correspondence: Anastasia Statiri, RN, MSc, PhD (c), Faculty of Nursing, University of West Attica, Faculty of Nursing, Egaleo Park Campus, Athens, 12243, Greece
Email: astatiri@uniwa.gr

Abstract

Background: Nursing students spend their time studying in both academic and clinical settings. Due to their proximity to patients, handling of bodily fluids, lack of experience, and high level of knowledge, nursing students are particularly vulnerable to exposure to HBV and other infections.

Aims: This systematic review focused on investigating the vaccination coverage of nursing students against hepatitis B.

Methodology: Systematic research of the international literature was conducted in the electronic databases "PubMed", "Scopus" and "Embase" with the keywords: "nursing students" and "HBV vaccination", and time restrictions from 2002 to 2022. Exclusion criteria included language, except English and Greek, case studies, editorials, reviews and letters to the editor.

Results: Out of the 84 published studies, 20 met the requirements for inclusion in the systematic review. The vaccination coverage rates of nursing students against hepatitis B ranged from 6.7% to 100%, with Eastern countries having the lowest rates. Reasons for not vaccinating students vary, such as fear of the injection. However, in the majority of the studies, the high cost and fear of injections was a deterrent to vaccination.

Conclusions: To conclude, vaccination coverage against hepatitis B virus in nursing students varies, despite its necessity. Targeted interventions are needed to raise students' awareness of the value of vaccination, to follow protocols in case of possible infection and to carry out organized actions for vaccination at university level.

Keywords: nursing students; hepatitis B; vaccination

Introduction

The liver infection known as hepatitis B has the potential to be a life-threatening condition. Fortunately, there are vaccines available since 1981 that have proven to be safe and effective, with a success rate of 98% - 100%. The introduction of these vaccines has significantly reduced the incidence of hepatitis B infection (Akazong et al., 2020). However, according to the World Health Organization (WHO), there are still 296 million people living with chronic hepatitis B

infection in 2019, and 1.5 million new infections occur each year (WHO, 2019). Due to their proximity to patients, handling of bodily fluids, lack of experience, and high level of knowledge, nursing students are particularly vulnerable to exposure to HBV and other infections (Schillie et al., 2018). To mitigate this risk, the WHO recommends the global vaccination of newborns and individuals with risk factors for HBV, including HCWs and nursing students (WHO, 2019). Guidelines for healthcare institutions

vary globally, but if anti-HBs levels are <10 mIU/mL, HCWs should receive one or more additional doses of the HBV vaccine and be retested (Verso et al., 2020).

A recent study by Yamazhan et al. revealed that most nursing students surveyed had received complete HBV vaccinations. However, 28.1% ($n=419$) of participants experienced needle-stick injuries, while 5.4% ($n=80$) encountered conjunctival exposure to patients' bodily fluids (Yamazhan et al., 2011). Other studies have reported HBV immunization rates ranging from 6.7% to 37.2% (Mengal et al., 2008; Pathoumthong et al., 2014; Batra et al., 2015; Wakibi and Kaye, 2016; Chingle et al., 2017; Gupta, Kaistha and Omar, 2020; Maina and Bii, 2020; Haile et al., 2021), which falls significantly short of the WHO's target of 100% immunization coverage among HCWs (WHO, 2019).

Extensive research has been conducted on the vaccination coverage of HCWs, however, there is a lack of research regarding the immunization status of nursing students. Recognizing the need for current data on HBV vaccination coverage among nursing students globally, this literature review aims to assess the control of HBV infection in nursing students, evaluate their immunization history, and explore any factors associated with vaccine uptake. Additionally, the review investigates the potential influence of nursing schools and nursing studies in this context.

Methodology

The present review was performed following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021). Two independent researchers searched "PubMed", "Scopus" and "Embase" using the key terms: ("nursing student*" OR "nurse student*") and ("HBV vaccination" OR "hepatitis B vaccination" OR "HBV vaccine*" OR "hepatitis B vaccine*"). A time restriction between 2002 and 2022 (September) was set. At first, papers were screened with their titles and abstracts to evaluate their relevance to the scope of the present review. The remaining articles were read in their full texts by which their relevance to the theme was further tested according to inclusion/exclusion criteria. At this point, the articles were also checked for duplicate

publications. Inclusion criteria were the following: research articles, English and Greek language, nursing students and HBV vaccination. Exclusion criteria included language, except English and Greek, case studies, editorials, reviews and letters to the editor. The origins of nursing students were the independent variable. The outcome was vaccination coverage.

Results

The searches on "PubMed", "Scopus" and "Embase" yielded 84 results. The total number of initial papers was reduced after checking for duplicate publications and title/abstract/keywords screening to 42. Out of the remaining 42 articles, 22 of them were excluded after reading their full texts as irrelevant to the scope of the present study. As a result, 20 studies were included in the present review. Figure 1 depicts the PRISMA flow diagram for the present investigation. The 20 included studies were evaluated for risk of bias using the Appraisal tool for Cross-Sectional Studies (AXIS) and were found to follow the tool's principles (Figure 2) (Downes et al., 2016). According to the prevalence of chronic hepatitis B carriers, the regions were divided into low prevalence areas ($<2\%$), medium prevalence areas (2-7.9%) and high prevalence areas ($\geq 8\%$), and the results were analyzed (Hyun Kim and Ray Kim, 2018). However, a literature review over the past two decades retrieved no data from low-prevalence countries, possibly because of the lower disease prevalence in these countries.

Data from areas of high HBV endemicity ($\geq 8\%$)

The sub-Saharan regions of Africa are known for their high prevalence of HBV, with an endemicity rate of at least 8%. In Africa, the vaccination coverage for HBV among nursing students varies significantly. According to various studies included in this review, the lowest coverage reported was 6.7% (Haile et al., 2021), while the highest coverage reached 78.3%. (Razwiedani, Mogale and Mawela, 2022). For instance, a recent study conducted in Gauteng province found that out of 244 nursing students, 78.3% (47 students) had received the HBV vaccine. Interestingly, 34.8% (31 students) had to pay for the vaccination as it was not provided free of

charge (Razwiedani, Mogale and Mawela, 2022).

In a study conducted with 75 nursing students in Ethiopia, it was discovered that only 18% of participants had received a vaccination against HBV.

Out of these participants, only 6.7% had received the full dose of the vaccine. The primary reasons mentioned for not receiving

the HBV vaccination included the unavailability and high cost of the vaccine, as well as a lack of knowledge about its benefits and concerns about potential side effects. Among the participants of the study, the most common reasons for not completing the full course of vaccination were forgetting to receive a follow-up dose, having a busy schedule, and already having obtained immunity (Haile et al., 2021).

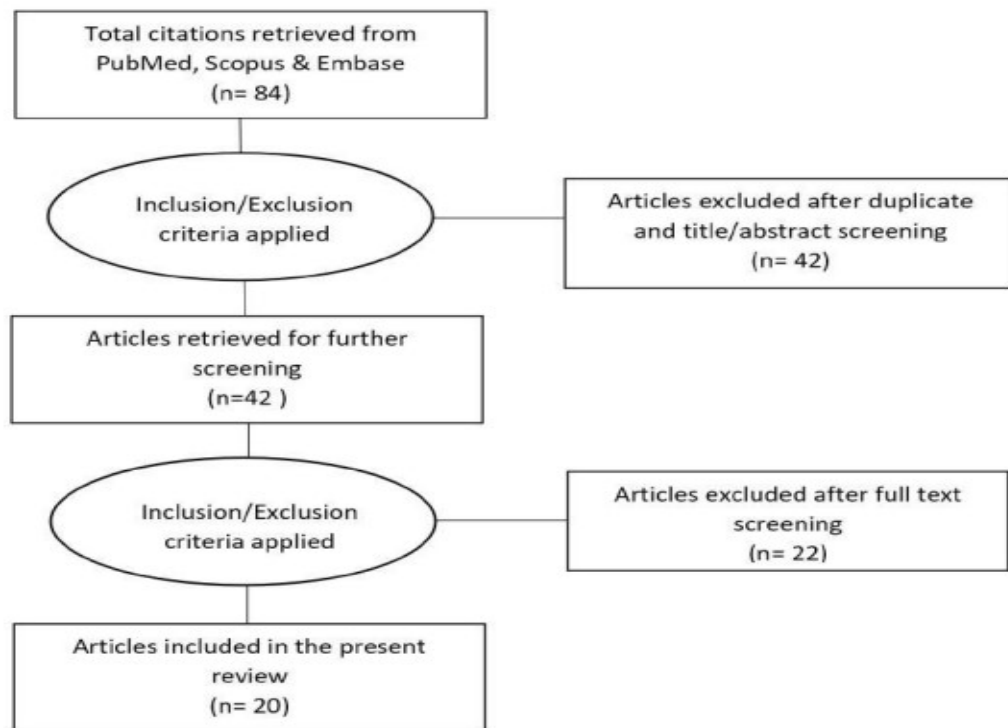


Figure 1: PRISMA flow diagram

*ABBREVIATIONS: Y=Yes; N=No; D= Do not know

	STUDY																			
TEM	Razwiedani et al, 2022	Haile et al, 2021	Maina & Bil, 2020	Chingale et al, 2017	Wakibi & Kaye, 2016	Yamazhan et al, 2011	Gupta et al, 2020	Karibuk et al, 2015	Batra et al, 2015	Bhattarai et al, 2014	Pathoumthong et al,	Mengal et al, 2008	Bijani et al, 2019	Mansour-Ghanaei et al., 2013	Zebni et al, 2013	Shiao et al, 2002	Verso et al, 2019	Verso et al, 2020	Ricco et al, 2006	Papagiannis et al, 2016
Clearly stated objectives	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Appropriate study design	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Justified sample size	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Population clearly defined	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Representant ive sample	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Proper selection process	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Address non-responders	N	N	N	N	N	D	N	Y	D	D	N	N	N	D	N	N	D	D	N	N
Appropriate measures	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Reliable measures	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Determined stat. significance	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sufficient methods description	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Data adequately described	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Possibility of non-response bias	D	Y	Y	D	D	Y	D	D	D	Y	D	D	D	D	D	D	Y	Y	D	D

Figure 2: Quality assessment of individual studies included in the systematic review based on the AXIS tool

Table 1. Summary of the studies in the systematic review

First author, Study design, Country	Purpose of the study	Population and Methodology	Results
Razwiedani et al, Cross-sectional study. South Africa, 2022	Investigating HBV vaccination amongst HCWs at a tertiary academic hospital in Gauteng province, South Africa.	244 nursing students completed a self-report questionnaire on their HBV vaccination status.	78.3% (n=47) fully vaccinated participants
Haile et al., Cross-sectional study. Ethiopia, Africa, 2021	Determining HBV vaccination coverage and associated factors, level of knowledge, attitudes, and practices towards HBV amongst health science students at Wolkite University.	75 nursing students completed a self-report questionnaire on their HBV vaccination status, level of knowledge, attitudes, and practices towards HBV.	Only 6.7% (n=5) fully vaccinated participants were found. Unavailability and high cost of the vaccine were frequently mentioned reasons for not being vaccinated against HBV. The year of study was significantly associated with full-dose vaccination status.
Maina & Bii, Concurrent mixed methods study. Kenya, Africa, 2020	Evaluating the influence of awareness, attitudes, practices, and access factors on HBV vaccination uptake by HCWs at Kenya Medical Training College (KMTC).	A quantitative study with the use of structured questionnaire was performed among 122 nursing students. For the qualitative component, two focus group discussions (FGDs) were conducted. The first FGD consisted of two Student Representative Council (SRC) members from each participating college; a total of 12 participants. The second FGD consisted of two staff members from participating campuses who were involved in leading the KMTC Vaccine Coordination Committee (VCC); a total of 12 participants.	15.6% (n=19) fully vaccinated participants were found. The major reason for not receiving the recommended doses was the unavailability of the vaccine. The qualitative study revealed challenges in the implementation of the vaccination program at KMTC.
Chingle et al., Cross-sectional study. Nigeria, Africa, 2017	Determining the HBV vaccination uptake and risk perception of hepatitis B infection among nursing	400 nursing students completed a pre-tested self-administered questionnaire.	The study revealed 20.6% (n=83) fully vaccinated participants. It was also found that nursing students direct from high school had no prior HBV protection and only students who had a prior diploma in nursing

	students in University of Jos.		had received any HBV vaccination.
Wakibi & Kaye, Cross-sectional study. Uganda, Africa, 2016	Determining the HBV vaccination uptake of first year nursing students in Mbarara University.	It was an exploratory study with the use of a six item questionnaire, in Mbarara University of Science and Technology, Uganda. A convenience sample of 73 first year medical and nursing students was used.	The study revealed 12.3% (n=9) fully vaccinated participants. The data indicated that direct nursing students from high school had no prior HBV protection.
Yamazhan et al., Cross-sectional study. Turkey, 2011	Detecting Turkish nursing students' level of knowledge on HBV, and evaluating their rates of exposure to blood as well as finding out their vaccination status.	A multi-centre cross-sectional study was conducted with the use of structured questionnaire among 1491 nursing students.	The study revealed 85.3% (n=1272) fully vaccinated participants and 28.1% (n=419) who had sustained a needle-stick injury and 5.4% (n=80) who had experienced conjunctival exposure to blood. The year of study was significantly associated with HBV knowledge score.
Gupta et al., Cross-sectional study. Rishikesh, India, 2020	Detecting HBV and HCV infection and assessing HBV immunity status amongst nursing students at AIIMS Rishikesh.	A cross-sectional study with the use of a structured questionnaire and serological tests using ELISA kits were conducted among 34 nursing students.	The results found 17.6% (n=6) fully vaccinated participants and none of them was positive for HBsAg.
Karthik et al., Cross-sectional study. India, 2015	Studying the safe injection practices among nursing college students.	A cross-sectional study with the use of a structured questionnaire was conducted among 112 nursing students.	The study revealed 78% (n=87) fully vaccinated participants. 33.5% (n=37) of the nursing students recalled having sustained at least one NSI over the last year and 58.9% (n=66) recalled having sustained between 1 and 4 NSIs in the past 12-months.
Batra et al., Prospective study. Jodhpur, India, 2015	Evaluating HBV immunization status and anti-HBs titer among HCWs.	The prospective study was conducted with the use of a structured questionnaire and serological tests using ELISA kits were done among 47 nursing students.	The study revealed 8.5% (n=4) fully vaccinated nursing students.
Bhattarai et al., Cross-sectional study. Nepal, 2014	Exploring HBV vaccination coverage among medical, dental and nursing students of a Medical school in Nepal, the main reasons for non-vaccination and the association between	The cross-sectional study was conducted among 73 nursing students with the use of structured questionnaire.	The study revealed that 91.8% (n=67) of the participants were fully vaccinated. Out of 210 students in clinical rotations, 90 (42.8%) had experienced at least one injury. Among those 90, 63 (70%) were nursing students. Needle stick and sharps-related injuries were significantly

	vaccination status and socio-demographic variables.		associated with nursing faculty (p = 0.042).
Pathoumthong et al., Cross-sectional study. Lao Democratic People's Republic, 2014	Assessing the immunization coverage against hepatitis B among the students of the University of Health Sciences (UHS) of Lao PDR in 2013 and looking for the causes of non-vaccination.	The cross-sectional study was conducted among 159 nursing students with the use of structured questionnaire.	The study revealed that 25.8% (n=41) of the participants were fully vaccinated. The most common reason (38.6%) given for non-vaccination was not knowing where to get vaccinated. Knowledge about HBV was poor for 86.5% of the students, but 77.5% were aware of the HBV vaccine.
Mengal et al., Cross-sectional study. Pakistan, 2008	Assessing the prevalence and the factors related to the acceptance of HBV vaccination by nursing students in a tertiary hospital in Pakistan.	The cross-sectional study was conducted among 196 nursing students with the use of structured questionnaire.	The study revealed that 37.2% (n=73) of the participants were fully vaccinated. More than half of the unvaccinated nursing students stated that they would accept vaccination if offered. The study indicated three variables significantly related to acceptance of HBV vaccination: history of accidental exposure to blood or blood products, acceptable knowledge about HBV infection, and adequate budget for HBV vaccination.
Bijani et al., Cross-sectional study. Iran, 2019	Determining the HBV vaccination coverage in health care students 2 decades after national neonatal HBV vaccination.	The cross-sectional study with the use of structured questionnaire and the serological tests with the use of ELISA kits were conducted among 110 nursing students.	90% (n=99) of the study population was fully vaccinated. The mean age of non-immuned students was significantly higher than that of students who had been post-boosting immuned and pre-boosting immuned (p=0.001 and 0.002, respectively).
Mansour-Ghanaei et al., Cross-sectional study. Iran, 2013	Determining the knowledge level and attitudes of medical science students in Guilan University toward hepatitis B and C viruses' infections.	The cross-sectional study was conducted among 424 nursing students with the use of structured questionnaire.	97.2% (n=412) of the participants were fully vaccinated. Students' attitude toward HBV and HCV was positively correlated with their mean knowledge level (r=0.14, p=0.004), (r=0.18, p=0.0001).
Zehni et al., Cross-sectional study. Iran, 2013	Determining HBV vaccination coverage and HBs antibody level among the students of the nursing and midwifery faculty of Kurdistan	The cross-sectional study was conducted among 163 nursing students with the use of structured questionnaire.	72.3% (n=115) fully vaccinated participants were found in the study. The average HBs antibody in subjects was 103.97 ul/ml. There was found a significant correlation between HBsAb level and the educational field.

	University of Medical Sciences.		
Shiao et al., Cross-sectional study. Taiwan, 2002	Describing the prevalence and characteristics of needlestick injuries (NSIs) in student nurses in Taiwan.	The cross-sectional study was conducted among 708 nursing students with the use of structured questionnaire.	52.4% (n=371) fully vaccinated participants were found in the study. NSIs during internship were reported by 61.9% (n=438) students, of whom 14.2% (n=62) made a formal report. Just over half (53.2%) of those sharp items involved in NSIs had been previously used on patients.
Verso et al., Cohort study. Sicily, Italy, 2019	Evaluating HBsAg, anti-HBs, and anti-HBc amongst nursing students at the University of Palermo, Italy.	A total of 520 students were enrolled at the University of Palermo and were evaluated for levels of anti-HBsAg antibodies. The students were examined during the first year of their Degree Course and were checked two years later.	All participants were fully vaccinated and all of them were HBsAg negative. The proportion of students that were vaccinated during adolescence showing anti-HBsAg ≥ 10 mIU/mL was higher than that observed in students who were vaccinated during infancy (69% versus 31.7%; p-value < 0.001).
Verso et al., Cohort study. Sicily, Italy, 2020	Evaluating anti-HBs titers in a sample of university nursing students followed up for two years, assessing the role of anti-HBV booster in relation to the time to decay of anti-HBs titers.	This study analysed the kinetics of serum antibodies against HBsAg, anti-HBs titers in relation to previous vaccine boosters in 483 Italian nursing students who were followed up for two years. Serum anti-HBs titers were evaluated at the first visit, after vaccine booster (if required) and at visit after two years.	All participants were fully vaccinated and all of them were HBsAg negative. A total of 254 (52.5%) students with a titer lower than 10 mIU/mL were offered an anti-HBV booster at their first visit.
Ricco et al., Cohort study. Parma, Italy, 2006	Evaluating the serologic status of nursing students of Parma University about HBV vaccination in order to offer new vaccination schedule, if needed.	The serologic status of 245 nursing students of Parma University was evaluated.	79.6% (n=195) fully vaccinated participants were found in the study, whereas biological markers resulted negative in 12 of them (non responders subjects), requiring a new vaccination schedule. No HCV positive subjects were identified.
Papagiannis et al., Cross-sectional study. Greece, 2016	Investigating the HBV vaccination coverage of Greek nursing students. The study looked into their attitudes towards the importance of vaccines and any possible reasons associated with not being vaccinated.	The cross-sectional, multi-center study was conducted among 716 nursing students with the use of structured questionnaire.	81.4% (n=583) fully vaccinated participants were found in the study. The vast majority of them (95%) had been vaccinated during childhood and 30% of the unvaccinated students declared fear over HBV vaccine safety.

In Kenya, out of the 122 nursing students surveyed, only 19 (15.6%) had received the complete vaccination, while 90 (73.8%) were partially vaccinated and 13 (10.6%) had never been vaccinated against HBV (Maina and Bii, 2020). The main obstacle preventing students from receiving the recommended doses was the unavailability of the vaccine when they sought it. In another study conducted in Nigeria, only 83 (20.6%) nursing students out of 400 had received the full HBV vaccine dose. A total of 382 nursing students (95.5%) were aware of the prevention measures for HBV through vaccination, and 370 (92.5%) had a good understanding of the risk of HBV infection (Chingle et al., 2017).

In a survey conducted among 73 students in Uganda, it was discovered that a significant percentage of students (78.1%, n=57) had not received any vaccinations. Out of the participants, only 2 (2.7%) had received a single dose of the HBV vaccine, while 9 (12.3%) had completed the recommended three-dose immunization (Wakibi and Kaye, 2016). The findings of the study revealed that only students with a previous diploma in medicine or nursing had received any vaccination for HBV. Conversely, nursing students who entered university directly from high school, did not have any prior protection against HBV (Wakibi and Kaye, 2016).

In a cross-sectional survey conducted in Lao Democratic People's Republic, which is also classified as a region with high HBV prevalence ($\geq 8\%$) (Hyun Kim and Ray Kim, 2018), it was found that out of 159 nursing students, 41 (25.8%) had received complete HBV vaccination, 20 (12.6%) had received partial vaccination, 68 (42.7%) had never been vaccinated, and 30 (18.9%) were unaware of their vaccination status. Additionally, 127 (79.9%) nursing students displayed a low level of knowledge regarding HBV infection (Pathoumthong et al., 2014). Another study involved 708 student nurses from Taiwan, a region in China with high HBV prevalence ($\geq 8\%$) (Hyun Kim and Ray Kim, 2018). A significant portion, specifically 47.6% (n=337), of students did not receive the necessary vaccination for HBV. Out of the total number of students, 61.9% (n=438) reported experiencing a needle stick injury during their internship, but

only a mere 14.2% (n=62) formally documented the incident (Shiao et al., 2002).

Data from areas of intermediate HBV endemicity (2-7.9%)

In the regions with intermediate HBV prevalence (2-7.9%), the Jodhpur area in India had the lowest vaccination rate among nursing students, with only 8.5% of participants fully immunized (Batra et al., 2015). Conversely, Italy boasted the highest level of immunization, with all nursing students having received the HBV vaccine (Verso et al., 2019; Verso et al., 2020). Since 1998, HBV vaccination has been included in the routine vaccination program for children in Turkey (Van Damme, 2001). In 2019, a comprehensive study was carried out across seven different regions of Turkey, involving seven universities. The study revealed that the rate of hepatitis B vaccination varied between 39.5% and 67.7% (Yamazhan et al., 2011). A total of 1762 nursing students participated in the study, and it was found that 87.3% of them (n=1538) possessed good knowledge regarding HBV infection. Additionally, 83.4% (n=1470) of the participants demonstrated good preventive practices (Yamazhan et al., 2011). Turkey has shown a high rate of vaccination coverage against HBV since 2011, as evidenced by a multi-centre cross-sectional study conducted in 14 nursing schools across the country's seven geographical regions. Out of the 1491 study participants, 85.3% (n=1272) had received the HBV vaccine, 28.1% (n=419) had experienced needle-stick injuries, and 5.4% (n=80) had encountered conjunctival exposure to blood. The nursing students displayed moderate knowledge scores, with better performance in questions related to transmission routes and poorer performance in questions concerning clinical outcomes. Notably, 93.7% of the students (n=1397) reported that their primary source of knowledge about HBV infection was their university education (Yamazhan et al., 2011). This finding suggests the need for standardized curricula among nursing schools.

In a study conducted in Rishikesh, India, it was found that among 34 nursing students, only 17.6% (n=6) had received the HBV vaccine. Out of these, 14.7% (n=5) were partially vaccinated, while a majority of 67.7% (n=23) had never received any dose of the

vaccine (Gupta, Kaistha and Omar, 2020). Another study in India, which included 112 nursing students in 2015, revealed that 78% (n=87) of the participants had been vaccinated against HBV. Additionally, 56% (n=63) of them followed safe injection practices, and a significant majority of 61% (n=68) were aware of universal precautions (Karthik et al., 2015). Similarly, a study conducted in Jodhpur, India in the same year, with 47 nursing students, showed a low vaccination rate. Only 8.5% (n=4) of the participants were fully vaccinated against HBV, 4.3% (n=2) were partially vaccinated, and a majority of 87.2% (n=41) had not received any dose of the HBV vaccine (Batra et al., 2015).

Out of a total of 73 nursing students in Nepal, an impressive 91.8% (67 students) had received full vaccination against HBV. Needle stick injury was significantly associated with faculty ($p = 0.042$) among medicine (64.3%), dental (56.3%) and nursing students (39.7%) (Bhattarai et al., 2014).

In Pakistan, nursing students typically receive HBV vaccinations at the start of their clinical rotations. However, due to budget constraints, not all students are able to receive vaccinations in a timely manner (Mengal et al., 2008). A cross-sectional study involving 196 nursing students revealed low vaccination coverage (37.2%, n=73). Interestingly, more than half (55.1%, n=27) of the unvaccinated nursing students expressed their willingness to accept vaccination if it was offered to them. Three variables were significantly associated with the acceptance of HBV vaccination: a history of accidental exposure to blood or blood products, sufficient knowledge about HBV infection, and adequate budget for HBV vaccination. 78.1% (n=153) of the nursing students had really low levels of knowledge about HBV vaccination and infection (Mengal et al., 2008).

According to a study conducted in Iran, all 110 nursing students who participated had received at least one dose of the HBV vaccine, with the majority (90%) being immunized at birth (Bijani et al., 2019). These findings are consistent with a previous study in Iran, which reported a high vaccination coverage rate of 97.2% among 412 students (Mansour-Ghanaei et al., 2013). Additionally, a cross-sectional study conducted at Kurdistan

University in 2013 found that out of 163 participants, 115 nursing students (72.3%) had completed their full HBV vaccination (Zehni et al., 2013).

Mediterranean countries in Europe, including Greece and Italy, are categorized as areas with intermediate levels of HBV prevalence. In the case of Italy, a comprehensive study conducted at Palermo University between 2015 and 2019 examined 520 nursing students who had previously received HBV vaccinations. The study revealed that receiving HBV vaccination during adolescence may lead to a higher long-term presence of anti-HBsAg titers ≥ 10 mIU/mL. Additionally, the administration of anti-HBV boosters was found to increase the levels of anti-HBsAg over a relatively short period, particularly in individuals who had been vaccinated during infancy. It is important to note that all participants tested negative for HBsAg (Verso et al., 2019).

One year later, the research team published another article that focused on a study involving 483 nursing students who had received full vaccination. Surprisingly, 254 students, accounting for 52.5% of the participants, had antibody levels below 10 mIU/mL, and 185 of them (72.8%) had no detectable antibodies against HBV (Verso et al., 2020). Furthermore, out of the students who required booster shots, 22 individuals (8.6%) had received vaccinations during their adolescence (Verso et al., 2020).

In 2006, Parma University conducted a study that revealed that 79.6% of the 245 nursing students surveyed mentioned HBV vaccination coverage (Ricco et al., 2006). A study conducted in Greece in 2016, which included 716 nursing students, found that 81.4% of them were fully vaccinated against HBV (Papagiannis et al., 2016).

Discussion

The purpose of this current study was to gather current information on HBV vaccination coverage among nursing students, assess the extent of HBV immunization among nursing students, and explore any factors that may be associated with vaccine uptake. The uptake of the HBV vaccine among nursing students varied significantly, ranging from as low as 6.7% (Haile et al.,

2021) to a perfect 100% (Verso et al., 2019; Verso et al., 2020). Interestingly, no studies were found regarding the vaccine uptake among nursing students in low-endemic countries during this literature review. It is possible that the scientific community does not prioritize investigating the vaccine uptake in these countries due to the low prevalence of hepatitis B. The prevalence of the disease appears to be linked to the HBV vaccine uptake, particularly in Africa where the seroprevalence of HBV is alarmingly high, surpassing 8% (WHO, 2019). To prevent perinatal and early horizontal transmission of HBV, the World Health Organization (WHO) recommends administering a birth dose within 24 hours of birth, followed by 2 or 3 doses of monovalent or multivalent hepatitis B vaccines.

Throughout the studies analyzed in this systematic review, it was consistently observed that nursing students had low rates of vaccination coverage over time. Specifically, studies conducted in Ethiopia, Kenya, Nigeria, and Uganda reported vaccination coverage rates of 18% (Haile et al., 2021), 15.6% (Maina and Bii, 2020), 20.6% (Chingle et al., 2017), and 12.3% (Wakibi and Kaye, 2016) respectively for HBV. However, there was one recent study conducted in a tertiary academic hospital in South Africa that showed a more promising vaccination rate of 78.3% (Haile et al., 2021). Among the African studies included in this review, two of them identified the unavailability and high cost of the vaccine as the main reasons for not receiving it (Maina and Bii, 2020; Haile et al., 2021). These findings should be taken into consideration by governments and nursing schools in order to address and eliminate these issues.

The same should also be applied to Laos (Pathoumthong et al., 2014), a country with a high prevalence ($\geq 8\%$) of chronic HBV infection among its adult population (Ott et al., 2012). To eliminate this burden, a national neonatal hepatitis B vaccination program has been implemented over the past two decades based on the WHO's Expanded Program on Immunization. In this setting, neonates receive a first dose of HBV vaccine at birth, followed by three more doses at 6, 10, and 14 weeks (Sitbounlang et al., 2022). Cross-

sectional survey results included in this review showed that only 25.8% of the study population was fully vaccinated against HBV. Low vaccination coverage was also associated with very low levels of knowledge about HBV infection for the majority of nursing students (79.9%) (Pathoumthong et al., 2014).

One of the most successful and effective hepatitis B vaccination programs in the world is in Taiwan. Launched in 1984, the program was the world's first universal neonatal hepatitis B program. After several revisions over the years, the final national program implemented since 1992 included 3 doses of vaccine at 0, 1 and 6 months of age (Chien et al., 2006). However, the studies included in this review provided disappointing results regarding hepatitis B vaccination rates among nursing students (52.4%), which was also associated with a higher incidence of NSI during internship (61.9%) (Shiao et al., 2002).

In Turkey, children born after 1998 receive hepatitis B vaccination as part of the routine vaccination program in areas with moderate HBV prevalence (2–7.9%) (Van Damme, 2001). Nursing students can receive the hepatitis B vaccine on their own or through the school's vaccination program. The role of Turkish nursing schools in preventing HBV infections is noteworthy, as demonstrated by a study conducted by Yamazhan et al. in 2011. The study revealed a high vaccination coverage rate of 85.3% among nursing students (Yamazhan et al., 2011).

In contrast, the Universal Immunization Program (UIP) in India, which has been incorporating HBV vaccinations for over a decade, found that only half of the children in the country are immunized against hepatitis B. Given that India accounts for one-fifth of the global population, it bears a significant burden of HBV cases (Khan, Shil and Mohanty, 2019). The findings of our systematic review align with the UIP's research. Gupta et al. (2020) discovered a low vaccination coverage rate of 17.6% among nursing students in Rishikesh (Gupta, Kaistha and Omar, 2020). Earlier studies from 2015 yielded conflicting results, with one reporting a vaccination coverage rate of 78% among nursing students (Karthik et al., 2015), while another reported a rate of 8.5% (Batra et al.,

2015). The HBV vaccine was implemented in Nepal back in 2002, and it is administered to infants exclusively at 6, 10, and 14 weeks of age, following the National Immunization Schedule of Nepal. However, the government has not established a specific initiative to vaccinate individuals at high risk, including nursing students (Shrestha et al., 2020). Due to a scarcity of scientific literature on the subject, it is difficult to draw definitive conclusions regarding the vaccination coverage of nursing students. Nevertheless, one study included in this review revealed that 91.8% of the participants had received complete HBV vaccination (Bhattarai et al., 2014).

In 2009, the Pakistan government incorporated HBV vaccination into its official program. This vaccine is provided free of charge during the first year of a child's life and is administered at 6, 10, and 14 weeks of age (Yousafzai et al., 2014). Additionally, as mentioned earlier, nursing students in Pakistan receive HBV vaccinations at the start of their clinical rotations. Unfortunately, the budget constraints prevent all students from receiving timely vaccinations, resulting in a low vaccination coverage rate of 37.2% (Mengal et al., 2008). Additionally, it is concerning that nursing students in Pakistan have a low level of knowledge (78.1%) regarding HBV vaccination and infection (Mengal et al., 2008).

In 1993, Iran implemented a national vaccination program for HBV, which includes newborns and individuals at high risk such as nursing students (Poorolajal and Majdzadeh, 2009). This program involves three doses of the vaccine administered at 0, 1, and 6 months after the initial injection. Additionally, since 2006, adolescents under 18 years old have been eligible for free vaccination (Tazhibi et al., 2014). The vaccination program in Iran and Kurdistan has shown promising results. Studies retrieved for the present review revealed high vaccination coverage, which varied from 72.3% (Zehni et al., 2013) to 97.2% (Mansour-Ghanaei et al., 2013).

Regarding Italy and Greece, student nurses and other medical professionals are advised to get vaccinated against HBV (Khan, Shil and Mohanty, 2019). Nonetheless, newborns are

required to receive the HBV vaccine in both nations. This appears to be the cause of the high adult vaccination rate reported in the studies by Verso et al. (2020) (Verso et al., 2020) and Papagiannis et al. (2016) (Papagiannis et al., 2016). However, additional research is required to provide us with information regarding the HBV vaccination coverage of nursing students in other European nations.

The most frequently cited reasons for not receiving the HBV vaccine were unavailability and high cost (Mengal et al., 2008; Pathoumthong et al., 2014; Maina and Bii, 2020; Haile et al., 2021); other possible reasons for not receiving the HBV vaccine included fear of shots (Papagiannis et al., 2016), low knowledge of hepatitis b (Mengal et al., 2008; Zehni et al., 2013; Mansour-Ghanaei et al., 2013; Pathoumthong et al., 2014), previous exposure to patient fluids (Mengal et al., 2008; Yamazhan et al., 2011), and history of needlestick injuries (Shiao et al., 2002; Yamazhan et al., 2011; Bhattarai et al., 2014; Karthink et al., 2015). A number of studies found a significant correlation ($p < 0.05$) between the length of years of nursing schooling and higher levels of knowledge about hepatitis b (Mengal et al., 2008; Yamazhan et al., 2011; Pathoumthong et al., 2014; Chingle et al., 2017; Haile et al., 2021; Razwiedani, Mogale and Mawela, 2022). These findings highlight the importance of the scientific knowledge on infection control provided by nursing schools.

Nursing schools need to be adequately funded to ensure that all students are fully vaccinated against vaccine-preventable diseases such as HBV (Wakibi and Kaye, 2016; De Schryver et al., 2020; Gupta et al., 2020; Razwiedani, Mogale and Mawela, 2022). All students should receive free post-vaccination testing to ensure they are protected against HBV (Batra et al., 2015; Chingle et al., 2017; Maina and Bii, 2020). Many studies emphasize the importance of nursing science in infection control and the correct use of protective measures (Ricco et al., 2006; Razwiedani, Mogale and Mawela, 2022). In addition to increasing HBV vaccine (Papagiannis et al., 2016; Haile et al., 2021) coverage, increasing nursing students' awareness and perception of safe practices against HBV should be a

priority for all nursing curricula (Yamazhan et al., 2011; Pathoumthong et al., 2014; Chingle et al., 2017). The current review showed that HBV vaccination rates among nursing students depend on the initiatives of each nursing school (Bhattarai et al., 2014; Chingle et al., 2017; Verso et al., 2020) and the priorities set by each school. The Ministry of Public Health and non-governmental organizations should work with nursing schools to raise awareness of the vaccine and promote vaccination campaigns (Yamazhan et al., 2011; Papagiannis et al., 2016; De Schryver et al., 2020).

Conclusions: The results of the present review suggest that the rate of HBV vaccination among nursing students varied from 6.7% to 100%, and various factors, such as the applicable laws of each country, affect the vaccine uptake. Although HBV vaccination coverage among nursing students in some countries is high, it is still lower than the WHO targets. There is a need for up-to-date data regarding vaccination coverage of nursing students in countries with low HBV endemicity, where no published data was found. Investment in the fight against HBV requires not only high vaccination coverage among the community and HCWs, but also education. Nursing schools can break the chain of infection by training their students on individual protective measures against HBV infection.

References

- Acikgoz, A., Yoruk, S., Kissal, A., Yildirimcan Kadicesme, Ş., Catal, E., Kamaci, G., Ersin, F. (2021). Healthcare students' vaccination status, knowledge, and protective behaviors regarding hepatitis B: a cross-sectional study in Turkey. *Hum Vaccin Immunother*, 17, 4595-4602.
- Akazong, W.E., Tume, C., Njouom, R., Ayong, L., Fondoh, V., Kuate, J.R. (2020). Knowledge, attitude and prevalence of hepatitis B virus among healthcare workers: a cross-sectional, hospital-based study in Bamenda Health District, NWR, Cameroon. *BMJ Open*, 10, e031075. DOI: 10.1136/bmjopen-2019-031075.
- Alshammari, T.M., Aljofan, M., Subaie, G., Hussain, T. (2019). Knowledge, awareness, attitude, and practice of health-care professionals toward hepatitis B disease and vaccination in Saudi Arabia. *Hum Vaccin Immunother*, 15, 2816-2823.
- Batra, V., Goswami, A., Dadhich, S., Kothari, D., Bhargava, N. (2015). Hepatitis B immunization in healthcare workers. *Ann Gastroenterol*, 28, 276-280.
- Bhattarai, S., K C, S., Pradhan, P.M., Lama, S., Rijal, S. (2014). Hepatitis B vaccination status and needle-stick and sharps-related Injuries among medical school students in Nepal: a cross-sectional study. *BMC Res Notes*, 7, 774. DOI: 10.1186/1756-0500-7-774.
- Bijani, B., Allami, A., Jafari, F., Hajmanoochehri, F., Bijani, S. (2019). Long-term immunogenicity of hepatitis B vaccine and impact of a booster dose on health care. *Med J Islam Repub Iran*, 33, 20. DOI: 10.34171/mjiri.33.20.
- Chien, Y.C., Jan, C.F., Kuo, H.S., Chen, C.J. (2006). Nationwide hepatitis B vaccination program in Taiwan: effectiveness in the 20 years after it was launched. *Epidemiol Rev*, 28, 126-135.
- Chingle, M.P., Osagie, I.A., Adams, H., Gwomson, D., Emeribe, N., Zoakah, A.I. (2017). Risk perception of hepatitis B infection and uptake of hepatitis B vaccine among students of tertiary institution in Jos. *Ann Afr Med*, 16, 59-64.
- De Schryver, A., Lambaerts, T., Lammertyn, N., François, G., Bulterys, S., Godderis, L. (2020). European survey of hepatitis B vaccination policies for healthcare workers: An updated overview. *Vaccine*, 38, 2466-2472.
- Downes, M.J., Brennan, M.L., Williams, H.C., Dean, R.S. (2016). Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ Open*, 6, e011458. DOI: 10.1136/bmjopen-2016-011458.
- Gupta, P., Kaistha, N., Omar, B. (2020). HBV and HCV in Health care workers and students of a newly established Tertiary care hospital at Rishikesh: Prevalence and immunity status. *Indian J Community Health*, 32, 454-457.
- Haile, K., Timerga, A., Mose, A., Mekonnen, Z. (2021). Hepatitis B vaccination status and associated factors among students of medicine and health sciences in Wolkite University, Southwest Ethiopia: A cross-sectional study. *PLoS One*, 16. DOI: 10.1371/journal.pone.0257621.
- Hyun Kim, B., & Ray Kim, W. (2018). Epidemiology of Hepatitis B Virus Infection in the United States. *Clin Liver Dis (Hoboken)*, 12, 1-4. DOI: 10.1002/cld.732.
- Karthik, R.C., Uma Devi, R., Gopalakrishnan, S., Raja, S., Rama, R. (2015). A Study on Knowledge And Practices Related To Safe Injection Practices Among Nursing Students In A Tertiary Care Hospital, Chennai, Tamil Nadu, India. *Research Journal of*

- Pharmaceutical, Biological and Chemical Sciences*, 6, 857-862.
- Khan, J., Shil, A., Mohanty, S.K. (2019). Hepatitis B vaccination coverage across India: exploring the spatial heterogeneity and contextual determinants. *BMC Public Health*, 19, 1263. DOI: 10.1186/s12889-019-7534-2.
- Maina, A.N., & Bii, L.C. (2020). Factors affecting HBV vaccination in a Medical training College in Kenya: A mixed methods Study. *BMC Public Health*, 20, 48. DOI: 10.1186/s12889-020-8158-2.
- Mansour-Ghanaei, R., Joukar, F., Souti, F., Atrkar-Roushan, Z. (2013). Knowledge and attitude of medical science students toward hepatitis B and C infections. *Int J Clin Exp Med*, 6, 197-205.
- Mengal, H.U., Howteerakul, N., Suwannapong, N., Rajatanun, T. (2008). Factors relating to acceptance of hepatitis B virus vaccination by nursing students in a tertiary hospital, Pakistan. *J Health Popul Nutr*, 26, 46-53.
- Ott, J.J., Stevens, G.A., Groeger, J., Wiersma, S.T. (2012). Global epidemiology of hepatitis B virus infection: new estimates of age-specific HBsAg seroprevalence and endemicity. *Vaccine*, 30, 2212-2219.
- Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. DOI:10.1136/bmj.n71.
- Papagiannis, D., Tsimtsiou, Z., Chatzichristodoulou, I., Adamopoulou, M., Kallistratos, I., Pournaras, S., Arvanitidou, M., Rachiotis, G. (2016). Hepatitis B Virus Vaccination Coverage in Medical, Nursing, and Paramedical Students: A Cross-Sectional, Multi-Centered Study in Greece. *Int J Environ Res Public Health*, 13, 323. DOI: 10.3390/ijerph13030323.
- Pathoumthong, K., Khampanisong, P., Quet, F., Lathaphasavang, V., Souvong, V., Buisson, Y. (2014). Vaccination status, knowledge and awareness towards hepatitis B among students of health professions in Vientiane, Lao PDR. *Vaccine*, 32, 4993-4999.
- Poorolajal, J., & Majdzadeh, R. (2009). Prevalence of chronic hepatitis B infection in Iran: a review article. *J Res Med Sci*, 14, 249-258.
- Razwiedani, L.L., Mogale, N.M., Mawela, M.P.B. (2022). Hepatitis B vaccination coverage amongst healthcare workers in a tertiary academic hospital in Gauteng province, South Africa. *S Afr J Infect Dis*, 37, 393. DOI: 10.4102/sajid.v37i1.393.
- Riccò, M., Renzulli, F.S., Cavalca, S., Sanchez, M.D.M.J., Maggio, C., Adami, E., Selis, L. (2006). Health surveillance and biological risk: Vaccinal coverage evaluation in nurse students of Parma University. *Giornale Italiano di Medicina del Lavoro ed Ergonomia*, 28, 81-83.
- Schillie, S., Vellozzi, C., Reingold, A., Harris, A., Haber, P., Ward, J.W., Nelson, N.P. (2018). Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. *MMWR Recomm Rep*, 67, 1-31.
- Shiao, J.S., Mclaws, M.L., Huang, K.Y., Guo, Y.L. (2002). Student nurses in Taiwan at high risk for needlestick injuries. *Ann Epidemiol*, 12, 197-201.
- Shrestha, D.B., Khadka, M., Khadka, M., Subedi, P., Pokharel, S., Thapa, B.B. (2020). Hepatitis B vaccination status and knowledge, attitude, and practice regarding Hepatitis B among preclinical medical students of a medical college in Nepal. *PLoS One*, 15, e0242658. DOI: 10.1371/journal.pone.0242658.
- Sitbounlang, P., Deharo, E., Lathaphasavang, V., Marchio, A., Soukhsakhone, C., Soixay, V., Mayxay, M., Steenkeste, N., Vincelot, P., Bertani, S., Palamy, S., Paboriboune, P., Pineau, P. (2022). Estimating the burden of hepatitis B virus infection in Laos between 2020 and 2021: A cross-sectional seroprevalence survey. *E Clinical Medicine*, 52, 101582. DOI: 10.1016/j.eclinm.2022.101582.
- Tazhibi, M., Hajivandi, A., Tafti, A.D., Fallahzadeh, H. (2014). The efficacy of hepatitis B vaccine in Iranian population: A systematic review and meta-analysis. *J Educ Health Promot*, 3, 53. DOI: 10.4103/2277-9531.134741.
- Van Damme, P. (2001). Hepatitis B: vaccination programmes in Europe-an update. *Vaccine*, 19, 2375-2379.
- Verso, M.G., Costantino, C., Vitale, F., Amodio, E. (2019). Immunization against Hepatitis B Surface Antigen (HBsAg) in a Cohort of Nursing Students Two Decades after Vaccination: Surprising Feedback. *Vaccines*, 8, 1. DOI: 10.3390/vaccines8010001.
- Verso, M.G., Costantino, C., Marrella, A., Immordino, P., Vitale, F., Amodio, E. (2020). Kinetics of Anti-Hepatitis B Surface Antigen Titers in Nurse Students after a Two-Year Follow-Up. *Vaccines (Basel)*, 8, 467. DOI: 10.3390/vaccines8030467.
- Wakibi, S., & Kaye, B. (2016). Level of hepatitis b virus protection of first year medicine and nursing students in Mbarara university. *Annals of Global Health*, 82, 497-498.
- World Health Organization (WHO) (2022) Hepatitis B. [Internet]. [cited 2022 Sept 27]. Available: https://www.euro.who.int/_data/assets/pdf_fi

- file/0007/377251/Fact-sheet-Hepatitis-B_2019-ENG.pdf
- Yamazhan, T., Durusoy, R., Tasbakan, M.I., Tokem, Y., Pullukcu, H., Sipahi, O.R., Ulusoy, S. (2011). Turkish Nursing Hepatitis Study Group. Nursing students' immunisation status and knowledge about viral hepatitis in Turkey: a multi-centre cross-sectional study. *Int Nurs Rev*, 58, 181-185.
- Yousafzai, M.T., Qasim, R., Khalil, R., Kakakhel, M.F., Rehman, S.U. (2014). Hepatitis B vaccination among primary health care workers in Northwest Pakistan. *Int J Health Sci (Qassim)*, 8, 67-76.
- Zehni, K., Rokhzadi, M.Z., Mohmodi, S.H., Ashjardalan, A. (2013). Vaccination and Immunity Status against Hepatitis B among Students of Nursing and Midwifery Faculty of Kurdistan University of Medical Sciences in. *Life Sci J*, 10, 23.